Dawson Forest Resources Management Plan Timber Supply Analysis

Timber Supply Analysis Report

Report date: **May 11, 2018**

Forsite Project: **1323-001**

Report Prepared for:

Tr'ondëk Hwëch'in Government;

Forest Management Branch, Yukon Government; and

Dawson District Renewable Resources Council (DDRRC)

Contract Manager

Kirk Price, Operations Manager

Forest Management Branch,

Energy, Mines and Resources

Yukon Government

Prepared by

Reg Davis, R.P.F.

Forsite Consultants Ltd

Acknowledgements

This was a collaborative project of

- Yukon Forest Management Branch;
- Tr'ondëk Hwëch'in Government;
- Dawson District Renewable Resources Council;
- Yukon Environment; and
- Forsite Consultants Ltd

Project oversight was provided by Kirk Price, Operations Manager, Energy, Mines and Resources, Forest Management Branch (FMB).

Mark Pedersen, Lisa Walker, Jennifer Platz, Robert Legare and Lauren Waters (Yukon Forest Management Branch) , Kay Linley (Land and Resources Manager, Tr'ondëk Hwëch'in), Darren Bullen (Land and Resources Officer, Tr'ondëk Hwëch'in) Ian Fraser (Chair of the Dawson District Renewable Resources Council (DDRRC)), John Mitchell (DDRRC), and Heather Onsorge (Yukon Environment) provided input and direction on the content of the Data Package Report.

Sue Deforest (Yukon Forest Management Branch) provided FMB GIS data and support, and Adam Thom (Land and Resources Officer/ GIS Coordinator) provided Tr'ondëk Hwëch'in GIS data.

Lead author and analyst for the project was Reg Davis, R.P.F. (Forsite Consultants Ltd). Documentation was also completed by Reg Davis, R.P.F., of Forsite Consultants Ltd..

_____

Reg Davis, RPF

Forsite Consultants Ltd.
#6 – 801B Baker Street,
Cranbrook, B.C. V1C 1A3
778.517.8061

Forsite Consultants Head Office:
330 - 42nd Street SW,
PO Box 2079
Salmon Arm, B.C. V1E 4R1
250.832.3366

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 Executive Summary

This document contains a timber supply analysis specific to the Dawson Forest Resources Management Plan area (FRMP). These analyses are an important part of the Yukon Forest Management Branch's Annual Allowable Cut (AAC) determination process, under the authority of Part 16(1) of the Forest Resources Act

The purpose of the timber supply analysis is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the Region.

The associated Dawson Forest Planning Area Timber Supply Analysis Data Package provides the detailed, technical information and assumptions regarding current forest management practices, policy and legislation which were used in this analysis. Based on the details in the Data Package, the area in this analysis (Public and First Nations lands) covers approximately 4.89 million hectares in the central-west of the Yukon.

The portion of this area considered available for timber production and harvesting under current management practices is called the timber harvesting land base (THLB). The THLB has been estimated through the analysis of spatial map layers and assumptions detailed in the Data Package Report. Based on these inputs, the current THLB is estimated to be 370,654hectares.

The purpose of the analysis report is to summarize the results of the timber supply analysis and provide a focus for public input and for decision makers to consider during the AAC decision. The contents of this Analysis Report will provide the Forest Management Branch Director with a portion of the information that is needed to make an informed AAC determination for the public lands within the Dawson FPA.

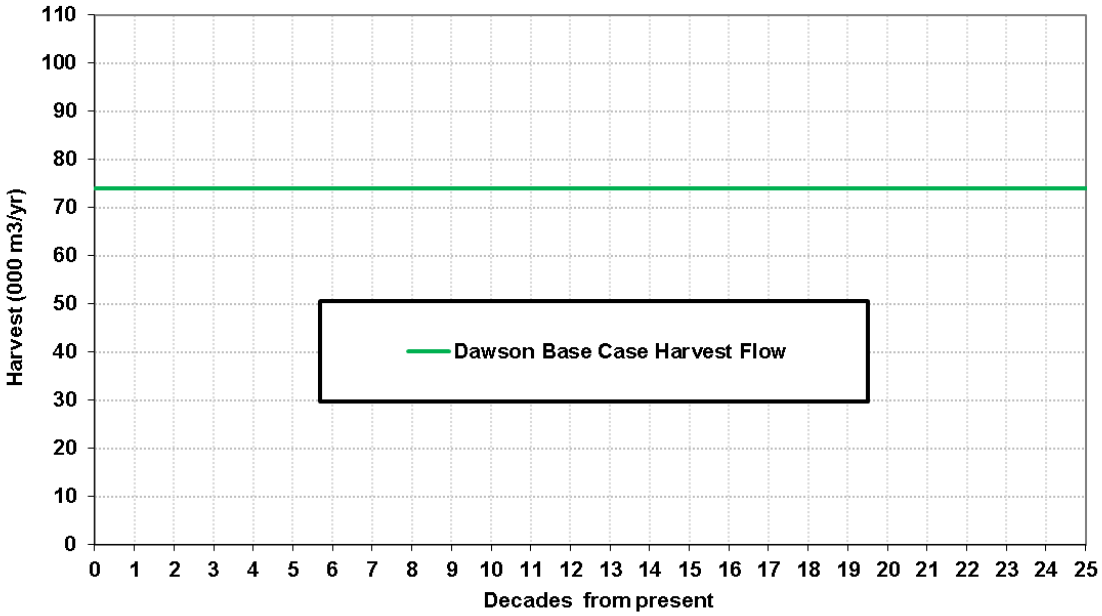
This report focuses on the Base Case Option, which represents current management practices in the Region. A even flow was chosen as the Base Case harvest flow.

The harvest flow of 74,000 m3/year comes from the combination of both Public and First Nations Settlement Lands. The public lands support 68,000 m3/year of the harvest, and the First Nations lands provide 5,000 m3/year of the harvest (values are rounded to the nearest 1000 m3/year).

The FMB Director will determine the AAC for the public lands.

The Tr'ondëk Hwëch'in (TH) will determine an AAC for their settlement lands.

Base Case Harvest Flow



A series of sensitivity analyses were completed to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecasts.

Uncertainties that altered the harvest flow by at least 10% were:

- decreasing stand breakup ages by 30 years (which simulates increased wildfires) (-26 %)
- setting the harvest threshold at a minimum of 60 m3/ha (+70 %); and
- setting the harvest threshold at a minimum of 100 m3/ha (-38 %); and
- increasing the within-block stand retention at the time of harvest to 30% (-12 %); and
- yield tables increased by ten percent (+12 %); and
- yield tables decreased by ten percent (-39 %).
- limiting harvest to stands within 7.5 km of existing access (-66 %); and
- limiting harvest to stands within 12.5 km of existing access (-54 %).

2.0 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in the forests, and they ensure that timber harvesting objectives are balanced against other social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities, to name a few.

This Analysis Report has been prepared by Forsite Consultants Ltd under contract with Forest Management Branch, Yukon Government. The Dawson TSA Technical Committee was formed to provide direction for the analysis and to communicate with stakeholders and public on performing the analysis and final reports. The Committee consisted of members from Dawson District Renewable Resource Council, Tr'ondëk Hwëch'in Government and Yukon Government.

Key persons contributing to this document, or providing input data for the analysis include the following:

Name	Agency	Role / Contribution
Kirk Price	Forest Management Branch	Project Manager
Mark Pedersen	Forest Management Branch	Team member
Jennifer Platz	Forest Management Branch	Team member
Lisa Walker	Forest Management Branch	Team member
Catherine Welsh	Forest Management Branch	Team member
Ian Fraser	Dawson District Renewable Resource Council	Team member
John Mitchell	Dawson District Renewable Resource Council	Team member
Kay Linley	Tr'ondëk Hwëch'in	Team member
Darren Bullen	Tr'ondëk Hwëch'in	Team member
Heather Onsorge	YG Department of Environment	Team member

2.1 Background

The essential background to this TSA process is:

The Dawson area covers the traditional territory of the Tr'ondëk Hwëch'in (TH), and has an approved Forest Resources Management Plans (FRMP).

The Forest Management branch (FMB) of the Yukon's Department of Energy, Mines, and Resources (EMR) regulates management, compliance and enforcement of forest resources in the Yukon. To fulfil this mandate, FMB undertakes the task of developing timber supply analysis (TSA) to support FMB's Annual Allowable Cut decision. The Forest Resources Act (FRA) and Regulation's (Regulation) outline the authority and factors that must be considered as part of the AAC determination; see Section 16 (1) of the FRA and Part 3 section 24 of the Regulation. The Regulation has 18 factors to consider prior to making an AAC determination.

A timber supply analysis for the Dawson region is scheduled for completion under a contract.

(*Ref: para. Forest Management Branch, 2015*)

2.2 Purpose

This timber supply analysis is an input to the AAC determination. The analysis is based on the current resource management objectives as established by the First Nation and Yukon governments, and as defined in legislation, legal orders, memoranda of understanding, and land use plans. This analysis is directed at the timber supply, and not at land use planning and land use decisions, which are outside the scope of the AAC determination.

As resource management objectives and practices change, and as better information becomes available, then these changes will be included in future timber supply analyses.

The specific purpose of this Analysis Report is to summarize the findings from the recently completed timber supply analyses and modelling.

2.3 The Timber Supply Analysis Process

The "Timber Supply Analysis Process" is completed prior to, and provides some of the input to the AAC determination. The Timber Supply Analysis process included these components:

1. Consolidation of the timber supply-related management assumptions;
2. Data discovery and technical data consolidation, such as gathering GIS data layers;
3. Preparation of a Timber Supply Data Package Report which summarizes the data, the management assumptions, and the growth and yield methodology;
4. Technical analyses and modeling of the timber supply;
5. Summary and interpretation of modeling results, as a Timber Supply Analysis Report;
6. Consultations with others, such as government agencies and interested groups, occurred throughout the above components.

The Timber Supply Analysis Technical Committee were involved in all the above components. Forsite's efforts were focused on the first five of the components, with minor contributions to the consultations.

The responsible authority for the Tr'ondëk Hwëch'in will make a determination on allowable cut on the Tr'ondëk Hwëch'in Settlement Lands.

FMB has issued a contract to Forsite Consultants to complete the timber supply analysis for the Dawson AAC Region. Forsite's main efforts will be on the first five of the components with minor contributions to the consultations (component 6).

The major background information used to prepare this Data Package and Analysis Reports included:

- *Tr'ondëk Hwëch'in Final Agreement – Chapter 17*
- *Dawson Forest Resources Management Plan (2013);*
- *Dawson Forest Resources Management Plan Implementation Memorandum of Understanding (2014);*
- *Forest Resources Act (2008); and*
- *Forest Regulations (2011))*

See the References section for a more extensive list of information that was consulted when preparing this document.

2.4 The AAC Determination Process

When the Director of the Forest Management Branch makes a determination for the Public land, he must do so according to Section 24 of the Forest Resources Regulation:

> *Sec 24. The Director must consider the following factors in respect of an area, prior to making a determination of the annual allowable cut for that area under subsection 16(1) of the Act:*
>
> *. . . <list of items (a) to (r)>*

Many of these items are incorporated into the Timber Supply Analysis. The list of items (a) to (r), and where they appear in the two Timber Supply Analysis Reports are listed in Appendix A.

2.5 Location of the Dawson Forest Planning Area

The Dawson Forest Resources Management Plan Area is located along the western boundary of the Yukon Territory. This is the gray shaded area in Figure 1.

Figure 1. Dawson Forest Planning Area

The major settlements in the project area are depicted in Figure 2.

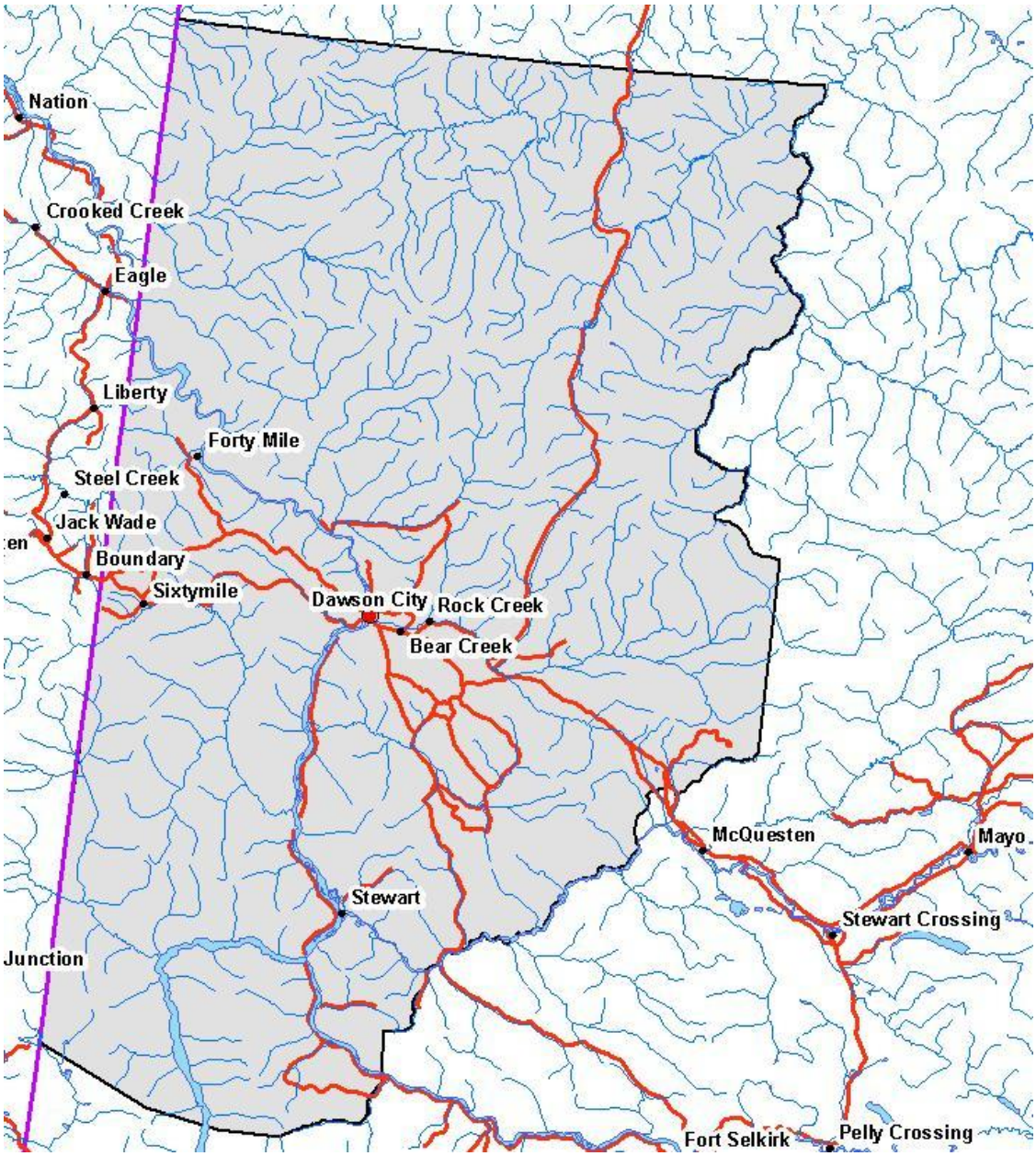


Figure 2. Overview Map of the Settlements in the Dawson Forest Planning Area.

2.6 Attributes of the Dawson Forest Planning Area

This section summarizes the current state of the forests in the Dawson Forest Planning Area and adjacent TH settlement lands. These descriptions of the forests are useful to understanding the timber supply analyses presented later in the document. The Timber Harvesting Land Base (THLB) and Contributing Forested Land Base (CFLB) referenced in this section are described in more detail in the TSA Data Package.

