Unlocking Hardwood Potential: Investment Opportunities in the Thunder Bay Region

Technical Report

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For all inquiries regarding hardwood fibre investment opportunities in the Thunder Bay region, please feel free to contact CRIBE (https://cribe.ca/contact/), City of Thunder Bay Community Economic Development Commission (https://gotothunderbay.ca/) or the listed Sustainable Forest Licence holder (see Section 2.1).

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Executive Summary

Hardwood species like trembling aspen, balsam poplar and white birch are among Ontario's most abundant tree species, together comprising nearly 30% of the merchantable growing stock in Crown forests. However, in many regions of the province—including the Thunder Bay region—this hardwood resource remains underutilized, representing a significant opportunity for new investment and value creation.

Despite this opportunity a key barrier to investing in this resource remains: limited access to investment grade forest inventory data tailored to industry needs. While Ontario's public forest inventories are comprehensive, they often lack the specific data investors require to assess opportunity. This includes:

- The aggregated birch and poplar volume for multiple Forest Management Units (FMUs) combined into one woodshed,
- Log profile data (species, diameter, and length classes),
- Haulage costs from forest to mill.

This report addresses those gaps by providing a detailed analysis of over 4 million hectares of productive Crown forest in the Thunder Bay region. Key findings include:

- **Current Fibre Availability:** Over 1.1 million cubic metres of poplar and 260,000 cubic metres of birch fibre are available annually on a sustainable basis, under current approved forest management plans.
- **Growing Stock Potential:** As forest management planning in the region has typically not focused on hardwoods, future forest management planning direction may be able to better address hardwood fibre opportunities given the existence of a substantial growing stock.
- **Log Profile:** Average log diameter is 20–24 cm. Processing logs at 2.4 metre lengths yield approximately 0.10–0.13 m^3 per log while logs at 4.8 metre lengths yield approximately 0.20-0.26 m^3 per log. Increasing log length to 4.8 metres, which may improve harvesting efficiency, reduces volume recovery for poplar by only ~5%. For birch logs, this decrease is significantly more (13%) due to birch trees being on average much shorter than poplar.
- **Haul Costs:** Based on a custom haul cost model, transportation costs from forest roadside to Thunder Bay range from $14 to $40 per m^3. Over 85% of the resource can be hauled for under $30/$m^3$.

Average Fibre Profile for the Hardwood Resource in the Thunder Bay Region Given Current Fibre Availability

Fibre Profile	2.4 m Log Scenario		4.8 m Log Scenario	
	Poplar	Birch	Poplar	Birch
Average Diameter at Log Top (cm)	23	20	23	19
Average Log Piece Size (m^3/log)	0.09	0.07	0.19	0.14
Average Log Piece Size (logs/m^3)	11	15	5	7
Average Haul Cost ($/$m^3$)	$24.35	$24.86	$24.29	$24.83
Total Fibre Currently Available (m^3/yr)	1,100,000	260,000	1,080,000	240,000

Based on this fibre supply, the region could support one or a combination of new forest product facilities. The most promising opportunities identified in this study include:

- **Engineered Wood Products (EWP):** Products such as oriented strand board (OSB) and laminated strand lumber (LSL) are proven uses for poplar and, to a lesser extent, birch. Demand for these products is growing, driven by trends in mass timber construction. These facilities could utilize the bulk of available fibre with established markets and technologies.
- **Liquid Biofuels:** As industries seek to decarbonize, renewable fuel sources are in increasing demand. Wood fibre is one of the most viable and scalable feedstocks for biofuels in Canada, especially compared to agricultural alternatives. These facilities can use lower-grade logs and mill residues, adding value to material that might otherwise go unused.
- **Veneer and Plywood:** There is potential to establish a veneer or plywood facility, focused on the utilization of higher-grade logs as a stand-alone product or, in the case of birch veneer, complimenting poplar and softwood plywood cores as the top layer. Global supply chains for substitutes like Lauan and Baltic birch are facing pressure due to sanctions, environmental regulations, and declining supply. However, suitable logs (large-diameter) are more limited, making this a more selective opportunity.

The table below shows potential maximum capacities for facilities producing different productions in the region. The co-location or integration of these facility types offers compelling synergies: high-quality birch logs can be directed to veneer production; mid-grade poplar fibre to engineered wood; and low-grade logs and residues to biofuels—maximizing overall resource utilization.

Potential Annual Production for Hardwood Processing Facilities in the Thunder Bay Region Given Current Fibre Availability

Product	Log Length	Minimum Diameter	Basis	Units	Production Capacity (Annual)
Veneer/Plywood	2.4 m	28cm	9.5mm (3/8")	m^2	90,000-110,000
Oriented Strand Board	2.4-4.8 m	10cm	9.5mm (3/8")	m^2	68,000,000
Engineered Wood Products	2.4-4.8 m	10cm	32mm (1-1/4")	m^2	20,000,000
Biofuel	2.4-4.8 m	None	Liquid Fuels	litres	135,000,000

Based on current industry trends, the production capacity of OSB or EWP from this region would support investment in a new, modern, OSB or EWP mill. The production capacity of the region for OSB is well within the range seen in other comparable facilities.[1] In conjunction with other opportunities, now is the right time to increase utilization of hardwoods in the Thunder Bay region.

In summary, this study demonstrates that the hardwood resources in the Thunder Bay region could viably support one or more forest product facilities. It provides detailed, investment-relevant data on log size distribution, fibre availability by diameter class and cost threshold, and operational trade-offs between different logging strategies.

Other provinces—particularly Alberta and Saskatchewan—have shown that unlocking the value of underutilized hardwoods can strengthen the forest sector, improve the ability to manage mixedwood forests, and fully realize the potential of the boreal forest. Thunder Bay has the resource, location, and conditions to follow suit.

[1] "OSB Mill Investments and Predictions." *Forisk Consulting*, 21 Mar. 2024, https://forisk.com/osb-mill-investments-and-predictions/.

1 Introduction

Hardwood utilization represents a major challenge in Northwestern Ontario. The wood basket around Thunder Bay Ontario has a large hardwood component with many mixedwood stands. Despite this abundance of supply, there are currently limited users of hardwood fibre in the region.

This project aims to assess the potential underutilized hardwood resources available in the Thunder Bay region forest management units of Lakehead Forest, Dog River-Matawin Forest, Black Spruce Forest, English River Forest and Lake Nipigon Forest (collectively referred to as the study area) which could provide feedstock to new forest product facilities. The wood baskets of interest are under the management of Resolute FP Canada Inc, Greenmantle Forest Inc. and Lake Nipigon Forest Management Inc. and represent 6.7 million hectares of combined area, with over 4 million hectares of productive forest (Figure 2-1).

The partners for this project include the Centre for Research and Innovation in the Bioeconomy (CRIBE), Lake Nipigon Forest Management Inc, Domtar (Resolute FP Canada Inc), Greenmantle Forest Inc, Lac Des Mille Lacs First Nation and the City of Thunder Bay Economic Development Corporation, all of whom work collaboratively to increase hardwood utilization and attract investment to the study area.

The Thunder Bay region once supported 2 oriented strand board (OSB) mills, two hardwood kraft pulp mills, a birch veneer mill and a hardwood sawmill. A second birch veneer mill also operated for a brief period. Many of these mills no longer operate. Mill closures were due to market forces and not limitations on fibre supply. This study examines the current fibre supply potential in terms of overall growing stock, currently approved harvest levels, existing utilization piece size and haul costs.

The primary outcome of this project is the production of an 'investment grade' forest inventory and fibre supply assessment. This study will seek to answer questions around quantity and location of fibre available, piece size metrics of the fibre, and cost. Existing data and on forest inventory, growth and yield, and fibre supply assessments was used to answer these questions.

1.1 Investment Grade Inventory

An 'investment grade' inventory is a forest inventory information to support investment decisions for new or upgraded forest products facilities. While current enhanced Forest Resource Inventories (FRI) provide a publicly available source of information on forest composition, these inventories lack detail on expected yield, products and costs. For this project, an 'investment grade' inventory will use available FRIs as a starting point, but will include the following information:

- Quantity and profile of underutilized fibre within the project area, including:
    - Species mix (trembling aspen, white birch, balsam poplar).
    - Piece size (m^3/log).
    - Piece count (number of logs per diameter class).
- Quantity of fibre available within various costing thresholds.

This information will help potential investors understand what an inbound log diet may look like so they can make the right decisions on design and process flow while at the same time optimizing the recovery of fibre.

2 Background

2.1 Study Area

The study area around Thunder Bay Ontario comprises of 5 Forest Management Units (FMUs):

1. Black Spruce Forest (current FMP effective 2021-2031) – tenure held by Resolute FP Canada Inc.
2. Dog River-Matawin Forest (current FMP effective 2021-2031) – tenure held by Resolute FP Canada Inc.
3. English River Forest (current FMP effective 2019-2029) – tenure held by Resolute FP Canada Inc.
4. Lakehead Forest (current FMP effective 2020-2030) – tenure held by Green Mantle Forest Inc.
5. Lake Nipigon Forest (current FMP effective 2021-2031) – tenure held by Lake Nipigon Forest Management Inc.

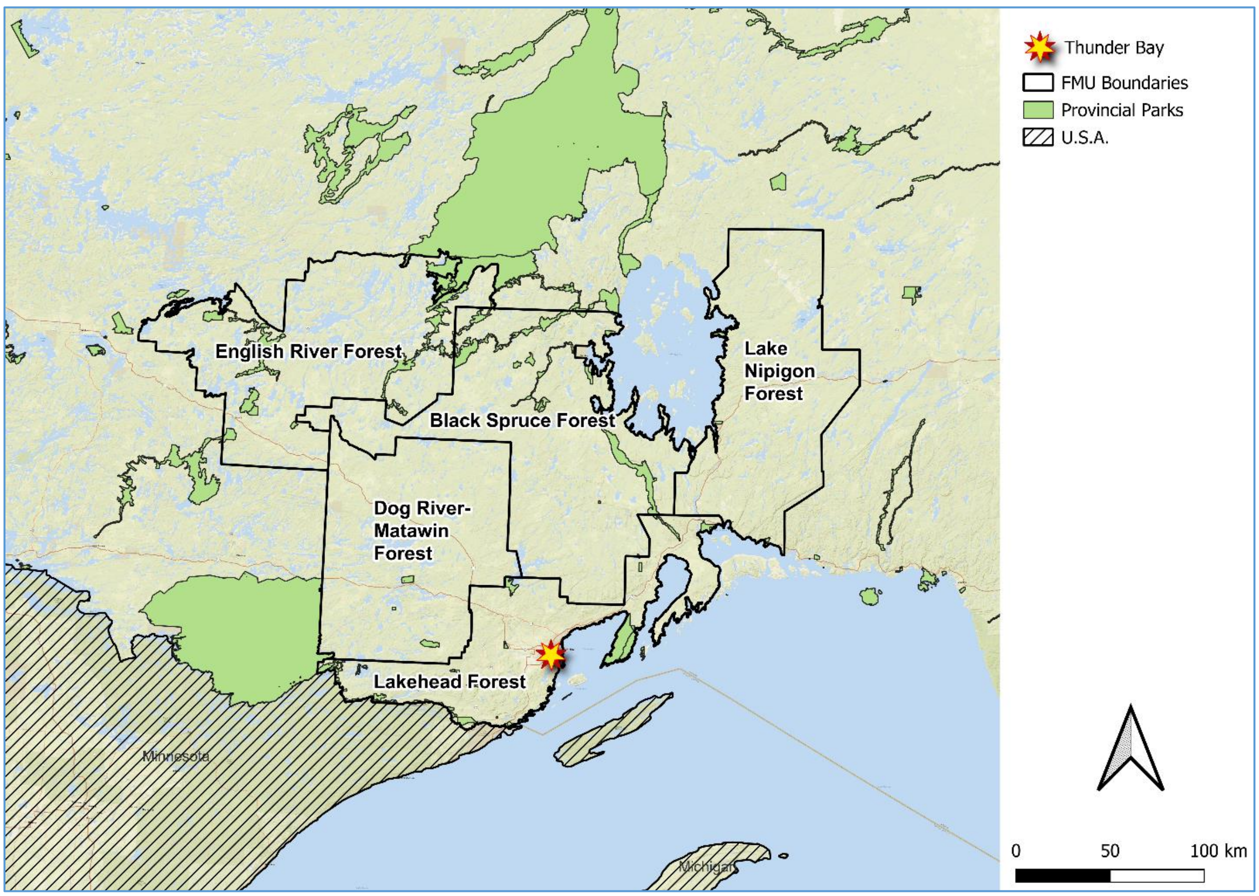

Figure 2-1. Map of study area and Thunder Bay region with Forest Management Units.

