UBC Alex Fraser Research Forest

Management And Working Plan #3

Effective January 1, 2007
to December 31, 2012
Special Use Permit 15382

UBC Forestry
University of British Columbia
Welcome to Our Classroom

Faculty of Forestry
UBC
ALEX FRASER RESEARCH FOREST

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January 5, 2007

Al Balogh, RPF
District Manager
Central Cariboo Forest District
640 Borland St.
Williams Lake, BC V2G 4T1

Dear Sir:

Re: Letter of Transmittal, Management and Working Plan #3, SUP 15382

Pursuant to our tenure agreement, please find enclosed Management and Working Plan #3. This document is intended to guide the management of our Research Forest by resolving our management objectives with strategic direction from the Forest and Range Practices Act and the Cariboo Chilcotin Land Use Plan.

There have been substantial changes to the practice of forestry in the Cariboo since MWP#2 was written in 1996. Working within that Management Plan has helped us to react to change in a constructive manner, and I fully expect that this new plan will continue to support our activities as our world continues to change around us.

I would like to direct your attention to several unique aspects of this plan.

- I have taken the step of summarizing the history of the area we manage, in the belief that our future is strongly influenced by our past.
- I am proposing that we convert our forest management to area regulation, and as such have stated our Allowable Annual Cut in hectares instead of cubic metres.
- We will implement an ongoing process of consultation, rather than simply referring this plan for comment.
- We have assembled a list of twenty action items, which will take us many years to complete.

We hereby submit this plan for your approval.

Sincerely,
UBC Alex Fraser Research Forest

Original Signed and Sealed

Ken Day, M.F., RPF
Manager

Cc: Jack Saddler, PhD, Dean of Forestry, UBC
Bruce Larson, PhD, Chair, Research Forest Advisory Committee, UBC

UBC Alex Fraser Research Forest

Management And Working Plan #3

Effective January 1, 2007 to December 31, 2012

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Prepared By:

Ken Day, MF, RPF
Manager

3 Jan 2007
Date

Accepted on Behalf of the UBC Faculty of Forestry

5 Jan 07

Jack Saddler, PhD
Dean, UBC Faculty of Forestry

Forestry
University of British Columbia
Welcome to Our Classroom

UBC Corporate Guidance

University of BC Vision

The University of British Columbia, aspiring to be one of the world's best universities, will prepare students to become exceptional global citizens, promote the values of a civil and sustainable society, and conduct outstanding research to serve the people of British Columbia, Canada, and the world.

Faculty of Forestry Vision

To be a world leader in education and research for the conservation and sustainable management of forests and forest products that contributes to preserving the environment and improving the welfare of society.

Faculty of Forestry Mission

To provide the citizens of British Columbia and the world with knowledge of how their forests grow and change, how to conserve and manage forests and create products to contribute diverse economic, social and spiritual benefits to communities, in ways that respect nature. (Faculty of Forestry 2004)

UBC Environmental Protection Compliance Policy

UBC will act responsibly and demonstrate accountable management of the property and affairs of UBC in protecting the environment. All individuals in the University community share the responsibility for protecting the environment. Administrative heads of unit are responsible for ensuring compliance with legislation and UBC procedures both on and off campus.

UBC Safety Policy

The University aims to provide a safe, healthy and secure environment in which to carry on the University's affairs. All possible preventive measures are taken to eliminate accidental injuries, occupational diseases and risks to personal security.

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1. Management Philosophy

We manage the Alex Fraser Research Forest to create opportunities for education, research and demonstration of sustainable forest management. We will steward the Research Forest to produce a sustainable flow of values, in a financially self-sufficient manner.

1.1. Goals of the Alex Fraser Research Forest

1. We will operate a viable forestry enterprise, to pursue the mission of the Faculty of Forestry and UBC. By managing our forest lands for education, research, and demonstration, we will positively affect natural resource science, management, and stewardship.
2. We will create a wide range of conditions to maintain a field laboratory that supports teaching, research, and demonstration in resource management and conservation.
3. We will protect investments in research and teaching from our management activities, and from other research activities.
4. We will thoughtfully carry out and document our activities, to actively support teaching and research for students, faculty, and professionals. We will make our experience available to those who seek it.
5. We will promote the use of the Research Forest, and ensure that the Research Forest remains relevant to the Faculty of Forestry, UBC, and the citizens of British Columbia and the world.

