North Coast LRMP

Description of Data Inputs and Assumptions for the Timber Supply Analysis (base case) for the North Coast TSA

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Executive Summary

As part of the North Coast Land and Resource Management Plan (LRMP), the British Columbia Forest Service has examined the availability of timber in the North Coast Timber Supply Area (TSA) through a timber supply analysis. The analysis assesses how current forest management practices in the TSA affect the supply of wood available in the future, if those practices continue. Because timber supply analysis is conducted on a timber management unit, this analysis includes an area that is outside the North Coast LRMP area, specifically, Princess Royal Island. The results of this analysis will be reported for both the North Coast TSA and LRMP areas.

The North Coast TSA is situated along the coast of northwestern British Columbia. It covers approximately 1.875 million hectares, which is about half the size of Vancouver Island. It is dominated by stands of old-growth western hemlock, amabalis fir and western red cedar. About 45% of the North Coast TSA is considered productive forest area managed by the Ministry of Forests. Currently, 137,323 hectares are available for timber harvesting. This represents about 16% of the productive forest, or 7% of the total TSA area. The size of the LRMP area is approximately 90% of the TSA area, with a timber harvesting landbase (THLB) of 123,532 hectares.

There have been several changes since the last timber supply analysis in 1998 which was completed as part of the Ministry of Forests' Timber Supply Review program (TSR). These changes include:

1) TSA boundary change (approx. 92,000 ha from the North Coast TSA was transferred to the Nass TSA and 6,000 ha from the Kalum TSA was transferred to the North Coast TSA),
2) Transfer of North Coast TSA to the Nisga'a Lands (approximately 58,000 ha),
3) Re-inventory,
4) New operability lines, which increased the area considered operable for timber harvesting,
5) Riparian stream classification study -- increase in area reserved for riparian reserve zones (7.49% from 4.8%),
6) Increase in the area of existing unclassified roads, trails and landings (1,697 ha from 1,430 hectares),
7) Increase in the volume of unsalvaged losses to account for blowdown (from 2,034 to 10,084 cubic metres/year),
8) Decrease in all volume over age curves by 1% to account for Identified Wildlife,
9) Managed stands were defined as 24 years old (from 21 years, three years ago),
10) Forest cover requirements for about 300 hectares of community watersheds within the timber harvesting landbase were applied,
11) Decrease in area managed by the Ministry of Forests to account for the potential Kitasoo Spirit Bear Protection Area, and
12) Decrease in allowable annual cut from 600,000 m^3/year to 573,624 m^3/year.

Introduction

Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth and the social and economic factors that affect the availability of trees for harvest, changes over time.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit, or timber supply area (TSA). Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

The following tables and discussion outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the North Coast TSA timber supply analysis. This information represents current forest management in the North Coast TSA area. The LRMP area follows the TSA boundary approximately, but does not include Princess Royal Island. Although a portion of TFL25 is within the North Coast LRMP area, it is not currently included in this timber supply analysis due to data issues.

A.1 Inventory Information

Table A-1. Inventory information

Data	Source	Vintage	Update	Scale
Forest cover inventory	MoF	1957/1997	01/05/08 – MSRM	1:20 000
Operability	MoF	2001	01/11/23 - MSRM	1:100 000
North Coast TSA boundary	MoF		01/05/05 - MSRM	1:20 000
Nisgaa settlement area	MoF	1997	01/06/11 - MSRM	1:250 000
North Coast LRMP Boundary	LUCO		01/10/05 - MSRM	1:250 000
Nass Partition	MoF		01/08/19 - MSRM	1:20 000
CCLRMP Zoning	LUCO		02/04/04 - MSRM	1:20 000
Visual Landscape Inventory	MoF		02/04/19 - MSRM	1:20 000
Scenic Areas	MoF	1995	01/09/14 - MSRM	1:20 000
Ownership	MoF		01/05/08 - MSRM	1:20 000
Biogeoclimatic ecosystem classification (BEC)	MoF	1995	02/04/17 - MSRM	1:250 000
Recommended landscape unit boundaries	MoF	1997	01/06/11 - MSRM	1:20 000
Existing Protected Areas	BC Parks		01/07/09 - MSRM	1:20 000
Visual Quality Objectives	MoF		01/07/09 - MSRM	1:250 000
Current Management Visual Quality Objectives	MoF		01/08/03 - MSRM	1:20 000
Community Watersheds	WALP		00/08/18 - WALP	1:20 000
Khutzeymateen GBPU/no hunting zone	WALP		01/04/10 - WALP	1:250 000
Settlement Areas	MSRM		01/09/24 - MSRM	1:20 000
Broad ecosystem inventory (BEI)	MSRM		01/11/16 - MSRM	1:250 000
Roads	MoF		00/02/29 - MoF	1:20 000
3rd order watersheds	MSRM		00/08/18 - MSRM	1:50 000
LRMP management zones	MSRM		01/11/16 - MSRM	Variable

A.2 Zone and Analysis Unit Definition

A.2.1 Management zones (groupings) and objectives

Management zones were used in this analysis to differentiate areas within the North Coast TSA that have different management emphasis or objectives. An outline of the objectives to be tracked is provided in Table A-2. Section A.1, "Inventory information" provides the sources of the inventories referenced below.