All of these FMUs currently have an active Sustainable Forest License (SFL) meaning that wood supply is currently available to various forest industries in the region by the province. Additionally, wood supply may be directed to facilities through Forest Resource Licenses (FRLs), wood supply agreements from the Crown and business-to-business agreements between forest industry participants.

This study area is primarily boreal forest, but small amounts of transitional forest exist in the southern reaches where some Great Lakes – St. Lawrence species are found. For the purposes of this report, the hardwood resource is limited to the two species that grow to commercial size and in sufficient quantity to commercialize: trembling aspen (*Populus tremuloides*) and white birch (*Betula papyrifera*). For the purposes of this report, trembling aspen is referred to as poplar. Other hardwood species do exist in the study area such as balsam poplar, maple, ash and oak, but do not occur in significant volume.

2.2 Forest Management Planning

Forestry operations on crown land are managed under a Forest Management Plan (FMP) for each FMU and renewed on a 10-year basis. As a part of every FMP, harvest volume levels are assessed against existing volume commitments and historic (actual) utilization of wood supply. It is important to note that forest management and planning in this study area has historically focused on softwoods for dimensional lumber and pulp. There may be opportunities to better address hardwood and mixedwood forest management in upcoming FMPs given the presence of new investment potential.

2.3 Current Merchantable Hardwood Fibre Utilization Within the Study Area

Merchantable hardwood fibre is currently underutilized in the study area, with limited use for pulp, firewood, and bioenergy. Ontario's 2020 *Forest Sector Strategy* notes that provincial fibre utilization is, on average, less than half of the sustainable harvest level, and the challenge is especially pronounced in the study area due to few existing users. This project was initiated by CRIBE at the request of local tenure holders and other stakeholders, all of whom agree that hardwood utilization is below current allocations and support initiatives to increase its use. The hardwood volume opportunity quantified in this report accounts for the existing utilization of current and potential users.

2.4 Hardwood Facility Opportunities and Specifications

Historically, the commercialization of poplar and birch was limited by a lack of suitable processing technologies. Today, that constraint has largely been overcome. A wide range of established and emerging technologies can now convert these species into value-added forest products. Current uses of hardwood are primarily for panelboard or pulp. New potential products which can utilize hardwood as a feedstock include bio-products like biochar, biocarbon and biofuels.

In this study, the following products were assessed:

<u>Engineered Wood Products (EWPs):</u>

- Oriented Strand Board (OSB)
- Mass timber products; Laminated Veneer Lumber (LVL) and Laminated Strand Lumber (LSL)
- Particleboard
- Hardboard
- Medium Density Fibreboard (MDF)
- Veneers
- Plywood

<u>Pulp:</u>

- Northern bleached hardwood kraft (NBHK)

<u>Biofuels:</u>

- Liquid fuels
- Pellets
- Biochar

To better understand how much of the available hardwood resource would meet the needs of these various producers, this study included a brief market scan and literature review of acceptable log specifications and conversion ratios. Findings from this indicated that, aside from plywood and veneer, producers of all these products could utilize fibre in the form of logs down to a 10cm diameter. Plywood and veneer mills typically require larger diameters. For this study, both plywood and veneer was limited to 28cm diameter logs. Log diameters considered 'oversized', over 60-70cm in diameter depending on the facility, were uncommon in the dataset analyzed in this study except in cases of defect (i.e. butt flare, crook, sweep). In this study, log diameter references the minimum diameter of a log inside bark (i.e. short end/top of log diameter).

With regards to facility species preferences, all panelboard facilities can accept some birch, but generally prefer a log diet of 90% poplar. Pulp mills in Canada generally do not accept birch as part of their feedstock. Bioenergy and biofuel facilities can accept any species mix. Other log profile factors such as length are variable depending on the facility and machine specifications.

The following table highlights both the conversion rate for the various products considered as well as the feedstock requirements:

Table 2-1. Hardwood Product Feedstock Requirements and Conversion Rates table.

Panelboard[2, 3]	Basis	Conversion	Minimum Log Diameter	Species Requirement
		Green m³ to m²	(cm)	(%)
Oriented Strand Board	9.5mm (3/8")	58	10cm	90 - Poplar
Laminated Strand Lumber	32mm (1-1/4")	18	10cm	90 - Poplar
Medium Density Fibreboard	16mm (5/8")	36	10cm	90 - Poplar
Particle Board	16mm (5/8")	40	10cm	90 - Poplar
Veneer	9.5mm (3/8")	19	28cm	Poplar or Birch
Plywood	9.5mm (3/8")	26	28cm	Poplar or Birch
Pulp[4, 5]	**Basis**	**Conversion**	**Minimum Log Diameter**	**Species Requirement**
		Green m³ to tonne	**(cm)**	**(%)**
NBHK	N/A	0.16-0.25	None	Primarily Poplar
Biofuel[6]	**Basis**	**Conversion**	**Minimum Log Diameter**	**Species Requirement**

[2] Kostiuk, Alan P. *Conversion Factors for the Forest Products Industry in Eastern Canada*. Research report, Forestry Canada No. 12, 3715K345, E-1322, Forestry Canada, Mar. 1992. Ottawa, Ontario.

[3] Fonseca, Matthew A., ed. *The measurement of roundwood: methodologies and conversion ratios*. Cabi Publishing, 2005.

[4] Nielson, R. W., J. Dobie, and D. M. Wright. *Conversion Factors for the Forest Products Industry in Western Canada*. Research report, Special Publication SP-24R, W-100, Apr. 1985. Vancouver, British Columbia.

[5] Fonseca, 2005.

[6] Wang, Wei-Cheng, and Ling Tao. *Bio-jet fuel conversion technologies*. Renewable and Sustainable Energy Reviews 53 (2016): 801-822.

		Green m^3 to litres	(cm)	(%)
Liquid fuels	N/A	92-103	None	Any

3 Fibre Analysis

3.1 Forest Inventories

The most recent provincial forest resource inventories (FRIs) for each of the five FMUs was obtained from the respective SFL holder, which included activities and depletions up until the previous timber year (2024). By providing information on forest composition and age, FRIs are used to develop forest management plans and determine sustainable harvest levels, they are typically redone every 10-years.

Stands with similar compositions are stratified into descriptive Forest Unit categories. These forest units serve as the basis for determining hardwood fibre profile. The Hardwood Mix (HRDMX or HRDMW) forest unit was merged with Hardwood Dominant (HRDOM) – a Forest Unit with similar species composition – due to it being a relatively minor component in each FRI and to align with strategies done in the recent FMPs. The age of each stand was recalculated according to Section 3.2.1 to align with MNR permanent sample plot measurement dates.

3.2 Data Compilation

The Ontario Growth & Yield Program permanent sample plots (PSPs) and permanent growth plots (PGPs) were utilized to assess the hardwood opportunity in the study area. The plot data was intersected with the forest inventories to identify plots only within the study area for the analysis. Plots were excluded if they lacked tree measurement data, had data collected before 2002, or were no longer in the productive forest. Additionally, plots marked as harvested, retired, or depleted (due to harvesting, wildfire, or blowdown) in the inventory on or after the measurement year were removed from the analysis.

In total, 668 plots were used in this analysis and were distributed as such in comparison to the proportion of the overall landbase. Plots were not separated by FMU in the compilation process.

Table 3-1. Plot distribution in comparison to the landbase proportion of each plan forest unit.

Plan Forest Unit	Plots	Plot Proportion	Landbase Proportion
BFDOM	23	3%	4%
BWDOM	17	3%	2%
CONMX	79	12%	17%
CONPJ	45	7%	0%
HRDOM*	105	16%	12%
OCLOW	5	1%	3%
OTHHD	2	0%	0%
PJDOM	141	21%	3%
PJMX1	34	5%	3%
PODOM	51	8%	2%
PRDOM	1	0%	0%
PRWMX	4	1%	0%
PWDOM	3	0%	0%
SBDOM	65	10%	12%
SBLOW	36	5%	16%
SBMX1	55	8%	7%
UPLCE	2	0%	0%
Grand Total	668	100%	100%

*HRDMW and HRDOM forest units were combined for the purposes of this analysis due to similar profiles and few plots in the HRDMW forest unit.

The plot distribution and proportionality to the overall landbase area was viewed as satisfactory, with the critical Forest Units of HRDOM, PODOM and BWDOM having an appropriate number of plots based on their landbase proportion.

3.2.1 Age and Age Group Calculation

While plots were well distributed across the landbase by Forest Unit, there were insufficient plots in each 10-year age class to compile volumes for each Forest Unit by 10-year age increments. To address this, the landbase and plots were stratified into broader age groups, ensuring each stratum (Forest Unit and age group combination) contained enough plots for reliable estimates. Age was calculated using the following inventory attributes, in order of precedence:

- Where overstory origin was known, age was calculated by subtracting this attribute's value from the plot measurement year.
- Where stand depletion year was known, age was calculated by subtracting this attribute's value from the plot measurement year.
- Where stand origin year was known, age was calculated by subtracting this attribute's value from the plot measurement year.

Age groups were stratified in approximately 20-year increments both above and below the operability ranges for each plan forest unit (Table 3-2). This was done to focus plot estimates as close to operable age as possible as it was identified that most of the available data was within the operable age ranges.

Five age groups were created as a result:

- Age group 1: sapling to immature stands
- Age group 2: Mature but below operability (<20-years under operable age)
- Age group 3: Mature and operable (<20-years over operable age)
- Age group 4: over-mature (20-40-years over operable age)
- Age group 5: old forest (>40-years over operable age)

Table 3-2. Age Group Classifications (Years).

Forest Unit	Operability Age (years)	Age Group 1	Age Group 2	Age Group 3	Age Group 4	Age Group 5
BFDOM	51	1 to 30	≥30 to <50	≥50 to <70	≥70 to 90	>90
BWDOM	51	1 to 30	≥30 to <50	≥50 to <70	≥70 to 90	>90
CONMX	61	1 to 40	≥40 to <60	≥60 to <80	≥80 to 100	>100
CONPJ	61	1 to 40	≥40 to <60	≥60 to <80	≥80 to 100	>100
HRDOM	51	1 to 30	≥30 to <50	≥50 to <70	≥70 to 90	>90
OCLOW	81	1 to 60	≥60 to <80	≥80 to <100	≥100 to 120	>120
OTHHD	N/A	1 to 30	≥30 to <50	≥50 to <70	≥70 to 90	>90
PJDOM	51-61	1 to 40	≥40 to <60	≥60 to <80	≥80 to 100	>100
PJMX1	61	1 to 40	≥40 to <60	≥60 to <80	≥80 to 100	>100

Forest Unit	Operability Age (years)	Age Group 1	Age Group 2	Age Group 3	Age Group 4	Age Group 5
PODOM	51	1 to 30	≥30 to <50	≥50 to <70	≥70 to 90	>90
PRDOM	91	1 to 70	≥70 to <90	≥90 to <110	≥110 to 130	>130
PRWMX	91	1 to 70	≥70 to <90	≥90 to <110	≥110 to 130	>130
PWDOM	91	1 to 70	≥70 to <90	≥90 to <110	≥110 to 130	>130
SBDOM	71	1 to 50	≥50 to <70	≥70 to <90	≥90 to 110	>110
SBLOW	91	1 to 70	≥70 to <90	≥90 to <110	≥110 to 130	>130
SBMX1	61	1 to 50	≥50 to <70	≥70 to <90	≥90 to 110	>110
UPLCE	71	1 to 50	≥50 to <70	≥70 to <90	≥90 to 110	>110

Most plots, within operability, in the key forest units (PODOM, HRDOM, BWDOM, and CONMX) fell within age groups 2, 3, and 4—representing mature stands that are either currently operable or approaching operability.

