APPENDIX 3-C

Greenhouse Gas Assessment Report

AtkinsRéalis

Report

Hydro One Networks Inc.

June 4, 2026

O/Ref. No.: 700128-4E-L01-00

Northeast Power Line Greenhouse Gas Assessment

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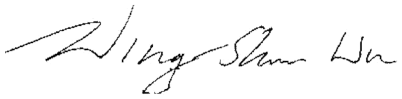

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1. Introduction

This report describes and summarizes the effects of the proposed Northeast Power Line (NEPL) Transmission Line Project (the Project) on Hydro-One's greenhouse gas (GHG) emissions inventory. Its purpose is to also understand how the Project will affect climate change within provincial and federal borders. The main results from this study will be documented in the Environmental Update Report (EUR) on the NEPL Project, meeting the requirements of the Ontario Regulation 234/25 "New proposed regulation regarding Environmental Assessment Act requirements for the Proposed Northeast Power Line Project".

1.1 Project Overview

Hydro One Networks Inc. (Hydro One) is supporting growth in northeastern Ontario as demand for energy in the region continues to increase. As such, Hydro One is planning to construct a previously approved, single-circuit 500 kilovolt (kV) transmission line between Hydro One's Hanmer Transformer Station (TS) located in Greater Sudbury and Mississagi TS, located near Wharncliffe in Ontario (Figure 1). This new line is part of the Independent Electricity System Operator's (IESO) electricity plans to address future growth in northeastern Ontario, so to improve the transmission network's overall resilience. This project will be constructed parallel to an existing line within an existing corridor and is anticipated to be approximately 205 kilometers (km) in length with a right-of-way (RoW) approximately 122 m wide. The Project components are expected to include:

- Two autotransformers;
- Transmission line towers; and,
- Conductors, wires and insulators.

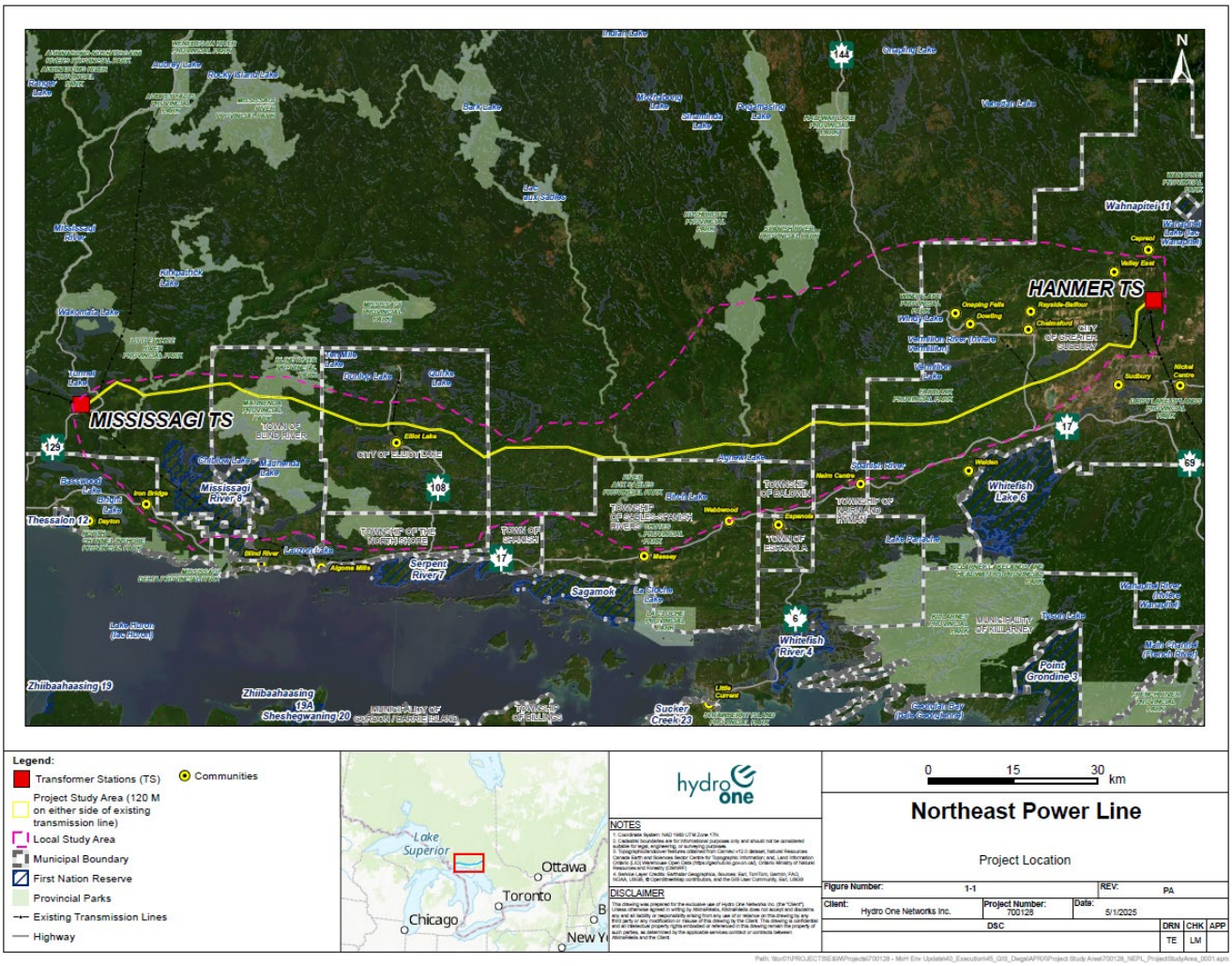
Planning and development of this new transmission line will be completed following an existing, approved Environmental Assessment (EA) for the Hanmer TS to Mississagi TS Line conducted by Ontario Hydro (now Hydro One). This existing EA included two transmission lines, only one of which was required to meet the region's electricity demands at the time. Because the project is operating under an approved EA, it is not subject to a new approval under the current *Environmental Assessment Act*, R.S.O. 1990, c. E.18 (EA Act), the EA Act and the Class EA for Transmission Facilities (Class EA [Hydro One, 2024]) were used to inform the EUR.