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Landscape unit biodiversity	Recommended landscape unit boundaries and biogeoclimatic classification and natural disturbance type.
Visual quality objectives in scenic areas	Visual quality objectives by scenic area zone.
North of the Nass River	Identified boundary
Princess Royal Island	Forest cover inventory (within North Coast TSA, outside of North Coast LRMP)
Marginally Operable areas (cedar in the stand) – **Conventional Zone**	Defined in the operability layer
Marginally Operable areas (cedar-leading stands) – **Helicopter Zone**	Defined in the operability layer
Cutblock adjacency in Integrated Resource Management (IRM) areas	Forest outside of scenic zones.
LRMP	Forest cover inventory

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics

Table A-3. Definition of analysis units

Analysis unit	Criteria	
	Inventory type groups	**Site index range (metres @ 50 years)**
1 Cedar, Hem/cedar: High	C, CH, HC ~ 9, 10, 11, 14	> 22
2 Cedar, Hem/cedar: Med	C, CH, HC ~ 9, 10, 11, 14	15-22
3 Cedar Hem/cedar: Low	C, CH, HC ~ 9, 10, 11, 14	< 15
4 Hem, Bal: H	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	> 22
105 Hem, Bal: H w thinning	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	> 22
6 Hem, Bal: M	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	15-22
107 Hem, Bal: M w thinning	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	15-22
8 Hem, Bal: L	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	< 15
9 Spruce: H	21 - 26	> 22
10 Spruce: M	21 - 26	15-22
11 Spruce: L	21 - 26	< 15
12 Cottonwood:	AC ~ 35, 36	All

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics (continued)

Table A-3. Definition of analysis units (continued)

Analysis unit	Criteria	
	Inventory type groups (ITG)	Site index range (metres @ 50 years)
23 Cedar Hem/cedar: Low	C, CH, HC ~ 9, 10, 11, 14	< 15
26 Hem, Bal: M	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	15-22
28 Hem, Bal: L	H, HB, HS, H DEC, B, BH, BS ~ 12, 13, 15, 16, 17, 18, 19, 20	< 15
30 Spruce: M	21 - 26	15-22
42 Cedar, Hem/cedar: Med	C, CH, HC ~ 9, 10, 11, 14	15-22
43 Cedar Hem/cedar: Low	C, CH, HC ~ 9, 10, 11, 14	< 15

Analysis units 23, 26, 28, and 30 are essentially the same as analysis units 3, 6, 8, and 10 except that they occur in marginally operable areas (see definition in Section A.3.5) where conventional timber harvesting is expected to occur.

Analysis units 42 and 43 are essentially the same as analysis units 2 and 3, except that they occur in marginally operable areas (see definition in Section A.3.5) where timber harvesting by helicopter is expected to occur.

Because the size of some analysis units that occurred in marginally operable areas were very small, they were aggregated with other analysis units. Specifically, analysis units 21, 22, and 23 became analysis unit 23; analysis units 24, 26, and 27 became analysis unit 26; analysis units 29, 30, and 31 became analysis unit 30; analysis unit 32 became analysis unit 12; analysis units 41, 44, 46, 48, 49, 50, and 51 became analysis unit 42.

Analysis units 5 and 7 do not exist because they were managed through juvenile spacing. As such, they were grown on managed stand yield curves (105 and 107 respectively). Analysis units for existing, natural stands were incremented by 100 when they became regenerated i.e., analysis unit 1 became analysis unit 101 when regenerated.

A.3 Definition of the Timber Harvesting Land Base

Land base information used in this analysis was assembled into a computer file by the Skeena Region of the Ministry of Sustainable Resource Management in 2002. This file contains information on the land in the North Coast TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur (e.g., land set aside for parks, land needed to protect riparian habitat, and right-of-ways for highways). These areas do not contribute to the timber supply of the TSA and were separated from the timber harvesting land base (THLB). The THLB is Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.

The following section describes the process by which the timber harvesting land base was determined for the North Coast TSA timber supply analysis.

A.3.1 Land not administered by the British Columbia Forest Service

The ownership (OWNER and OWNR_CH) codes on the inventory file were used to determine areas not managed by the B.C. Forest Service for timber supply. This category may include parks, ecological reserves, private land and various special use permit areas. Only those forests with ownership codes 62 C (forest management unit), 69 C (forest reserve) and 61 (UREP) contributed to the timber supply. From this area, the Kitasoo Spirit Bear proposed protected area was assumed to not contribute to the timber supply.

A.3.2 Non-productive forest and non-forest land

Non-forest and non-productive forest (TYPID_PR = 6) and non-typed (TYPID_PR = 8) areas did not contribute to the timber harvesting land base. These categories include areas covered by such things as sparse alpine forest, ice, swamps, water, and rock.

A.3.3 Non-commercial (brush) forest cover

Non-commercial brush types (TYPID_PR = 5) did not contribute to the timber harvesting land base.

A.3 Definition of the Timber Harvesting Land Base

A.3.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources to warrant their exclusion from timber harvesting. These areas are identified and delineated during a forest inventory and are called environmentally sensitive areas (ESAs). The ESA system employs the following categories: soil (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), wildlife (Ew), water (Eh). Two ESA classes are recognized within each category: high (1) and moderately sensitive (2).

The following table lists the per cent of the area classified that did not contribute to the timber harvesting land base.

Table A-4. Environmentally sensitive areas unavailable for timber harvesting

ESA category	ESA description	Reduction per cent (%)
Es 1	High soil sensitivity	100
Es 2	Moderate soil sensitivity	25
Ep 1	High regeneration problems	100
Ep 2	Moderate regeneration problems	50
Eh 1	High water quality	100
Eh 2	Moderate water quality	100
Ea	Snow avalanche hazard	100

No reductions were made for Ew, as wildlife habitat requirements were met in areas outside of the timber harvesting land base in wildlife tree patches and riparian reserve zones.

No reductions were made for recreation areas, as visual landscape management requirements apply to these areas.

Areas identified as Ep 1 are difficult to reforest due to wildlife browsing on seedlings and brush competition. Areas identified as Ep 2 may have problems associated with natural tree density and brush, which is controllable on about one-half of the area.

Reductions of 100% were applied to areas identified with Eh and Ea, since areas with important water quality considerations and avalanche hazard sensitivity are not harvested.

A.3 Definition of the Timber Harvesting Land Base

A.3.5 Description of operable areas

In October 2001, staff from the Ministry of Forests, the Ministry of Sustainable Resource Management and licencees updated the 1994 operability maps. This new operability presents a much more realistic view of where harvesting actually occurs. Following is the three-phase method they used to determine which stands were operable. All stands coded as inoperable (I) were not included in the timber harvesting land base.