Table 3-3. Number Of Plots By Age Group And Plan Forest Unit.

Plan Forest Unit	Age Group 1	Age Group 2	Age Group 3	Age Group 4	Age Group 5	Total
BFDOM	3	7	4	6	3	23
BWDOM	1	3	10	3	0	17
CONMX	23	27	12	13	4	79
CONPJ	35	4	2	4	0	45
HRDOM	14	36	19	27	9	105
OCLOW	0	0	4	1	0	5
OTHHD	0	0	0	0	2	2
PJDOM	103	22	5	8	3	141
PJMX1	15	5	8	4	2	34
PODOM	14	16	5	14	2	51
PRDOM	1	0	0	0	0	1
PRWMX	4	0	0	0	0	4
PWDOM	0	1	0	0	2	3
SBDOM	33	15	12	5	0	65
SBLOW	13	6	12	3	2	36
SBMX1	35	8	6	5	1	54
UPLCE	0	0	0	0	2	2
Grand Total	294	150	99	93	32	668

Table 3-4. Landbase Area (Ha) By Age Group And Plan Forest Unit.

Plan Forest Unit	Age Group 1	Age Group 2	Age Group 3	Age Group 4	Age Group 5	Total
BFDOM	14,226	25,457	28,229	36,546	63,554	168,012
BWDOM		11,855	40,298	59,127		111,280
CONMX	105,740	55,786	88,811	139,621	130,156	520,114
CONPJ	58,820	57,006	7,379	28,967		152,172
HRDOM	104,589	137,036	100,747	172,392	297,145	811,909
OCLOW			11,852			11,852
OTHHD					4,352	4,352
PJDOM	226,613	124,356	13,725	49,410	18,877	432,980
PJMX1	69,365	41,795	12,905	52,460	23,286	199,811
PODOM	133,161	87,107	29,355	53,669	69,300	372,591
PRDOM	885					885
PRWMX					978	978
PWDOM	213,821	29,803	66,039	114,887		424,551
SBDOM	157,516	76,878		127,521	176,032	537,946
SBLOW	80,871	23,458	34,950	69,573	32,677	241,530
SBMX1					9,646	9,646
UPLCE						0
Grand Total	1,165,606	670,536	434,291	904,174	826,003	4,000,609

3.2.2 Height Calculation

Height data were not collected for all individual trees in the PSPs and PGPs. To address this, the Chapman Richard model[7] was incorporated to predict tree heights based on their diameter-at-breast height (DBH) measurements. The Chapman Richard model is a non-linear height diameter relationship model calibrated for major tree species in Ontario and is commonly used in forest ecology and management. When model parameters were not available for a given species, parameters from a similar species with shared life history traits (e.g., growth rates, shade tolerance, successional status) were used in its place.

3.2.3 Volume Calculation

Volumes were compiled to 15-cm diameter outside bark at the stump, with a stump height of 30-cm and a 9.1-cm diameter inside the bark at the top, with the exception

[7] Peng C., et al. (2001). Developing and validating nonlinear height-diameter models for major tree species of Ontario's boreal forests. NJAF. 18(3): 87-94.

of white birch which was compiled to an 11.1-cm diameter inside the bark at the top, in alignment with Ontario's Scaling Manual and growth and yield approaches. Zakrzewski and Penner's taper equation model and parameters were used to calculate merchantable lengths and cross-sectional areas[8]. Newton's volume compilation formula was used to compile volumes per tree and per log at two log lengths (2.4 m and 4.8 m)[9]. This approach is consistent with Ontario's Model Inventory and Support Tool (MIST), which is the basis of growth and yield projection in Ontario FMPs and considered an industry standard.

Deciduous volumes for each plot were compiled and subdivided based on the two major species:

- White Birch
- Trembling Aspen

Species log volumes were classified into 2 cm diameter classes based on the log's top end diameter inside bark. Volume compilations were done for gross merchantable volume (GMV), subject to minimum diameter and length requirements. Net merchantable volume (NMV) was calculated later through the application of a cull deduction and the removal of the waste piece where the top log length was less than 2.4 m or 4.8 m.

3.3 Net Merchantable Volume Calculation

To calculate net merchantable volume (NMV) it was necessary to estimate both cull (defect and decay), as well as the portion of the merchantable stem that does not meet the log length requirement (i.e. short logs).

3.3.1 Cull Calculation

Stem decay (i.e. cull) is a major issue in Boreal hardwood species, particularly aspen. So much so that NMV begins to decrease significantly in over mature stems. Standard

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[8] Zakrzewski W.T., Penner, M. (2013). A comparison of tree stem taper models for use in Ontario. Applied Research and Development Ontario Ministry of Natural Resources. Forest Research Report No. 176.

[9] Huang, S. (1994). Ecologically Based Individual Tree Volume Estimation for Major Alberta Tree Species. AB Sustainable Resource Development, Public Lands and Forests Divisions, p. 1-80.

cull estimates have been used in MIST and can be applied by species and age as per Basham, 1991[10]. GMV estimates were reduced by the cull rates by species and age using the coefficients from MIST (based on Basham, 1991) to produce a final NMV. Cull estimates range from 1-2% for sapling and immature stands, up to >30% for old and over mature stands. At maturity (40-60 years) cull for white birch and poplar estimated at 5% and 13% respectively. Losses for waste and breakage were not estimated as part of this cull calculation.

[10] Basham, J. T. "Stem decay in living trees in Ontario's forests: A users' compendium and guide. Information report No. OX-408." (1991).

3.3.2 Short Log Calculation

'Short logs' are those produced from a portion of the stem that has a merchantable top diameter but does not have sufficient length to produce a merchantable full-sized log given the log length requirement of either 2.4 m or 4.8 m. In the example shown, a tree with a merchantable stem of 25ft can produce either three 2.4 m logs or one 4.8 m log. The merchantable portion of the stem is defined as being above the 30cm stump and below the height where the stem tapers to <9.1cm. In this example, an 2.4 m log length compilation would produce a 1ft short log while a 4.8 m compilation would produce a 9ft short log.

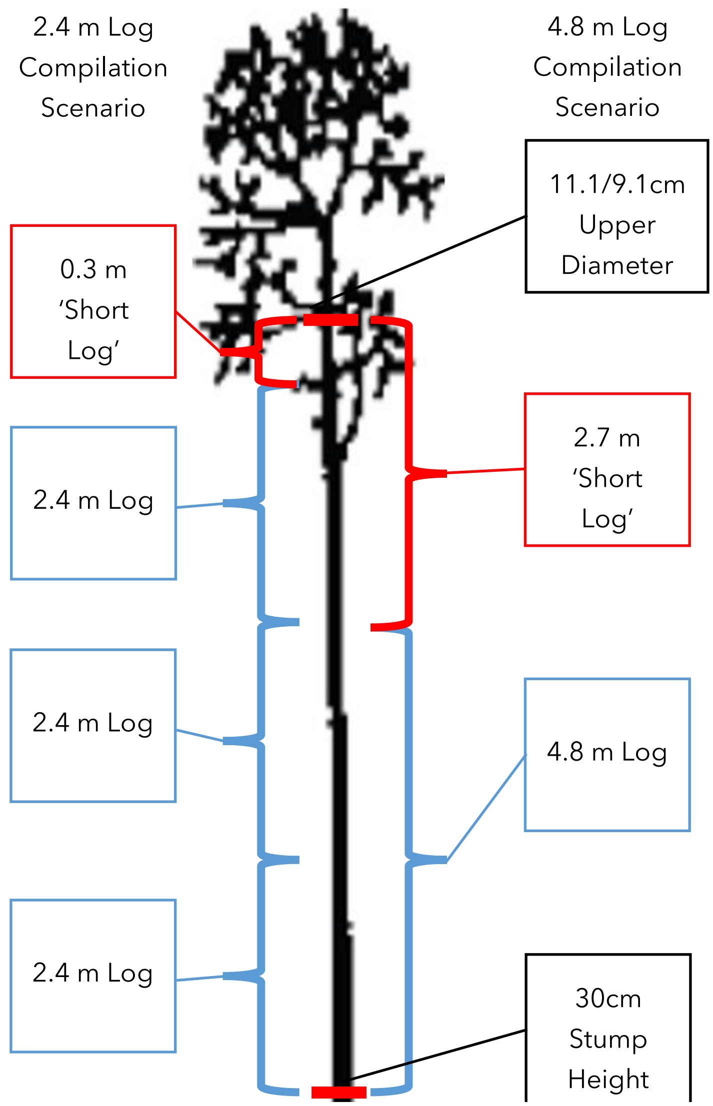


Figure 3-1 Short Log Example (8m Tree)

Short log volume was included as part of the plot compilation process to help determine how log length impacts recovery of stem volumes.

3.4 Yield Projections

Once compiled, plot NMVs were converted to per hectare yields so they could be extrapolated using the landbase areas. Per hectare yield estimates for each stratum (plan forest unit and age group combination) are presented in Table 3-5 and Table 3-6 for both the 2.4 m and 4.8 m log scenarios.

Of note is the minor reduction in expected yield when going from a 2.4 m log length to a 4.8 m log length (approximately a 7% decrease in yield). This is due to a greater number of 'short logs', or logs not meeting minimum log lengths but being of suitable diameter, being produced when using a 4.8 m log length. These estimates are for production of roundwood to be transported to a facility in log form. Tree length logging operations or chipping and grinding of biomass in the forest (i.e. in-bush) will yield more fibre.

Table 3-5. Estimated Per Hectare Yields (2.4 m Scenario).

Plan Forest Unit	Age Group 1			Age Group 2			Age Group 3			Age Group 4		
	Birch	Poplar	Total	Birch	Poplar	Total	Birch	Poplar	Total	Birch	Poplar	Total
	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)
BFDOM	1.3		**1.3**	25.4	38.4	**63.8**	21.8	7.1	**28.9**	35.1	45.6	**80.7**
BWDOM				93	30	**123**	63.2	3.7	**66.9**	29.8	0.5	**30.3**
CONMX	2.6	2.5	**5.1**	2.1	30.2	**32.3**	16.1	23.3	**39.4**	10.7	24.5	**35.2**
CONPJ	0.8	2.6	**3.4**	9	8.4	**17.4**	1	53	**54**	7.6	20.8	**28.4**
HRDOM	0.6	3.2	**3.8**	4.2	44.6	**48.8**	31.4	97.3	**128.7**	30.1	61.7	**91.8**
OCLOW							15.4	18.5	**33.9**			
OTHHD										52		**52**
PJDOM	0.1	0.7	**0.8**	0.8	21.9	**22.7**	0.6	12.4	**13**	58.4	13.4	**71.8**
PJMX1		1.6	**1.6**	0.2	2.7	**2.9**	2.9	3.8	**6.7**	0.8	22.1	**22.9**
PODOM	11.1	19.2	**30.3**	4.9	36.3	**41.2**	6.1	230	**236.1**	10.8	147.1	**157.9**
SBDOM	0.1	24	**24.1**	2.1	6.3	**8.4**	17.6	5.6	**23.2**	0.7	5.5	**6.2**
SBLOW				4.6		**4.6**				19.7		**19.7**
SBMX1	1.3	3.5	**4.8**	0.1	17.9	**18**	2.1	17.4	**19.5**	4.1	107	**111.1**
UPLCE										8.6		**8.6**

Table 3-6. Estimated Per Hectare Yields (4.8 m Scenario).