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, 2024). 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 Hydro One's targets are examples.

- Convert 50% of sedan and SUV fleet to EVs or hybrids by 2025 and 100% by 2030.
- Reduce sulfur hexafluoride (SF_6) emissions by continuing to work with standard bodies and vendors to explore available alternatives.

The pathways and actions towards achieving such targets are not included in this GHG emissions 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 associated with the Project.

Figure 1-1 Overview of the Northeast Power Line Project



The guidance documents *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 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 NEPL transmission line. It follows the general framework provided in *Ontario Regulation (O. Reg.) 390/18 Greenhouse Gas*

Emissions: Quantification, Reporting, and Verification (Government of Ontario, 2021), 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

Comments pertaining to GHGs that were raised by Indigenous communities during engagement and how they are addressed in the EUR are listed in Table 1-1.

Table 1-1 Summary of Comments Raised During Engagement Related to GHGs

Comment	How Addressed in the Environmental Assessment	Indigenous Community or Stakeholder
No estimate of construction-related GHGs or particulates is provided, even though that's common in EAs for transparency.	An expected range of GHG emissions during the construction phase including land-use change related emissions is provided in the next iteration of the Draft EUR.	Sagamok Anishnawbek

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- 2023: Greenhouse Gas Sources and Sinks in Canada* (ECCC, 2025). The NIR is the most recent annual dataset available in Ontario which also contains many inputs and emission factors relevant to all GHG emission sources that can occur in the country, including those relevant to the Project. The *2006 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 considered for GHG emissions related to land-use changes for the Project.

For the purposes of the EUR, 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 1-2.

Table 1-2 Greenhouse Gases Criteria and Indicators

Criteria	Rationale	Indicator	Measurement of Potential Effects
GHGs	▪ Commitment to avoid or minimize emissions of GHGs, which contribute to climate change. ▪ Hydro One corporate commitment to achieve net-zero GHG emissions by 2050, with a target of achieving a 30% GHG emissions reduction by 2030.	▪ Change to GHG emissions of: ▪ carbon dioxide (CO_2); ▪ nitrous oxide (N_2O); and, ▪ methane (CH_4).	▪ Quantification of projected construction emissions of CO_2, N_2O and CH_4 expressed in units of equivalent CO_2 (CO_2e).

GHGs comprise prominently the following chemical species: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). For this assessment, only CO_2, CH_4 and N_2O emissions are considered and so the indicators for the GHGs criteria can be defined as follows:

- **Estimated total fossil CO_2 emissions**: Emissions of CO_2 originating from fossil fuel combustion are expressed on an annual basis in tonnes of CO_2e per year (t CO_2e/yr). Fossil CO_2 has a Global Warming Potential (GWP) of 1, as specified in the Intergovernmental Panel for Climate Change (IPCC) 6th Assessment Report (2021).
- **Estimated total CH_4 emissions**: Emissions of CH_4 are expressed on an annual basis in t CO_2e/yr. CH_4 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 N_2O emissions**: Emissions of N_2O are expressed on an annual basis in t CO_2e/yr. N_2O has a GWP of 273, as specified in the IPCC 6th Assessment Report (2021).
- **Estimated total biogenic CO_2 emissions**: Emissions of CO_2 originating from biomass combustion are expressed on an annual basis in t CO_2e/yr. Biogenic CO_2 also has a GWP of 1, but is accounted separately from fossil CO_2 emissions.