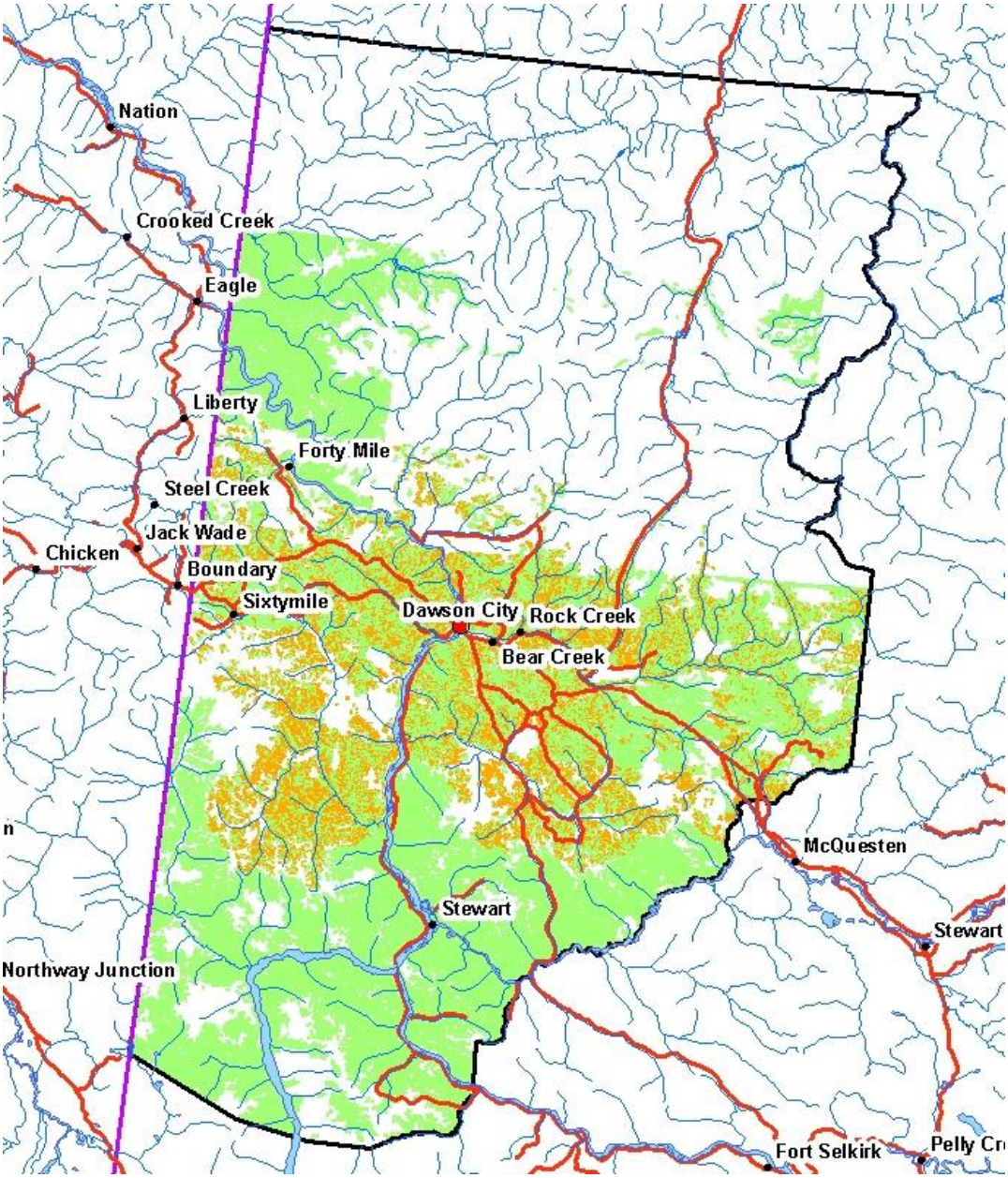


Figure 3 Dawson Planning Area Land Base

Notes: *Green areas are contributing, productive forest land base (CFLB).*
Orange is timber harvest land base (THLB).

Approximately 1.68 million hectares, or 34% of the total area of the Dawson Forest Resources Management Plan Area (4.89 million ha) is considered productive forest land. The remaining 66% is either not-mapped, or is considered non productive (i.e. rock, ice, tundra, alpine, roads, etc.). Within the productive land base 370,654 ha, or 22.1 % is considered potentially available for timber harvesting. This represents about 7.57 % of the gross area.

The 370,654 ha of potential THLB is further reduced by "no harvest" and within-block retention areas. Over the whole of the Timber harvest land base it was assumed that 20% of the THLB would be retained from harvest at the block level at the time of harvest. The net effective THLB area, after the within-block retention is applied, is 296,523 ha, which is 6.06 percent of the gross landbase, or 17.65 percent of the productive forest area.

The effective timber harvest landbase of 296,523 ha is reduced by another 5%, in the future, to account for future roads, trails and landings. Assuming that all of the THLB area was eventually logged then the net, effective timber harvest landbase becomes 281,697 ha, which is 5.76 percent of the gross landbase, or 16.76 percent of the productive forest area.

To simplify comparisons between the Base Case option and all the sensitivities, the gross potential timber harvest land base value of 370,654 hectares is used throughout this report, unless specifically mentioned otherwise.

Age Class and Species Group Distribution ()

Statistics and charts of the age class distribution of the Dawson Planning Area forests are provided in Table 1, and Figure 4 and Figure 5.

Table 1 Dawson Planning Area Age Class Distribution

Age Class	Age Range	THLB (ha)	THLB (%)	NHLB (ha)	NHLB (%)	Total (ha)	Total (%)
0	0	75,529	20.38	281,945	21.53	357,474	21.27
1	1-20	1,915	0.52	4,574	0.35	6,489	0.39
2	21-40	18,422	4.97	52,850	4.04	71,272	4.24
3	41-60	59,254	15.99	298,245	22.77	357,499	21.28
4	61-80	54,800	14.78	201,570	15.39	256,370	15.26
5	80-100	47,159	12.72	193,523	14.78	240,683	14.32
6	101-120	48,990	13.22	113,594	8.67	162,583	9.68
7	121-140	48,785	13.16	108,648	8.30	157,432	9.37
8	141-250	15,702	4.24	54,708	4.18	70,410	4.19
9	251+	98	0.03	3	0.00	101	0.01
	Totals	**370,654**	**100.00**	**1,309,660**	**100.00**	**1,680,314**	**100.00**

Notes:
NHLB = non-timber harvest landbase - productive forest that is not in the THLB.
THLB = timber harvest land base, aka "working forest".
Age Class 0 = areas that have been updated for fires since the inventory was completed

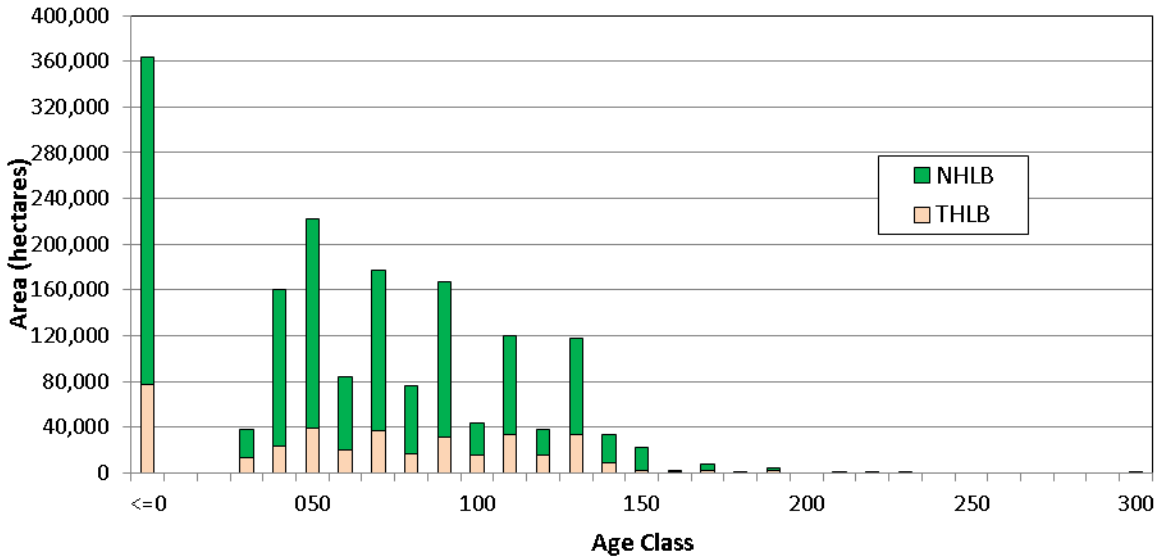


Figure 4 Age Class of the Productive Forest

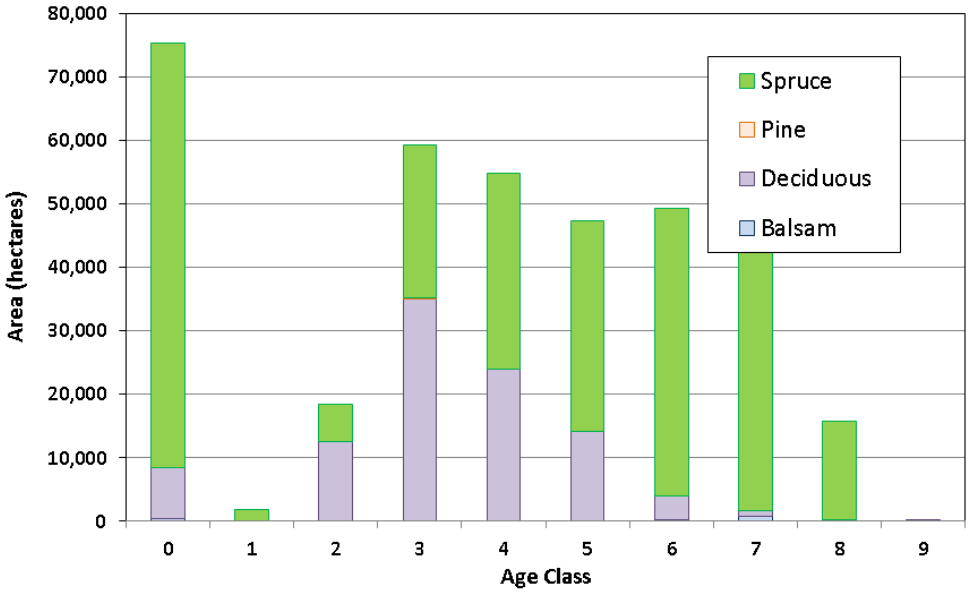


Figure 5 Age Class Distribution by Species Group for the Timber Harvesting Land Base (THLB)

Spruce-leading stands cover almost 73% of the THLB area, deciduous-leading stands cover 27%, and other species cover a trace amount.

Table 2 Stand Leading Species in the timber harvesting land base (THLB)

	Balsam	Deciduous	Pine	Spruce	Total
Area (ha)	1,978	98,267	212	270,197	370,654
Percent	0.53	26.51	0.06	72.90	100.00

In the non-timber harvesting land base (NHLB), the leading species are spruce (68 %), deciduous (32 %) followed by balsam (1 %) and a trace amount of pine-leading stands (Table 3 and Figure 6).

Table 3 Stand Leading Species in the NHLB

	Balsam	Aspen/Birch	Pine	Spruce	Total
Area (ha)	13,130	415,872	2	880,657	**1,309,660**
Percent	1.00	31.75	0.00	67.24	**100.00**

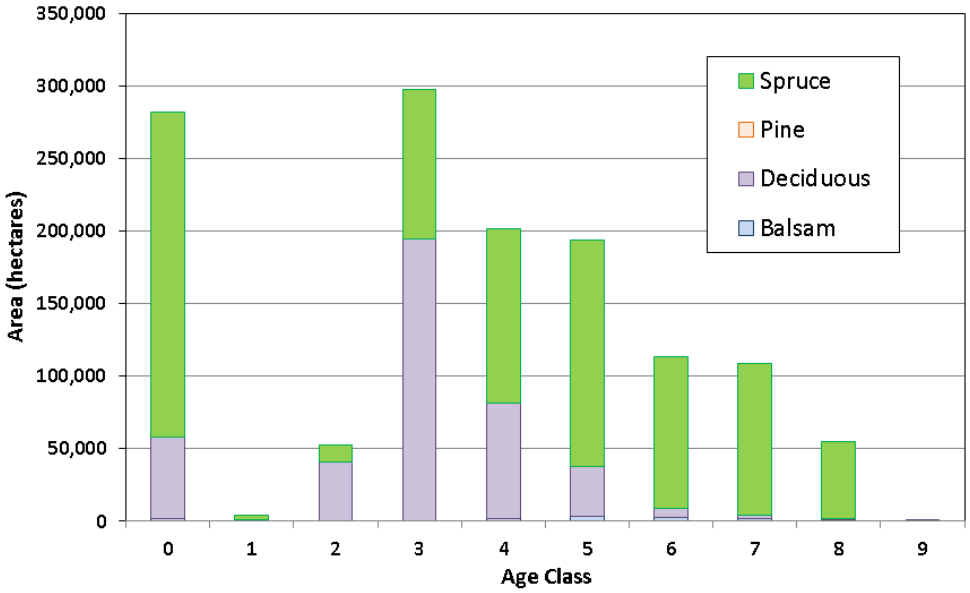


Figure 6 Age class distribution by species group for non-timber harvesting landbase (NHLB)

Note: Age classes: 1=1-20, 2-21-40, 3=41-60, 4=61-80, 5=81-100, 6=101-120, 7=121-140; 8=141-250, 9=251+

3.0 Timber Supply Analysis Methods

A large amount of information is required to complete a timber supply analysis. Information must be obtained in four broad categories: land base, forest inventory, management practices, and forest dynamics. This information is then translated into a computer model formulation that can explore sustainable rates of harvest in the context of integrated resource management. This section is a summary of the data inputs, assumptions, and modeling procedures. More detail is provided in the Dawson Forest Planning Area TSA Data Package (Forsite, 2018).

3.1 Land Base Definition

There are three major land base classifications in this analysis: (1) gross land base, (2) productive, contributing forest land base and (3) timber harvesting land base.

The GIS analysis database extends past the Dawson Forest Planning Area boundary. Those areas outside the boundary and a small amount of area that doesn't contain data required for modelling are considered "non-contributing" and removed from the data, leaving the gross land base.

The gross land base is then "netted down" to a productive, contributing forest land base (CFLB). The CFLB excludes "non-contributing" areas such as municipalities, land dispositions and licenses, and any areas where forest management may not take place. The CFLB also excludes "non-productive" areas such as water, rock, non-forested areas, and non-productive forested types. The remainder, the contributing forest land base (CFLB) is productive forest that contributes to landscape level objectives for biodiversity and other non-timber resources.

The timber harvesting land base (THLB) is the portion of the productive land base where timber harvesting occurs. The THLB excludes areas that are uneconomic for timber harvesting, "no-go" areas that are permanently set aside for other resources, parks and reserves, and areas otherwise off-limits to timber harvesting.

Estimates are also made for block level retention, and future reductions to the THLB, such as future roads and landings.

In summary, the netting down of the total GIS database to the gross land base, contributing productive forest land base (CFLB), and timber harvest land base (THLB) is summarized in Table 4, resulting in the net area of CFLB and THLB of 1,680,314 ha and 370,654 ha, respectively.

Table 4 Land Base Netdown Types

Starting Area	Remove These Areas	Results In This Area	Gross Area (ha)
Total Area in GIS Database	Outside, No-data, etc.	Gross TH FRMP Land Base	4,893,457
Gross TH FRMP Area AAC Region Land Base	Non-Contributing and Non-Productive Areas	Contributing, Productive Forest Land Base (CFLB)	1,680,314
Contributing, Productive Forest Land Base (CFLB)	Permanent No-Go Areas, and Not-Harvestable Areas	Timber Harvest Land Base (THLB)	370,654

Table 5 presents the individual reductions to the gross area of the Dawson Forest Planning Area GIS database to arrive at the contributing forest land base (CFLB), and the timber harvesting land base (THLB).

Table 5 Timber Harvesting Land Base Determination

Landbase / Netdown Category	Area (ha)	Landbase (ha)	Percent of Gross	Percent of CFLB
Dawson Forest Planning Area - Gross Area	**4,893,457**	**4,893,457**	**100.00**	
Contributing Forest LandBase (CFLB) Netdowns				
No forest inventory	*1,464,596*		29.93	
Non-Productive	*873,888*		17.86	
Non-Vegetated	*615,858*		12.59	
Site Index less than 3	*187,089*		3.82	
Agricultural Dispositions	*210*		0.00	
General Dispositions	*3,083*		0.06	
Land Licenses	*511*		0.01	
Surveyed Land Parcels	*5,133*		0.10	
Communities	*1,339*		0.03	
First Nations Land Exclusions	*5,186*		0.11	
Active Placer Leases	*52,946*		1.08	
Quartz Mining	*1,358*		0.03	
Roads and Rights-of-way	*1,942*		0.04	
Block-level landings	*4*		0.00	
Total CFLB netdowns	***3,213,143***		65.66	
Net CFLB (ha)		**1,680,314**	**34.34**	**100.00**
Timber Harvest Landbase (THLB) Netdowns				
Parks and Hinterland Areas	*793,568*		16.22	47.23
Slopes over 30%	*155,838*		3.18	9.27
Highway Buffers	*447*		0.01	0.03
Aspen Leading Stands	*106,919*		2.18	6.36
Site Index less than 10	*199,612*		4.08	11.88
Riparian Buffers	*53,275*		1.09	3.17
Total THLB netdowns	***1,309,660***		26.76	77.94
Gross THLB Landbase (ha)		**370,654**	**7.57**	**22.06**
Within-block Retention	*74,131*		1.51	4.41
Current, Effective THLB Landbase (ha)		**296,523**	**6.06**	**17.65**
Future Roads, Trails, Landings (5%)	*14,826*		0.30	0.88
Future, Effective THLB Landbase (ha)		**281,697**	**5.76**	**16.76**

Notes:

1. All totals are subject to rounding.
2. Note that any overlaps between net-downs are discounted from the totals in the above table. Any overlap will accrue to the first (highest) category in the table.
3. First Nations Land Exclusions = areas excluded for other resource values by the TH

3.2 Management Practices

Management practice assumptions can be grouped into three broad categories: Integrated Resource Management, Silviculture, and Harvesting.