Phase 1
Physical operability limits identify a road development plan and a helicopter zoning plan for undeveloped drainages. The road development plan includes log dumps, mainlines and log handling/storage areas. The helicopter zoning plan includes heli-drop zones, flight distance and log handling/storage areas.

Phase 2
Cutblock configurations from logging over the past 9 years were overlayed onto the forest cover maps to identify a timber inventory profile. The profile was then separated into six categories that were used to build the new operability map. The six categories are:

Conv_Log Areas previously harvested under conventional harvesting systems.
Conv_4 All tree species >=400m^3/ha within a conventional zone, on slopes<60% and height class>=4 (>=28.5m)
Conv_marg Combination Western red cedar stands >=250m^3/ha within a conventional zone, on slopes <60% and height class >=3 (>=19.5m)
Heli_Log Areas previously harvested under non-conventional harvest systems.
Heli_350 All tree species with leading volume >=350 m^3/ha within a helicopter zone, on slopes >=60% and height class >=4
Heli_CW_250 Leading Western Redcedar stands with leading volume>=250 m^3/ha within a helicopter zone, on slopes >=60% and height class >=3

There is some uncertainty in the reliability of the information used to determine whether a stand would be harvested conventionally or by helicopter in the future. However, no distinction has been made in this analysis for the timber harvesting land base between harvesting methods. A stand was either operable or inoperable.

A.3 Definition of the Timber Harvesting Land Base

A.3.5 Description of operable areas (cont'd)

Phase 3

There were 32 operable areas that were considered unlikely to be harvested under any market condition, but still met the criteria according to the forest cover inventory. These areas, totalling 1,320 hectares, were further reviewed using air photos. This comparison found that errors in the forest cover file and/or TRIM data resulted in the delineation of these areas as operable. Twenty-seven of these areas (1,112 hectares) were manually coded as inoperable.

A.3.6 Sites with low timber growing potential

Sites may have low productivity because of inherent site factors (e.g., exposure, nutrient availability, excessive moisture), or because they are not fully occupied by commercial tree species. All stands with site index estimates of less than 10 metres at a breast height age of 50 years were excluded from the timber harvesting land base. As well, all stands which had reached age class 5 (81-100 years), but had not attained a height greater than height class 2 (10.5 - 19.4 metres) were excluded.

Table A-5. Sites with low timber growing potentia

Characteristics	Reduction per cent (%)
SI<10	100
>= Age class 5 (81-100 years) and <= Height class 2 (10.5 – 19.4 m)	100

In some cases, stands with site index < 10 are more productive than their inventory SI is reporting, but because of competition, are unable to utilize the productivity of the site. The climax species on the coast often grow in an understory condition, limiting height growth. These young stands can grow in a suppressed state for many years until the overstory is removed. Some of these stands may express a fairly good SI if grown in a managed state. Section A.4.7, *Site productivity for managed stands* attempts to address this.

A.3 Definition of the Timber Harvesting Land Base

A.3.7 Problem forest types

Problem forest types are stands that are physically operable and exceed low site criteria, but are not currently utilized or have marginal merchantability. These types did not contribute to the timber harvesting land base.

Table A-6. Problem forest types criteria

Inventory type group	Characteristics			
	Age (years)	Stocking code	Crown closure (%)	Reduction per cent (%)
All		> 1		100
All	> 60		< 36	100
Pine -leading (27-32)				100
Broad-leaved except cottonwood (37-42)				100

Pine and broad-leaved trees other than cottonwood are species not currently utilized in the North Coast TSA. Stands that have low stocking or are close to mature ages and do not have closed canopies are generally not economic to harvest.

A.3.8 Existing and future unclassified roads, trails and landings

Estimates only account for the area that is permanently removed from the timber harvesting land base. These estimates only apply to unclassified areas. All highways and larger municipal roads are of a sufficient size to be mapped as polygons and classified as non-forest areas in the forest inventory.

Existing: To account for existing unclassified roads, trails and landings a total of 1,697 hectares (current to July 2001) was excluded from forest stands less than 50 years of age on conventionally operable stands, and from conventionally operable stands which had already been logged. This estimate was revised from the December 1996 figure used in TSR2 (1,430 ha) to account for an additional 174 km of road built since then. The calculations used to arrive at this figure are as follows:

A.3 Definition of the Timber Harvesting Land Base

A.3.8 Existing and future unclassified roads, trails and landings (cont'd)

The average disturbed width of a Class 5 (single lane) forest road based on measurements taken from the toe of the fill slope to the top of the cut is 13.5 metres horizontal distance. The total area lost due to landings, pullouts, and borrow pits (average 3/km) is 0.18 ha/km. Therefore, the estimated loss of site due to existing unclassified roads, trails and landings is 1.53 ha/km of road:

$\{ (13.5 \text{ m} \times 1{,}000 \text{ m}/10{,}000 \text{m}^2) + 0.18 \text{ ha/km} \} = 1.53 \text{ ha/km}.$

The total existing unclassified roads, trails and landings to July 2001 is:
(1.53 ha/km x 1,109 km of road built) = 1,697 hectares

Future: All future road, trail and landing development was accounted for by applying an area reduction of 8.4% after harvest to existing, natural stands that were at least 50 years old.

From several planning documents, district staff estimated the length of road required per conventionally harvested cubic metre to be 0.09 metres. Using the district average of 607 m^3/ha, and the estimate of 1.53 ha/km of road constructed calculated for existing roads, trails and landings:

$$\frac{607 \text{ m}^3/\text{ha} \times 0.09 \text{ m}/\text{m}^3 \times 1.53 \text{ ha/km}}{1{,}000 \text{ m}} = 8.4\%$$

The *North Coast Timber Supply Area Timber Supply Review Data Package* (February 1998) provides a more detailed description of how the area in roads, trails and landings was estimated.

A.3.9 Riparian management areas (riparian reserve zone component only) and wildlife tree patches

Riparian areas occur next to the banks of streams, lakes, and wetlands and include both the area dominated by continuous high moisture content and the adjacent upland vegetation that exerts an influence on it. Riparian ecosystems contain many of the highest value non-timber resources in the natural forest.