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2. Greenhouse Gas Emission Scope

2.1 Temporal Boundaries

The Project is planned to occur during three stages:

- **Construction stage**: the period from the start of construction to the start of operation (estimated at 30 months for the NEPL as part of this assessment). Emissions expected during the construction phase will include sources of fuel combustion associated with 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 (aka, loss of CO_2 sequestration potential from vegetation), and the management of removed vegetation (e.g., burning) are also part of construction phase GHG emissions inventory.

- **Operational stage:** the period from the start of operation and maintenance activities through to the end of the Project's life. GHG emission sources during the operational phase of the Project will include fuel combustion for maintenance vehicles and equipment, ongoing loss of a carbon sink, 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 SF_6 and PFC emissions from transmission and distribution equipment. On that respect, Hydro One is actively assessing corporate emissions associated with both transmission line losses and from SF_6, and PFCs outside of this EUR. In collaboration with third parties, such as electricity generators, equipment suppliers and regulators, Hydro One is developing operational practices and standards to minimalize 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 operation's emissions will be managed under the corporate climate change mitigation program and reported in annual sustainability reports, as Hydro One works to meet its GHG emissions targets.

- **Retirement stage**: the period from the end of the Project's life and start of retirement activities through to the end of final land reclamation.

Only emissions from the construction phase are considered in this assessment since the highest annual emissions throughout the Project's life will occur during that time, primarily due to land clearing. Without details and schedules on land clearing activities at this point, the one-time loss from the removal of vegetation over very large surfaces (> 1,500 ha) during construction is assumed to take place all in one year, as a measure of conservatism, but also to allow for 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.

The construction stage is therefore carried forward as the reporting boundary for this GHG emissions assessment. The potential effects and mitigation measures for the operational and retirement phases are not characterized as part of the EUR considering that the NEPL is expected to operate for an indefinite period and the timing of retirement / decommissioning is not known at this time. The construction period is sufficient to capture the maximum effects of the Project on GHG emissions.

2.2 Spatial Boundaries

Spatial boundaries are not defined for this assessment because GHG emissions are both regional and global by nature. Spatial boundaries for GHG emissions correlate with the administrative inventory boundaries that currently apply to federal and provincial GHG policy, regulations, and legislation.

2.3 Emission Sources

For the purpose of accounting and reporting, as defined in ISO 14064-1 standard, a GHG emissions source is typically classified as either a direct source (Scope 1), an indirect source from purchased energy (Scope 2), or another indirect source.

- **Scope 1: 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).
- **Scope 2: Indirect GHG emissions from purchased energy:** Emissions from the generation of purchased electricity, heating, and cooling consumed by the proponent.
- **Scope 3: 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).

The GHG emissions estimates focused on the sources directly linked to the Project (Table 2-1). Consistent with the federal GHG reporting program for individual projects, estimation of Scope 3 emissions are not required (ECCC, 2025).

Table 2-1 Greenhouse Gas Emission Sources for the Project included into this Assessment

Emission Scope	GHG Emission Source during Construction
Scope 1	▪ Diesel combustion from mobile equipment (e.g., excavators, loaders, drill rigs, cranes, wire pullers and tensioners, and forest logging equipment); ▪ Diesel combustion from equipment categorized as stationary (e.g., portable generators, water pumps and chain saws); ▪ Diesel combustion from heavy-duty vehicles for mobilization / demobilization of equipment; ▪ Light-duty vehicles using gasoline for crew transportation; ▪ Aviation fuel from air travel by crew members; ▪ Aviation fuel from helicopters during construction; ▪ Land clearing (carbon stock removal, loss of carbon sink, and burning).
Scope 2	▪ Not included in the assessment
Scope 3	▪ Not included in the assessment

2.3.1 Exclusions

Given the breadth of activities required to build the new transmission line, other emission sources may occur but are excluded considering that they would be minor when compared to the main emission sources described above. 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 in ATVs is not included due to their low horsepower and usage compared to other mobile equipment.
- Carbon loss from disturbed soil during excavation.
- Vegetation left in place to degrade over time resulting in the emissions of small amounts of biogenic CO_2 (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 phase.