1.2. Forest Management Objectives

The objectives of forest management on the Research Forest support the goals outlined above. Our objectives for management are to:

1. Harvest timber to provide sufficient revenue to pay for the management of the Research Forest;
2. Provide opportunities for education, research, and demonstration in forest resources conservation and management;
3. Provide opportunities to vary practices from current standards to test unorthodox approaches;
4. Protect the productivity and hydrologic function of the soil in all operations;
5. Sustain or enhance the resources available on the Research Forest for
   - fish and wildlife habitat
   - water
   - timber
   - range
   - recreation;
6. Protect and conserve the values in place on the Research Forest, including
   - research and education sites

- visual quality
- biological diversity
- cultural heritage resources;

7. Protect the forest from catastrophic losses due to
   - forest fires
   - insect and disease infestations
8. Grow and harvest a diverse range of timber products and non-timber forest products for sale;
9. Regulate the harvest of timber and non-timber forest products to minimize the periodic variation in revenue;
10. Regulate the composition of the forest to ensure
    - vigorous and productive forests
    - a diversity of habitats
    - a diversity of product opportunities;
11. Carry out our activities to provide a safe, healthy, and secure environment in which to conduct our affairs.

2. Description of the Area

2.1. Physical description

The Research Forest comprises two distinct blocks of forest land near Williams Lake in the Central Cariboo Forest District. Please refer to the key map at Figure 1. The southern-most block, known as the Knife Creek block, is located on very gentle terrain adjacent to the San Jose Valley and is 3,487 ha in area. The Gavin Lake block, covering 6,315 ha, is located adjacent to Beaver Valley near Quesnel Lake, on gently rolling terrain. Both blocks are serviced by well maintained highways.

The dominant landform material on both blocks is a gravelly loamy morainal blanket or veneer over gently rolling terrain. The most commonly occurring soils on the Knife Creek block are Gray Luvisols. Dystric Brunisols and Gray Luvisols are the dominant soils found on the Gavin Lake block.

The Gavin Lake Forest Education Society (GLFES) operates a residential Forestry Centre for up to one hundred people of various ages at Gavin Lake, which is contained by the Research Forest. The area immediately surrounding the Centre is used extensively for forest resource education and recreation through GLFES programs. The Forestry Centre and its environment are fundamental to the development of the Research Forest. A formal Memorandum of Understanding between the Gavin Lake Forest Education Society and the University of British Columbia will ensure ongoing co-operation to the benefit of both parties.

2.2. Biogeoclimatic Description

The Knife Creek block is located in the IDFdk3 biogeoclimatic subzone, with a small component of IDFxm. These subzones are dominated by interior Douglas-fir[1], but are differentiated by the absence of lodgepole pine and presence of bluebunch wheatgrass (*Agropyron spicatum*) in the IDFxm. The eastern portion of the Knife Creek Block is transitional to the SBPSmk subzone, which is dominated by interior spruce and lodgepole pine.

The Gavin Lake block is primarily located in the SBSdw1 subzone, with a significant component of ICHmk3. The SBSdw1 is dominated by mixed stands of Douglas-fir, lodgepole pine, and trembling aspen. The ICHmk3 supports western redcedar, hybrid spruce (*Picea glauca* x *P. engelmannii*), and subalpine fir. Please refer to Table 1 for biogeoclimatic data.

1 Common names are used throughout this plan, except for species of plants and animals that may be unfamiliar or ambiguous to the reader.