3.2.1 Integrated Resource Management

Integrated resource management is the basic premise for the practice of forestry in the Dawson Forest Resources Management Plan. Timber harvesting is planned and managed is such a way that allows a wide range of other values to co-exist on the land base. The manner in which each value is considered is dictated by federal or provincial legislation, or by the Yukon and First Nation government policies. Examples of these are the federal Fisheries Act, the Forest Resources Act and Forest Resources Regulations , the Dawson Forest Resources Management Plan (2013) and the Dawson Forest Resources Management Plan Implementation Memorandum of Understanding (2014).

These documents address requirements for a wide range of non-timber issues. The most significant values influencing forest management in the Region are:

- Biodiversity;
- Wildlife habitat;
- Recreation; and
- Riparian habitat.

The areas affected by each of these non-timber resource values and the specific forest management practices required to address them are detailed in the Dawson Forest Planning Area TSA Data Package (2018).

Forest cover requirements are applied within the timber supply model to accommodate the timber and non-timber resource objectives. These requirements aim to maintain appropriate levels of specific forest types that are needed to satisfy the objectives for wildlife habitat, biological diversity, etc. Forest cover requirements are used by the model to limit harvesting within the THLB. These requirements are typically expressed as one of three conditions:

- no harvesting is allowed (“no go” areas); or alternately
- “go light” areas, with “proportionate targets”, in terms of
    - a maximum amount of forest that can be younger than age X; or
    - a minimum amount of forest that must be older than age W.

Forest cover requirements for one or more non-timber resources may be overlapping. The model will evaluate each requirement independently to ensure that the harvesting of a specific area does not violate any one of the requirements.

In the Dawson Forest Management Plan Area (FPA) the major “no go” areas are the Tombstone Territorial Park, and the Hinterland Forest Zones (Figure 7). These areas cover 1,754,174 hectares of the Dawson Forest Planning Area. At the time of this analysis, there are no “go light” areas with proportionate (percentage) targets established in the Dawson FPA.

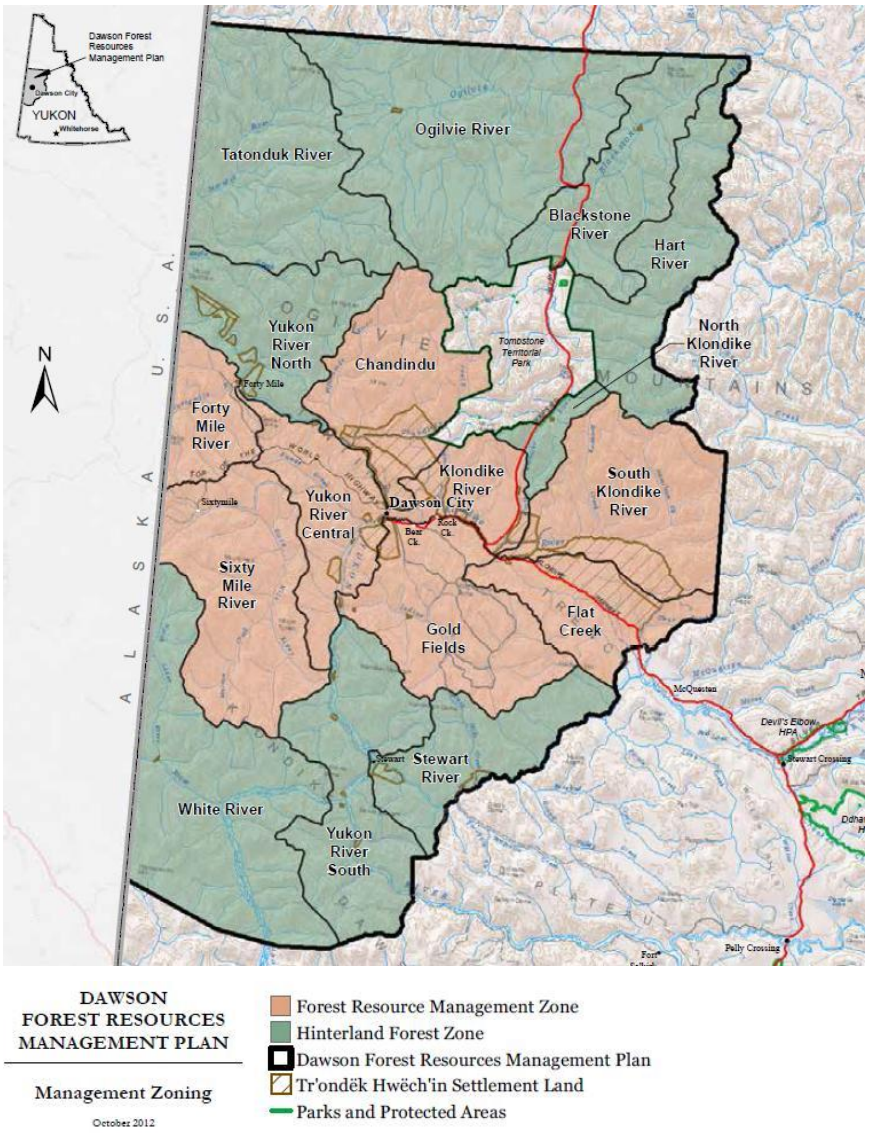


Figure 7 Map of Dawson Landscape Units and Strategic Management Zones

3.2.2 Harvesting

For this analysis, stands will be eligible for harvest if they are within the timber harvesting land base, and contain a minimum merchantable volume of 75 m^3/ha of live wood. In order for any stand within the timber supply model to be considered for harvesting, it must achieve that minimum volume. This ensures that the timber supply model is harvesting stands that meet reasonable economic criteria, and emulates what is considered the current practice by forest licensees. The definition of merchantable wood includes all coniferous and deciduous species.

Note that these are minimums, and are not the actual volume (and not the specific age the stand meets that volume) at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives while other stands may be not be harvested until well past their "optimal" timber production age due to management objectives for other resource values.

3.2.3 Silviculture Systems

Silviculture systems are predominately selection harvest with variable retention. A retention level of 20% of the original stand is assumed. Natural regeneration is the predominant method of regeneration

3.3 Forest Dynamics

Forest dynamics refers to the changing state of the forest through time. Changes occur as the forest ages, or when natural or human caused disturbances occur. The way in which the model addresses these issues is described below.

3.3.1 Growth and Yield Strata

To reduce the complexity and volume of information in the timber supply analysis, individual stands are aggregated into strata[1]. Groups are commonly based on parameters that determine growth rates, such as the dominant tree species and timber growing capability (site index). Other strata-defining parameters typically relate to the silvicultural regime (e.g. clearcut or partial cut), and/or the harvesting regime (e.g. ground-based or cable-based systems). For example, Spruce-leading stands on moderate growing sites with a variable retention silviculture regime may be grouped into a single strata.

Each strata has at least one associated yield table that provides the model[2] with the net, merchantable volume at different stand ages. Only the productive forest stands are assigned to strata and are modeled.

The parameters that will be used to define the strata in this analysis are:

- Harvestable or not-harvestable (essentially in the THLB or the NHLB, respectively);
- Species group (or STRATUM, such as stands with more than 80% spruce);
- Site class (good, medium, poor and low);
- Silviculture system (assuming within-block retention of 20%).

These strata-defining parameters are described in more detail, below.

3.3.2 Stand Breakup / Succession

There are two categories of interest:

- Stands in the non-harvest land base (NHLB) where harvesting will not occur, and
- Stands in the THLB where harvesting may occur, or stand breakup may occur.

In both categories, if a stand reaches the age-of-succession it will revert back to a new stand.

3.3.3 Species Group

The species groupings are based on the vegetation inventory's STRATUM, which is defined in Table 6. Not all of these STRATUM (species groups) occur in the Dawson FPA.

[1] Strata: other names are "stand groups" or "analysis units"

[2] Model = the forest estate model

Table 6 Definition of Stratum (from the 2015 Version Yukon Vegetation Inventory)

Strata Name	Description	STRATUM (YVI Code)
Spruce	Spruce leading stands where the spruce component exceeds 80% based on crown closure.	1
Pine	Lodgepole pine leading stands where the pine component exceeds 80%.	2
Deciduous	Aspen, balsam poplar and white birch leading stands where these exceed 80%.	3
Spruce / Pine	Spruce leading stands where the secondary species is lodgepole pine.	4
Spruce / Deciduous	Spruce leading stands where the secondary species is aspen, balsam poplar or birch.	5
Pine / Spruce	Lodgepole pine leading stands where the secondary species is white spruce or black spruce or fir.	6
Pine / Deciduous	Lodgepole pine leading stands where the secondary species is aspen or balsam poplar or white birch.	7
Deciduous / Spruce	Aspen, balsam poplar or birch leading stands where the secondary species is spruce or fir.	8
Deciduous / Pine	Aspen, balsam poplar or birch leading stands where the secondary species is lodgepole pine.	9
Fir	Fir stands where the fir exceeds 80%.	10
Fir Mix	Fir where secondary species is > 30%	11
Other	Any species or species group not described in the other categories.	12

3.3.4 Natural Disturbances

Each year a portion of the forest is killed by natural events. These events include a number of catastrophic factors such as wildfire, insects, disease, blowdown, and flooding. Stands also undergo non-catastrophic senescence and death.

Endemic, background-type pest losses are built into the growth and yield model (VDYP7). The catastrophic factors, along with senescence, are modeled using leading species-based succession ages (Table 7). When a stand reaches its age of senescence it will revert back to age = 0, and a new stand will regenerate after the appropriate regeneration delay. Stand succession (or “breakup”) may occur in any productive stand, within both the THLB and NHLB.

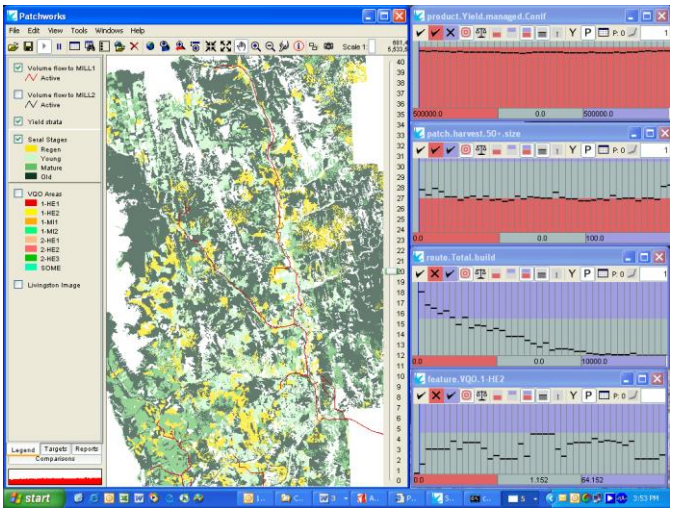
Table 7 Age of Succession

Stand Leading Species	Age of Succession
Spruce- and Balsam-leading	250 years
Pine-leading	200 years
Aspen- and other Deciduous-leading	150 years

3.4 Timber Supply Model

The Patchworks modeling software was used for forecasting and analysis. This suite of tools was developed by Tom Moore and Cary Lockwood, and is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (Tom Moore – www.spatial.ca).

Patchworks is a fully spatial forest estate model that is capable of incorporating real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets/goals defined by the user. Targets can be set on any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, coarse woody debris (CWD)levels, equivalent clearcut area (ECA), specific mill volumes by species, road building/hauling costs, delivered wood costs, net present values, and so on.



Harvest Flow Objectives

The biological capacity of the land base in combination with the objectives for the non-forest resources will dictate the sustainable harvest level. There are many possible harvest flows for any particular land base. By convention, the base case harvest level would be chosen to best reflect objectives such as the following:

- Attempt to maintain a constant harvest level for as long as possible during the short term (1 to 30 years), and if possible extend this harvest level into the mid-term (30 to 100 years);
- If necessary, as the growing stock is depleted, decrease the harvest level in the mid-term as little as possible; and
- Transition to an even-flow, long-term harvest level that produces a non-declining growing stock in the long term (200 to 300 years).

Modeling was performed for 300 years, using 10-year periods. Reporting is for the first 250 years.

4.0 Base Case Analysis (Current Practice)

The Base Case Scenario (model run) is the benchmark for the rest of the timber supply analysis. It is based on current management practices within the Dawson Forest Resources Management Plan Area (FPA). This is defined by operational management practices, characteristics of and natural resource values found on the land base, current silviculture practices, and estimates of present and future growth of forest stands.

Current management reflects:

- Harvesting performance over the last 10 years;
- Management to meet requirements, such as the Forest Resources Act and Regulation and associated regulations, and other locally relevant legislation and policy;
- Management for non-timber resources, including biodiversity, cultural values; wildlife; fish habitat and water quality; and others.

Some of the more significant inventories include mapping of:

- Forest cover inventory, compiled in 2006;
- Private and Community lands, and Land Dispositions, etc.;
- Dawson Forest Resources Management Plan (2013), especially the Hinterland Forest Zones map; and
- Riparian buffers for streams, lakes and wetlands.

Silviculture practices, harvesting methods and projections of current and future stand yields include:

- Definition of the operating land base and, conversely, of non-operating areas defined by non-merchantable stands, or land use planning decisions;
- Estimates of stand yields based on the BC Ministry of Forest's Variable Density Yield Projection (VDYP7) software, adjusted by estimates of the maximum-expected yields for local conditions; and
- Basic silviculture practices.

The data and assumptions that are included in the Base Case are described in detail in the Data Package report.

4.1 Alternative Base Case Harvest Flows

Numerous alternative harvest forecasts are possible for a given set of modeling assumptions. Figure 8 shows the simplest option, an even, non-declining and non-rising harvest flow. The total harvest, as well as the contribution from the First Nations Settlement (FNS) and public lands are shown. In this case, the harvest from all the lands (public and First Nation, combined) was controlled and the harvest on the public and First Nation lands allowed to fluctuate.

In the final Base Case, and all the other scenarios, the harvest from the First Nation lands, and the harvest from the public lands were individually controlled, and the total harvest is the passive total from the First Nations and the public lands.

The model estimates the harvest to extremely small portions of a cubic meter, which is unrealistically precise. The values in the harvest flow charts were rounded to the nearest 1000 m^3/year, which is assumed to better reflect the true precision. However, it also results in some bumps or dips in the charts as the model does not output exactly the same values in each period. When values are rounded, they sometimes round up, and other times down.

Several potential harvest flows for the Base Case follow.

Alternate Flow #1 is even flow on (only) the combined public and first nation lands (Figure 8). This has a level of 75,000 m3/year which is slightly lower than Alternate Flow #2 below.

Alternate Flow #2 is even flow on both the public and first nation lands, with no flow control on the total harvest (which is the total of both of the even flows). The total harvest level is 74,000 m3/year, slightly less than Alternate Flow #1, above.

Alternate Flow #3 has an initial harvest rate of 99,000 m^3/yr., which is higher than the other Alternatives (and the even flow) for four decades. It eventually falls below the other two Alternatives in decade 5. It starts increasing in decade 25, and eventually surpasses the other Alternatives in decade 26 (off the chart).