3. Baseline Overview

Baseline conditions with regard to GHG emissions are presented herein, with the intent of comparing the impact of the Project within the spatial boundaries (Ontario and Canada). For this purpose, the latest reported GHG emissions data were used to characterize existing GHG emissions at the federal and provincial levels using the ECCC *National Inventory Report 1990-2023: Greenhouse Gas Sources and Sinks in Canada* (ECCC, 2025).

For 2023, approximately 694 Mt CO_2e 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 2023, respectively (ECCC, 2025). Specific to the emissions sources covered in this assessment, approximately 192 and 5.0 Mt CO_2e of GHGs were emitted nationally in 2023 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 24% of these emissions when put together.

Table 3-1 Baseline Greenhouse Gas Emissions

Jurisdiction	Relevant NIR Category [1]	GHG Emissions (Mt CO_2e) [2]
Canada-wide 2023 GHG emissions	Total	694
	Transport (Off-road), Manufacturing, Mining and Construction	103
	Land use, land use change and forestry (land converted into settlements)	5.0
Ontario-wide 2023 GHG emissions	Total	159
	Transport (Off-road), Manufacturing, Mining and Construction	26
	Land use, land use change and forestry (land converted into settlements)	-0.6

(1) Corresponds to the main GHG category (and smallest sub-category) from ECCC NIR 1990:2023 relevant to sources from the Project.

(2) Mt CO_2e = million metric tons of carbon dioxide equivalent.

4. Potential Effects, Mitigation Measures, and Net Effects

4.1 Potential Effects

4.1.1 GHG Emissions from Construction Activities

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

Effects of Land Clearing: It is estimated by Hydro One that a total area of 1,550 ha will need to be cleared to give way to the NEPL, with 951 ha of vegetation that will be cut, piled and expected to be burned on site. Another 358 ha of trees are expected to produce merchantable timber by forest companies, while the remaining 241 ha will be cleared by hand and expected to be left in place. Land clearing emissions also represent a loss of the carbon sink associated with forest growth. In fact, the highest land clearing emissions occur when there is a loss of the existing carbon sink with negligible vegetation regrowth afterwards, which is expected to be mostly the case for the NEPL since trees will not naturally regrow or be replanted within the RoW. A summary of input data used for the land clearing and biomass burning calculations is provided in Table 5-1. 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 Emission Rate Calculations	References

Carbon stock removal from land clearing	▪ Total area of vegetation to be cleared
	▪ Types and amount of vegetation to be removed (assuming boreal coniferous forests), including:
	  ▪ Mean above-ground dry biomass content;
	  ▪ Below-to-above ground biomass ratio;
	  ▪ Carbon fraction in wood.
		IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories and Draft Technical Guide Related to the SACC (Government of Canada 2021)

Carbon sink loss from land clearing (1) (2)	▪ Total area of vegetation to be cleared
	▪ Types and amount of vegetation to be removed (assuming boreal coniferous forests), including:
	  ▪ Mean above-ground dry biomass growth;
	  ▪ Below-to-above ground biomass ratio;
	  ▪ Carbon fraction in wood.	

Wood burning	▪ Area of vegetation to be cleared for pile and burn only
	▪ Types and amount of vegetation to be removed (assuming boreal coniferous forests), including:
	  ▪ Mean above-ground dry biomass content;
	  ▪ Carbon fraction in wood.
	  ▪ Wood burning CH_4 and N_2O emission factors.	

Note (1): This source accounts for the loss of annual removal of CO_2 from the atmosphere. Since the construction stage is expected to span approximately 30 months, GHG emissions as a result of sink loss were calculated for 2.5 years. Sink loss will continue over the years; however, it is not covered in this assessment, as the operational phase accounts for a small amount compared to the GHG emissions from the construction stage. Since CO_2 from tree burning emissions is not from a fossil fuel source, CO_2 generated from this source is categorized as biogenic CO_2 (CO_2 bio).

Note (2): Calculations assume that the vegetation will not be allowed to regrow, but it is understood that temporary disturbances will be reclaimed and that compatible vegetation will be allowed within the RoW. This revegetation would provide carbon sinks in the region during the operational stage of the Project.

Fuel Consumption: GHG emissions totals from construction activities were calculated based on the fuel consumption estimations for diesel, gasoline, and Jet A in combination with published emission factors from the NIR 1990-2023 (ECCC, 2025) as listed in Table 5-2. More details on values used in the GHG emissions assessment are provided in Appendix A.