Riparian management areas consist of a riparian management zone (RMZ) and a riparian reserve zone (RRZ). Within the management zone, constraints to forest practices were applied (see Section A.4.13).

Within the reserve zones, the timber harvesting land base was reduced by 7.49% after all the previously discussed exclusions were made. This figure is based on the *North Coast Riparian Classification Inventory, September 2001*, which examined eleven

A.3 Definition of the Timber Harvesting Land Base

A.3.9 Riparian management area (riparian reserve zone component only and wildlife tree patches (cont'd)

representative watersheds in the North Coast forest district. An inventory of streams within these watersheds was completed, and the riparian reserve zone area within the operable area was measured, using the *Forest Practices Code Riparian Management Area Guidebook*. The per cent area excluded from the timber harvesting land base was calculated by dividing the riparian reserve zone area by the operable area (from TSR2 data) for these 11 watersheds:

RRZ / Operable area = Total net loss (%)

Note that the operable area used in the calculation was from the TSR2 land base, and not on the new operability lines produced in 2001.

Stand-level biodiversity is managed in part by retaining reserves of mature timber or wildlife trees (WTs) and patches (WTPs) within cutblocks and in adjacent inoperable and other retained areas to provide structural diversity and wildlife habitat. Cutblocks in the North Coast TSA tend to be linear, relatively small and generally proximal to a number of streams. These characteristics mean that most of the (WTP) requirements can be fulfilled by locating the WTPs within riparian reserve zones. As such, there were no further reductions made to the timber harvesting land base specific to wildlife trees or patches.

A.3.10 Timber licence reversions

There are no Timber Licences in the North Coast TSA.

A.3.11 Woodlot licences

The *Forest Act* requires AACs determined for TSAs to be exclusive of the areas and timber volumes allocated to woodlot licences. One woodlot licence was awarded in March 1998 in the TSA. It is approximately 400 hectares in size, and has an Allowable Annual Cut (AAC) of 776 m^3/year. This area did not contribute to the timber harvesting land base for this analysis.

A.3 Definition of the Timber Harvesting Land Base

The following table identifies the areas that were separated from the timber harvesting land base as part of the definition of the timber harvesting land base section.

Table A-7. Timber harvesting land base for the North Coast Timber Supply Area

Land base Classification	Land base reductions (hectares)	Land base area (hectares)
North Coast TSA		**1,875,334**
Not managed by MoF	191,104	
Non-forest	833,436	
Productive forest managed by the MoF		**850,794**
Non-commercial cover	335	
ESA	233,590	
Low growth potential	281,131	
Problem species	14,046	
Inoperable	171,554	
Existing roads	1,697	
Riparian reserve zones	11,118	
Timber harvesting land base		**137,323**

A.4 Forest Management Assumptions

A.4.1 Utilization levels

Utilization levels define the maximum stump height, minimum top diameter inside bark (dib), and minimum diameter at breast height (dbh) used to calculate merchantable volume tables. The following levels reflect expectations that second-growth managed stands will be subject to closer utilization than existing stands.

Table A-8. Utilization levels

	Utilization		
Stand types	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Managed	12.5	30	10
Existing	17.5	30	10

The North Coast TSA utilization standards specify a 15 cm minimum top diameter and a 30 cm maximum stump height with a 17.5 cm minimum dbh for old growth stands (> 120 years). However, the volume estimates are only available for a 10 cm top diameter inside bark (dib). The Ministry of Forests' Resources Inventory Branch staff have conducted research that shows the difference in volume between a 10 cm and a 15 cm top is less than 1%. In younger, second-growth stands, a minimum top diameter of 10 cm (dib) and 12.5 cm minimum dbh is specified.

A.4.2 Volume exclusions for mixed species stands

All broad-leaved species except cottonwood were excluded from the estimation of volume in coniferous-leading mixed species stands. All stands dominated by deciduous species, except for cottonwood stands, did not contribute to the timber harvesting land base (see Section A.3.7, "Problem forest types").

A.4.3 Minimum harvestable ages

The minimum harvestable age is the time required for a stand to grow to a harvestable size. While harvesting may occur in stands at the minimum age to meet forest level objectives (e.g. maintaining overall harvest levels for a short period of time, or avoiding large changes in harvest levels), most stands will not be harvested until past their minimum age.

A.4 Forest Management Assumptions

A.4.3 Minimum harvestable ages (continued)

In the North Coast TSA, stands other than those in marginally operable areas must meet three criteria before being eligible for harvest:

1) a minimum average diameter of 35 cm for the 250 largest trees,
2) achievement of 95% of culmination of mean annual increment (CMAI),
3) a minimum standing volume of 375 m^3/ha

Note that the diameter criterion is not applicable to natural stands.

For natural stands in marginally operable areas, only a minimum standing volume of 250 m^3/ha is required. Once these stands are harvested, the same three criteria as for the other areas must be met before these stands can be harvested again. Tables A-9 and A-10 identify at what ages these criteria are met.

Table A-9. Minimum harvestable ages by analysis unit

AU	Leading species	SI range (m @ 50 y)	Age range (years)	Management	Age when average diameter of 250 prime stems is >= 35 cm	Age at 95% of CMAI	Age when yield >=375 m^3/ha	Minimum harvest age
1	C, HC	>22	>=24	natural	N/A	60	70	70
2	C, HC	15-22	>=24	natural	N/A	80	120	120
3	C, HC	<15	>=24	natural	N/A	90	180	180
4	H, B	>22	>=24	natural	N/A	60	60	60
6	H, B	15-22	>=24	natural	N/A	70	90	90
8	H, B	<15	>=24	natural	N/A	90	150	150
9	S	>22	>=24	natural	N/A	50	60	60
10	S	15-22	>=24	natural	N/A	70	80	80
11	S	<15	>=24	natural	N/A	90	110	110
12	Cottonwood	all	all	natural	N/A	N/A	N/A	50
101	C, HC	>22	<24	managed	70	80	60	80
102	C, HC	15-22	<24	managed	120	100	90	120
103	C, HC	<15	<24	managed	180	110	130	180
104	H, B	>22	<24	managed	70	70	60	70
105	H, B	>22		managed	50	90	60	90
106	H, B	15-22	<24	managed	110	100	90	110
107	H, B	15-22		managed	70	100	70	100
108	H, B	<15	<24	managed	190	120	130	190
109	S	>22	<24	managed	50	80	60	80
110	S	15-22	<24	managed	90	90	70	90
111	S	<15	<24	managed	130	120	110	130
112	Cottonwood	all	all	natural	N/A	N/A	N/A	50