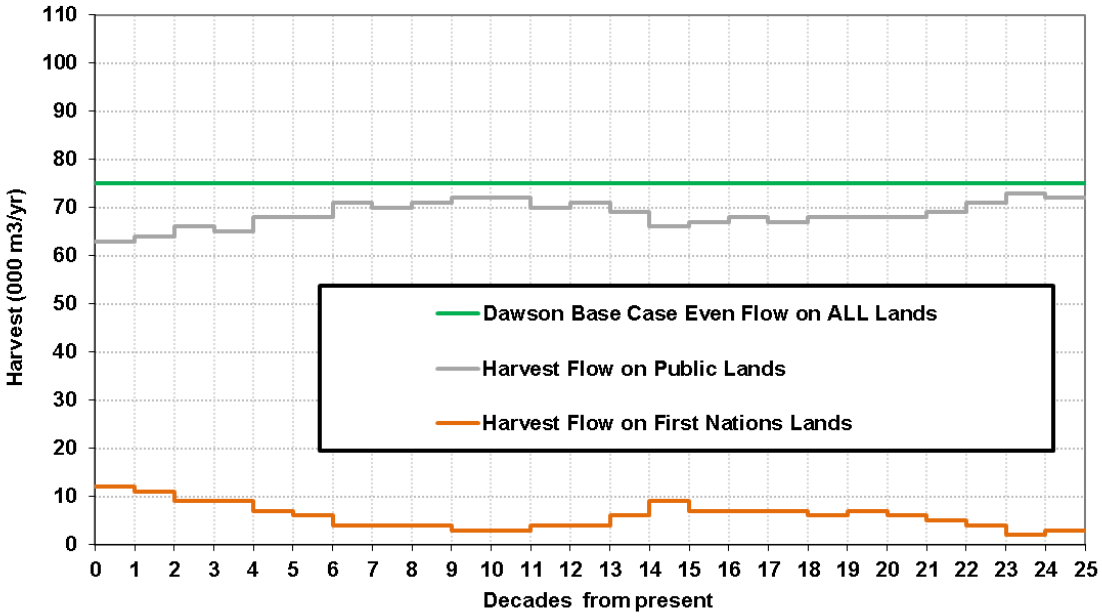


Figure 8 Alternative Harvest Flow #1

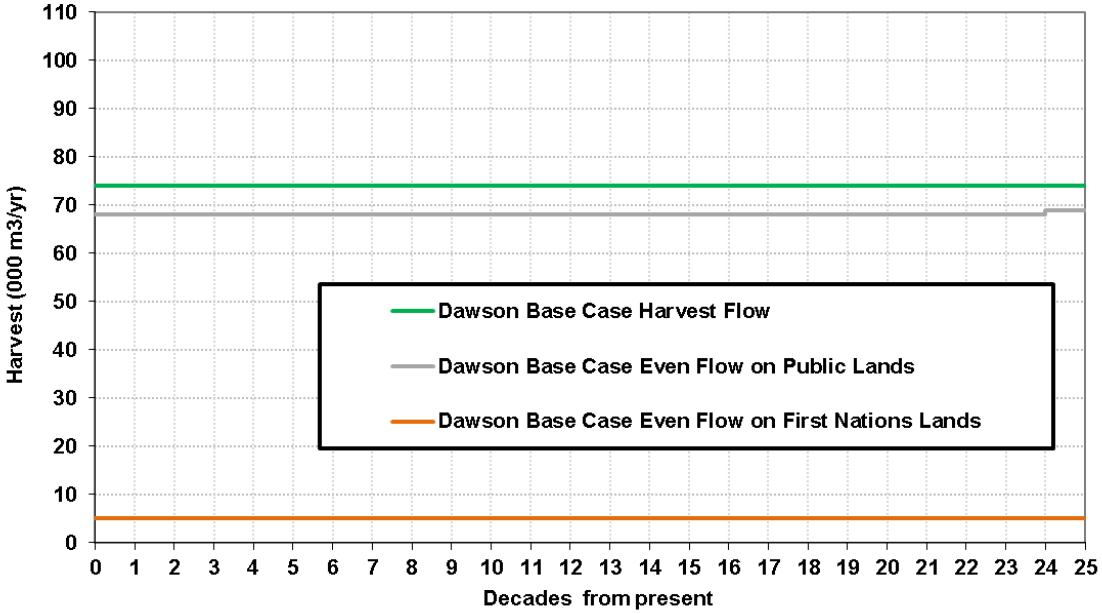


Figure 9 Alternate Harvest Flow #2

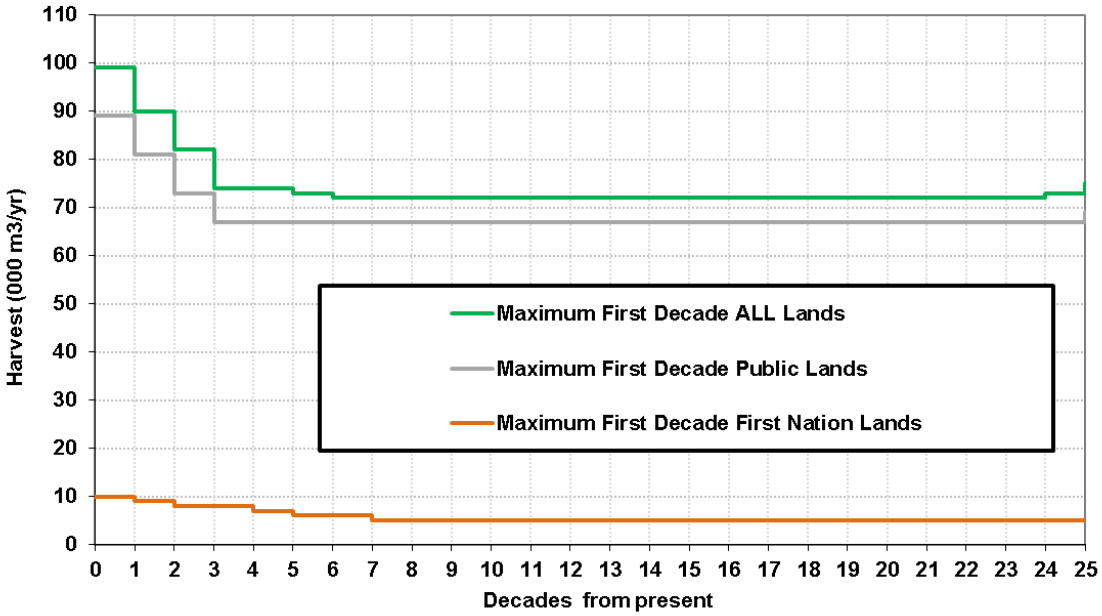


Figure 10 Alternate Harvest Flow #3

The three alternative harvest flows are summarized in Table 8.

Table 8 Base Case Alternate Harvest Flow Comparison

Alternative	Initial Harvest Flow	Relative Harvest Flow Values
Alternate Flow 1	75,000	Even Flow (rounds to 75,000), Public and First Nation harvests are variable.
Alternate Flow 2	74,000	Even Flow (rounds to 74,000), Public and First Nation harvests are both even flows.
Alternate Flow 3	99,000	Initially higher than the other alternatives, falling below them in decade 5, and eventually rising in decade 25.

4.2 Selected Base Case Harvest Flow

The second, Alternative #2 (Figure 9) was selected as the Base Case flow. The total harvest flow, as well as the contributions from the First Nations and Public Lands is shown in Figure 11, and Table 9.

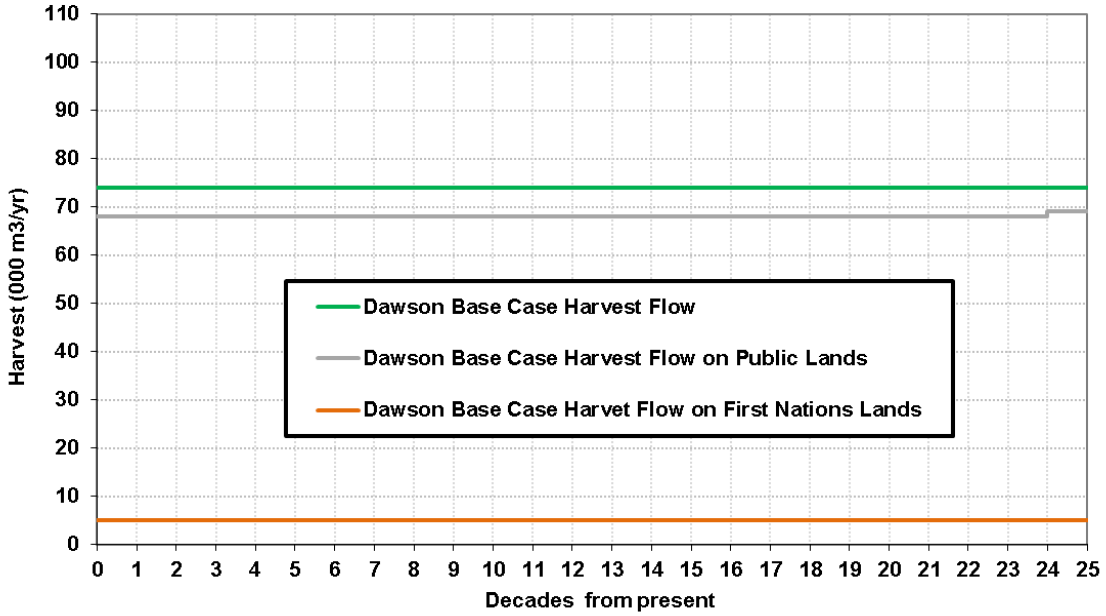


Figure 11 Dawson FPA Base Case Harvest Flow (Public, FNS, Combined)

Table 9 Base Case Option Harvest Flow (Public, First Nations, and All Lands Combined)

Decade	All Lands (m3/yr.)	First Nations (m3/yr.)	Public Lands (m3/yr.)		Decade	All Lands (m3/yr.)	First Nations (m3/yr.	Public Lands (m3/yr.)
1	74,000	5,000	68,000		14	74,000	5,000	68,000
2	74,000	5,000	68,000		15	74,000	5,000	68,000
3	74,000	5,000	68,000		16	74,000	5,000	68,000
4	74,000	5,000	68,000		17	74,000	5,000	68,000
5	74,000	5,000	68,000		18	74,000	5,000	68,000
6	74,000	5,000	68,000		19	74,000	5,000	68,000
7	74,000	5,000	68,000		20	74,000	5,000	68,000
8	74,000	5,000	68,000		21	74,000	5,000	68,000
9	74,000	5,000	68,000		22	74,000	5,000	68,000
10	74,000	5,000	68,000		23	74,000	5,000	68,000
11	74,000	5,000	68,000		24	74,000	5,000	68,000
12	74,000	5,000	68,000		25	74,000	5,000	69,000
13	74,000	5,000	68,000					

Note: Values in each cell have been rounded to the nearest 1000 m3/yr. (e.g. 5,400 + 68,400 = 73,800 will appear in the table as 5,000 + 68,000 = 74,000)

4.3 Base Case Attributes

In order to understand and evaluate the base case harvest forecast, this section describes the stands being harvested and the state of the forest over time. Numerous forest management assumptions have been modeled in the base case analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to better understand the assumptions, and the impact of the composition of the forest on the harvest flow.

4.3.1 Growing Stock Prior to Harvesting

Growing stock is the volume of timber on the landbase. The growing stock is an indication of

- when timber is available for harvest. The higher the growing stock the more volume that is expected to be available for harvest. Conversely if growing stock is low then the volume available for harvest is expected to be low; and
- when the forest is in equilibrium. The more even (flat) the growing stock curve over time, the more stable the forest is. Conversely the more the growing stock is changing the more the forest is changing.

The magnitude and trajectory of the growing stock is a combination of the "natural" growing stock, and the effect of harvesting. The growing stock can be divided several ways. The growing stock pattern prior to modeling any harvest, for the CFLB and THLB, is depicted in Figure 12.

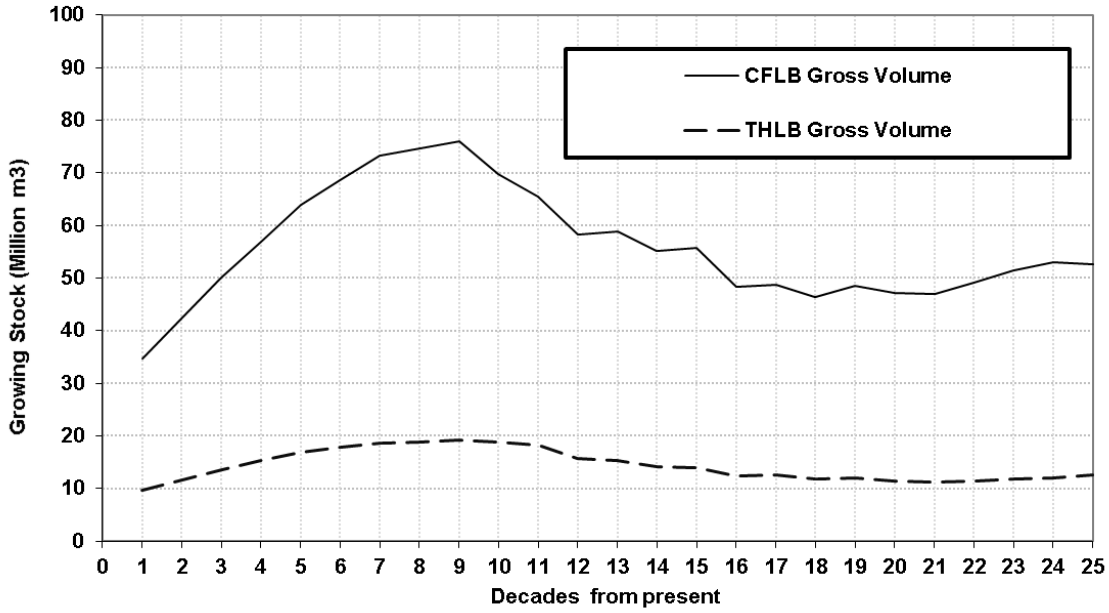


Figure 12 Growing Stock Prior to Harvesting

The THLB growing stock can be sub-divided several ways. The growing stock within just those stands that will eventually attain 75m3/ha (the minimum volume for harvest) is shown in (Figure 13) ("THLB Potential Stands volume"), as well as the 20% of the THLB volume that is retained on site if the stand is logged ("THLB retention volume").

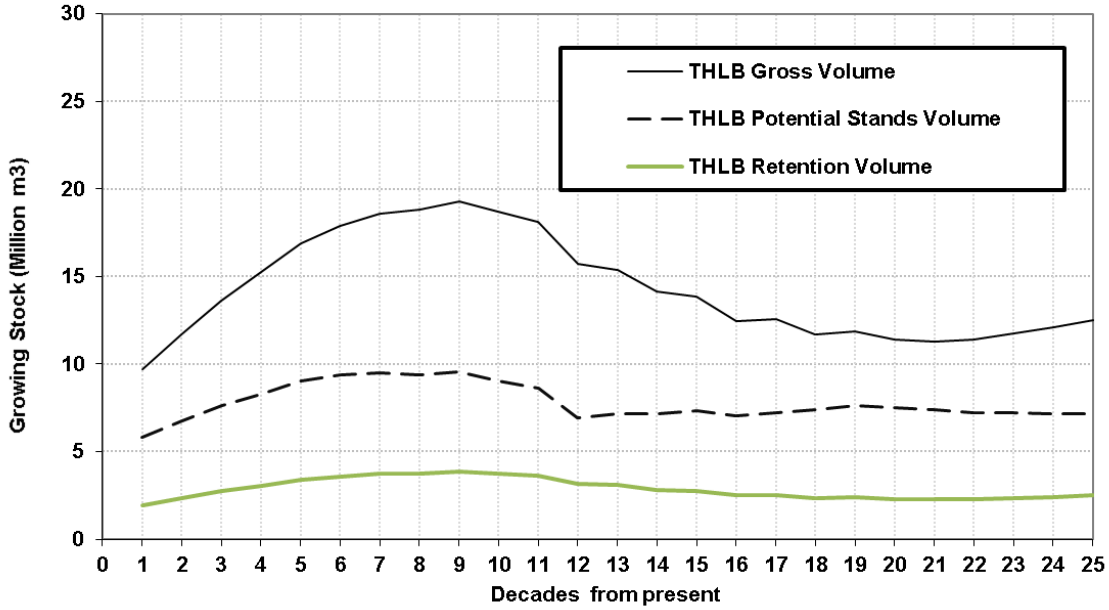


Figure 13 THLB Growing Stock Prior to Harvesting

Within the "potential stands volume" (stands that will attain 75 m3/ha at some time), the volume of in stands that are currently at or above 75 m3/ha are depicted in Figure 14 as the "THLB Merchantable Volume". It is from this merchantable volume that the model must find its harvest. Even when no harvesting occurs, the merchantable volume is a very small component of the total forest volume, e.g. it is approximately 6 million m3 out of the total of 95 million m3 in the forest, in decade 9 (Figure 12 and Figure 14).

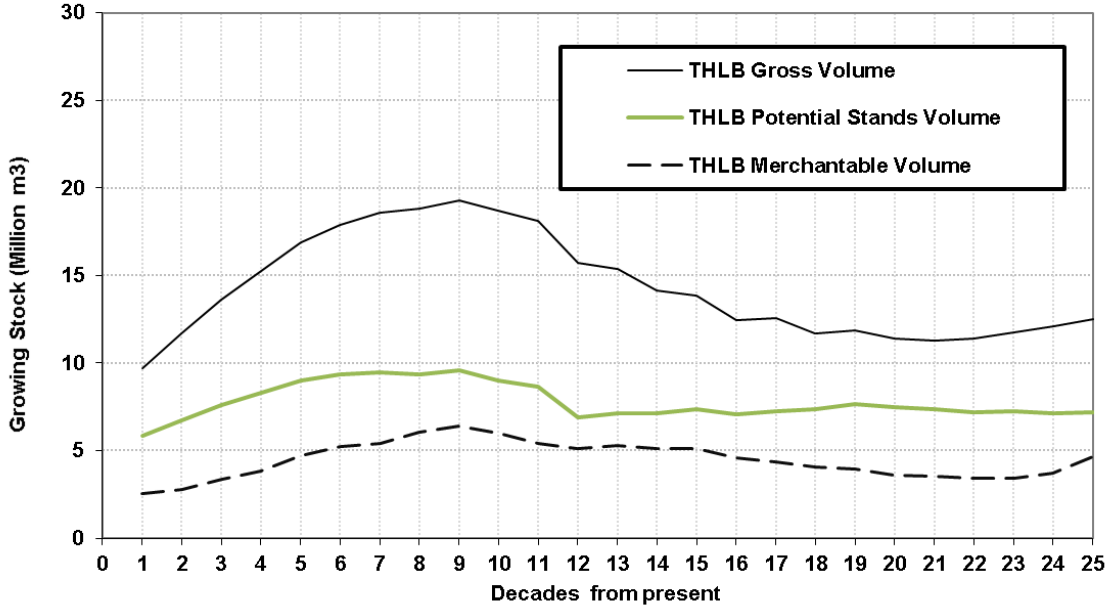


Figure 14 THLB Merchantable Growing Stock Prior to Harvesting

Comments on the growing stock prior to harvest

- The pattern for any of the categories is a wave shape.
- There is a large variation in growing stock over time, with a very low point in the first decade, which rises to a peak in decade 9.
- There is no evidence that the forest is reaching equilibrium over the 250 years depicted in the figure (or in the 300 years modelled).