Plan Forest Unit	Age Group 1			Age Group 2			Age Group 3			Age Group 4		
	Birch (m³/ha)	Poplar (m³/ha)	Total (m³/ha)	Birch (m³/ha)	Poplar (m³/ha)	Total (m³/ha)	Birch (m³/ha)	Poplar (m³/ha)	Total (m³/ha)	Birch (m³/ha)	Poplar (m³/ha)	Total (m³/ha)
BFDOM	0.6		**0.6**	22.8	37.3	**60.1**	19.5	6.9	**26.4**	31.6	53.1	**84.7**
BWDOM				86.6	29.7	**116.3**	56.9	3.5	**60.4**	25.3	0.5	**25.8**
CONMX	2.8	2.5	**5.3**	1.8	28.5	**30.3**	14.2	22.5	**36.7**	9.3	24.3	**33.6**
CONPJ	0.6	2.6	**3.2**	7.9	7.5	**15.4**	1	50.9	**51.9**	5.6	19.5	**25.1**
HRDOM	0.3	2.7	**3**	3.5	41.5	**45**	28.3	94.7	**123**	27.4	60	**87.4**
OCLOW							12.8	18.1	**30.9**			
OTHHD										50		**50**
PJDOM	0	0.8	**0.8**	0.7	19.6	**20.3**	0.4	12.1	**12.5**	59.9	13.5	**73.4**
PJMX1		1.4	**1.4**		2.5	**2.5**	2.6	3.6	**6.2**	0.6	23.2	**23.8**
PODOM	14.4	17.3	**31.7**	3.8	32.7	**36.5**	4.8	224.9	**229.7**	10.7	141.4	**152.1**
SBDOM		21.8	**21.8**	1.9	5.8	**7.7**	16.9	5.3	**22.2**	0.5	5.1	**5.6**
SBLOW				4.4		**4.4**				14.6		**14.6**
SBMX1	1	4	**5**		15.9	**15.9**	1.9	16.2	**18.1**	3.3	111.9	**115.2**
UPLCE										6.2		**6.2**

3.5 Yield Comparison and Validation

3.5.1 MIST Yield Curve Comparison and Validation

A comparison of the compiled volume data from this project against the growth and yield curves presented in approved FMPs for each FMU was completed to assess and validate the volumes determined in this analysis. Yield curves from FMPs were compiled and averaged into similar age groups for each plan forest unit for comparison. The results of this suggest that overall differences between MIST curves and the compiled volume estimates in this report are greatest in the BWDOM forest unit and least in the HRDOM forest unit (Table 3-7). Differences were collectively higher in age groups 1 and 5. For the PODOM forest unit. Results were most different in age groups 1, 2 and 5, where the least number of plots were available.

In general, the plot compilation results in this study estimated higher per hectare yields than the FMP MIST curves. This is likely due to the mechanics of the MIST models including coefficients used. It is important to note that forest management in Ontario is primarily area regulated, so differences in estimated yields do not impact approved harvest levels.

Table 3-7. Comparison of Compiled Volumes and MIST Yields (m3/ha) for Each Plan Forest Unit by Age Group and FMU

Age Group	Forest Management Unit	Plan Forest Unit	MIST Yield (m^3/ha)	Compiled Volume (m^3/ha)	Difference (%)
1	English River, Dog River-Matawin, Black Spruce	BWDOM	25.6	N/A	N/A
		HRDOM	15.8	4.0	-295%
		PODOM	27.7	37.0	25%
	Lake Nipigon	BWDOM	5.3	N/A	N/A
		HRDOM	6.4	4.0	-60%
		PODOM	10.5	37.0	72%
	Lakehead	BWDOM	7.5	N/A	N/A
		HRDOM	4.6	4.0	-15%
		PODOM	8.3	37.0	78%
2	English River, Dog River-Matawin, Black Spruce	BWDOM	61.4	121.0	49%
		HRDOM	50.5	40.0	-26%
		PODOM	80.5	41.0	-96%
	Lake Nipigon	BWDOM	36.4	121.0	70%
		HRDOM	49.5	40.0	-24%

Age Group	Forest Management Unit	Plan Forest Unit	MIST Yield (m^3/ha)	Compiled Volume (m^3/ha)	Difference (%)
		PODOM	66.5	41.0	-62%
	Lakehead	BWDOM	47.1	121.0	61%
		HRDOM	44.5	40.0	-11%
		PODOM	67.8	41.0	-65%
3	English River, Dog River-Matawin, Black Spruce	BWDOM	70.1	68.0	-3%
		HRDOM	72.6	99.0	27%
		PODOM	105.1	205.0	49%
	Lake Nipigon	BWDOM	58.9	68.0	13%
		HRDOM	107.3	99.0	-8%
		PODOM	131.0	205.0	36%
	Lakehead	BWDOM	77.7	68.0	-14%
		HRDOM	101.2	99.0	-2%
		PODOM	145.1	205.0	29%
4	English River, Dog River-Matawin, Black Spruce	BWDOM	68.7	31.0	-122%
		HRDOM	81.0	83.0	2%
		PODOM	114.4	143.0	20%
	Lake Nipigon	BWDOM	63.4	31.0	-104%
		HRDOM	136.9	83.0	-65%
		PODOM	163.3	143.0	-14%
	Lakehead	BWDOM	92.3	31.0	-198%
		HRDOM	121.7	83.0	-47%
		PODOM	195.4	143.0	-37%
5	English River, Dog River-Matawin, Black Spruce	BWDOM	37.5	N/A	N/A
		HRDOM	32.7	39.0	16%
		PODOM	71.2	99.0	28%
	Lake Nipigon	BWDOM	15.0	N/A	N/A
		HRDOM	56.1	39.0	-44%
		PODOM	58.6	99.0	41%
	Lakehead	BWDOM	24.8	N/A	N/A
		HRDOM	17.6	39.0	55%
		PODOM	49.8	99.0	50%

3.5.2 LiDAR Yield Estimate Comparisons

In addition to MIST, compiled plot volumes were also compared against Ontario T2 Forest Resource Inventory (FRI) volume estimates derived from LiDAR. Specifically, results were compared to the T2 inventory prepared for the Dog River – Matawin forest (within the study area for this project). This inventory was prepared and presented as part of a Forestry Futures knowledge transfer and tool development (KTTD) project. The results of the KTTD project on the Dog River – Matawin forest indicate a higher overall average estimated NMV than the MIST yield estimates, with this study's average volume being slightly less than the T2 LiDAR derived yield estimates. This suggests that for the key forest units, BWDOM, HRDOM, and PODOM, average yield estimates are either in line with or are conservative when compared to LiDAR derived yield estimates. This demonstrates that despite higher yield estimates than the MIST projections, the compiled plot volumes used in this analysis are likely well within the range of natural variation expected for the study area and represent a reasonable estimate of hardwood volumes.

Table 3-8. Forestry Futures Knowledge Transfer and Tool Development (KTTD) Project Comparison.

Forest Management Unit	Plan Forest Unit	KTTD Plots	Project Plots	Average KTTD Volume (m^3/ha)	Average Compiled Volume (m^3/ha)	Difference (%)
Dog River-Matawin	BWDOM	13	17	146 (0 - 331)	124 (1 - 440)	-15%
	HRDOM	14	105	175 (55 - 361)	133 (2 - 1127)	-24%
	PODOM	60	51	286 (51 - 730)	181 (5 - 1072)	-37%

4 Cost Analysis

A critical component of an investment grade inventory assessment is an understanding of fibre costs. This study assessed fibre availability within various costing thresholds to address fibre costs. Hauling is a substantial portion of delivered wood costs and the main driver in cost variability. As such, hauling costs were the focus of this study's cost analysis. Harvesting (i.e. logging) costs are generally consistent across the province and so were excluded from the cost analysis. Other costs like forest renewal, stumpage and management fees fluctuate with markets and so were also excluded from this analysis.

4.1 Speed and Distance Modelling

Haul cost is primarily a function of distance and time (i.e. travel speed). To calculate hauling cost first distance from Thunder Bay needed to be assessed. Thresholds in a 50km radius zones with a centre point in Thunder Bay were used to assess average distance. Six buffer zones were created to reach a maximum distance of 300 km, capturing the furthest extent of the English River Forest and Lake Nipigon Forest management units (Figure 4-1).

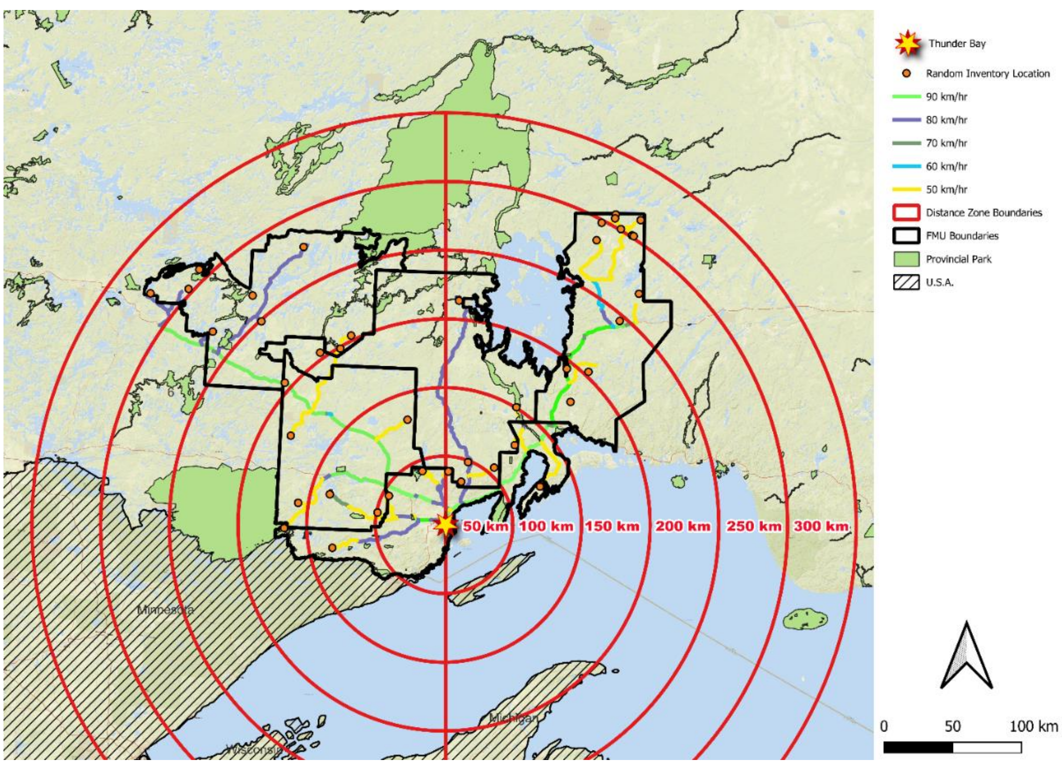


Figure 4-1. Map of Randomized Hardwood Inventory Locations and Road Networks.

