Tree Farm Licence 37

Twenty-Year Plan Report
for Sustainable Forest Management Plan 9
June 14, 2005

Submitted to:

Charles Van Hemmen, R.P.F.
District Manager, North Island Central Coast Forest District
Ministry of Forests
2291 Mine Road Place
Port McNeill, BC V0N 2R0
tel (250) 956-5000 fax (250) 956-5005
email: charles.van.hemmen@gems1.gov.bc.ca

Submitted by:

Patrick Bryant, R.P.F.
Strategic Planning Forester
Canadian Forest Products Ltd., Coastal Operations
103-990 Cedar Street
Campbell River, BC V9W 7Z8
tel 250-850-5865 fax 250-850-5858
email: patrick.bryant@canfor.com

Prepared by:

Forest Ecosystem Solutions Ltd.
210 – 275 Fell Avenue
North Vancouver BC V7P 3R5
tel 604-998-2222 fax 604-986-0361

Colin Mahony, F.I.T.
email: cmahony@forestecosystem.ca
Antti Makitalo M.Sc., R.P.F
email: amakitalo@forestecosystem.ca

EXECUTIVE SUMMARY

The Twenty-Year Plan (TYP) is a sequence of possible cutblocks for the first twenty years of the TYP planning horizon of the timber supply analysis. The TYP is used to verify the short-term feasibility of the harvest levels forecasted in the timber supply analysis Base Case. These results are submitted to the District Manager, Ministry of Forests North Island Central Coast Forest District, and are used by the Chief Forester of British Columbia to support the determination of the allowable annual cut (AAC).

The heuristic timber supply model ***FSOS*** was used to create hypothetical cutblocks that mimic operational practices in terms of size and shape. These model-built cutblocks supplemented an existing set of recently logged and planned operational cutblocks to create a population of blocks available for harvest in the TYP. The timber supply model then harvested the cutblocks in a sequence that achieved base case harvest levels. In addition to the base case constraints, the TYP sequence was constrained by (1) cutblock size; (2) cutblock adjacency; (3) short-term accessibility; and (4) watershed management. The TYP planning horizon roughly corresponds to the current cut control period (2001-2006) plus the twenty years following the upcoming AAC determination, for a total of twenty-five years.

Base Case harvest levels were achieved using a harvest pattern that mimics operational practices on TFL37. Several harvest profiles were tested against the THLB, including logging system, economic operability, current access, stand origin, tree species, stand age, average diameter, and top height. The harvest profiles of the TYP are reasonable and not substantially biased than the overall profile of the Timber Harvesting Landbase (THLB).

The TYP indicates that base case harvest levels are spatially feasible for the twenty years following the upcoming AAC determination expected in early 2006.

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

The Twenty Year Plan (TYP) is a sequence of cutblocks for the first twenty years of the timber supply analysis. The TYP is used to verify the short-term feasibility of the harvest levels forecasted in the timber supply analysis Base Case. These results are submitted to the District Manager, Ministry of Forests North Island Central Coast Forest District, and are used by the Chief Forester of British Columbia to support the determination of the allowable annual cut (AAC).

The Base Case and sensitivity analyses presented in the timber supply analysis report (Forest Ecosystem Solutions Ltd. 2005) are not explicitly spatial, in that the timber supply model is not required to aggregate harvests into realistic cutblocks. The primary difference between the non-spatial and spatial analyses is the method used to sequence harvests. Assumptions for the TYP are identical to those of the Base Case, with the exception of these additional spatial constraints.

The TYP was created using a landscape design computer program, followed by detailed review and modifications by Canfor planning staff and engineers. Actual harvesting on TFL 37 is constrained by several factors that were not explicitly incorporated into the Base Case, namely (1) cutblock size limits; (2) cutblock adjacency; (3) short-term accessibility; and (4) watershed management. The TYP reduces the abstraction of timber supply analysis by organizing harvests so that they comply with these constraints.

Forest Simulation and Optimization System (***FSOS***) is a proprietary timber supply model developed by Dr. Guoliang Liu of Forest Ecosystem Solutions Ltd. ***FSOS*** can organize and sequence harvests using an heuristic algorithm—a search procedure that progressively improves a solution towards a desired state. The heuristic mode of ***FSOS*** is fully spatial, meaning that it can incorporate true cutblock adjacency and block size targets.