The rising and falling pattern (wave pattern) is due to:

- Live stand volumes increase as the live stand component grows;
- Break-up of stands is at age=250 years for most of the forest. Break-up of some stands starts in period 1. At the time of breakup the stand volume is reset to zero.;
- At first, there are more stands adding volume than are experiencing breakup;
- Eventually the rate of volume loss due to stand break-up matches the volume growth in live stands in decade 9, and then;
- The impact of breakup is greater than volume growth, and the growing stock declines;
- Eventually the pattern reverses in decade 18 when the pattern will start to repeat.
- Given that most stands in the THLB are spruce leading, and they have a breakup age of 250 years, and an additional 10-12 year regen delay, the pattern can be expected to repeat itself, every 260 years, far into the future.

This pattern is very hard to avoid if, for example, one wants to attain a fairly even harvest rate over time. The harvest will have a tendency to follow the same wave pattern as the growing stock.

4.3.2 Growing Stock for the Base Case

The growing stock on the timber harvest land base (THLB) for the Base Case Option is depicted in Figure 15 and Table 10.

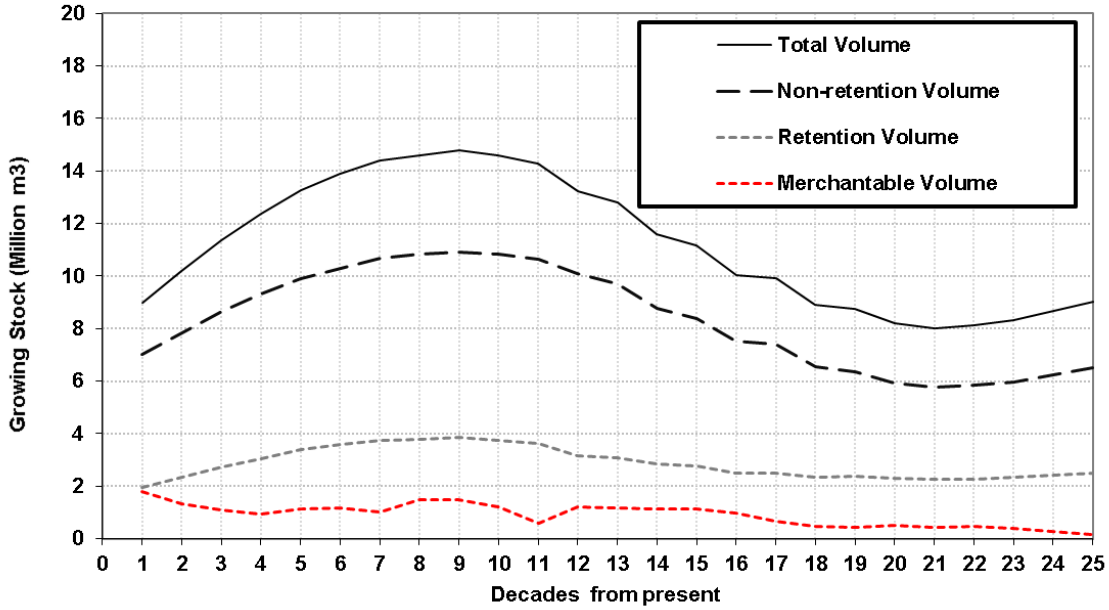


Figure 15 Base Case Merchantable and Total Growing Stock on the THLB

Table 10 Merchantable and Total Growing Stock on the THLB

Decade	Total (million m3)	Merch (million m3)		Decade	Total (million m3)	Merch (million m3)
Start	7.79	--		13	12.78	1.16
1	8.96	1.80		14	11.58	1.12
2	10.19	1.31		15	11.15	1.12
3	11.37	1.10		16	10.02	0.97
4	12.35	0.94		17	9.92	0.67
5	13.27	1.12		18	8.90	0.46
6	13.87	1.18		19	8.74	0.43
7	14.39	1.02		20	8.21	0.51
8	14.60	1.49		21	8.02	0.44
9	14.77	1.49		22	8.12	0.48
10	14.57	1.21		23	8.31	0.40
11	14.27	0.60		24	8.65	0.26
12	13.24	1.20		25	9.03	0.17

The merchantable growing stock is the lowest in decade 11, and again in decades 18 to 25, corresponding to pinch-points in the timber supply. Total growing stock is lowest in decade 21 which corresponds only somewhat with the minimum merchantable volume in the long term. Total growing stock and merchantable growing stock do not correspond in the short- and mid-term.

If, as in the Base Case Option, the model is asked to find highest, more-or-less even flow, then it tries to address any shortfalls in two ways:

- it will defer harvesting merchantable stands shortly before a shortfall, and then try to harvest those stands during the shortfall, or
- it will harvest stands well before a shortfall - if the regenerating stand can attain merchantable volume status during the shortfall.

In the former case, the model is forced to choose stands where breakup is going to occur after the shortfall, otherwise the volume cannot be deferred because breakup will occur and the volume is lost. In the latter case, the model will try to choose stands where breakup (or harvest) would occur prior to the shortfall, and where harvesting those stands earlier in time allows them to attain merchantable volume at the time of the shortfall. Essentially the two strategies are to

- defer harvesting and shift volume to a later date, or
- shift volume forward in time by performing an early harvest in the previous growth cycle.

4.3.3 Age Class Distribution

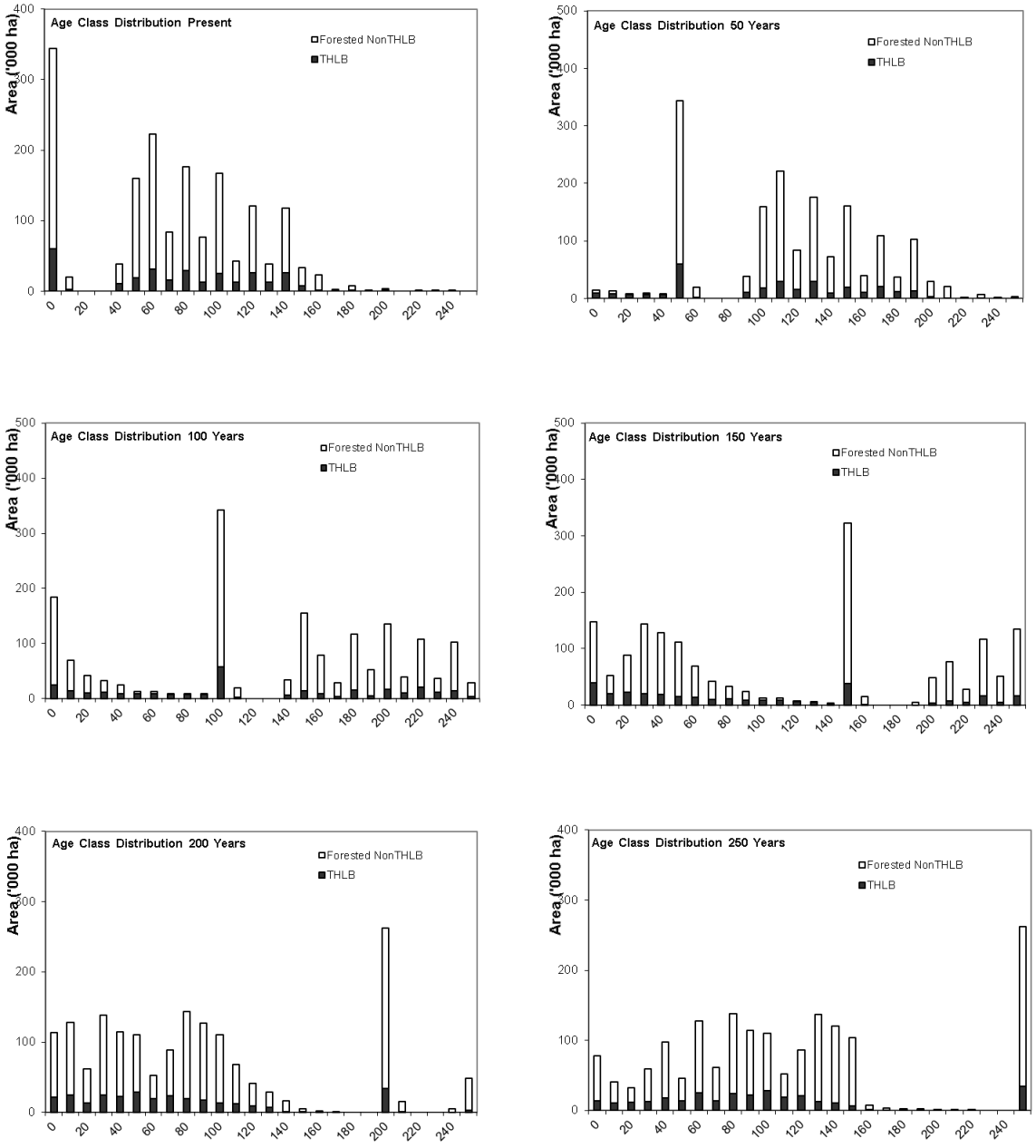


Figure 16 Age class composition of the Dawson FPA: six snapshots from the base case

Figure 16 provides a temporal forecast of the age-class distribution for the Dawson FPA in 50 year increments. Both the present day THLB and NHLB stands ages are concentrated in the zero years class (due to historic fires) and the age range from 50 to 140 years. Most of these stands are spruce-leading, which have a stand breakup age of 250 years, so most present stands, unless harvested, will undergo stand break-up 110 to 200 years in the future.

All the stands in the NHLB will continually cycle from young to old age, then through stand break-up and back to young age, forever. As almost all the stands are spruce-leading, and the breakup age is 250 years,

the age class distribution pattern one sees at time=0 will largely match the pattern at time=250, or time=500. Some perturbation of the pattern occurs due to the regeneration period (ranging from 10-12 years in the Base Case), as well as the different break-up ages for the non-spruce leading stands.

If all of the THLB was eligible for harvest, then the age class distribution of the THLB could be expected to become more and more evenly distributed, over time, due to harvesting a more-or-less constant number of hectares each year. In the far future the age class distribution of the THLB would become concentrated within the range of age classes that were less than the age required to reach the minimum merchantable volume (say 100 years old). However, this pattern is subdued because of two factors:

(a) the "retention" portion of the THLB (non-harvested portion of cut-blocks) undergoes the same dynamics as the NHLB, and

(b) many stands in the THLB never reach the required merchantable volume, and they too will never be harvested.

These two factors confound the distribution, as both will cycle through young to old age and then through stand-breakup, in the same manner as the NHLB stands.

Base Case Harvest – Harvest Area

Figure 17 shows the average harvested area each decade. Average harvest area slowly increases over the planning horizon, and reaches a maximum in decades 19 to 25, which reflects the time where the growing stock is lowest (refer back to Figure 15).

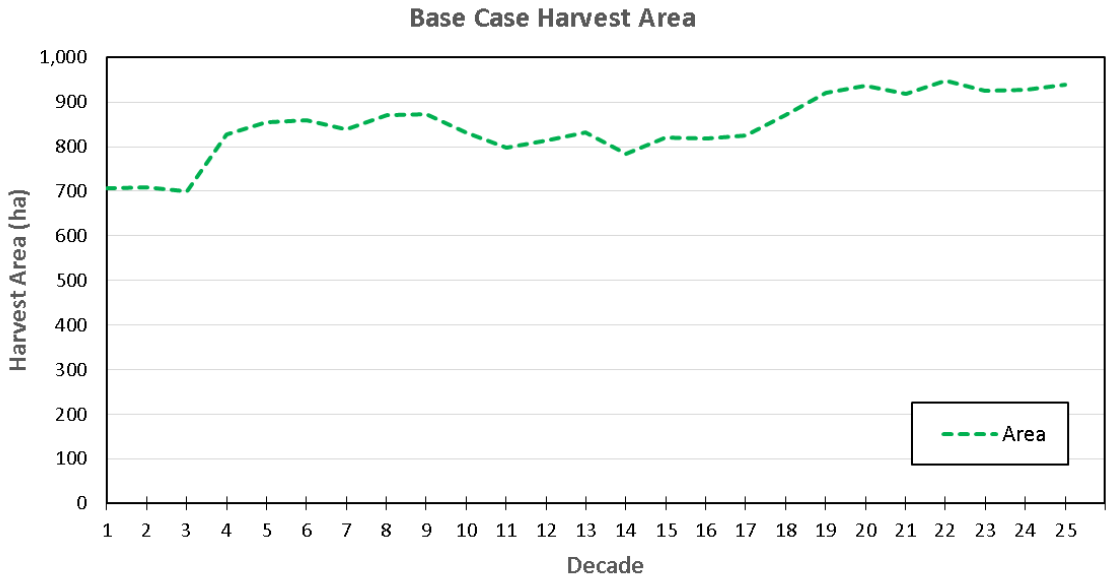


Figure 17 Base Case Harvest Area

Base Case Harvest - Volume per Hectare

Figure 18 shows the maximum, minimum and (area weighted) average stand volume per hectare for each decade. Note that the maximum values are for any amount of harvest, however small, and therefore can be expected to fluctuate widely, which they do.

The minimum harvest volume per hectare is always close to 75 m3/ha which is the minimum volume to be eligible for harvest. After decade 3 the average volume harvested is much closer to the minimum than the maximum (especially in decades 19 to 25), which indicates that almost all of the harvest is coming from stands that are at, or close to the minimum of 75 m^3/ha.

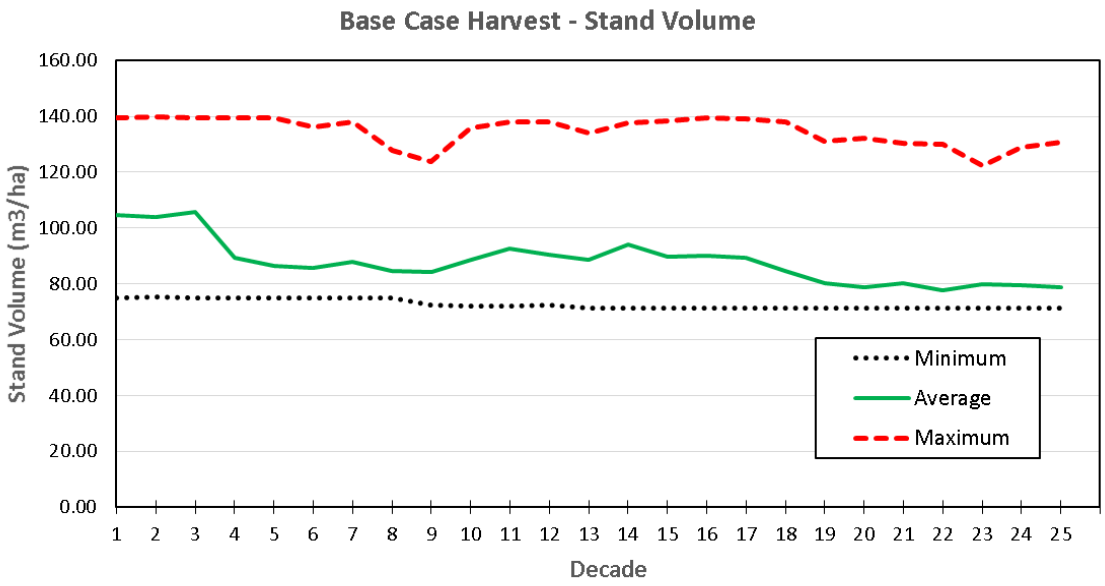


Figure 18 Base Case Harvest – Stand Volume

Base Case Harvest – Stand Age

Figure 19 shows the maximum, minimum and (area-weighted) average stand age that was harvested each decade.