Randomized points with significant hardwood concentrations were generated for each of the distance buffer zones within the FMU boundaries. These randomized locations were selected for hardwood dominated stands of operable age to avoid heavy or pure concentrations of conifer. This was done to provide a coarse but realistic estimate of hauling locations.

Routes from the randomized inventory locations to Thunder Bay were created by prioritizing the highest speed limits and the most direct path from the point to Thunder Bay. Speed limits were applied by using a Government of Ontario road network GIS layer to recognize established and maintained roads, cross referenced with an Esri and Government of Ontario speed limits GIS layer. Using an MNR GIS layer for forest roads (primary and branch), entry points to existing operations nearest to the inventory locations were selected as the starting point to track the route distance. Forest road entry points were also selected based on avoiding the need to cross a body of water or unnecessary implementation of new forest roads. The mean distance by speed limit for each distance buffer zone was recorded and applied to the hardwood haul rate model.

A haul rate model was run using two steps to calculate haul cost. (1) The haul rate by FMU and distance zone was calculated using the average distance of the randomly selected inventory points within the FMU and distance zone to Thunder Bay. (2) The average haul for the total FMU calculated using volume weighted averages by distance zone to give a fair representation of distance value/usage.

4.2 Cost Analysis Methodology

The cost analysis presented in this report is based on a costing model developed and maintained by Silvacom Ltd. It is regionally calibrated using input from regional forest industry professionals and updated to account for parameter changes (i.e. fuel adjustments, inflation, etc.) Machinery costs and efficiencies were sourced directly from the manufacturer's and include factors for current capital and maintenance costs.

The fuel rate used within this report is based on the ultra-low-sulfur diesel (ULSD) fuel rack rate (i.e. wholesale) price of $1.02/litre as of February 2025, these rates are adjusted daily. All applicable fuel taxes were included in the cost analysis. Fuel adjustment rates can vary between an additional 10%-20% for overall hauling cost.

Haul costs are based on hourly labour and equipment rates (i.e. trucking), average load size for a variety of truck and trailer combinations, as well as road type, speed, and average distance travelled across the study area. The study examined transportation logistics, including fuel, maintenance as well as time constraints related to route and road conditions.

4.3 Hauling Cost Results

Travel distance and, more importantly time (a function of distance and speed), are the main variables impacting haul costs. Fuel usage and hourly rates (both equipment and labour) are dependent on haul time, which is variable depending on the amount of on-highway vs. off-highway travel. Load, unload, and check times are also factored into total haul time and cost.

The other important consideration is the haul capacity (volume and weight) per trip. This is determined by the specific trailer configuration. Table 4-1 shows a comparison of two different trailer configurations and their ability to move hardwood logs. Straight axle trailers (4 axles) and B-train trailers (5 or more axles) are both common in Northern Ontario. B-train configurations consist of two independent trailers connected via a fifth-wheel coupling. Each configuration has different costs and, importantly, payload capacities. In general, B-train configurations have slightly higher payload capacities. Haul cost analysis was performed using the midpoint of the payload range for each configuration.

Table 4-1. Haul Capacity for Studied Trailer Configurations.

Hauling Method	Volume (m^3)	Weight (GMT)
4 Axle Straight Log Trailer	46-48	40-42
5 Axle B Train Log Trailer	49-50	43-44

While increased haul weight and volume helps to reduce cost, the benefit of this is generally passed on to logging contractors (i.e. the base rates are set for the average haul capacity methods).

Haul rates are calculated using the following formula:

- Travel time = distance/speed limit class * 60, (Σ(distance_i / speed limit class_i)) / 60
- Total haul time = travel time + loading (45 minutes), unloading (45 minutes), and check times (20 minutes).
- Trips per shift= number of trips possible within the government max shift of 13 hrs. Trips per shift were maximized where possible.
- Haul cost = total haul time * number of trips * hourly rates (equipment and labour)
- Haul rate = haul cost / (payload * number of trips)

This approach was applied to the 6 distance zones within the 300 km study area around Thunder Bay to produce the following haul rates by FMU and zone by volume-weighted haul distance.

Table 4-2. Volume Weighted Average Haul Rate ($/m3) by FMU.

FMU	Haul Rate ($/m^3)	
	5 Axle B-Train Trailer	4 Axle Log Trailer
Lake Nipigon	$27	$30
English River	$31	$33
Black Spruce	$21	$22
Dog River	$24	$26
Lakehead	$17	$18
Volume Weighted Average	$23	$24

Table 4-3. Volume Weighted Average Haul Rate ($/m3) by Zone.

Zone	Haul Rate ($/m^3)	
	5 Axle B-Train Trailer	4 Axle Log Trailer
50km	$15	$16
100km	$19	$20
150km	$23	$24
200km	$28	$30
250km	$32	$34
300km	$34	$35
Volume Weighted Average	$23	$24

4.4 Haul Cost Validation

Cost validation was done using recent contractor reports and findings on hauling costs over the last several years.

In addition, the *Economic Fibre Supply Model* from CRIBE/Nexfor[11] data compiled in 2022 was used to help validate the haul rates shown (Table 4-4). The haul cost table presents average FMU rates for delivering hardwood logs to Thunder Bay. The model used in this study had an average variation from the EFSM model distance at +/- 4 km; English River had the lowest variance at +1 km, while Lake Nipigon had the greatest variance with +17 km. Considering the extremely wide variability in Ontario forest operational roads and subsequent rural routes to major highways, this minor variation in volume weighted average distances by FMU is not significant.

Table 4-4. Comparison of Haul Distances and Costs by FMU between this Study and the EFSM Model.

FMU	EFSM Avg. Distance	Silvacom Avg. Distance	($/m^3)		
			EFSM Avg. Haul Rate	Silvacom B-Train Avg. Haul Rate	Silvacom Log Trailer Avg. Haul Rate
Lake Nipigon	223	240	$21.84	$28	$30
English River	295	296	$28.16	$31	$33
Black Spruce	133	127	$15.23	$21	$22
Dog River	144	141	$15.27	$24	$26
Lakehead	75	84	$8.48	$17	$18

The model used in this study showed an average of +$6/m^3 variance from the EFSM validation model. This variance can largely be attributed to changes in costs that have occurred over the last several years, as well as the use of a 300km hauling radius in this study compared to a 250km hauling radius in the validation model.

[11] CRIBE/Nextfor (2024). Economic Fibre Supply Model. https://experience.arcgis.com/experience/964064b7105b4315a22a2eb75da63568/

5 Hardwood Fibre Assessment

Using the results of the plot compilation, estimated yields were assigned to the study area landbase and available harvest area (AHA) to provide an estimate of the overall merchantable hardwood growing stock as well as the potential hardwood volume opportunity under the approved FMPs (i.e. the sustainable harvest level). The AHA is used in Ontario to regulate harvesting on an area basis, as such, the volume within that area represents the available harvest volume. AHA's for FMPs were sourced from table FMP-8 for each FMP – all of which can be found on Ontario's Natural Resources Information Portal (NRIP).[12]

This hardwood fibre assessment is presented in cubic metres (m3), but can be converted to green metric tonnes (GMT) or oven dry tonnes (ODT) using the conversion table in Appendix A.

Fibre assessments were done for both 2.4 m logs and 4.8 m. logs to identify trade-offs between the different log lengths. A tree length logging scenario was also examined, but only estimates for total volume are provided for this scenario as the log profile of tree lengths does not provide substantial detail on a potential facilities log feedstock.

The tables for overall growing stock provide estimates for only at mature and merchantable fibre, excluding fibre in age groups 1 and 5 as being too young or over mature.

Summaries are provided for both:

- The ***growing stock*** of the study area. This is all merchantable hardwood fibre that exists in the study area within age groups 2-4. This fibre is not all part of the harvest plans in currently approved forest management plans (FMPs), but serves as an indicator for long-term fibre supply security and potential.
- The ***currently available*** volume in the study area. This is volume that is estimated to be available in currently approved FMPs through their available harvest area (AHA). These volumes are net of current and predicted utilization from established hardwood users in the study area.

[12] https://nrip.mnr.gov.on.ca/s/fmp-online?language=en_US

Table 5-1. Merchantable Hardwood Growing Stock (m3) by FMU and Log Length.

Forest Management Unit	2.4 m Log Scenario		4.8 m Log Scenario		Tree Length Scenario	
	Poplar	Birch	Poplar	Birch	Poplar	Birch
	(m^3)	(m^3)	(m^3)	(m^3)	(m^3/year)	(m^3/year)
Black Spruce	15,360,000	6,680,000	14,670,000	5,950,000	16,040,000	7,370,000
Dog River – Matawin	9,820,000	3,550,000	9,360,000	3,160,000	10,270,000	3,920,000
English River	9,800,000	3,760,000	9,320,000	3,370,000	10,270,000	4,150,000
Lakehead	10,820,000	4,000,000	10,380,000	3,560,000	11,320,000	4,450,000
Lake Nipigon	6,520,000	3,550,000	6,250,000	3,200,000	6,810,000	3,900,000
Total	**52,320,000**	**21,540,000**	**49,980,000**	**19,240,000**	**54,710,000**	**23,790,000**

Table 5-2. Merchantable Hardwood Fibre (m3) Currently Available by FMU and Log Length.

Forest Management Unit	2.4 m Log Scenario		4.8 m Log Scenario		Tree Length Scenario	
	Poplar	Birch	Poplar	Birch	Poplar	Birch
	(m^3/year)	(m^3/year)	(m^3/year)	(m^3/year)	(m^3/year)	(m^3/year)
Black Spruce	310,000	60,000	300,000	60,000	320,000	70,000
Dog River – Matawin	240,000	60,000	240,000	50,000	260,000	60,000
English River	160,000	50,000	160,000	40,000	160,000	50,000
Lakehead	210,000	40,000	210,000	40,000	210,000	50,000
Lake Nipigon	180,000	50,000	170,000	50,000	180,000	60,000
Total	**1,100,000**	**260,000**	**1,080,000**	**240,000**	**1,130,000**	**290,000**

5.1 Harvest Profile

Volume estimates for a 2.4 m and 4.8 m log scenario have been broken out to show the fibre profile by:

- Total net merchantable fibre available by species (poplar and birch) and diameter class (Table 5-5/Table 5-6)
- Total number of logs by species and diameter class (Table 5-7/Table 5-8).
- Average piece size (m3/log) by species across diameter classes (Table 5-9/Table 5-10)

In general, the profile between the 2.4 m and 4.8 m log scenarios are similar, with the 4.8 m log scenario having a larger piece size as the logs are twice as long.

Tables Table 5-5 and Table 5-6 show the average fibre profile as it currently exists for both the entire study area's hardwood growing stock, as well as within the AHA.

Table 5-3. Fibre Profile of the Growing Stock (m3) by Log Length.

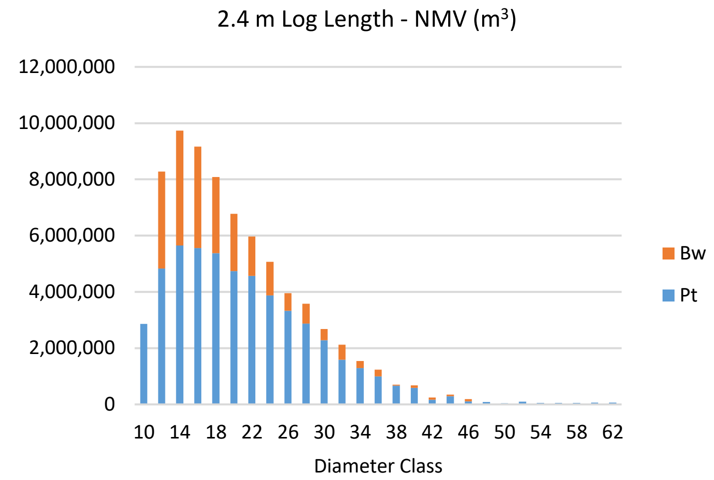
Fibre Profile	2.4 m Log Scenario		4.8 m Log Scenario	
	Poplar	Birch	Poplar	Birch
Average Diameter at Log Top (cm)	21	19	21	18
Average Log Piece Size (m^3/log)	0.07	0.06	0.14	0.13
Average Log Piece Size (logs/m^3)	15	16	7	8

Table 5-4. Fibre Profile of the Currently Available Fibre (M3) by Log Length.