A.4 Forest Management Assumptions

A.4.3 Minimum harvestable ages (continued)

Table A-10. Minimum harvestable ages by analysis unit for Marginally Operable areas

AU	Leading species	SI range (m @ 50 y)	Age range (years)	Management	Age when average diameter of 250 prime stems is >= 35 cm	Age at 95% of CMAI	Age when yield >=250 m³/ha	Minimum harvest age
23	C, HC	all	>=24	natural	N/A	N/A	140	140
26	H, B	>=15	>=24	natural	N/A	N/A	60	60
28	H, B	<15	>=24	natural	N/A	N/A	130	130
30	S	all	>=24	natural	N/A	N/A	60	60
42	C, HC	>=15	>=24	natural	N/A	N/A	90	90
43	C, HC	<15	>=24	natural	N/A	N/A	130	130

					Age when average diameter of 250 prime stems is >= 35 cm	Age at 95% of CMAI	Age when yield >=375 m³/ha	Minimum harvest age
123	C, HC	all	<24	managed	240	130	170	240
126	H, B	>=15	<24	managed	100	90	80	100
128	H, B	<15	<24	managed	270	140	190	270
130	S	all	<24	managed	90	90	70	90
142	C, CH	>=15	<24	managed	120	100	100	120
143	C, CH	<15	<24	managed	190	120	150	190

For the marginally operable helicopter units (142-143), the Western red cedar component of the stand must meet the minimum volume requirement of 375 cubic metres/ha.

Because the existing (natural) stands in the North Coast TSA are very old, they are harvested well beyond the stated minimum harvestable ages in the tables.

A.4 Forest Management Assumptions

A.4.4 Site productivity estimates for managed stands

Yield analysis uses site index (SI) as a measure of site productivity. Site index is an estimate of potential height growth on a site over a fixed period of time. In BC, we use SI_{50}, or height at breast height age 50 years.

The productivity of a site largely determines how quickly trees grow and thus volume production and merchantable/rotation age. In recent years, extensive site index sampling of second growth stands (less than 120 years in age) has indicated that site productivity estimates from our forest cover inventory underestimate actual site productivity of regenerated stands. Second growth forest stands tend to grow faster than projected by inventory-based site index estimates from old-growth stands (Olivotto and Meidinger 2001, Nigh 1998, Nussbaum 1998).

Site index is tied closely to ecological site factors such as soil moisture and nutrient regime. Within the Biogeoclimatic Ecosystem Classification (BEC) system the site series expresses soil moisture and nutrient regime. The Site Index – BEC Project (SIBEC) has produced a database summarizing site index estimates (from second growth field data) by site series for coniferous tree species in BC and "look-up site index tables" have been produced for most biogeoclimatic subzones/variants in BC (Site Productivity Working Group 1998).

Where terrestrial ecosystem mapping (TEM) exists, SIBEC site index estimates can be assigned to site series polygons in order to generate yield estimates for growth of regenerated stands. Detailed TEM mapping of large areas such as TSA's is prohibitively expensive, but predictive ecosystem mapping (PEM) approaches using forest cover and TRIM inventories have been recently developed within BC (Meidinger et al. 2000). PEM is much more cost effective than TEM and provides the required level of detail for landscape-level analyses such as yield analysis.

EcoGen is a PEM approach being developed by the Ministry of Forests. An EcoYield module has also been developed to produce an ecologically-based yield analysis from the EcoGen mapping; a pilot has recently been completed in the North Coast Forest District (Meidinger et al. 2001). EcoGen mapping for the entire North Coast District is planned for completion by September 2002, at which time all maps will be available for use in a timber supply analysis. Currently, five mapsheets have been completed and gone through a quality assurance process.

Because there is some uncertainty regarding the application of predictive ecosystem mapping – site index – TSR analysis unit relationships from five mapsheets to the entire TSA, for the base case analysis, the site index data from the forest cover inventory was applied. To test the sensitivity of a change in site productivity estimates, the data from the PEM/SIBEC study was used in a sensitivity analysis. The regional Forest Ecologist proposed the following approach in order to apply the SIBEC estimates to that sensitivity analysis:

A.4 Forest Management Assumptions

A.4.4 Site productivity estimates for managed stands (continued)

1) SIBEC site index estimates, including recent data from 450 plots collected throughout the southern portion of the TSA (south of the Nass River) were applied to the EcoGen polygons for five mapsheets (including 27,880 ha of THLB). Note that the THLB figure is from TSR2.

2) An EcoYield analysis was generated for the five mapsheets (Meidinger et al. 2001).

3) Forest cover mapping was overlaid with the EcoGen mapping and area summaries of ecosystem polygons produced for each TSR analysis unit.

4) Area-weighted mean SIBEC site index was calculated for each analysis unit by applying the site index estimates to the ecosystem area summaries for each analysis unit.

5) A table of predicted EcoGen/SIBEC site index by TSR analysis unit was compiled (Table A-11).

6) The predicted EcoGen/SIBEC site index was applied in place of the forest cover site index to each analysis unit in completing the sensitivity analysis for the entire timber harvesting landbase.

Note that the Cedar analysis unit includes stands in Inventory Type Group 14 (leading Hw with major Cw component – HC). The EcoGen map sheets included areas with site index lower than was included in the TSR2 analysis – these areas are separated out (Cedar-lower) in computing the predicted site index in Table A-11.