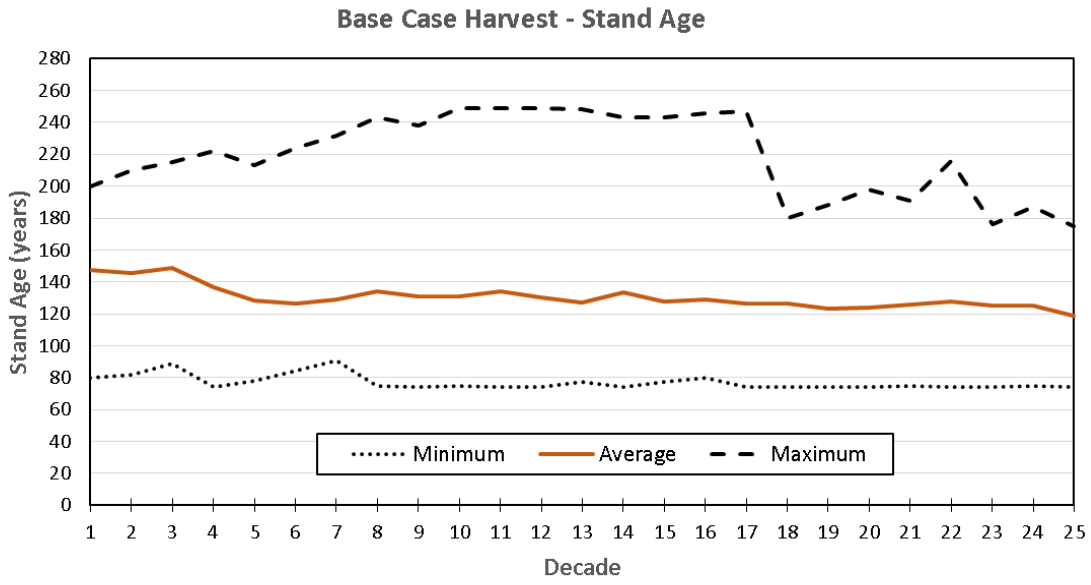


Figure 19 Base Case Harvest – Stand Age

Average harvested stand age, although it is relatively stable over the whole of the planning horizon, although it decreases slightly.

Table 11 Base Case Harvest Statistics – Area, Stand Age and Stand Volume

Period	Harvest Area (ha)	Harvest Volume (m3/ha)			Harvest Age		
		Minimum	Average	Maximum	Minimum	Average	Maximum
1	705.88	75.03	104.66	139.44	80	147.63	200
2	709.43	75.19	104.12	139.86	82	145.77	210
3	698.77	75.09	105.68	139.41	89	148.77	215
4	826.86	75.09	89.25	139.35	74	136.8	222
5	854.38	75.03	86.3	139.41	78	128.62	213
6	859.61	75.03	85.81	136.21	84	126.62	224
7	838.34	75.03	88	138.2	91	128.73	232
8	871.84	75.03	84.58	127.84	75	134.12	243
9	873.56	72.59	84.41	123.94	74	131.18	238
10	831.86	71.97	88.63	136	75	130.95	249
11	797.51	72	92.48	137.97	74	134.2	249
12	813.57	72.59	90.64	137.97	74	130.14	249
13	832.92	71.33	88.54	134.12	77	127	248
14	783.89	71.33	94.08	137.59	74	133.7	243
15	820.26	71.33	89.9	138.23	77	127.62	243
16	819.38	71.28	89.98	139.5	80	128.66	246
17	826.04	71.33	89.27	139.29	74	126.71	247
18	870.74	71.28	84.72	138.17	74	126.62	180
19	919.99	71.28	80.19	131.01	74	123.34	188
20	937.24	71.28	78.75	132.35	74	123.75	198
21	919.46	71.28	80.28	130.36	75	125.87	191
22	948.33	71.28	77.83	130.1	74	127.84	216
23	925.3	71.28	79.81	122.36	74	125.17	176
24	928.62	71.28	79.55	128.96	75	125.35	187
25	939.47	71.28	78.66	130.61	74	118.8	175

Base Case Harvest – Coniferous and Deciduous

Figure 20 and Table 12 show the proportion of deciduous and coniferous volume in the harvest. Deciduous harvest (poplar, birch and aspen) comprises 36.0 % of the harvest over the 25 decades, ranging from a low of 19.2 % in decade 14 to a high of 53.8 % in decade 22. Most of the deciduous volumes are a component of the coniferous-leading stands, as most of the deciduous-leading stands were netted out of the timber harvest landbase.

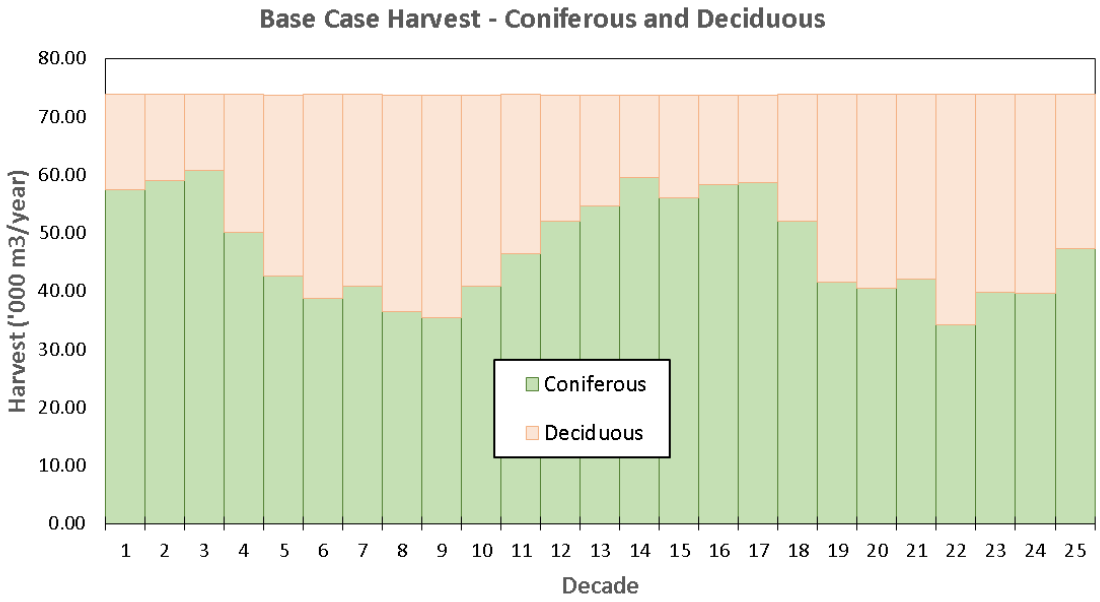


Figure 20 Base Case Harvest - Coniferous and Deciduous Volume

Table 12 Base Case Harvest - Deciduous and Coniferous Harvest Volume

Period	Total Harvest	Conifer-ous	Decid-uous	Period	Total Harvest	Conifer-ous	Decid-uous
1	73.88	57.42	16.45	**14**	73.75	59.57	14.18
2	73.87	59.04	14.83	**15**	73.74	56.01	17.74
3	73.84	60.74	13.11	**16**	73.73	58.36	15.37
4	73.8	50.02	23.78	**17**	73.74	58.61	15.13
5	73.73	42.56	31.17	**18**	73.77	52.01	21.75
6	73.76	38.7	35.06	**19**	73.77	41.51	32.26
7	73.78	40.78	33	**20**	73.8	40.43	33.38
8	73.74	36.45	37.29	**21**	73.81	42.13	31.69
9	73.74	35.39	38.35	**22**	73.81	34.11	39.7
10	73.73	40.87	32.85	**23**	73.85	39.82	34.03
11	73.75	46.37	27.39	**24**	73.87	39.64	34.23
12	73.75	52.09	21.66	**25**	73.9	47.3	26.6
13	73.75	54.54	19.2				

Note: Volumes are '000 m3/year.

The deciduous and coniferous harvest is divided into Public and First Nations Lands in Table 13.

Table 13 Base Case Deciduous and Coniferous Harvest Volume on Public and First Nations Lands

Period	First Nations			Public			Total		
	Total	Conif	Decid	Total	Conif	Decid	Total	Conif	Decid
1	5,496	3,729	1,766	68,382	53,695	14,688	73,878	57,424	16,454
2	5,496	3,782	1,714	68,372	55,255	13,117	73,868	59,037	14,831
3	5,473	3,681	1,792	68,370	57,056	11,314	73,843	60,737	13,106
4	5,435	2,659	2,775	68,363	47,364	20,999	73,798	50,023	23,774
5	5,404	2,199	3,205	68,328	40,365	27,965	73,732	42,564	31,170
6	5,398	1,895	3,503	68,362	36,809	31,555	73,760	38,704	35,058
7	5,431	2,215	3,217	68,345	38,563	29,783	73,776	40,778	33,000
8	5,386	2,302	3,085	68,355	34,152	34,204	73,741	36,454	37,289
9	5,383	2,326	3,057	68,357	33,065	35,293	73,740	35,391	38,350
10	5,386	1,989	3,398	68,340	38,885	29,456	73,726	40,874	32,854
11	5,388	3,453	1,935	68,366	42,915	25,451	73,754	46,368	27,386
12	5,387	4,253	1,134	68,358	47,836	20,522	73,745	52,089	21,656
13	5,396	3,702	1,694	68,349	50,839	17,510	73,745	54,541	19,204
14	5,373	3,934	1,438	68,372	55,632	12,742	73,745	59,566	14,180
15	5,372	3,763	1,609	68,369	52,244	16,126	73,741	56,007	17,735
16	5,361	3,508	1,853	68,367	54,849	13,519	73,728	58,357	15,372
17	5,372	3,229	2,143	68,370	55,380	12,991	73,742	58,609	15,134
18	5,380	2,267	3,114	68,386	49,746	18,641	73,766	52,013	21,755
19	5,387	2,294	3,093	68,383	39,218	29,167	73,770	41,512	32,260
20	5,376	2,266	3,111	68,428	38,161	30,268	73,804	40,427	33,379
21	5,384	2,338	3,046	68,428	39,791	28,638	73,812	42,129	31,684
22	5,369	2,197	3,172	68,439	31,915	36,526	73,808	34,112	39,698
23	5,382	2,289	3,093	68,469	37,529	30,941	73,851	39,818	34,034
24	5,388	2,724	2,664	68,485	36,918	31,568	73,873	39,642	34,232
25	5,389	3,337	2,052	68,511	43,960	24,552	73,900	47,297	26,604

Note: Volumes are m3/year.

4.4 Modeling of Non-timber Objectives

Many timber supply analyses include high level constraints for non-timber values. These constraints are meant to address issues related to wildlife habitat and biodiversity by limiting the amount of harvest area.

This analysis is unique in that all the non-timber values are represented in the model as landbase "netdowns", and are "no harvest" areas.

Table 14 summarizes the management zones and strategies that were included in the Dawson FPA model.

Table 14 Non-timber Resource Values

Non-Timber Resource Value	Criteria to Delineate Zone / Group	Rationale / Comments
Hinterland Forest Management Zone	Forest Resource Management Zone	Designated as "no harvest" zones.
Riparian Areas	Reserves (buffers) around classified streams, lakes and wetlands	Equivalent-width reserve zones are based on the Riparian Management on Streams and Lakes and the Wetlands Riparian Management Regulations, which specify management zone and reserve zone buffers are to be established around riparian features.
Site disturbance and access management	Productive forest within each cut-block	The Soil Conservation, Standards and Guidelines Regulation specifies that a maximum area of 5% of a harvest block may be occupied by skid trails.
Wildlife, General	Productive forest within each cut-block	A default of 20% of the forested area in each block to be retained on-site.

Table 15 Non-timber Resource Areas – Areas Reserved from Harvest

Non-Timber Resource Value	Total Area (ha)	Effective Reduction Area (ha)	Forest Resource Requirements
Hinterland Forest Management Zone	1,754,174	793,568	No harvest zone.
Riparian Areas	447,716	53,275	No harvest within riparian buffers around classified streams, lakes and wetlands.
Site disturbance and access management	14,826	14,826	Apply a 5% reduction of the future, productive forest area to account for future roads, trails and landings.
Wildlife, General	370,654	74,131	20% of the forest, in each cut-block, is to be retained on-site.

5.0 Base Case Sensitivity Analyses

The data and assumptions used in any timber supply analysis are often subject to uncertainty. To provide perspective on the sensitivity of changes to modeled assumptions, sensitivity analyses are commonly performed. Typically only one variable (data or assumption) from the information used in the Base Case is changed in order to explore the sensitivity of that variable. Sensitivity analyses help to frame the potential impacts of uncertainty by analyzing scenarios that are more pessimistic and more optimistic than the Base Case.

An unlimited number of sensitivity runs are possible. The runs chosen for the Dawson TSA are summarized in Table 16.

Table 16 Dawson FPA Timber Supply Analysis Sensitivity Runs

Base Case Run Number	Model Code	Parameter Adjusted	Definition / Comments
201	**BK1**	Wildfire (+)	Increased wildfire: The age of break-up is decreased (**- 30** years)
202	**BK2**	Wildfire (-)	Decreased wildfire: The age of break-up is increased (**+ 30** years)
203	**M06**	Minimum stand Volume threshold	Change minimum stand merchantability from **75** m3/ha to **60** m3/ha.
204	**M10**	Minimum stand Volume threshold	Change minimum stand merchantability from **75** m3/ha to **100** m3/ha.
205	**RG1**	Regeneration Period (+)	Regeneration period is increased by 15 years (**+15** years).
206	**RT1**	Within-block retention (+)	Increased within-block retention (**+ 10**%) (new value: **30** %)
207	**YT1**	Stand yields (+)	Stand yields increased (**+ 10** %)
208	**YT2**	Stand yields (-)	Stand yields decreased (**- 10** %)
209	**AC1**	Timber harvest Landbase	Harvest only in stands that are within **7.5** km of designated, existing access roads.
210	**AC2**	Timber harvest Landbase	Harvest only in stands that are within **12.5** km of designated, existing access roads.

There are three sections in the **Base Case Sensitivity Analysis** section:

- **Individual Sensitivity Runs**. Each sensitivity run is individually summarized as a description, a harvest flow chart, and a volume/percentage change compared to the Base Case harvest flow; and
- **Summary of Sensitivity Runs' Harvest Flows**. Following the individual sensitivity run results, a summary table of all the sensitivity runs and the difference in harvest flow compared to the Base Case.
- **Summary of Sensitivity Run Availability**. A summary table of the availability, or eligibility, of stands for harvest in each sensitivity. The availability statistics correlate well with the harvest flow results.

5.1 Individual Sensitivity Runs

5.1.1 Increased and Decreased Wildfire

Wildfire is the major, natural disturbance agent in the Yukon forest. Climate change is expected to change both wildfire frequency and severity. The stand break-up age is used in the model (as an abstraction) to simulate both stand succession and fire kill. I.e., there is no calculation that is based on fire indices (fire return intervals, fire severity, etc.) to determine the breakup ages used in the model.

Two scenarios were completed to examine the uncertainty in frequency and severity of wildfires.

Methodology

Run	How was it analyzed?
Increased wildfire.	Stand break-up ages were decreased by 30 years
Decreased wildfire.	Stand break-up ages were increased by 30 years

Results

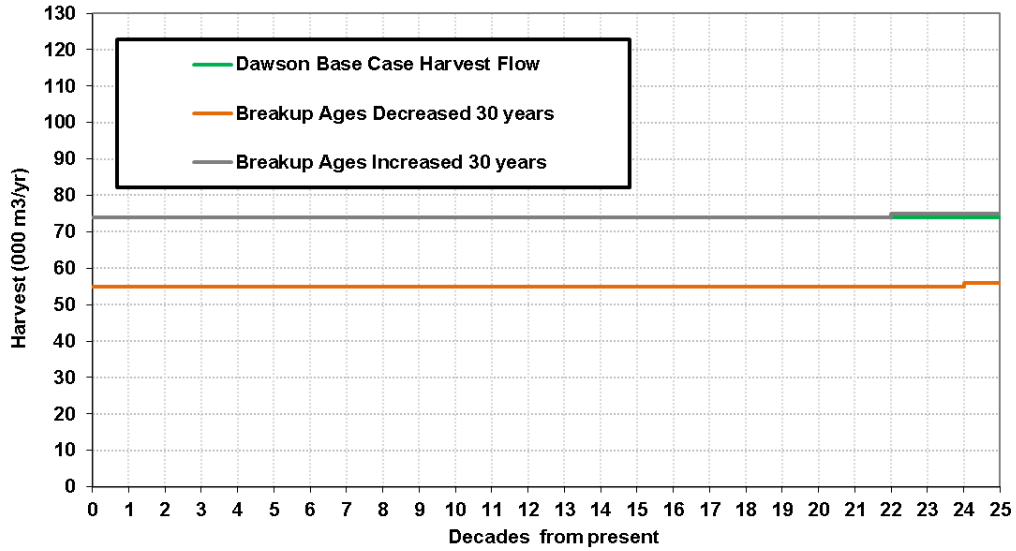


Figure 21 Harvest flows when breakup ages are increased and decreased

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Increased wildfire.	The Base Case Option harvest level of 74,000 m3/yr. is reduced to 55,000 (a change of -25.7 percent).	Decreased by 25.7 %.	Decreased by 25.7 %
Decreased wildfire.	The Base Case Option harvest level of 74,000 m3/yr. remains as is.	No change.	Increased by +0.4 %.

Increasing the amount of fire (by decreasing the breakup ages) results in a significant reduction in the harvest flow. Increased wildfire reduces the ability of the model to bridge any periods where the merchantable volume is in short supply. In this case, the earlier age of break-up exacerbates the volume

shortfall in decade 11 (Sec 4.3.2). When wildfire was reduced, there was no significant change in the harvest flow.