The TYP is not intended for use as an operational plan. The actual location of cutblocks on TFL 37 will differ from the sequence of harvests presented in this plan, perhaps substantially. The TYP simply provides a greater degree of certainty that the short-term harvest levels forecasted in the Base Case are operationally feasible.

2 METHODS

2.1 SFM PLAN 9 BASE CASE ASSUMPTIONS

SFM Plan 9 Base Case assumptions were used for this analysis, except where stated below. These assumptions are described in detail in the timber supply analysis information package (Forest Ecosystem Solutions Ltd. 2004). The timber harvesting landbase (THLB) is 91,325 ha and the initial standing volume of the THLB is 36.5 million m^3.

2.2 PLANNING HORIZON

The purpose of the TYP is to ensure that harvest is spatially feasible for the twenty years following the allowable annual cut determination. Therefore, the TYP planning horizon was set to twenty-five years, which is roughly the current five-year cut control period plus the following twenty years.

2.3 HARVESTING DEPLETIONS AND OPERATIONAL CUTBLOCKS

Recently logged cutblocks and those that have cutting permit (CP), Category A Approved, or Category A Proposed status were included in the TYP. However, the resultant database—the list of basic land management units—for this analysis was created in 2002. Some of the new cutblocks do not fit well into the existing shape of the resultant polygons that represent them. As a result, the TYP harvest blocks that represent the operational blocks are distorted in size and shape. This is a limitation of the analysis that was difficult to avoid without considerable additional expense of updating the resultant database.

2.4 SPATIAL OBJECTIVES

The following objectives were incorporated into the TYP to mimic the spatial constraints on harvesting in TFL37.

2.4.1 Cutblock size

The default maximum recommended cutblock size for coastal operations is 40 ha (Operational and Site Planning Regulation Section 3.1.11, upheld in FRPA). The Vancouver Island Land Use Plan Higher Level Plan Order (VILUP HLPO) (BC MoF, 2001) varies from the default maximum cutblock size regulations, depending on resource management objectives in resource management zones in TFL 37:

- Retention silviculture systems are used throughout the special management zones (SMZs) in TFL 37. Consequently, maximum cutblock size in SMZs is 40 ha, consistent with Section II.A.1(c) of the VILUP HLPO.
- Cutblocks in the Enhanced Forestry Zone (EFZ) may be larger than 40 ha, as specified in Section 2.D.7 (a). Consistent with this direction, the target maximum cutblock size in the EFZs was set at 60 ha for the purposes of the TYP.

Although there are no minimum cutblock size regulations for TFL 37, a target minimum cutblock size of 20 ha was implemented in the TYP to reflect operational practices. Cutblocks between 10 and 20 ha were considered acceptable.

2.4.2 Adjacency green-up height

As directed previously in Section 68(5) of the Operational Planning Regulation and upheld in the Forest and Range Practices Act, the green-up height in Special Management Zones (SMZs) and General Management Zones (GMZs) is 3 metres. As specified in the VILUP HLPO (BC MoF, 2001), the green-up requirement for the Enhanced Forestry Zone (EFZ) is 1.3 m. Although ***FSOS*** can apply green-up constraints using stand

height, the height output from TIPSY is different from the silviculture survey data used to determine cutblock green-up. Also, height growth is only specific to the nearest 5 years, the length of the planning periods over which harvests are tracked in ***FSOS***. To provide consistent and transparent results, green-up was defined as 5 years (1 period) in the EFZ, 10 years (2 periods) in the Coastal Western Hemlock BGC zone in the GMZs and SMZs, and 15 years (3 periods) in the Mountain Hemlock BGC zone of the GMZs and SMZs.

2.4.3 Watershed management

Based on recommendations from operational personnel, three areas were identified—Kilpala, Noomas, and Sebalhall drainages—as watersheds where further harvesting would likely be suspended to address hydrologic concerns. With the exception of CP and Category A operational cutblocks, harvesting in the TYP was deferred for the first two periods of the TYP planning horizon.

2.4.4 Existing road access

Stands identified as operable using ground or cable harvesting systems must be within 400 metres horizontal distance of an existing or proposed road to be eligible for harvest in the first two periods of the TYP planning horizons. This rule applies only to blocks that are not currently designated as CP and Category A operational cutblocks. The 400-metre distance is observed in practice where spur roads within blocks are used to optimize yarding distance.