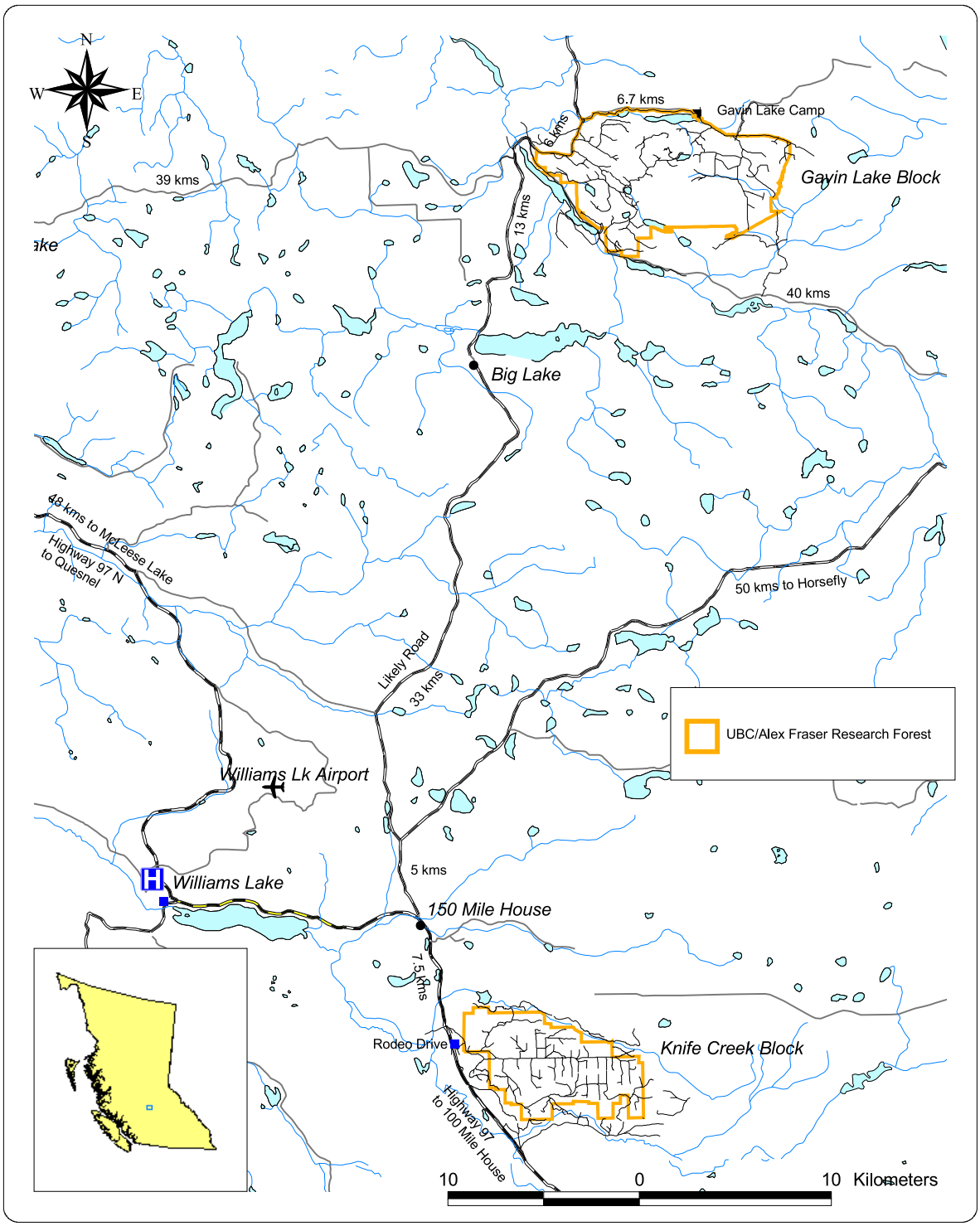


Figure 1: Location map for the UBC/Alex Fraser Research Forest.

Table 1: Biogeoclimatic data for the variants occurring on the UBC/Alex Fraser Research Forest (adapted from Anon 1987).