5.1.2 Decreased and Increased Minimum Harvest Threshold

In the Base Case Option, the minimum threshold volume for a stand to be considered merchantable and available for harvest is 75 m3/ha. These scenarios examine the impact of lowering the threshold to 60 m3/ha, and increasing it to 100 m3/ha.

Methodology

Run	How was it analyzed?
Minimum merchantable volume of 60 m3/ha.	The minimum volume threshold was reduced to 60 m3/ha. In turn, the age windows changed for when the stands were available for harvest.
Minimum merchantable volume of 100 m3/ha.	The minimum volume threshold was increased to 100 m3/ha. In turn, the age windows changed for when the stands were available for harvest.

Results

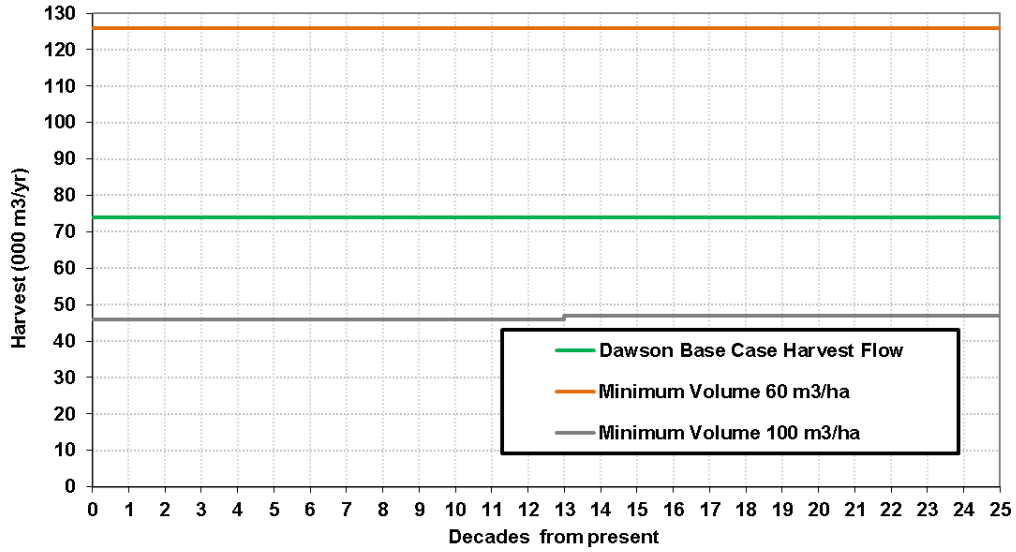


Figure 22 Harvest flows when minimum harvest volume is increased and decreased

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Minimum merchantable volume of 60 m3/ha.	The Base Case Option harvest level of 74,000 m3/yr. is increased to 126,000 (an increase of 70.3 %).	Increased by 70.3 %.	Increased by 70.3 %
Minimum merchantable volume of 100 m3/ha.	The Base Case Option harvest level of 74,000 m3/yr. is decreased to 46,000 (a decrease of -37.8 %).	Decreased by -37.8 %.	Decreased by -36.5 %

The positive impacts on the harvest flow are surprisingly large for several reasons:

(a) moving a stand from below the minimum threshold to above the threshold results in the harvest of both the volume difference (e.g. 60 to 75 m3/ha) as well as the volume below 60 m3/ha; and

(b) many stands exist that are have a maximum volume between 60 to 75 m3/ha. Approximately 142,000 ha of stands are moved from below the minimum merchantable volume, to above the merchantable volume (Table 19

The opposite effects occur when a higher minimum volume threshold is chosen.

5.1.3 Increased Regeneration Delay

In the Base Case Option, the regeneration delay after a stand is logged, or after a stand undergoes breakup ranges from 8 to 12 years, depending upon the site index. This scenario examines the impact of increasing the regeneration delay by 15 years.

Methodology

Run	How was it analyzed?
Regeneration Delay increased.	The regeneration delay value in the Base Case was increased by 15 years. Therefore, stands will take 15 more years to reach the minimum volume threshold to be eligible for harvesting.

Results

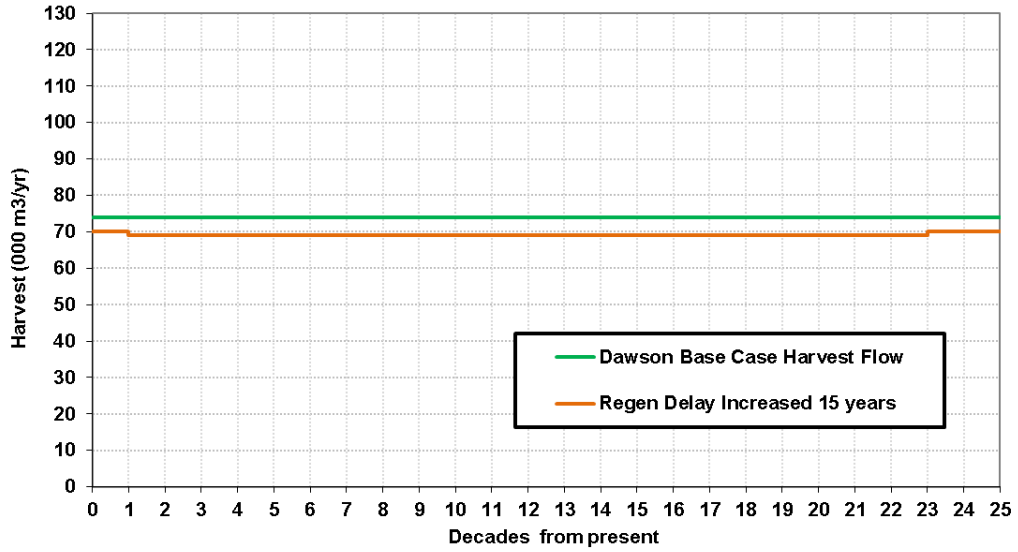


Figure 23 Harvest flows when regeneration delay is increased 15 years

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Regeneration delay increased by 15 years.	The Base Case Option harvest level of 74,000 m3/yr. is decreased to 69,000 m3/yr. (a decrease of -6.5%).	Decreased by 6.5 %.	Decreased by 6.8 %

Increasing the regeneration period by 15 years results in a decrease in the harvest flow of approximately 6.5 %.

5.1.4 Stand Retention Increased to 30 Percent

The predominant silviculture method in the Dawson Forest Planning Area is selection with variable retention. The amount of retention was estimated as 20% in the Base Case scenario. The percentage is an estimate from field staff, and has not been confirmed through on-the-ground measurements. Opinions vary on whether the actual percentage is higher or lower.

To examine this uncertainty, two sensitivities were completed, one with higher retention, one with lower.

Methodology

Run	How was it analyzed?
Stand retention increased by 10 %	Retention is applied to stands in the THLB, as a portion of the stand area that is not harvested when the rest of the block is. Retention was set to 30%, i.e. for each 10 hectares of gross block area, 3 hectares is not-logged.

Results

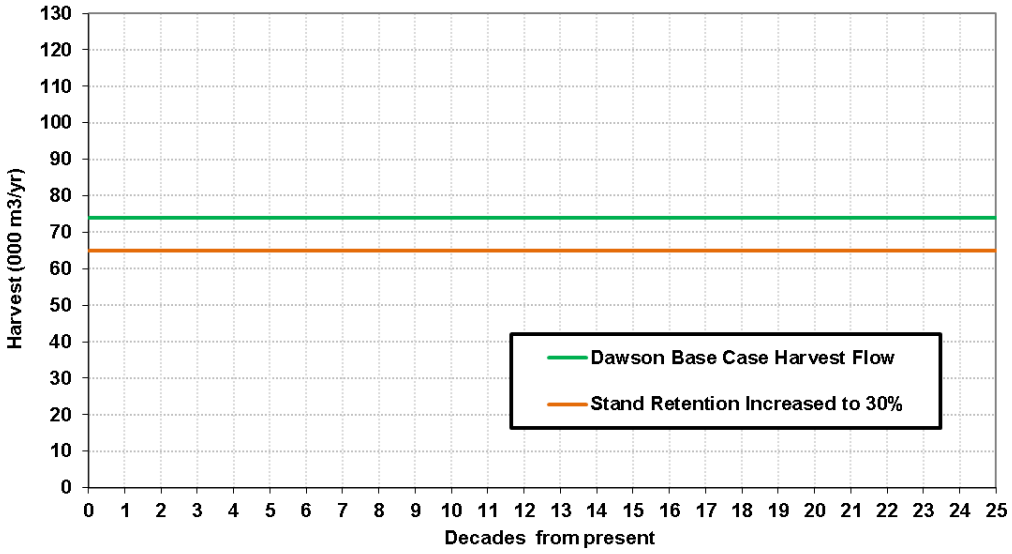


Figure 24 Harvest flows when within-stand retention is increased to 30 %

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Stand retention increased by 10 % to 30%.	The Base Case Option harvest level of 74,000 m3/yr. is decreased to 65,000 m3/year (a decrease of -12.2%).	Decreased by -12.2 %.	Decreased by -12.2 %

The impact on the harvest flow is proportionate to the change in retention, i.e. moving from 80% harvest (20% retention) to 70% harvest (30% retention) is a drop of 12.5 %.

5.1.5 Yield Tables Increased and Decreased

Empirically derived (based on field work) yield tables are not available to directly connect the forest inventory to yield estimates. This analysis used BC's VDYP7 yield projection software, along with a number of assumptions to estimate the stand yields for the forest inventory.

Considerable uncertainty exists as to how accurate the estimated yields are to actual volumes in the field. Two sensitivities were completed to examine the impact of over- and under-estimation of the stand volumes.

Methodology

Run	How was it analyzed?
Yield tables increased by 10%	The yield tables from the Base Case were increased by 10 %.
Yield tables decreased by 10%	The yield tables from the Base Case were decreased by 10 %.

Results

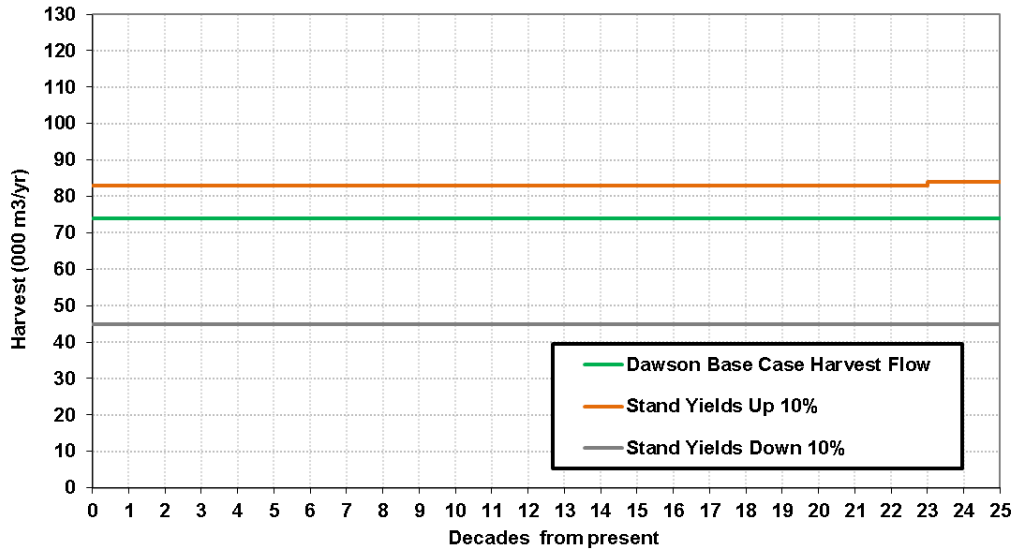


Figure 25 Harvest flows when stand yields are increased and decreased by 10%

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Yield tables increased by 10%	The Base Case Option harvest level of 74,000m3/yr. is increased to 83,000 m3/year (an increase of 12.2%).	Increased by 12.2 %.	Increased by 12.2 %
Yield tables decreased by 10%	The Base Case Option harvest level of 74,000 m3/yr. is decreased to 43,000 m3/year (a decrease of -39.2 %.	Decreased by 39.2 %.	Decreased by 39.2 %

The impact on the harvest flow (12.2%) is roughly proportionate to the increase of the yield tables (10%),

However, it is disproportionate when the yields are decreased. The impact of decreased yields is related to a combination of factors:

- the yield table decrease itself; and
- the movement of some stands from "above minimum merchantability volume" (75 m^3/ha) to "below minimum merchantable volume".

For example, the effective THLB is decreased by approximately 44,000 hectares when yield tables are decreased (Table 19).

5.1.6 Harvesting Restricted to Near Access Roads

The Dawson FPA has limited road access. Many of the forest stands that are assumed to be in the THLB, and which the model harvests in the Base Case scenario, are distant from existing roads.

If significant new roads are not built then the harvest will be limited. These two scenarios examine the impact of assuming limited, new road development.

Methodology

Run	How was it analyzed?
Harvest is restricted to within 7.5 km of existing access.	The model was only allowed to harvest within 7.5 km from designated, existing access roads.
Harvest is restricted to within 12.5 km of existing access.	The model was only allowed to harvest within 12.5 km from designated, existing access roads.

Results

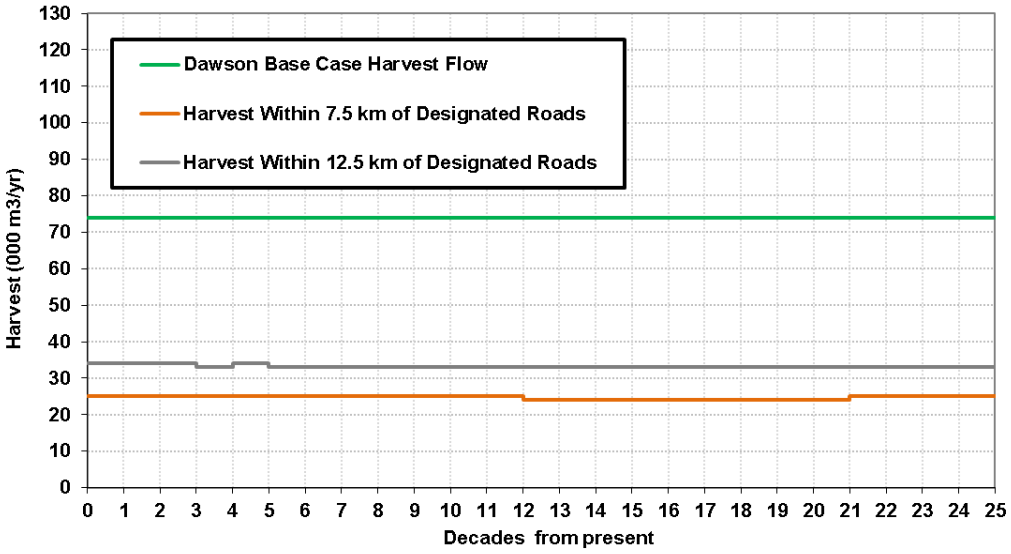


Figure 26 Harvest flows when timber harvesting is restricted to near existing access roads

Run	Short Term (decades 1 to 3).	Mid Term (decades 4 to 15)	Long Term (decades 16+)
Harvest within 7.5 km. of existing roads.	The Base Case Option initial harvest level of 74,000 m3/yr. is decreased to 25,000 m3/year(a decrease of -66.2 %).	Decreased by 67 %.	Decreased by 67 %
Harvest within 12.5 km. of existing roads.	The Base Case Option initial harvest level of 74,000 m3/yr. is decreased to 34,000 m3/year(a decrease of -54.3 %).	Decreased by 55.4 %.	Decreased by 55.4 %

Restricting harvest to within 7.5 km, or within 12.5 km from designated, existing access roads significantly reduces the area available for harvest. The area reductions (-72,000 ha reduction, or 65% reduction, in area for the 7.5 km scenario, and -60,000 ha, or 54% reduction in THLB area for the 12.5 km scenario) are proportionate to the impact on the harvest flows (67% and 55%, respectively).

5.2 Summary of the Harvest Flows for the Sensitivity Runs

The relative increase or decrease in the harvest flows, for each of the sensitivities is summarized below.