Fibre Profile	2.4 m Log Scenario		4.8 m Log Scenario	
	Poplar	Birch	Poplar	Birch
Average Diameter at Log Top (cm)	23	20	23	19
Average Log Piece Size (m^3/log)	0.09	0.07	0.19	0.14
Average Log Piece Size (logs/m^3)	11	15	5	7

Table 5-5. Growing Stock volume (m3) by diameter class, species, and log length.

Diameter Class	2.4 m Log NMV (m³)		4.8 m Log NMV (m³)	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	2,860,000	0	2,930,000	0
12	4,830,000	3,460,000	5,740,000	4,010,000
14	5,650,000	4,090,000	5,590,000	3,900,000
16	5,550,000	3,610,000	5,520,000	3,420,000
18	5,380,000	2,710,000	5,020,000	2,000,000
20	4,740,000	2,030,000	4,670,000	1,680,000
22	4,570,000	1,400,000	4,130,000	1,110,000
24	3,880,000	1,190,000	3,710,000	800,000
26	3,330,000	620,000	3,120,000	590,000
28	2,880,000	700,000	2,560,000	600,000
30	2,290,000	390,000	1,910,000	310,000
32	1,590,000	530,000	1,180,000	430,000
34	1,300,000	250,000	1,130,000	90,000
36	990,000	240,000	900,000	80,000
38	660,000	40,000	440,000	0
40	590,000	90,000	550,000	150,000
42	170,000	80,000	170,000	70,000
44	300,000	50,000	70,000	0
46	110,000	80,000	0	0
48	80,000	0	180,000	0
50	40,000	0	90,000	0
52	90,000	0	0	0
54	50,000	0	0	0
56	50,000	0	120,000	0
58	60,000	0	120,000	0
60	60,000	0	0	0
62	70,000	0	0	0
Sub Total	52,170,000	21,550,000	49,840,000	19,230,000
Total	73,720,000		69,070,000	



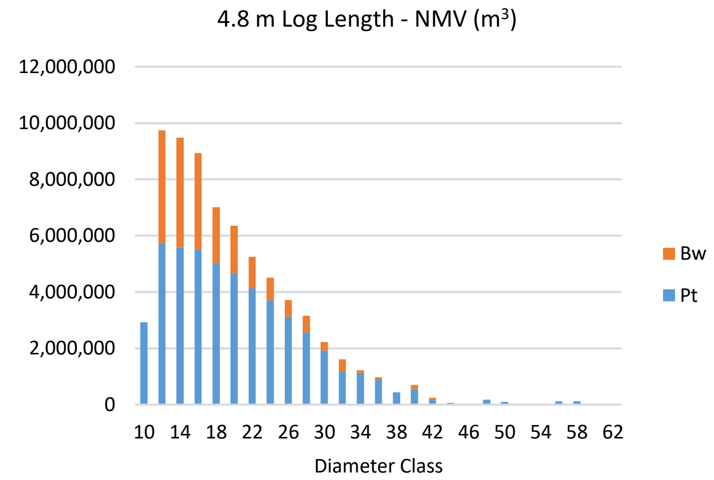
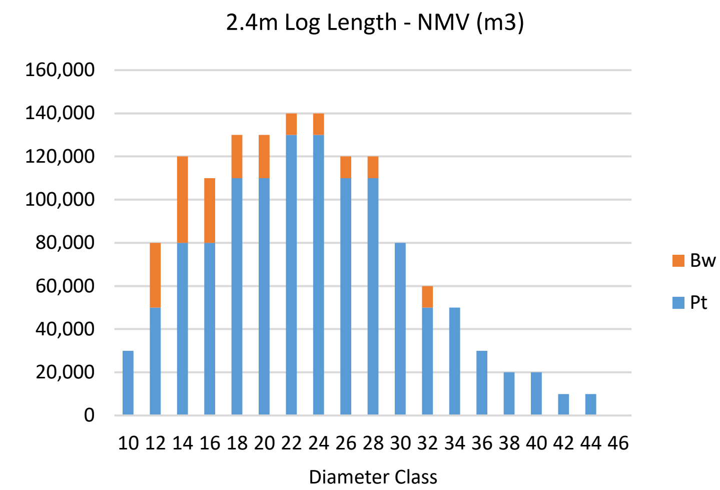


Table 5-6. Currently Available volume (m3) by diameter class, species, and log length.

Diameter Class	2.4 m Log NMV (m^3)		4.8 m Log NMV (m^3)	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	30,000	0	40,000	0
12	50,000	40,000	60,000	50,000
14	70,000	50,000	80,000	50,000
16	70,000	40,000	70,000	40,000
18	100,000	20,000	100,000	20,000
20	100,000	20,000	110,000	20,000
22	120,000	10,000	120,000	10,000
24	120,000	10,000	110,000	10,000
26	100,000	10,000	100,000	10,000
28	100,000	10,000	90,000	10,000
30	70,000	0	60,000	0
32	50,000	10,000	40,000	10,000
34	50,000	0	50,000	0
36	30,000	0	20,000	0
38	20,000	0	20,000	0
40	20,000	0	20,000	0
42	10,000	0	0	0
44	10,000	0	0	0
46	0	0	0	0
Sub Total	1,100,000	260,000	1,080,000	240,000
Total	1,360,00		1,320,000	



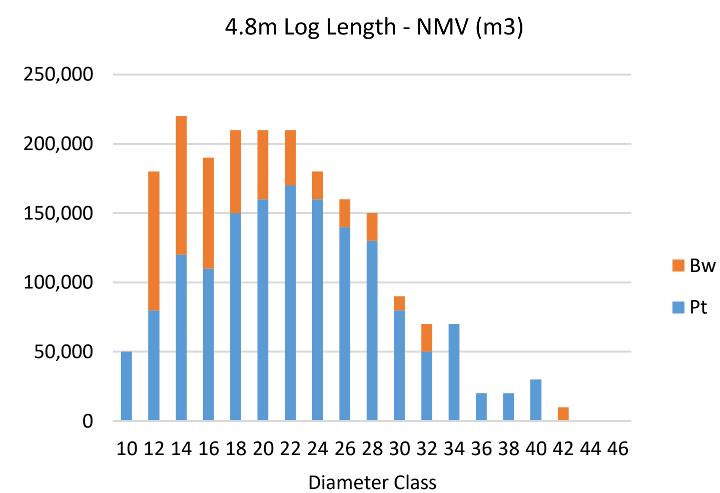
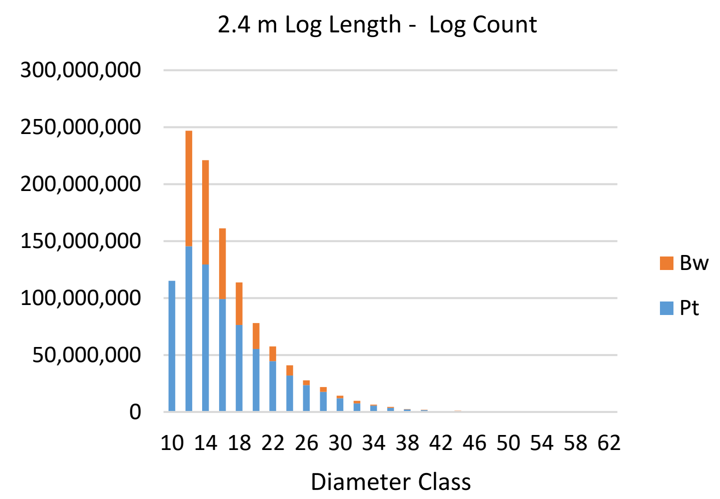


Table 5-7. Potential log output of the study area growing stock by diameter class, species, and log length.

Diameter Class	Number of 2.4 m Logs		Number of 4.8 m. Logs	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	115,270,000	0	47,760,000	0
12	145,540,000	101,320,000	75,830,000	50,130,000
14	129,330,000	91,740,000	56,260,000	37,020,000
16	99,120,000	62,100,000	43,780,000	25,260,000
18	76,500,000	37,260,000	32,150,000	11,730,000
20	55,240,000	22,700,000	24,930,000	8,170,000
22	44,590,000	13,020,000	18,370,000	4,480,000
24	31,890,000	9,190,000	14,070,000	2,630,000
26	23,440,000	4,310,000	10,030,000	1,850,000
28	17,670,000	4,060,000	7,280,000	1,520,000
30	12,150,000	2,050,000	4,670,000	730,000
32	7,520,000	2,340,000	2,710,000	860,000
34	5,430,000	990,000	2,160,000	210,000
36	3,640,000	810,000	1,560,000	120,000
38	2,200,000	120,000	760,000	0
40	1,720,000	240,000	690,000	240,000
42	470,000	200,000	160,000	80,000
44	660,000	120,000	90,000	0
46	210,000	200,000	0	0
48	120,000	0	120,000	0
50	120,000	0	120,000	0
52	120,000	0	0	0
54	120,000	0	0	0
56	120,000	0	120,000	0
58	120,000	0	120,000	0
60	120,000	0	0	0
62	120,000	0	0	0
Sub Total	773,540,000	352,780,000	343,730,000	145,040,000
Total	1,126,320,000		488,770,000	



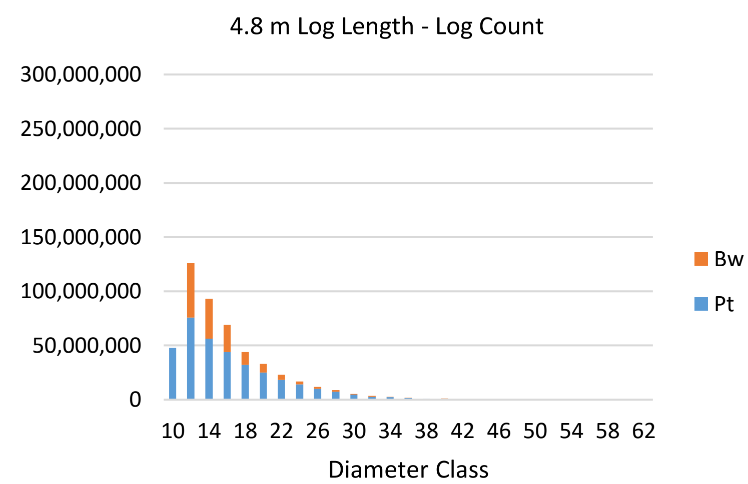
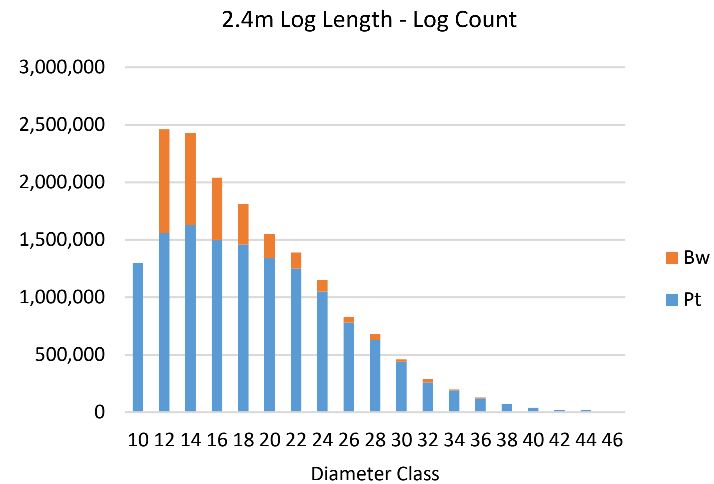


Table 5-8. Potential log output of the study area currently available volume by diameter class, species, and log length.