The five mapsheets contained a representative cross section of stand types and ecological site conditions for the southern portion of the TSA. These five mapsheets contain 12% of the THLB within the North Coast TSA. However, the volumes calculated from this data could be 10-20% too high when applied to the northern portion of the TSA (north of the Nass River), which accounts for about 12% of the THLB. This analysis can be refined once EcoGen is complete for the entire TSA. The SIBEC site index estimates can also be supplemented with recent data collected from the northern part of the TSA – the SIBEC samples represent a significant second – growth productivity database for the North Coast TSA for subsequent analyses.

Table A-11 shows the EcoGen/SIBEC predicted site indices for analysis units using TSR2 data. Table A-12 provides a comparison between the site indices used in the base case analysis from the forest cover data, and the EcoGen/SIBEC predicted site indices used in the sensitivity analysis.

A.4 Forest Management Assumptions

A.4.4 Site productivity estimates for managed stands (continued)

Table. A-11 EcoGen/SIBEC predicted SI for analysis units for TSR 2

Analysis unit	Species	Site Class	SI range in inventory (m @ 50 yrs)	Net area (ha)	Net area in North Coast sample (ha)	EcoGen/SIBEC predicted SI for regenerated stands (m @ 50 yrs)
1	Cedar*	H	> 22	401	133	22.8
2	Cedar	M	15 – 22	27,206	1,316	22.5
3	Cedar	L	10 – 14	19,417	6,837	19.8
	Cedar	Lower	< 10	0	12,568	14.1
4 & 5	Hemlock, Balsam**	H	> 22	4,322	151	25.1
6 & 7	Hemlock, Balsam	M	15 – 22	44,858	2,173	23.4
8	Hemlock, Balsam	L	10 – 14	13,684	2,725	22.3
	Hemlock, Balsam	Lower	< 10	0	1,071	16.4
9	Spruce***	H	> 22	1,843	114	29.9
10	Spruce	M	15 – 22	5,270	305	28.8
11	Spruce	L	10 – 14	1,726	388	28.0
	Spruce	Lower	< 10	0	100	25.6
12	Cottonwood****	All	All	395	0	n/a
Total				119,130	27,880	

*includes leading redcedar, yellow cedar and HC stands
**includes leading hemlock (except HC), balsam and lodgepole pine stands
***mainly sitka spruce
****deciduous stands were excluded from the EcoGen study

Table A-11 refers to the area in TSR2. The site index figures in the last column were applied to managed stands (<24 years) and to all regenerated stands in the sensitivity analysis for the LRMP. No adjustments were applied to stands with less than a site index of 10, as these types were identified as not contributing to the timber harvesting land base. For the marginally operable areas, which were not included in TSR2 and therefore do not appear in the above table, the same predicted SI was applied to them as to the stands not in marginal areas. For example, AU3 has the same species and site combination as AU23, except that AU23 occurs in marginally operable areas where harvesting by conventional methods can take place. AU43 is also the same as AU3, except that AU43 occurs in cedar-leading marginally operable areas where harvesting by helicopter can take place.

Table A-12 provides a comparison of estimates of site index applied in the base case analysis from the forest cover to managed and regenerated stands, with estimates applied in the sensitivity analysis from the EcoGen/SIBEC data for managed and regenerated stands for the TSA.

A.4 Forest Management Assumptions

A.4.4 Site productivity estimates for managed stands (continued)

Table A-12. Forest Cover SI for LRMPAnalysis vs. EcoGen/SIBEC predicted SI

Analysis unit	THLB area (ha)	Forest Cover SI for regenerated stands	EcoGen/SIBEC predicted SI for regenerated stands (m @ 50 yrs)
1, 101 C,HC	1,300	24.8	22.8
2, 102 C,HC	12,404	16.6	22.5
3, 103 C,HC	24,331	13.1	19.8
4, 104 H,B	6,160	25.3	25.1
105 H,B	174	26.6	25.5
6, 106 H,B	29,764	17.5	23.4
107 H,B	1,438	22.0	23.4
8, 108 H,B	28,637	13.1	22.3
9, 109 S	2,135	26.5	29.9
10, 110 S	4,831	18.7	28.8
11, 111 S	2,724	12.9	28.0
12, 112 Cottonwood	445	36.6	N/A
23, 123 C,HC	9,291	11.9	19.8
26, 126 H,B	543	19.1	23.4
28, 128 H,B	3,867	10.9	22.3
30, 130 S	160	18.5	28.8
42, 142 C,HC	1,979	16.5	22.5
43, 143 C,HC	7,140	12.9	19.8
Total	137,323		

The site indices applied to the regenerated and managed stands in the base case were calculated averages from the existing analysis unit. For example, the mean site index of analysis unit 1 was applied to analysis unit 101, which is simply analysis unit 1 that has been regenerated or managed.

A.4.5 Harvesting scheduling priority

Priority for harvest was highest for stands that were the oldest relative to the applicable minimum harvestable age. This is termed a "relative oldest first" harvest rule.

A.4.6 Silviculture systems

The timber supply analysis assumed that all harvesting was by clearcut. Although some partial harvesting is occurring in the TSA, it is limited.

A.4 Forest Management Assumptions

A.4.7 Unsalvaged losses

Unsalvaged volume losses due to epidemics of fire and wind damage were deducted prior to reporting volume harvested in the analysis report, for a total of **10 084 cubic metres per year.**

Average annual unsalvaged losses due to fire were estimated at 2 034 cubic metres per year. These losses were based on a 20 -year average loss of timber.

In 1998, a report estimating blowdown losses in the North Coast TSA was completed. This study estimated that annual unsalvaged losses to wind are 13 417 cubic metres on the operable land base. Ministry of Forests staff reviewed this report, and adjusted the blowdown estimate to 8 050 cubic metres per year to reflect unsalvaged losses on the timber harvesting land base.

While porcupine damage is evident in some second-growth stands, the long-term effect on timber production is not fully understood. Possible effects include lengthened regeneration delays, lower stocking, and lower volume yields. Unsalvaged losses due to porcupine damage remain unquantified, and as such, no unsalvaged losses have been attributed to this pest.