Table 17 Sensitivity Runs Harvest Flows vs Base Case Harvest Flow

Run / Sensitivity	Starting Harvest	Periods 1-3	Periods 4-15	Periods 16-25
Dawson FPA Base Case Harvest Flow	0.0	0.0	0.0	0.0
Maximum Harvest in First Decade	33.8	13.2	-2.7	-2.6
Even Flow Only on Total Harvest	1.4	1.4	1.4	1.4
Breakup Ages Decreased 30 years	-25.7	-25.7	-25.7	-25.5
Breakup Ages Increased 30 years	0.0	0.0	0.0	0.4
Minimum Volume Threshold of 60m3/ha	70.3	70.3	70.3	70.3
Minimum Volume Threshold of 100m3/ha	-37.8	-37.8	-37.3	-36.5
Regen Delay Increased by 15 years	-5.4	-6.5	-6.8	-6.5
Stand Retention Increased to 30%	-12.2	-12.2	-12.2	-12.2
Yield Tables Increased 10%	12.2	12.2	12.2	12.4
Yield Tables Decreased 10%	-39.2	-39.2	-39.2	-39.2
Harvest Within 7.5 km of Designated Roads	-66.2	-66.2	-67.0	-67.0
Harvest Within 12.5 km of Designated Roads	-54.1	-54.3	-55.4	-55.4

Table 18 Sensitivity Runs Average Harvest Volume

	Average Volume Harvested (m3/year) During Periods			
Run / Sensitivity	**Period 1**	**Periods 1-3**	**Periods 4-15**	**Periods 16-25**
Dawson FPA Base Case Harvest Flow	**74,000**	**74,000**	**74,000**	**74,000**
Maximum Harvest in First Decade	99,000	83,800	72,000	72,100
Even Flow Only on Total Harvest	75,000	75,000	75,000	75,000
Breakup Ages Decreased 30 years	55,000	55,000	55,000	55,100
Breakup Ages Increased 30 years	74,000	74,000	74,000	74,300
Minimum Volume Threshold of 60m3/ha	126,000	126,000	126,000	126,000
Minimum Volume Threshold of 100m3/ha	46,000	46,000	46,400	47,000
Regen Delay Increased by 15 years	70,000	69,200	69,000	69,200
Stand Retention Increased to 30%	65,000	65,000	65,000	65,000
Yield Tables Increased 10%	83,000	83,000	83,000	83,200
Yield Tables Decreased 10%	45,000	45,000	45,000	45,000
Harvest Within 7.5 km of Designated Roads	25,000	25,000	24,400	24,400
Harvest Within 12.5 km of Designated Roads	34,000	33,800	33,000	33,000

Note: Values are the average of values which were previously rounded to the nearest 1000 m3/yr.

5.3 Summary of the Availability for the Sensitivity Runs

Stands may be located in the THLB, but may never become "available" for harvest unless they attain the minimum volume threshold of 75 m3/ha (in the Base Case and in most sensitivity runs, or a minimum of 60 m3/ha, or 100 m3/ha, in the two minimum volume-type sensitivity runs). In the Base Case, 184,696 ha of stands are never eligible for harvest (Table 19). The increase or decrease in the area of "available" stands is one factor, and is sometimes the major factor that impacts the harvest flow in the sensitivity runs.

For example, decreasing the stand yields by 10% results in a disproportionate decrease of -39 percent in the harvest flow. Most of that change is due to the decrease in available stands (-44,000 ha, or -39% of the THLB area).

As a general statement, the effect of "availability" complicates the sensitivity run results, as it may completely mask what the impact is expected to be in a particular sensitivity run.

Table 19 Area of stands that attain the minimum volume threshold.

Run	Run	Description	THLB Stands That Reach Minimum Volume (ha)	THLB Stands That Never Reach Minimum Volume (ha)	THLB Total (ha)	Change (ha)	Change (%)
101	BC1	Dawson FPA Base Case	111,827	184,695	296,522	0	0.00
201	BK1	Breakup Ages Decreased 30 years	76,494	220,028	296,522	-35,333	-31.60
202	BK2	Breakup Ages Increased 30 years	111,827	184,695	296,522	0	0.00
203	M06	Minimum Volume Threshold of 60m3/ha	254,331	42,191	296,522	142,504	127.43
204	M10	Minimum Volume Threshold of 100m3/ha	67,810	228,712	296,522	-44,017	-39.36
205	RG1	Regen Delay Increased by 15 years	111,827	184,695	296,522	0	0.00
206	RT1	Stand Retention Increased to 30%	97,849	161,608	259,457	-13,978	-12.50
207	YT1	Yield Tables Increased 10%	111,827	184,695	296,522	0	0.00
208	YT2	Yield Tables Decreased 10%	67,810	228,712	296,522	-44,017	-39.36
209	AC1	Harvest Within 7.5 km of Designated Roads	39,325	257,197	296,522	-72,502	-64.83
210	AC2	Harvest Within 12.5 km of Designated Roads	51,895	244,627	296,522	-59,932	-53.59

Note: The areas are the effective THLB area after the 20% reduction for within-block retention
(or after the 30% within-block retention in Run 206 / RT1)

6.0 Conclusions

This analysis report presents a non-declining, non-rising even harvest flow, over time, for current practice (or Base Case) scenario. The harvest level is 68,000 m3/year for public lands, and 5,000 m3/year for First Nations Settlement lands, for a combined total of 74,000 m3/year (values have been rounded to the nearest 1000 m3/year).

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecast, a series of sensitivity analyses were completed. All the sensitivities were modelled with the same even flow as used in the Base Case.

The harvest levels are sensitive to several of the factors that were examined in the sensitivity runs.

Uncertainties that altered the harvest flow by at least 10% were:

- decreasing stand breakup ages by 30 years, which simulates increased wildfires (-26 %);
- setting the harvest threshold at a minimum of 60 m3/ha (+70 %);
- setting the harvest threshold at a minimum of 100 m3/ha (-38 %);
- increasing the within-block stand retention at the time of harvest to 30% (12 %);
- yield tables increased by ten percent (+12 %);
- yield tables decreased by ten percent (-39 %);
- limiting harvest to stands within 7.5 km of existing access (-66 %); and
- limiting harvest to stands within 12.5 km of existing access (-54 %).

Non-timber resource objectives were represented in the model using

- a combination of “no harvest zones” (aka “landbase netdowns) such as the Hinterland Forest Zones, and riparian reserves; and
- using an average 20% within-block retention of every stand, at the time of harvest.

The growth rates of forest stands are the primary influence on the harvest flows, as well as the definition of what constitutes a merchantable volume. For example, definitions that strongly influenced the harvest flow were minimum stand volume (e.g. 60 vs 75 vs 100 m3/ha).

7.0 Recommendations

Growth and Yield

We had no empirically derived methodology for translating the current forest inventory into volume estimates. Instead, we developed a methodology (a sequence of assumptions and steps) based on logic.

The result is that the inventory, combined with the growth and yield methodology, causes many of the yield tables to just attain, and many others to almost but don’t quite attain, the minimum stand volume of 75m3/ha.

In turn, the result is that the sensitivity analyses show that the harvest flow is very sensitive to factors that determine if the stand attains the minimum volume to be available for harvest, or the converse, to not attain the minimum volume required.

Growth and Yield - Recommendation

A field sampling program should be conducted to compare the estimates of stand volume from this project to field-measured values. The results would indicate whether (from best to worst case) if our volume estimates:

- match the field-measured estimates. No further work is required.

- are off by a consistent factor (e.g. our estimates are consistently 5 % low). Future analyses could apply our methodology, with the addition of a 5% bump-up; or
- show no correlation with field estimates. In this case a new methodology should be developed. For example, develop Yukon-specific VDYP7 s/w parameters – since the current software is calibrated for B.C. conditions.

Forest Inventory

The forest inventory for the Dawson Forest Planning Area is, essentially, a composite of several inventories. This shows up as long, straight discontinuities along mapsheet edges. This is visible in the Dawson landbase map (Figure 3) as a straight line border between forested and non-forested areas, and the Dawson Forest Resources Management Plan (e.g. the Forest Cover by Leading Species Map, page 35, where a straight line delineates the black spruce vs white spruce leading stands, as well as the forested vs non-forested areas).

For that reason, it is recommended that if the correlations between inventory and volume (above) are developed, that each "inventory" may need its own correlation.

Independent First Nation and Public Timber Supply Analyses

Two timber supply analyses were embedded within this one analysis: one for the public lands, and one for the First Nation lands. At some time in the future they should be separated from one another. That would allow a finer scale analysis of the much smaller First Nation lands, such as customizing the management objectives, and adopting more FN-lands specific volume correlations.

At this time, however, it is a much more efficient use of resources and expertise to keep the two together.

References

========== Yukon ==========

Dawson Forest Management Planning Team. 2013. Dawson Forest Resources Management Plan. March 2013.

Dawson Forest Resources Management Plan Implementation Memorandum of Understanding (2014). MOU between the Tr'ondëk Hwëch'in and the Government of Yukon. November 14, 2014.

Govt. of Yukon. 2015. Timber Supply Analysis for the Dawson and Haines Junction Annual Allowable Cut Regions. A Request for Proposals, prepared by Energy, Mines and Resources, Forest Management Branch. February 20, 2015.

The Tr'ondëk Hwëch'in Final Agreement (July 16, 1998), and Amendment to the 1998 Tr'ondëk Hwëch'in Final Agreement: 9.6.1 Land Exchange, and Amendment to the 1998 Tr'ondëk Hwëch'in Final Agreement: P.C. 2009-0612. April 23, 2009.

Legislation and Operational Guidelines

Govt. of Yukon. 2008. Forest Resources Act. Assented to December 09, 2008

Forest Management Branch. 2011a. Riparian Management on Streams and Lakes, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective October 11, 2011.

Forest Management Branch. 2011b. Wetlands Riparian Management, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective October 11, 2011.

Forest Management Branch. 2012. Soil Conservation, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective July 3, 2012.

Govt. of Yukon. 2014. Yukon Vegetation Inventory Manual. Version 3.1 July 31, 2014. Forest Management Branch, Energy, Mines and Resources, Yukon Government

Unknown. 2009. Watson Lake Region Timber Supply Overview. Final Draft. Unpublished report. June 19, 2009.

========== British Columbia ==========

Jahraus and Assoc. and Churlish Consulting. 2008. VDYP7 Sensitivity Analysis. Report prepared for: Ministry of Forests and Range. Prepared by: Jahraus & Associates Consulting Inc., Maple Ridge BC, & Churlish Consulting Ltd., Victoria BC. Final Draft. AUGUST 2008.

Ministry of Forests. 2003a. Supplemental Guide for Preparing Timber Supply Analysis Data Packages. Forest Analysis Branch, Ministry of Forests, June 2003

Ministry of Forests. 2003b. Modeling Options for Disturbance Outside the THLB - Working Paper. Forest Analysis Branch, Ministry of Forests, June 2003.

Ministry of Forests. 2007. Glossary of Statistical Reporting Terms. Timber Supply Branch. Web site address: http://www.for.gov.bc.ca/hts/inventory/reports/glossary/index.html

Ministry of Forests. 2009. Variable Density Yield Projection Volume 3 - VDYP7Console Interface Guide. Version 3. Ministry of Forests, Forest Analysis and Inventory Branch, Victoria, B.C. September 2009.

Ministry of Forests. 2016. TIPSY v4.3 - April 5, 2016. https://www.for.gov.bc.ca/hts/growth/download/download.html

APPENDIX A. SECTION 24 FACTORS CONSIDERED IN THE TSA

The Forest Resources Regulation specifies:

> **DETERMINATION OF ANNUAL ALLOWABLE CUT AND ANNUAL LIMITS**
>
> **Annual allowable cut – factors to be considered**
>
> *24. The Director must consider the following factors in respect of an area, prior to making a determination of the annual allowable cut for that area under subsection 16(1) of the Act ... <list of factors>*

Many of these factors are integrated into the timber supply analysis. The factors, along with where they appear in the Data Package Report and/or Analysis Report are itemized in the table, below.

Section 24 Requirement	Data Package (DP) or Analysis Report (AR) Sections Pertinent to the Sec 24 Requirements
24 (a) if there is an applicable approved plan, the management objectives related to forest resources identified in that plan	(DP) 1.1 Background (Dawson Forest Resource Management Plan). (DP) 4.4 Parks and Protected Areas (Hinterland Forest Zone) (AR) 3.2 Management Practices (Integrated Resource Management; Biodiversity; Wildlife Habitat; Recreation; Riparian Habitat)
24 (b) land use objectives identified in any applicable land use plans referred to in subsection 13(1) of the Act	(DP) 4.4 Parks and Protected Areas (Hinterland Forest Zone) (DP) 10.0 Non-Timber Forest Resource Management (Hinterland Forest Zone); (AR) 3.2 Management Practices (Integrated Resource Management; Biodiversity; Wildlife Habitat; Recreation; Riparian Habitat)
24 (c) an analysis of the supply of timber resources based upon consideration of the type, productivity and accessibility of timber resources	(DP) 3.1 Forest Inventory (DP) 5.0 Description of the Land Base (age class, species distribution, site index, seral stage distribution) (DP) 6.0 Inventory Aggregation (stand breakup, species group, site class) (DP) 7.0 Growth and Yield (site index, site curves, utilization level, decay, waste and breakage; volume reductions; Yield Table Development – Pre-First Harvest Stands and Post-Harvested Stands; Silviculture Management Regime; Regeneration Delay (DP) 11.1 Minimum harvesting age / merchantability standards. (AR) 3.1 Land Base Definition
24 (d) the amount of timber harvesting that may be conducted under another enactment	--

. . . cont.

Section 24 Requirement	Data Package (DP) or Analysis Report (AR) Sections Pertinent to the Sec 24 Requirements
24 (e) the composition and expected rate of growth of forest resources before and following timber harvesting	(DP) 6.0 Inventory Aggregation; (DP) 7.0 Growth and Yield; (DP) Appendix A. Development of the Yield Tables (Live Volume; Dead Volume; Regen Delays; etc.); (AR) 3.3 Forest Dynamics (Growth and Yield Strata; Stand Breakup / Succession; Natural Disturbances;)
24 (f) any silviculture treatments to be applied following timber harvesting	(DP) 6.0 Inventory Aggregation (silviculture system); (DP) 7.0 Growth and Yield (Yield Table Development – Pre-First Harvest Stands and Post-Harvested Stands; Silviculture Management Regime; (DP) 11.6 Silviculture Systems (AR) 3.2 Management Practices (Harvesting; Silviculture Systems
24 (g) the anticipated regenerative capacity of forest resources	(DP) 7.0 Growth and Yield; (DP) 7.7.2. Regeneration Delay; (DP) 11.6 Silviculture Systems; (AR) 3.3 Forest Dynamics (Growth and Yield Strata);
24 (h) any geographic features that may limit or prevent safe and sustainable timber harvesting	(DP) 4.5 Inoperable (steep slopes)
24 (i) the rate of utilization of timber resources to be harvested, including any allowance for damage and waste during harvesting	(DP) 7.0 Growth and Yield (Utilization Level; Decay, Waste and Breakage; Volume Reductions) AR 3.2 Management Practices (Harvesting)
24 (j) forest resources health	(DP) 9.0 Unsalvaged Losses (Stand Breakup);
24 (k) other uses of the land for which the annual allowable cut is to be determined which may reduce the amount of timber resources available for harvesting	(DP) Sec 4. Exclusions from the Timber Harvesting Land Base; (DP) 4.2. land dispositions, agricultural dispositions, private land parcels, municipal boundaries; (DP) 4.6 Highway Management Zone (for visuals and firewood cutting) (DP) 4.8 Riparian Reserves and Management Zones (around streams, lakes and wetlands) (DP) 4.4. Parks and Protected Areas (DP) 4.9 Future Land Base Reductions (within-block retention; roads, trails and landings)
24 (l) any other factors related to the capability of the area to produce forest resources that may affect the rate or level of timber	(DP) 4.1. Non-productive Areas (DP) 4.7 Non-Merchantable Stands (DP) 4.3. Roads Trails and Landings (AR) 3.1 Land Base Definition

. . . cont.

Section 24 Requirement	**Data Package (DP) or Analysis Report (AR) Sections Pertinent to the Sec 24 Requirements**
24 (m) the environmental and socio-economic conditions	--
24 (n) the effect of alternative rates of timber harvesting on the long term timber supply for Yukon	(DP) 11.7 Harvest Flow Objectives (DP) 12.3 Alternate Harvest Flows (DP) 12.4 Sensitivity Analyses (AR) 4.1 Alternative Base Case Harvest Flows (AR) 5.0 Base Case Sensitivity Analyses (Wildfire; Merchantability; Regeneration Delay; Within-block Retention; Stand Yields)
24 (o) the effect of varying timber harvest rates on the socio-economic conditions of Yukon residents within and adjacent to the area	To be obtained through the FN/public information and FN/public input sessions. (AR) 5.0 Base Case Sensitivity Analyses (Wildfire; Merchantability; Regeneration Delay; Within-block Retention; Stand Yields)
24 (p) the short and long term environmental implications on ecosystems of alternative rates of timber harvesting	(AR) 4.3 Base Case Attributes (Growing Stock Prior to Harvesting; Growing Stock for the Base Case; Age Class Distribution; Stand Origin; Harvest Area; (AR) 4.4 Constraints Analysis (Modeling of Non-timber Objectives : Hinterland Zone) (AR) 5.0 Base Case Sensitivity Analyses (Wildfire; Merchantability; Regeneration Delay; Within-block Retention; Stand Yields)
24 (q) the short and long term socio-economic implications for Yukon residents and first nations residing in the area of alternative rates of timber harvesting	To be obtained through the FN/public information and FN/public input sessions. (AR) 5.0 Base Case Sensitivity Analyses (Wildfire; Merchantability; Regeneration Delay; Within-block Retention; Stand Yields)
24 (r) potential changes to forest resources health due to fire, insects or disease and actions taken in response to such factors	(AR) 5.0 Base Case Sensitivity Analyses (Wildfire; merchantability);