Table 4-2 Data Used for Fuel Consumption Emission Calculations

Emission Source	Fuel Type	Total volume (L)	Applicable Emission Factors Reference
Stationary fuel combustion equipment	Diesel (B3)	56,201	ECCC NIR 1990:2023 (Annex A6.1.6)
Off-road mobile equipment	Diesel (B3)	2,291,997	ECCC NIR 1990:2023 (Annex A6.1.15)
Crew vehicles including light-duty trucks	Gasoline (E10)	783,864	
Heavy-duty transport trucks including mobilization / demobilization	Diesel (B3)	8,276,237	
Air travel and aerial work including wiring	Jet A fuel	3,412,853	

Total Construction Emissions: The estimated total GHG emissions for the construction stage of the Project are summarized in Table 5-3, while the estimated GHG emissions for the highest year are compiled in Table 5-4.

Table 4-3 Summary of Estimated Greenhouse Gas Emissions during Construction

Source	Construction Stage GHG Emissions (t CO_2e)						Percent Contribution (%)
	CO_2	CH_4	N_2O	Total	CO_2b	Total (incl. CO_2b)	
Fuel Consumption	37,968	52	373	38,392	927	**39,319**	**13%**
Land Clearing (carbon stock removal)	0	0	0	0	233,601	**233,601**	**77%**
Land Clearing (carbon sink loss)	0	0	0	0	9,282	**9,282**	**3%**
Land Clearing (wood burning)	0	14,072	6,652	20,724	0	**20,724**	**7%**
Total	**37,968**	**14,123**	**7,024**	**59,116**	**243,810**	**302,926**	**100%**

Table 4-4 Summary of Annual Greenhouse Gas Emissions (Highest Year)

Source	Highest Year GHG Emissions (t CO_2e)						Percent Contribution (%)
	CO_2	CH_4	N_2O	Total	CO_2b	Total (incl. CO_2b)	
Fuel Consumption	16,114	24	169	16,307	432	**16,739**	**6%**
Land Clearing (carbon stock removal)	0	0	0	0	233,601	**233,601**	**85%**
Land Clearing (carbon sink loss)	0	0	0	0	1,856	**1,856**	**< 1%**
Land Clearing (wood burning)	0	14,072	6,652	20,724	0	**20,724**	**9%**
Total	**16,114**	**14,096**	**6,821**	**37,031**	**235,889**	**272,920**	**100%**

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4.2 Mitigation Measures

The following mitigation measures align the Project with the 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

The Project is predicted to have a low effect on emission levels of CO_2, N_2O, and CH_4 based on the comparison between the Project's maximum estimated annual emissions to both the federal and provincial annual GHG emissions inventories (Table 4-5). It represents 0.17% of the provincial total and 0.039% of the Canada-wide total. A further comparison of the Project's highest annual GHG emissions to the 2023 construction emissions from Ontario and Canada represents 0.064% and 0.016%, respectively. Comparing land use related emissions (land converted into settlements), the Project's highest annual GHG emissions would represent about 5% of 2013 of Canada's annual emissions.

Table 4-5 Impact of the Project on Ontario's and Canada's GHG Emissions Inventory

	NIR Total	NIR Construction Category	NIR Land Use Category
Project highest annual GHG emissions (1)	272,920 t CO_2e	16,739 t CO2e	256,181 t CO_2e
Comparison to Ontario total	0.17%	0.064%	n/a (2)
Comparison to Canada-wide total	0.039%	0.016%	5.1%

(1) The project's emissions are represented using the highest projected annual emissions during the construction stage and include associated biogenic CO_2 emissions from carbon stock removal.

(2) Not applicable, since the annual GHG emissions are negative in Ontario.

Although mitigation will help to reduce GHG emissions, they will not be eliminated; thus, the remaining emission of GHGs from construction activities was classified as a net effect and was carried forward to net effects characterization.

4.3.1 Net Effects Characterization

Net effects are described after the implementation of effective mitigation measures, and summarized according to direction, magnitude, geographic extent, duration / reversibility, frequency, and probability of the effect occurring following the methods described in Appendix B. For magnitude, effect levels are defined in Table 4-6.

The net effects of the Project on GHG emissions are characterized in Table 4-7. In summary, the net effects associated with construction are anticipated to be minimal due to the short timeframe during which they will be produced. Nonetheless, GHG emissions associated with Project construction activities will additively increase overall provincial and federal GHG emissions, and contribute permanently to global cumulative GHG emissions. In terms of magnitude, the effects are assessed as low considering that the highest emission year is projected to represent 0.17% of the Ontario total and 0.039% of the Canada-wide total.