Helicopter-operable stands that are currently greater than one kilometre from an existing or proposed road are excluded from harvest within the TYP planning horizon. A sensitivity analysis in the timber supply analysis tested the timber supply impact of removing these areas from the THLB.

2.5 MODELING METHODS

The TYP was created using a combination of heuristic (pseudo-optimization), simulation, and manual methods, proceeding in the following phases:

2.5.1 Cutblock generation

The resultant is made up of polygons (spatial units) as small as 0.1 ha. One of the major challenges of the TYP is to organize these polygons into cutblocks that are operationally realistic both in terms of size and shape. The heuristic mode of ***FSOS*** was used to build a population of cutblocks that are within the size objectives and that also tend towards "squareness". No attempt was made during this phase to comply with adjacency constraints.

2.5.2 Harvest sequencing

Once a sufficient population of cutblocks was generated, the simulation mode of ***FSOS*** was used to harvest the cutblocks in a sequence that complies with all the forest cover objectives, including cutblock adjacency constraints. Base Case harvest levels were followed for the entire planning horizon. The product of this phase was a draft TYP.

2.5.3 Operational Review and Modifications

Canfor staff reviewed the draft TYP. Following this review, manual changes were made to cutblock size, shape, and sequencing. The product of this phase was the final TYP presented in this report.

3 RESULTS

3.1 HARVEST SUMMARY

The attributes and the harvest profiles of the TYP are summarized in Table 1. Each attribute is discussed briefly below. All profiles are based on harvest volume. Where relevant, the equivalent profile for past performance (1998-2001) and for the entire THLB is shown for reference.

Table 1: Harvest summary of the twenty-year plan

	Cut Period						
	0[1]	**1**	**2**	**3**	**4**	**5**	**All**
Harvest Summary	*1998-2001*	2002-2006	2007-2011	2012-2016	2017-2021	2022-2026	**2002-2026**
Target Harvest Rate (m^3/yr)	*1,025,000*	1,074,000	970,000	922,000	875,425	831,654	**934,616**
Achieved Harvest Rate (m^3/yr)	*1,003,333*	1,077,568	971,149	921,546	874,888	832,342	**935,499**
Total Harvest Area	*5,829*	6,626	6,369	6,258	6,171	5,792	**31,216**
Number of Blocks		357	269	257	282	340	**1,484**
Average Block Size by Area (ha)		22	29	29	26	20	**25**
Average Block Size by Volume[2] (ha)		30	35	32	29	23	**30**

1 – Past performance from annual tracking of harvest profiles relative to Management Plan 8 targets.
2 – This average block size is prorated by volume for comparative purposes.

3.1.1 Harvest Forecast

Target harvest levels for the TYP are the same as those of the base case. However, due to the necessity of aggregating harvest into larger units (cutblocks), the TYP harvest may be slightly under or over the target in each period. The first period harvest is 3,500 m^3/yr (0.3%) higher than the target harvest level. The deviation from the target harvest level does not exceed 2,000 m^3/yr (0.2%) in following periods.

3.1.2 Total Harvest Area

The total harvest over the TYP planning horizon affects approximately one-third of the THLB. Harvests are generally around 6,000 ha each period, or 1,200 ha/yr, which is 1.4% of the THLB per year.

3.1.3 Block size distribution

The average block size in the TYP is 25 hectares, which is consistent with current practices on TFL 37. All model-built blocks are between 10 and 60 hectares in size (Figure 1). A small proportion of operational blocks are smaller than 10 hectares, due to poor alignment with existing resultant polygons or because they are windfall salvage blocks adjacent to or within other cutblocks. Ten Category A operational cutblocks exceed the 60-hectare maximum block size constraint. In some cases, this is due to distortions in block size resulting from an imperfect fit with resultant linework. In other cases, large block size is allowable because of planned internal retention or partial harvesting.