ZONE & VAR.	CLIMAX TREE SPECIES	ASSOC. TREE SPECIES	DOMINANT UNDER-GROWTH	MEAN PRECIP (mm)		MEAN TEMP (°C)	
				Year	Grow	Year	Grow
IDFxm	Fdi	At,Ac,Sx, (Pli),Jt	snowberry-pinegrass bluebunch wheatgrass-forbs	389	204	4.1	13.3
IDFdk3	Fdi	Pli,At,Ac, Sx,(Ep)	pinegrass-forbs	444	214	3.0	11.9
ICHmk3	Cw,Sx,	Fd,Pl,At, Ac,Ep	falsebox-forbs-moss	664	308	4.5	12.0
SBPSmk	Sx	Pli, At, Ac, (Bl), (Fdi)	blueberry - pinegrass - forb	534	227	2.7	10.9
SBSdw1	Sx,Fdi	Bl,Pli,At Ac,Ep	shrubs-forbs pinegrass-moss	527	274	3.7	12.8

Tree Species Symbols:

Ac -- cottonwood

At -- trembling aspen

Bl -- subalpine fir

Cw -- western redcedar

Ep -- white birch

Fdi -- Douglas-fir (interior form)

Jt -- Rocky Mountain juniper

Pli -- lodgepole pine (interior form)

Sx -- hybrid white x Engelmann spruce

2.3. Area Summary

Figure 2 and Figure 3 display the distribution of Research Forest area by biogeoclimatic subzone, and by site series (respectively) (Klinka et al. 2003). Klinka et al. (2003) mapped transitional areas between subzones that are included as unique subzones in the area summary provided.

Table 2 shows the area of non-forest-land on the Alex Fraser Research Forest. Table 3 describes the forest inventory by age class and leading species and is depicted graphically in Figure 4.

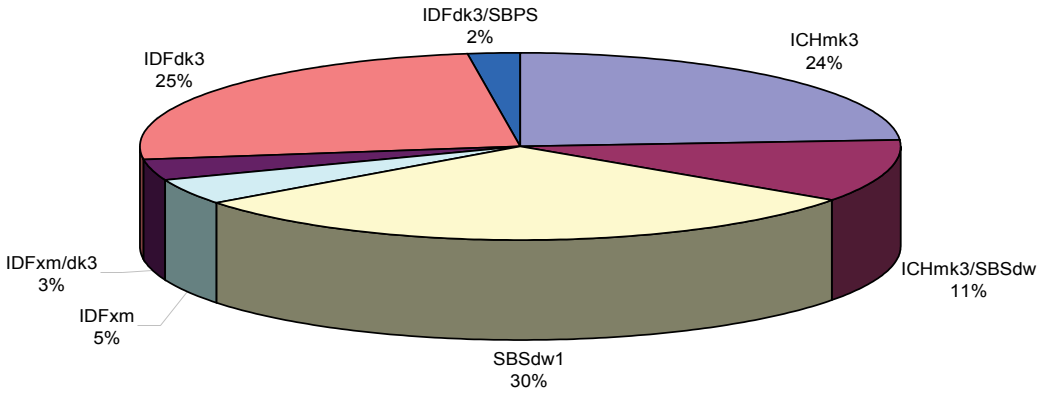


Figure 2: Proportion of area by Biogeoclimatic subzone for the Alex Fraser Research Forest.