Table 4-6 Magnitude Effect Levels for Greenhouse Gas Emissions

Indicator / Net Effect	Negligible	Low	Moderate	High
GHG emissions during construction activities	<0.1% of the provincial emissions level <0.01% of the national emissions level	0.1–1% of the provincial emissions level <0.1% of the national emissions level	1–5% of the provincial emissions level 0.1–1% of the national emissions level	>5% of the provincial emissions level >1% of the national emissions level

Table 4-7 Projected Net Effects of the Project on Greenhouse Gas Emissions

Parameters	Project Effect Characterization
Indicator	Projected GHG emissions in t CO_2e
Net Effect	GHG emissions during construction activities
Direct / indirect	Direct
Direction	Negative
Magnitude	Low
Geographic Extent	Beyond regional
Duration / irreversibility	Permanent
Frequency	Continual
Likelihood of Occurrence	Certain
Significance	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

This appendix supplements the report and documents the methods, data, and assumptions that were used to estimate GHG emissions during the construction stage for the proposed Northeast Power Line Project. GHGs are defined as gases that trap radiation, essentially heating the atmosphere. The most common GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone, perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF_6). 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 estimates and may overestimate the actual emissions. GHG reporting requirements should be based on actual annual emission totals and not those reported in this document.

A.1.2 Identification of Greenhouse Gas Emission Sources

The GHG emissions were estimated for the Project's construction stage based on information provided by Hydro One Networks Inc. (Hydro One) consultants with regard to the type and number of equipment expected on site and use durations. This assessment of Project effects on GHG emissions considers impacts that occur during the construction stage, as the annual GHG emissions over the lifespan of the Project are anticipated to be highest during this stage of the Project. During construction, the Project will generate CO_2, CH_4 and N_2O from the combustion of fossil fuels from the operation of mobile equipment (vehicles, construction equipment and helicopters), as well as from land clearing (loss of carbon sink).

Based on the Project's description, activities that would result in GHG emissions within each Project phase are listed in Table A-1.

Table A-1 Greenhouse Gas Emission Sources

GHG Emission Source	GHGs Involved	Emissions Scope
Fuel Consumption	CO_2, CH_4, N_2O	Scope 1
Land-use clearing (carbon stock removal)	Biogenic CO_2	Scope 1
Land-use clearing (carbon sink loss)	Biogenic CO_2	Scope 1
Land-use clearing (wood combustion)	CH_4, N_2O	Scope 1

A.1.3 Greenhouse Gas Emissions Calculations

This subsection includes information on the methods used to calculate emissions from fuel consumption, and land-use clearing.

A.1.3.1 Fuel Consumption

Emission rates of fuel consumption are calculated as follows.

Mobile Land Equipment and Non-mobile Equipment with Engines

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

$E_{k,i}$	total emissions of GHG i (i = CO_2, CH_4, or N_2O) for equipment k (t CO_2e)
P_k	rated power of equipment k (hp)
LF_k	average engine load factor of equipment k (-)
$BSFC_k$	brake-specific fuel consumption of equipment k (L/hp-h)
T_k	total operation time for equipment k (h)
EF_i	emission factor for GHG i (i = CO_2, CH_4, or N_2O) for the combustion of diesel fuel (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / t)

$P_k \times LF_k \times BSFC_k \times T_k$ 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 = CO_2, CH_4, or N_2O) for vehicle k (t CO_2e)
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 = CO_2, CH_4, or N_2O) for the combustion of gasoline (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / 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 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 = CO_2, CH_4, or N_2O) for conveyed material using route k (t CO_2e)
M_k	total amount of conveyed material using route k (m^3 of material)
P_k	average truck payload for conveyed material using route k (m^3/ trip)
D_k	average 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 = CO_2, CH_4, or N_2O) for the combustion of diesel (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / 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 Equipment

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

$E_{k,j}$	total emissions of GHG i (i = CO_2, CH_4, or N_2O) for equipment category k (t CO_2e)
N_k	total number of trucks transporting equipment category k (-)
D	total distance of each route (km one-way)
FC	fuel consumption rate of heavy-duty trucks (L/km one-way)
EF_i	emission factor for GHG i (i = CO_2, CH_4, or N_2O) for the combustion of diesel (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / 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

$$E_{k,i} = N_k \times D_k \times FC_k \times EF_i \times GWP_i / 10^6 \quad (5)$$

$E_{k,j}$	total emissions of GHG i (i = CO_2, CH_4, or N_2O) from origin k (t CO_2e)
N_k	total number of passengers travelling by air from origin k (psg)
D_k	distance travelled by air for category k (km)
FC_k	specific fuel consumption rate for airplanes (L/psg-km)
EF_i	emission factor for GHG i (i = CO_2, CH_4, or N_2O) for the combustion of turbo fuel (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / t)