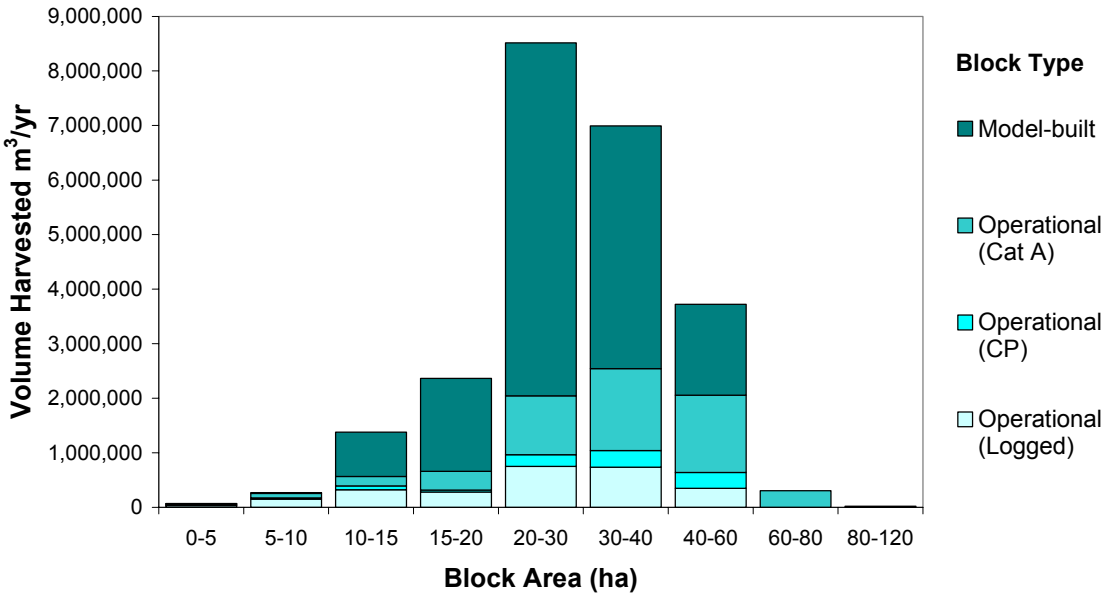

Figure 1: Block size distribution over the twenty-five year planning horizon.

3.2 HARVEST PROFILES

The harvest profiles of the TYP are summarized in Table 2. Each attribute is discussed briefly below. All profiles are based on harvest volume. Where relevant, the equivalent profile for past performance (1998-2001) and for the entire THLB is shown for reference.

3.2.1 Logging system

There are three basic harvest systems used in TFL 37: ground systems, cable systems, and helicopter systems. Ground and cable systems each cover approximately 40% of the THLB, and the harvesting forecasted in the TYP reasonably balances these two harvest systems. However, there is a trend of decreasing cable systems and increasing ground systems as the relative importance of low-elevation, gentle-sloped second growth stands increase over the TYP planning horizon.

There is considerable uncertainty about the long-term merchantability of helicopter operable stands with less than 30% cedar, cypress, or Douglas-fir by volume ("hembal-heli"). Consequently, hembal-heli is distinguished from other helicopter-operable stands in the logging system profile. 20% of the THLB is helicopter-operable, and 13% is hembal-heli. The first period is entirely composed of operational blocks, and demonstrates an operationally feasible harvest of 7% hembal-heli. Periods three to five harvest a slightly higher proportion of hembal-heli, especially in the third period, where 13% of the harvest is hembal-heli. Despite the uncertainty surrounding the hembal-heli profile, it does not indicate that the TYP is not feasible with less harvest in hembal-heli.

3.2.2 Economic operability

Economically marginal areas are old growth stands that would be economically operable only under favourable markets. Marginally operable areas were included in the Base Case THLB, and occupy a net area of 6569 ha (7.2% of the THLB). 7% of the TYP harvest is economically marginal, and ranges from 4 to 9% in any given period.