Diameter Class	Number of 2.4 m Logs		Number of 4.8 m. Logs	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	1,190,000	0	580,000	0
12	1,430,000	1,110,000	660,000	560,000
14	1,490,000	990,000	800,000	410,000
16	1,380,000	670,000	570,000	260,000
18	1,340,000	430,000	660,000	140,000
20	1,230,000	260,000	580,000	100,000
22	1,150,000	170,000	530,000	60,000
24	960,000	120,000	430,000	20,000
26	720,000	60,000	310,000	40,000
28	580,000	60,000	270,000	20,000
30	400,000	20,000	130,000	10,000
32	240,000	40,000	80,000	10,000
34	170,000	10,000	100,000	0
36	110,000	10,000	30,000	0
38	60,000	0	20,000	0
40	40,000	0	30,000	0
42	20,000	0	0	0
44	20,000	0	0	0
46	0	0	0	0
Sub Total	**12,530,000**	**3,950,000**	**5,780,000**	**1,630,000**
Total	16,480,000		74,100,000	



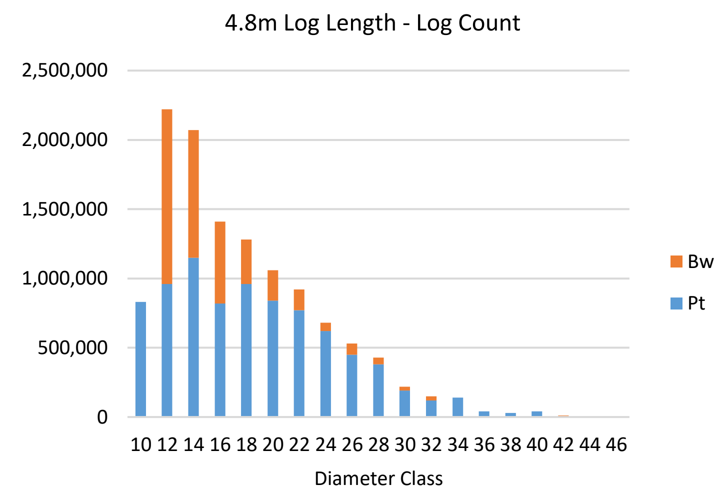
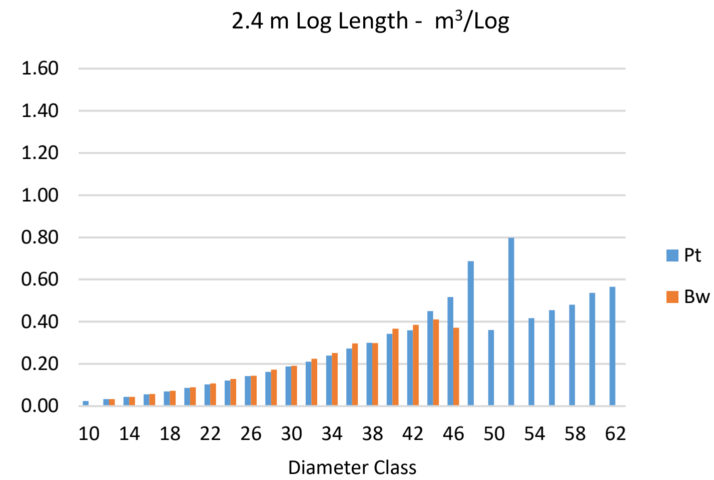


Table 5-9. Growing Stock average log piece size (m³/log) by diameter class, species, and log length.

Diameter Class	Volume (m³) / 2.4 m Log		Volume (m³) / 4.8 m Log	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	0.02		0.06	
12	0.03	0.03	0.08	0.08
14	0.04	0.04	0.1	0.11
16	0.06	0.06	0.13	0.14
18	0.07	0.07	0.16	0.17
20	0.09	0.09	0.19	0.21
22	0.1	0.11	0.23	0.25
24	0.12	0.13	0.26	0.3
26	0.14	0.14	0.31	0.32
28	0.16	0.17	0.35	0.39
30	0.19	0.19	0.41	0.42
32	0.21	0.22	0.44	0.5
34	0.24	0.25	0.52	0.44
36	0.27	0.3	0.58	0.66
38	0.3	0.3	0.57	
40	0.34	0.37	0.8	0.61
42	0.36	0.39	1.04	0.92
44	0.45	0.41	0.74	
46	0.52	0.37		
48	0.69		1.49	
50	0.36		0.78	
52	0.8			
54	0.42			
56	0.46		0.99	
58	0.48		1.05	
60	0.54			
62	0.57			
Average	**0.11**	**0.09**	**0.22**	**0.18**



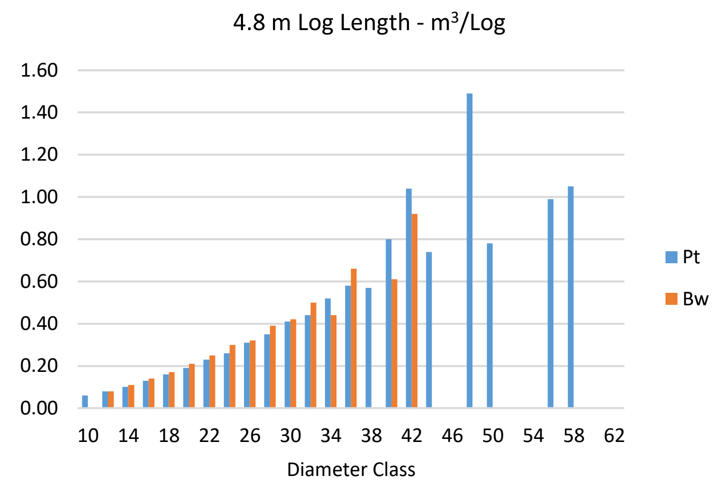
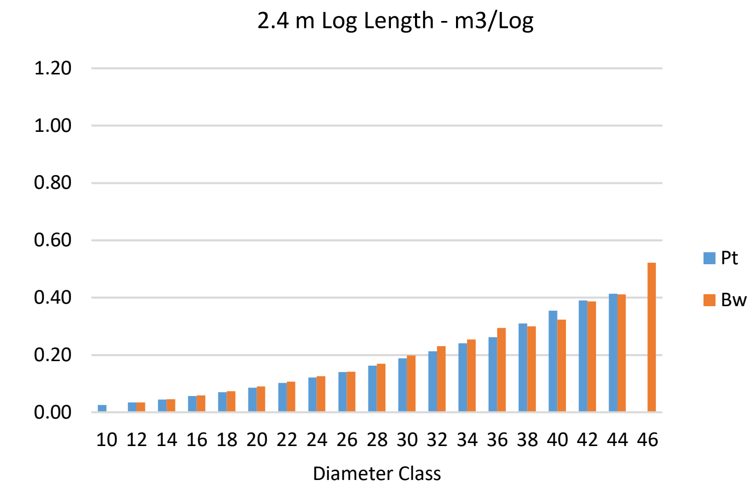
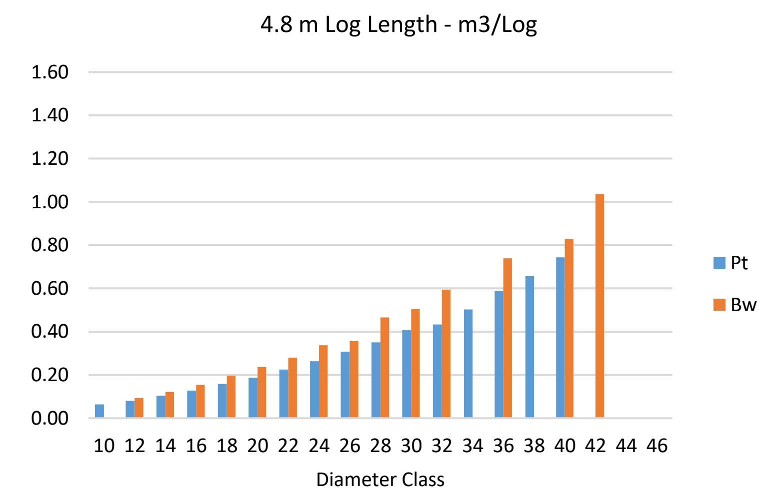


Table 5-10. Currently available volume average log piece size (m^3/log) by diameter class, species, and log length.

Diameter Class	Volume (m^3) / 2.4 m Log		Volume (m^3) / 4.8 m Log	
	Poplar (Pt)	Birch (Bw)	Poplar (Pt)	Birch (Bw)
10	0.03		0.06	
12	0.03	0.03	0.08	0.08
14	0.05	0.05	0.10	0.11
16	0.06	0.06	0.13	0.14
18	0.07	0.07	0.16	0.17
20	0.09	0.09	0.19	0.21
22	0.10	0.11	0.22	0.25
24	0.12	0.13	0.26	0.30
26	0.14	0.14	0.31	0.31
28	0.16	0.17	0.35	0.41
30	0.19	0.20	0.40	0.45
32	0.21	0.23	0.44	0.54
34	0.24	0.25	0.50	
36	0.26	0.30	0.59	0.66
38	0.31	0.30	0.65	
40	0.35	0.32	0.74	0.74
42	0.39	0.39		0.92
44	0.41	0.41		
46		0.52		
Average	**0.13**	**0.10**	**0.26**	**0.20**





5.2 Short Log Fibre Results

Producing 4.8 m logs results in significantly more short logs than 2.4 m log production (Table 5-11). This results in 2.4 m log production producing higher yields, with only 4% of poplar volume being lost to short logs. Under a 16ft log production scenario, up to 9% of volume is in short logs below minimum log specifications. Under both scenarios, birch has much higher losses to yield due to the generation of short logs (up to 24% in some FMUs profiles under a 16ft scenario).

Table 5-11. Short Log Volume (%) Produced Annually Given Currently Available Volumes by FMU and Log Length.

FMU	Short Log Volume (%)			
	2.4 m Log Scenario		4.8 m Log Scenario	
	Poplar	Birch	Poplar	Birch
Black Spruce	3%	9%	8%	23%
Dog River	4%	8%	10%	22%
English River	5%	9%	12%	22%
Lake Nipigon	6%	9%	13%	24%
Lakehead	3%	8%	7%	22%
Total	**4%**	**9%**	**9%**	**22%**

Table 5-12 provides the number of short logs produced by off cut length, showing the large increase in short log volume under a 16ft scenario. Some of this volume may be recoverable, but can present challenges operationally both while hauling and in facilities where it can cause issues in log yards and processing lines.

Table 5-12. Short Logs Fibre (m^3) by Off Cut Length.

Short Log Length (ft.)	Short Log m^3 from 2.4 m, Logs			Short Log m^3 from 4.8 m Logs		
	Pt	Bw	Total	Pt	Bw	Total
1	2,000	1,000	3,000	1,000	1,000	2,000
3	6,000	2,000	8,000	3,000	1,000	4,000
5	7,000	9,000	16,000	4,000	4,000	8,000
7	13,000	9,000	22,000	6,000	4,000	10,000
9	N/A			7,000	4,000	11,000
11				12,000	6,000	18,000
13				13,000	14,000	27,000
15				21,000	15,000	36,000
17				2,000	1,000	3,000
Total	**28,000**	**21,000**	**49,000**	**14,000**	**10,000**	**24,000**

5.3 Fibre Costs Results

Table 5-13 shows volume available and haul cost in the study area based on hauling either 2.4 m or 4.8 m hardwood logs by 5 axle B-Train trailer or by 4 axle log trailer. Table 5-14 provides the same information, but for the entire merchantable growing stock of the study area. The tables provide analysis by FMU and distance zone.