Losses due to insects and other pests are endemic in nature. As such, they have been accounted for elsewhere by operational adjustment factors and by decay, waste and breakage factors.

A.4.8 Regeneration activities in managed stands

Table A-13 shows the regeneration assumptions by analysis unit. Regeneration delay reflects current operational practice and is defined as the time after harvest but before planting or seed germination occurs. Regeneration delays were applied in the FSSIM forest estate model, not in the TIPSY yield model.

Provincial average operational adjustment factors (OAFs) values were applied to the managed stand yield curves as recommended by the Ministry of Forests, Research Branch — as no local values were available. OAF 1 reflects small stocking gaps in stands, while OAF 2 reflects an estimate for decay, waste and breakage that increases with age, passing through 5% at 100 years of age.

Recent regeneration (< 24 years) and future stands were grown on managed stand yield tables produced using the Forest Service Table Interpolation Program for Stand Yields (TIPSY) growth and yield model. Because TIPSY does not include data for Cottonwood stands, these stands were grown according to a VDYP curve for existing, natural stands. As well, because densities of 10,000 trees/ha are not available for planted

A.4 Forest Management Assumptions

A.4.8 Regeneration activities in managed stands (continued)

stands, the density was changed to 4,444 for analysis units 10 and 30.

While there is some planting in the TSA, there is often considerable ingress of existing species to cause the regenerated stand to develop more like a natural stand. Analysis units were therefore assumed to regenerate to the same species composition as the existing analysis unit.

Table A-13. Regeneration assumptions by analysis unit

Analysis unit	Composition	Regen delay[a] (years)	OAFs[b] (%)		Method	Density (stems/ha)	
			1	2		Initial	Thinned
1 Cedar: H	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	
2 Cedar: M	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	
3 Cedar: L	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	
4 HemBal: H	Hemlock/balsam	2	15	5	Natural	10,000+	
5 HemBal: H with	Hemlock/balsam	2	15	5	Natural	10,000+	700
6 HemBal: M	Hemlock/balsam	2	15	5	Natural	10,000+	
7 HemBal: M with	Hemlock/balsam	2	15	5	Natural	10,000+	700
8 HemBal: L	Hemlock/balsam	2	15	5	Natural	10,000+	
9 Spruce: H	Spruce	2	15	5	Plant	1,000	
10 Spruce: M	Spruce	2	15	5	Plant	4,444	
11 Spruce: L	Spruce	2	15	5	Natural	10,000+	
23 Cedar: L	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	
26 HemBal: M	Hemlock/balsam	2	15	5	Natural	10,000+	
28 HemBal: L	Hemlock/balsam	2	15	5	Natural	10,000+	
30 Spruce: M	Spruce	2	15	5	Plant	4,444	
42 Cedar: M	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	
43 Cedar: L	Cedar, hemlock/cedar	1	15	5	Natural	10,000+	

A.4 Forest Management Assumptions

A.4.9 Immature managed stand history

The purpose of this section is to identify areas of existing immature forest where density (stems per hectare) is controlled and therefore should be assigned to appropriate managed stand yield curves. All NSR and future harvested stand volume projections will be based on managed stand yield curves.

A juvenile spacing program has treated 2 393 hectares of hemlock/balsam stands since 1985 to November 2001. To reflect this, hemlock and balsam stands on good and medium sites which had an activity code of 'J' assigned (analysis units 105 and 107), were grown on yield curves which reflect density management with thinning.

The expectation noted in TSR2 that juvenile spacing would continue, is no longer valid, as funding is no longer available for spacing. However, those stands that were assigned to yield curves to reflect thinning will continue to grow on those curves.

A.4.10 Not satisfactorily restocked (NSR) areas

Land classified in the TSA inventory file as type identity 4 or 9 is included in the timber harvesting land base. These types correspond to non-satisfactorily restocked areas. The NSR area is expected to regenerate within the regeneration delays specified in the table of regeneration assumptions.

The Integrated Silvicultural Information System (ISIS) records a total of 4,591 hectares of NSR as of October 5, 2001, while the forest inventory file records a total of 3,368 hectares of NSR, with 1,259 hectares within the timber harvesting land base. See Table A-14 for details.

Table A-14. Area of NSR from ISIS database

Description	NSR area (ha)	Comments
Total from ISIS	**4,591**	
Current NSR	**1,856**	stocked on a 2 year regeneration delay cycle
Backlog NSR:	**2,735**	
Estimated stocked but not updated in ISIS	1,511	Needs to be reclassified in ISIS after a survey
Estimated to be stocked with mixed red alder and a low percent of conifers	526	Needs to be reclassified in ISIS after a survey. Also needs DNC decision to manage and accept red alder on appropriate sites.
Estimated to be non-productive	101	Needs to be reclassified in ISIS after a survey
Area estimated to never reach full site potential until next rotation	597	It is estimated that only 50 % site occupancy will be attained mostly under an alder canopy.

A.4 Forest Management Assumptions

A.4.10 Not satisfactorily restocked (NSR) areas (continued)

There is typically a discrepancy between these two databases; for a variety of reasons they are not directly reconcilable. Discrepancies in area of NSR between ISIS and forest inventory information can be attributed to: inaccuracies in both databases, lags in data entry and the potential for backlog areas recorded by ISIS to be classified as restocked or non-forest during re-inventory.

Because the amount of NSR is very small, to be efficient, the area of NSR recorded on the inventory file was used in the timber supply analysis. The inventory NSR was assigned to the timber harvesting land base according to the distribution of analysis units in the 1-20 year age class, based on species and site description. The NSR area outside the timber harvesting land base was regenerated to an inoperable analysis unit.

A.4 Forest Management Assumptions

A.4.11 Visual Quality, Integrated Resource Management, and Water Quality

The following forest cover requirements were applied to each management emphasis within each landscape unit.