Table 2: Harvest profiles of the twenty-year plan

		Cut Period						All TYP	Entire
		0[1]	1	2	3	4	5	Periods	THLB
Profile Type	**Profile Class**	*1998-2001*	2002-2006	2007-2011	2012-2016	2017-2021	2022-2026	**2002-2026**	(2002)
Stand Origin	Old	*84%*	91%	84%	73%	60%	64%	**75%**	75%
	Transitional	*11%*	8%	14%	23%	26%	16%	**17%**	16%
	Existing managed	*4%*	1%	1%	3%	14%	20%	**7%**	10%
	Future managed	*0%*	0%	0%	0%	0%	0%	**0%**	0%
Age Class	21-40 years old	*0%*	0%	0%	0%	0%	0%	**0%**	
	41-80 years old	*10%*	7%	10%	16%	32%	29%	**18%**	
	81-140 years old	*13%*	5%	8%	14%	11%	8%	**9%**	
	141-250 years old		4%	2%	2%	1%	1%	**2%**	
	>250 years old	*76%*	83%	80%	68%	56%	62%	**71%**	
Tree Species	Hw/Hm/Ba	*68%*	69%	70%	69%	61%	61%	**66%**	65%
	Cw	*13%*	13%	11%	11%	10%	8%	**11%**	14%
	Fdc	*12%*	9%	9%	11%	20%	20%	**13%**	10%
	Yc	*7%*	7%	10%	8%	8%	10%	**8%**	9%
	Deciduous	*0%*	0%	1%	1%	1%	1%	**1%**	1%
	Other	*1%*	0%	0%	0%	0%	1%	**0%**	0%
Quadratic mean DBH	21-30 cm		1%	3%	2%	2%	4%	**2%**	
	31-40 cm		16%	17%	24%	27%	41%	**24%**	
	41-60 cm		64%	65%	62%	59%	49%	**60%**	
	>60 cm		20%	16%	12%	11%	6%	**13%**	
Stand Height	11-20 m		1%	0%	1%	0%	0%	**1%**	
	21-30 m		15%	23%	23%	21%	20%	**20%**	
	31-40 m		57%	57%	55%	63%	64%	**59%**	
	>40 m		27%	20%	22%	16%	16%	**21%**	
Logging Type	Ground	*92%*	37%	42%	44%	54%	47%	**44%**	41%
	Cable		52%	45%	37%	33%	32%	**40%**	40%
	Heli	*8%*	5%	4%	6%	5%	7%	**5%**	7%
	Hembal-Heli		7%	9%	13%	9%	13%	**10%**	13%
Economic Operability	Economic	*84%*	96%	92%	91%	93%	92%	**93%**	91%
	Marginal	*13%*	4%	8%	9%	7%	8%	**7%**	9%
	Uneconomic	*3%*	0%	0%	0%	0%	0%	**0%**	0%
Current Access	Road High (<175m)		79%	64%	45%	52%	48%	**58%**	69%
	Road Med (<400m)		8%	17%	25%	24%	22%	**19%**	14%
	Road Low (>400m)		1%	6%	11%	10%	10%	**8%**	6%
	Heli High (<500m)		10%	10%	14%	10%	15%	**12%**	8%
	Heli Med (<1000m)		1%	3%	5%	4%	5%	**3%**	3%
	Heli Low (>1000m)		1%	0%	0%	0%	0%	**0%**	1%

1 – Past performance from annual tracking of harvest profiles relative to Management Plan 8 targets.

3.2.3 Current access

There are two profiles of current access, one for road-based (ground and cable) harvesting, and one for helicopter harvesting. Current access for both systems is defined in terms of distance from the nearest road, and also the distance from major lakes in the case of helicopter harvesting. Road-based blocks are considered to have "high" current access if they are within 175 metres (an average yarding distance) of an existing or proposed road. Helicopter-operable systems are considered high-access if they are within 500m of a potential drop site. Areas greater than 400 and 1000 meters, respectively, from an access point are considered to have low access.

The majority of the THLB has high current access, and this profile is reflected in the TYP harvest profile. 89% of the volume harvested in the first period has high access, and only 2% is harvested from low-access areas. One of the spatial rules of the TYP is exclusion of future harvest in low-access helicopter harvest areas, this constraint is followed throughout the TYP planning horizon except for the harvest of a category A cutblock in the first period. Harvest of low access roads was deferred for 10 years from all areas outside FDP cutblocks. Opportunities to build access roads during the first three periods are indicated by increasing dependence on harvest in low- and medium access areas for road-based systems.

3.2.4 Stand origin

Three general categories of stands are available for harvest in the TYP period: Old Natural Stands (current age >80 years old), Transitional Natural Stands (current age 41-80 years old or deciduous), and Existing Managed Stands (current age 6-40 years old). Second growth stands (transitional and existing managed stands) become increasingly important during the TYP planning horizon, and make up more than one-third of the harvested volume in the fourth and fifth periods.

3.2.5 Tree species

The overall species profile of the TYP is close to the profile of the THLB. Periods 4 and 5 however, show a decreasing dependence on hemlock and balsam and an increasing harvest of Douglas-fir. Western redcedar shows a slight decline from 13% to 8%, but harvest of yellow cypress is relatively stable. On average, 1% of the projected harvest volume is from deciduous species, primarily red alder.