$N_k \times D_k \times FC_k$ is used to estimate the volume of jet A fuel expected to be consumed for the air traveling 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 Helicopter

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

$E_{k,j}$	total emissions of GHG i (i = CO_2, CH_4, or N_2O) for helicopter k (t CO_2e)
T_k	total operation time for helicopter k (h)
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_2O) for the combustion of turbo fuel (g/L)
GWP_i	global warming potential for GHG i (t CO_2e / t)

$T_k \times FC_k$ 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, which is 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 this reservoir corresponds to CO_2 that has been captured over the years by the biomass that will be re-released in the atmosphere, at least in part. No field measurements specific of the study area in terms of biomass density were carried out and so the present calculations rely on default values provided by the IPCC.

Carbon stock removal

$$E_{k,i} = S_k \times AG_k \times (1 + BG) \times CF \times 44/12 \times GWP_i \quad (7)$$

$E_{k,i}$	total emissions of GHG i (i = CO_2 bio) for sector k (t CO_2e)
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	below-ground to above-ground biomass ratio (-)
CF	carbon content in dry wood (t C/t dry)
GWP_i	global warming potential for GHG i (t CO_2e / t)

Carbon sink loss

$$E_{k,i} = S_k \times SG_k \times (1 + SG) \times CF \times 44/12 \times T \times GWP_i \quad (8)$$

$E_{k,i}$	total loss of GHG I sink (i = CO_2 bio) for sector k (t CO_2e)
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)
SG	below-ground to above-ground biomass ratio (-)
CF	carbon content in dry wood (t C/t dry)
T	sink loss duration (yr)
GWP_i	global warming potential for GHG i (t CO_2e / t)

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 = 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 = CH_4, and N_2O) (kg/t dry)
GWP_i	global warming potential for GHG i (t CO_2e / t)

A.1.4 Greenhouse Gas Emissions Assessment Data Requirements

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

Table A-2 Greenhouse Gas Emissions Assessment Data Sources

Emission Source	Parameter	Value	Unit	Data Source
Fuel Consumption	Total diesel consumption from mobile equipment	2,291,997	L	Calculated based on information provided by Aecon on the number of equipment, the model when available, and expected operation time.
	Total diesel consumption from stationary equipment	56,102	L	
	Total gasoline consumption from crew vehicles	783,864	L	
	Total diesel consumption from heavy-duty trucks	7,850,230	L	
	Total diesel consumption for land mobilization and demobilization	426,007	L	

Emission Source	Parameter	Value	Unit	Data Source
	Total turbo fuel consumption for air travel	185,741	L	
	Total turbo fuel consumption for helicopters	3,227,112	L	
Diesel consumption for stationary 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 1990-2023: GHG Sources and Sinks in Canada (ECCC, 2025) 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 uses the biodiesel emission factor and is multiplied by 0.031.
	CH_4 EF for diesel combustion	0.078	g CH_4/L	
	N_2O EF for diesel combustion	0.022	g N_2O/L	
	CO_2b EF for diesel combustion	77	g CO_2b/L	
Diesel consumption for 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 1990-2023: GHG Sources and Sinks in Canada (ECCC, 2025) 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 uses the biodiesel emission factor and is multiplied by 0.031.
	CH_4 EF for diesel combustion	0.073	g CH_4/L	
	N_2O EF for diesel combustion	0.12	g N_2O/L	
	CO_2b EF for diesel combustion	77	g CO_2b/L	
Diesel consumption for 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 1990-2023: GHG Sources and Sinks in Canada (ECCC, 2025) 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 uses the biodiesel emission factor and is multiplied by 0.031.
	CH_4 EF for diesel combustion	0.14	g CH_4/L	
	N_2O EF for diesel combustion	0.082	g N_2O/L	
	CO_2b EF for diesel combustion	77	g CO_2b/L	
Gasoline consumption for crew trucks	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 1990-2023: GHG Sources and Sinks in Canada (ECCC, 2025) 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 uses the ethanol emission factor and is multiplied by 0.095.
	CH_4 EF for gasoline combustion	0.43	g CH_4/L	
	N_2O EF for gasoline combustion	0.20	g N_2O/L	
	CO_2b EF for gasoline combustion	143	g CO_2b/L	
Aviation turbo fuel consumption for aircrafts	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 1990-2023: GHG Sources and Sinks in Canada (ECCC, 2025)
	CH_4 EF for turbo fuel combustion	0.018	g CH_4/L	
	N_2O EF for turbo fuel combustion	0.071	g N_2O/L	