Table A-15. Forest cover requirements for integrated resource management (IRM), water quality, and visual quality objectives (VQO)

Management emphasis	Zone or group	Maximum allowable disturbance (% area)	Green-up height
IRM	Integrated Resource Management areas	33	3 m
Water quality	Community Watershed	5	5 y
Visual resources	Inside Passage (1) — preservation	1	7 m
Visual resources	Inside Passage (1) — retention	5	7 m
Visual resources	Inside Passage (1) — partial retention	15	7 m
Visual resources	Skeena River Corridor (2) — preservation	1	7 m
Visual resources	Skeena River Corridor (2) — retention	5	7 m
Visual resources	Skeena River Corridor (2) — partial retention	15	7 m
Visual resources	Portland / Work Channel (3) — modification	25	4 m
Visual resources	Douglas / Gribbell (4) — modification	25	4 m

There are four different scenic area zones in the North Coast TSA:
1) Inside Passage,
2) Skeena River Corridor,
3) Portland/Work Channel, and
4) Douglas/Gribbell

The VQO objectives vary between scenic zones to reflect differences in visual sensitivity and management techniques. The forest cover requirements were applied to the total productive forest area within each VQO area within each scenic zone and recommended landscape unit.

Although the recommended VQO's for zones 3 and 4 are partial retention, they are being managed as modification, and were modeled as such.

A.4 Forest Management Assumptions

A.4.11 Visual Quality, Integrated Resource Management, and Water Quality (cont'd)

IRM requirements were applied to all areas outside of these four scenic zones by landscape unit. IRM objectives are specified as a proxy for adjacency constraints associated with maximum clearcut and patch size guidelines. The maximum allowable disturbance constraint for the IRM areas was applied to the timber harvesting land base only.

All stand heights shown in Table A-15 refer to top heights. Top height, for green-up purposes, is the average height of the tallest 100 trees per hectare and is generally based on the height of the leading species. The report, *Age to Green-up Height: Using Regeneration Survey Data*, was used to derive green-up ages for each analysis unit. Where data was not available in the report, the SiteTools model supported by the BC Ministry of Forests Research Branch was used.

Where community watersheds occur, a maximum allowable disturbance from the *Forest Practices Code Community Watershed Guidebook* was applied to protect water quality. The constraint was applied to the timber harvesting land base only.

A.4.12 Landscape-level biodiversity

Operationally, low-biodiversity emphasis is assumed for all landscape units, as specified by the *Biodiversity Guidebook* when emphasis options have not yet been formally assigned. Although interim Biodiversity Emphasis Options (BEO) have been assigned to each recommended landscape unit, they have not been legally established. Therefore, they can not be used for the base case analysis.

As it is unknown which landscape units will be assigned low-, intermediate- or high-biodiversity objectives, a single weighted constraint for the old-seral stage requirement was applied based on the anticipated distribution of 10% high-, 45% intermediate- and 45% low-emphasis. The values shown in Table A-16 reflect the weighted *Biodiversity Guidebook* values. They represent a phase-in of the cover requirement, with an initial requirement that one-third of the *Biodiversity Guidebook* old-seral stage percentage be met in the low-emphasis portions. As seen in the table, the cover requirements are increased over time to ensure that the full minimum retention of old-seral forest is met by the end of three rotations.

It was assumed that application of the full requirement at the beginning of the third rotation (in decade 14), when it still may not be achieved, would ensure the required forest cover will be built up over that rotation.

Minimum retention objectives were applied to the productive forest land base in each recommended landscape unit / BEC variant combination.

A.4 Forest Management Assumptions

A.4.12 Landscape-level biodiversity (continued)

Appendix 3 of the *Biodiversity Guidebook* notes all areas within the Prince Rupert Forest Region are in NDT 1 or 2. The Ministry of Forests' Research Branch staff clarified that essentially all of the CWHvh2 and CWHvm within the North Coast TSA should be considered to be NDT 1.

Table A-16 Forest cover requirements for landscape-level biodiversity

		Old-seral stage requirements			
			Minimum retention area by decade (%)		
Biogeoclimatic unit	**NDT**	**Minimum age (years)**	**1**	**7**	**14**
CWHvh2	1	250	9.7	11.65	13.6
CWHvm	1	250	9.7	11.65	13.6
CWHvm1	1	250	9.7	11.65	13.6
CWHwm	1	250	9.7	11.65	13.6
CWHvm2	1	250	9.7	11.65	13.6
MHmm1	1	250	14.2	17.05	19.9
MHmm2	1	250	14.2	17.05	19.9
MHwh1	1	250	14.2	17.05	19.9
CWHws1	2	250	6.7	8.1	9.4
CWHws2	2	250	6.7	8..1	9.4

A.4 Forest Management Assumptions

A.4.13 Riparian management areas (riparian management zone component only)

Riparian areas occur next to the banks of streams, lakes, and wetlands and include both the area dominated by continuous high moisture content and the adjacent upland vegetation that exerts an influence on it. Riparian ecosystems contain many of the highest value non-timber resources in the natural forest.

Riparian management areas consist of a riparian management zone (RMZ) and a reserve zone (RRZ). Within the reserve zone, the timber harvesting land base was reduced by 7.49% (see Section A.3.9 *Riparian management areas (riparian reserve zone component only) and wildlife tree patches*). This figure is based on the *North Coast Riparian Classification Inventory, September 2001.*

The appropriate method to account for the timber supply implications of riparian management practices within riparian management zones (RMZ) depends upon the management practices applied in these zones (e.g. harvest pattern) and the availability of inventory information.

To account for the timber volume that will be left unharvested in riparian management zones, as specified under the *Forest Practices Code Riparian Management Area Guidebook*, all volume over age curves were reduced by 4.2%. This assumption is based on average stream density figures for the coast, as reported in the 1994 study by Wild Stone Resources.

A.4.14 Identified wildlife management strategy

Habitat for certain wildlife species will be managed through implementation of the Identified Wildlife Management Strategy (IWMS). Currently, there are no wildlife habitat areas established under the IWMS within the North Coast TSA, and no higher level plans that identify other wildlife management practices.

However, given the Province's commitment to implementing the strategy, and given the policy decisions and projected maximum allowed one-percent impact - and noting the expected occurrence of identified wildlife in the TSA, all volume over age curves were reduced by 1%.

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