3.2.6 Stand age

The TYP covers a period where harvest in TFL 37 is in transition from old growth to second growth stands. During the TYP planning horizon, old stands (>250 years old) decline from 83% to 62% of the volume harvested, and younger second growth stands, mainly in the 41-80 year category, increase from 13% to 37% of harvest. Relatively little harvest comes from mature stands between 141 and 250 years old.

3.2.7 Average stem diameter

The quadratic mean diameter-at-breast-height (DBH) is the diameter (outside bark) at breast height of the tree of average basal area in a stand. Because a stand average is used, the DBH profile gives the average diameter of the stands harvested, rather than the actual profile of tree diameters. The log diameter profile would include larger and smaller logs than the quadratic mean DBH profile shown in Table 1.

Large-diameter stands (>40cm dbh) dominate the profile throughout the TYP planning horizon. However, smaller diameter stands are increasingly important in the later periods, and comprise 45% of the harvest volume in period 5.

3.2.8 Top height

Similar to the DBH profile, the height profile reports on a measure of stand height, rather than a measure of individual tree height. Top height is the average height of the 100 trees/ha of largest diameter at breast height.

Overall, the top height profile does change considerably over the TYP planning horizon. The most notable trend is the decrease in the proportion of tall stands (>40m) from 27% in period 1 to 16% in period 5.

4 DISCUSSION AND CONCLUSIONS

Base Case harvest levels were achieved using a harvest pattern that mimics operational practices on TFL37. The TYP indicates that base case harvest levels are spatially feasible for the twenty-years following the upcoming AAC determination expected in early 2006. This plan does not provide an assessment of spatial feasibility beyond the year 2026.

4.1 UNCERTAINTIES

The sensitivity analyses provided in the timber supply analysis report provide an idea of the relative importance of key timber supply assumptions. In addition, there are some spatial assumptions that are unique to the TYP. The TYP would be substantially different, and possibly not achievable at base case harvest levels, if the following changes to assumptions were made:

- Economic operability is the major uncertainty in the THLB. Changes to wood values and harvesting costs would affect the feasibility of some of the TYP cutblocks.
- Removal of some or all of the hembal-heli stands from the operable land base would require a reduction in harvest levels of up to 7%.
- Changes to green-up heights or to the assumed relationship between green-up height and age could reduce the spatial opportunities for locating cutblocks. The 1.3m greenup requirement in the Enhanced Forestry Zone is crucial to achieving the base case harvest levels in the TYP.

4.2 OPERATIONAL FEASIBILITY

The cutblocks portrayed in the TYP mimic operational cutblocks, but they are not intended to be 100% operationally feasible. The TYP cutblocks differ from operational cutblocks in the following ways:

- **Shape**: TYP cutblocks follow the boundaries of resultant polygons, and sometimes follow unfeasible shapes.
- **Internal retention**: small reserves such as wildlife tree patches, dispersed retention, and riparian reserve zones are not spatially delineated in the TYP. Instead, these features are accounted for by reducing the volume harvested from each cutblock.
- **Stand isolation**: the configuration of cutblocks in the TYP often leaves small patches of unharvested timber in an isolated position. The heuristic mode of ***FSOS*** is designed to minimize these residual patches, but the solutions are not perfect. Operational cutblock layout is more efficient at minimizing stand isolation.

Translating the TYP into an operational plan would require adjustments to the cutblock boundaries. Nevertheless, the plan represents a feasible sequence of harvest.

5 REFERENCES

B.C. Ministry of Forests 2001. *Vancouver Island Higher Level Plan Order, effective December 2000*. Victoria, Province of British Columbia.

Forest Ecosystem Solutions Ltd. 2005. Tree Farm Licence 37: Timber Supply Analysis Report for Sustainable Forest Management Plan 9. Contract report prepared for Canadian Forest Products Ltd. April 19, 2005.

Forest Ecosystem Solutions Ltd. 2004. Tree Farm Licence 37: Information Package for Sustainable Forest Management Plan 9. Contract report prepared for Canadian Forest Products Ltd. December 19, 2004.

B.C. Ministry of Forests 1998. Forest Practices Code of BC Act—Operational and Site Planning Regulation. B.C. Reg. 107/98 Deposited April 2, 1998. O.C. 0426/98 effective June 15, 1998 (Consolidated to December 12, 2003). Victoria, Province of British Columbia.

APPENDIX A: TWENTY-YEAR PLAN MAPS