Emission Source	Parameter	Value	Unit	Data Source
Land-use Change: Carbon Stock Removal	Total surface area cleared (S_k)	1,550	ha	For calculation of total carbon stock removal
	Average above-ground biomass affected by disturbance (AG_k)	62.9	t dry / ha	Table 4.7 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol. 4, Chapter 4. Boreal coniferous forest.
	Ratio of below-ground to above-ground biomass (BG)	0.39	—	Table 4.4 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol. 4, Chapter 4. Boreal forest with biomass density <75 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).
Land-use Change: Carbon Sink Loss	Total surface area cleared (S_k)	1,550	ha	
	Average annual above-ground biomass growth (SG_k)	1	t dry / ha / y	Table 4.12 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories, Vol. 4, Chapter 4. Boreal Coniferous Forest
	Ratio of below-ground to above-ground biomass (SG)	0.39	—	Table 4.4 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol. 4, Chapter 4. Boreal forest with biomass density <75 tonnes/ha
	Loss of growth period (T)	2.5	years	Assumes sink loss of 2.5 years during the construction stage.
Land-use Change: Wood Burning	Total surface area cleared (S_k)	951	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_2O EF for wood biomass burning	0.29	t N_2O / t dry	Assuming N_2O equivalent to 0.017% of CO_2 as per ECCC SACC guidelines
Global Warming Potentials (GWP)	CO_2	1	t CO_2e/t CO_2	IPCC AR6 (2021)
	CH_4 (non-fossil)	27	t CO_2e/t CH_4	
	CH_4 (fossil)	29.8	t CO_2e/t CH_4	
	N_2O	273	t CO_2e/t N_2O	

Appendix B. Net Effects Characterization

Predicted net effects, where identified, are described in terms of the following significance factors (MNRF 2002, MNRF 2005):

- Direct/indirect;
- Direction;
- Magnitude;
- Geographic extent;
- Duration/reversibility;
- Frequency;
- Likelihood of occurrence; and
- Context (where applicable).

General definitions of these factors are provided in Table B-1.

Table B-1 Greenhouse Gas Emission Sources

Effects Characteristic	Definition	Description
Direct / indirect	Identifies if the effect is caused directly by a project activity or if it is caused by another environmental effect.	▪ Direct – effect is caused directly by a project activity ▪ Indirect – effect is caused by another environmental effect (direct or indirect) due to project
Direction	The direction of change in the effect relative to the current value or state.	▪ Positive – net gain or positive effect ▪ Neutral – no change ▪ Negative – net loss or adverse effect
Magnitude	Magnitude is the intensity of the effect or a measure of the degree of change from existing (baseline) conditions expected to occur in the criterion.	▪ To be defined by each criteria-specific assessment
Geographic extent	Geographic extent refers to the spatial area over which an effect will occur/can be detected (distance covered or range).	▪ Project footprint – effect is limited to the direct physical disturbance from the Project ▪ Local – the effect is confined to the LSA, but outside of the Project footprint ▪ Regional – the effect extends beyond the LSA boundary, but is confined within the RSA ▪ Beyond regional – the effect extends beyond the RSA

Effects Characteristic	Definition	Description
Duration/ reversibility	Duration is the period of time over which the environmental effect will be present. The amount of time between the start and end of an activity or stressor, plus the time required for the effect to be reversed. Reversibility is an indicator of the potential for recovery of the criterion from an effect. Reversible implies that the effect will not influence the criterion at a future predicted period in time. For effects that are permanent, the effect is determined to be irreversible.	▪ Short-term – the effect occurs during construction and/or operation and maintenance, and persists for the duration of the activity, but is reversible ▪ Medium-term – the effect occurs during construction and/or operation and maintenance, and persists after the activity is complete, but is reversible ▪ Long-term – the effect occurs during construction and/or operation and maintenance, and persists for the life of the Project, but is reversible ▪ Permanent – the effect occurs during construction and/or operation and maintenance and is irreversible
Frequency	Frequency refers to the repeated occurrence of the environmental effect over time, whether it is because an activity occurs repeatedly over time, or because time periods change (e.g., seasonal effects may occur annually).	▪ Infrequent – the effect is expected to occur rarely. ▪ Frequent (or periodic) – the effect is expected to occur intermittently. ▪ Continual – the effect is expected to occur continually.
Likelihood of occurrence	Likelihood of occurrence is a measure of the probability that an activity will result in an environmental effect.	▪ Unlikely – the effect is not likely to occur ▪ Possible – the effect may occur, but is not likely ▪ Probable – the effect is likely to occur ▪ Certain – the effect will occur

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