Table 5-13. Fibre Cost and Annual Volumes Currently Available by Haul Zone and FMU for Different Scenarios

FMU	Radial Distance from Thunder Bay (km)	Haul Rate ($/m3)		Volume (m^3/year) 2.4 m Logs		Volume (m^3/year) 4.8 m Logs	
		5 Axle B-Train Trailer	4 Axle Log Trailer	Poplar	Birch	Poplar	Birch
Lake Nipigon	150	$21	$22	60,000	14,000	58,000	12,000
	200	$27	$28	89,000	20,000	88,000	19,000
	250	$34	$36	80,000	19,000	79,000	17,000
	300	$38	$40	4,000	1,000	4,000	1000
English River	150	$29	$30	2000	0	2000	0
	200	$30	$32	45,000	15,000	40,000	14,000
	250	$31	$33	61,000	21,000	55,000	17,000
	300	$33	$34	9,000	2,000	8,000	2,000
Black Spruce	50	$14	$15	17,000	4,000	17,000	2,000
	100	$16	$17	127,000	25,000	125,000	22,000
	150	$20	$21	133,000	26,000	131,000	24,000
	200	$28	$29	106,000	21,000	104,000	19,000
Dog River	50	$15	$16	6,000	1,000	6,000	1,000
	100	$20	$21	114,000	31,000	111,000	28,000
	150	$26	$27	96,000	26,000	94,000	24,000
	200	$25	$27	2,000	0	2,000	0
Lakehead	50	$15	$16	99,000	22,000	96,000	20,000
	100	$21	$22	42,000	10,000	42,000	9,000
	150	$27	$28	6,000	1,000	5,000	1,000
TOTAL				**1,100,000**	**260,000**	**1,080,000**	**240,000**

Table 5-14 Fibre Cost and Growing Stock in the study area by Haul Zone and FMU for Different Scenarios

FMU	Radial Distance from Thunder Bay (km)	Haul Rate ($/m3)		All Hardwood Volume (m^3) 2.4 m Logs	All Hardwood Volume (m^3) 4.8 m Logs
		5 Axle B-Train Trailer	4 Axle Log Trailer		
Lake Nipigon	150	$21	$22	2,590,000	2,410,000
	200	$27	$28	3,870,000	3,640,000
	250	$34	$36	3,480,000	3,270,000
	300	$38	$40	140,000	130,000
English River	150	$29	$30	140,000	130,000
	200	$30	$32	5,290,000	4,940,000
	250	$31	$33	7,080,000	6,610,000
	300	$33	$34	1,070,000	1,000,000
Black Spruce	50	$14	$15	970,000	910,000
	100	$16	$17	7,310,000	6,860,000
	150	$20	$21	7,650,000	7,180,000
	200	$28	$29	6,100,000	5,670,000
Dog River	50	$15	$16	400,000	380,000
	100	$20	$21	6,930,000	6,500,000
	150	$26	$27	5,900,000	5,510,000
	200	$25	$27	140,000	130,000
Lakehead	50	$15	$16	10,020,000	9,460,000
	100	$21	$22	4,270,000	3,980,000
	150	$27	$28	530,000	490,000
TOTAL				**73,870,000**	**69,210,000**

5.4 Hardwood Facility Production Potential

Based on the underutilized hardwood volume in the study area – both the overall forest growing stock and the currently available volume as per existing forest management plans – a number of hardwood processing facilities could potentially be supplied by this feedstock. The tables below show potential expected maximum facility production rates for a variety of facilities. The estimate is based on currently approved harvest levels, current utilization levels are not factored in as hardwood utilization may fluctuate with forest management and planning decisions. While the below table shows the maximum potential annual production for a variety of facilities, the likely optimal scenario is multiple facilities sharing different portions of the hardwood resource feedstock and profile.

Table 5-15. Potential Annual Production for Hardwood Processing Facilities in the Study Area Given Currently Available Hardwood Volume

Product	Basis	Units	Production Capacity (Annual)		
			2.4 m Log Scenario	4.8 m Log Scenario	Tree Length Scenario
Oriented Strand Board	9.5mm (3/8")	m^2	68,000,000	66,000,000	70,000,000
Laminated Strand Lumber	32mm (1-1/4")	m^2	20,000,000	18,000,000	22,000,000
Medium Density Fibreboard	16mm (5/8")	m^2	42,000,000	40,000,000	44,000,000
Particle Board	16mm (5/8")	m^2	47,000,000	45,000,000	49,000,000
Veneer	9.5mm (3/8")	m^2	110,000	N/A	N/A
Plywood	9.5mm (3/8")	m^2	90,000	N/A	N/A
NBHK	N/A	tonnes	220,000	210,000	230,000
Biofuel	Liquid Fuels	litres	135,000,000	130,000,000	140,000,000

While all of these facility types have potential, given current market conditions, OSB and LSL are the most likely opportunities to consume large amounts of poplar roundwood. Biofuels have potential to consume lower grade logs (i.e. defect, etc.) as well as the residuals produced from an OSB or LSL facility. While a birch veneer or LVL facility presents a unique opportunity to utilize birch fibre for which there are few potential users of. It should be noted that due to the large diameter requirements for veneer logs and shorter overall height of birch trees, producing 16ft birch logs is likely uneconomical due to the large volume of short logs it would produce.

6 Key Findings for Investors

1. Based on current and known future wood commitments, approximately 1.1 million cubic metres poplar and 260,000 cubic metres of birch is available annually in the study area. Business-to-business relationships are likely necessary to access much of this fibre, but the region is keen to achieve increased utilization.

2. Haulage costs across the study area range from under $14/m³ to over $40/m³, with an average cost of approximately $25/m³. Over 85% of the resource can be hauled for under $30/m³.

3. Hardwood log diameters in the study area are modest, averaging between 20–24 cm. 4-9% of merchantable fibre is off cut short logs in a 2.4 m logging scenario. This increases to 9% for poplar and 22% for birch in a 4.8 m logging scenario.

4. Opportunity exists for future forest management plans (FMPs) to develop new hardwood management and utilization strategies given increase demand for this resource. All FMPs in the study area will be renewed in the next 5-years.

5. The study area is an ideal location for hardwood processing facilities with good market access, a variety of transportation connections, an established forestry sector and a long history of sustainable forest management practices.

6. Co-location of an EWP and biofuels facilities targeting hardwood fibre, with existing sawmill and pulp facilities in Thunder Bay will unlock efficiencies through utilization of the study area's entire fibre profile. All industries will benefit from synergies in both forest management and operations.

7 Conclusion and Next Steps

Ontario’s forest sector has untapped potential to deliver greater economic and social value. Increasing the utilization of hardwoods—particularly poplar and birch—is key to unlocking it. No region is better positioned to lead this effort than Thunder Bay. The area offers a secure and plentiful supply of hardwood fibre, a cost-competitive environment, and a well-established infrastructure network including highway, rail, and port access. Additionally, Thunder Bay is a regional hub for woodland enterprises: logging and trucking companies, equipment dealers, machine shops, bulk dealers, financial and administrative services.

Thunder Bay’s existing softwood-focused forest products sector presents compelling synergies for hardwood-based investments. The co-location of new engineered wood product or biofuel facilities with existing sawmills and pulp operations can reduce costs, improve fibre efficiency, and create circular value chains. The diversity and availability of hardwood resources in the study area can support a wide range of forest product manufacturing—from OSB and LSL to biofuels and other high-value uses.

This combination of resource security, infrastructure, cost efficiency, and industrial synergy makes Thunder Bay a uniquely attractive location for investment in hardwood processing. By capitalizing on these strengths, investors have a clear opportunity to drive innovation, enhance forest management, and generate long-term value across the sector.

7.1 Next Steps for Potential Investors

Following this study, prospective investors in the study area may wish to explore the following areas to support informed decision-making:

Understand Fibre Access and Licensing

While a significant portion of the study area's hardwood fibre remains underutilized, much of it is already formally allocated. New entrants will need to engage with local forest managers, Sustainable Forest Licence (SFL) holders, and the Ministry of Natural Resources (MNR) to identify options for access this unutilized fibre. As hardwood make up significant components of softwood stands, and full forest utilization brings costs down for all users, existing forest users will be keen to work with and support new entrants to this market.

Develop an Operational Strategy and Determine Contractor Capacity

Understanding the capabilities and availability of local logging contractors is critical to developing a reliable fibre supply chain. Investors should assess harvesting infrastructure, equipment configurations, and potential partnerships with contractors to support cost-effective and consistent feedstock delivery. Strategically locating facilities in areas with backhaul potential for existing forest users may be an option to increase value.

Assess Fibre Quality and Data Gaps

While this study used the best available regional data, field sampling and targeted research on key attributes such as cull rates, decay, and moisture content are recommended to validate resource suitability for specific end uses.

Develop a Case Study for a Specific Facility

A case study, supported by the findings of this report, can further incentivize and derisk investment in Thunder Bay. Assessing the potential of a specific facility in Thunder Bay through a targeted case study can include more detailed assessments of feasibility for specific end users.

Engage in Upcoming Forest Management Planning Processes

All the forest management plans in the study area are scheduled for renewal within the next five years. Given the current underutilization of hardwoods, there are opportunities to update forest management and harvest planning strategies to better support hardwood and mixedwood stand management. Early engagement in the FMP process can help align future supply with facility needs.

Engage with Local Communities and Indigenous Communities

Building strong relationships with local communities—particularly Indigenous communities—is essential for long-term project success. Early and meaningful engagement can support social license, facilitate partnerships, and help connect investors with potential local labour sources and collaborative opportunities.

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Appendix A: Conversion Factors

The following table outlines important conversion factors used in the analysis of hardwood inventory supply and costs. These conversion factors are regionally calibrated to Northwestern Ontario and have been sourced from sawmill and pulp mill weigh scale receipts. All loads of fibre coming from the forest must be measured (volume and weight) before being unloaded in a mill.

Conversion Factors for Hardwood Logs

Hardwood Conversion Table (Logs)			
Units	Cubic Metres (m^3)	Green Metric Tonnes (GMT)	Oven Dry Tonnes (ODT)
1 Cubic Metres (m^3)	N/A	0.870	0.380
1 Green Metric Tonne (GMT)	1.149	N/A	0.559
1 Oven Dry Tonne (ODT)	2.629	1.790	N/A

Appendix B: Haul Model Inputs

Haul Cost Factors for Logs within the study area. Average distance by FMU has been weighted by volume in distance zones.

Factor	Lake Nipigon	English River	Black Spruce	Dog River	Lakehead	Average
Average Haul Distance One Way (km)	240.2	296.8	127.6	141.2	84.0	178.0
Average Speed (km/hr)	74.3	77.5	63.1	62.4	54.2	66.3
Average Drive Time Two Way (hrs)	6.4	7.6	4.0	4.5	3.1	5.1
Load, Unload and Check Times (hrs)	2.2	2.2	2.2	2.2	2.2	2.2
Load Size Log Trailer (m^3)	46.0	46.0	46.0	46.0	46.0	46.0
Load Size B-Train Trailer (m^3)	49.0	49.0	49.0	49.0	49.0	49.0
Total Trip Time (hrs)	8.6	9.8	6.2	6.7	5.3	7.3