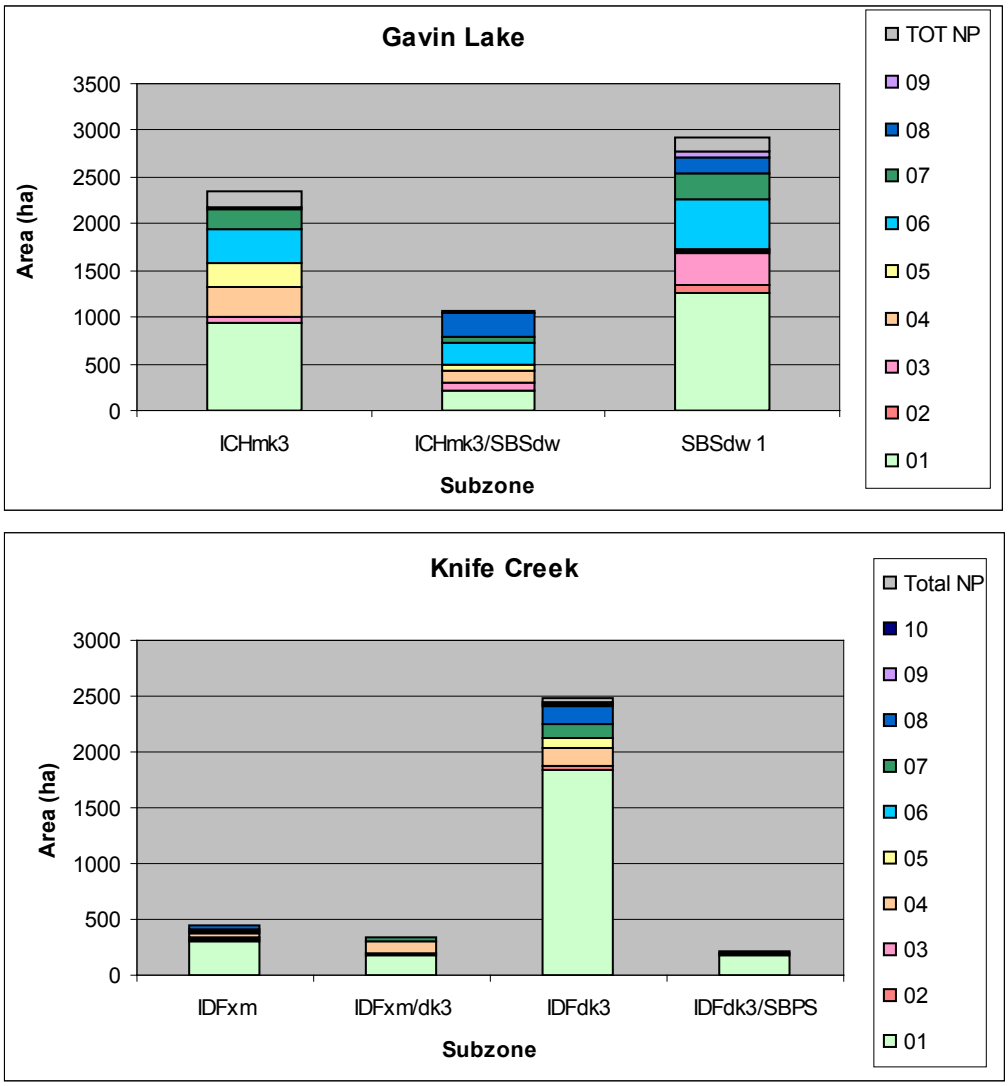


Figure 3: Site series distribution for the Alex Fraser Research Forest by biogeoclimatic subzone.

Table 2: Area of non-forest land classified according to the updated forest inventory (2004) for the Alex Fraser Research Forest.

	Area of Non-Forest Land (ha)					
Block	Cleared	Lakes	Brush	Swamp	Urban	Grand Total
Gavin Lake	12	215	56	52	20	355
Knife Creek	47		3	12		62
Grand Total	59	215	59	64	20	417

Table 3: Forested area by age class and leading species according to the updated forest inventory (2004) for the UBC Alex Fraser Research Forest.

Block	Age class	Area (ha) By Leading Species									Grand total
		Ac	At	Bl	Cw	Ep	Fd	Pl	Sx	Not Stocked	
Gavin Lake	0									57	57
	1	5			62	13	69	148	266		563
	2	59	21	48	235		57	85	141		645
	3		99	22	13	10	10		18		172
	4	17	62				1,016	31	133		1,259
	5	4	91	44	3		480	16	25		663
	6		46			35	429	7	33		551
	7	6	5				1,262	22	177		1,472
	8			22	72		289	3	122		508
	9				131		5		4		139
Gavin Lake Total		91	323	136	516	58	3,617	313	918	57	6,030
Knife Creek	0									1	1
	1		7				33	66			106
	2		15				32	56			103
	3						681		13		694
	4						508				508
	5						296	17			313
	6		2				76	2			80
	7		5				522	90	4		622
	8						995	0			995
Knife Creek Total			28				3,144	231	18	1	3,422
Grand Total		91	352	136	516	58	6,761	545	935	59	9,452

Age Classes

1 -- 1-20 years

2 -- 21-40

3 -- 41-60

4 -- 61-80

5 -- 81-100

6 -- 101-120

7 -- 121-140

8 -- 141-250

9 -- 251+

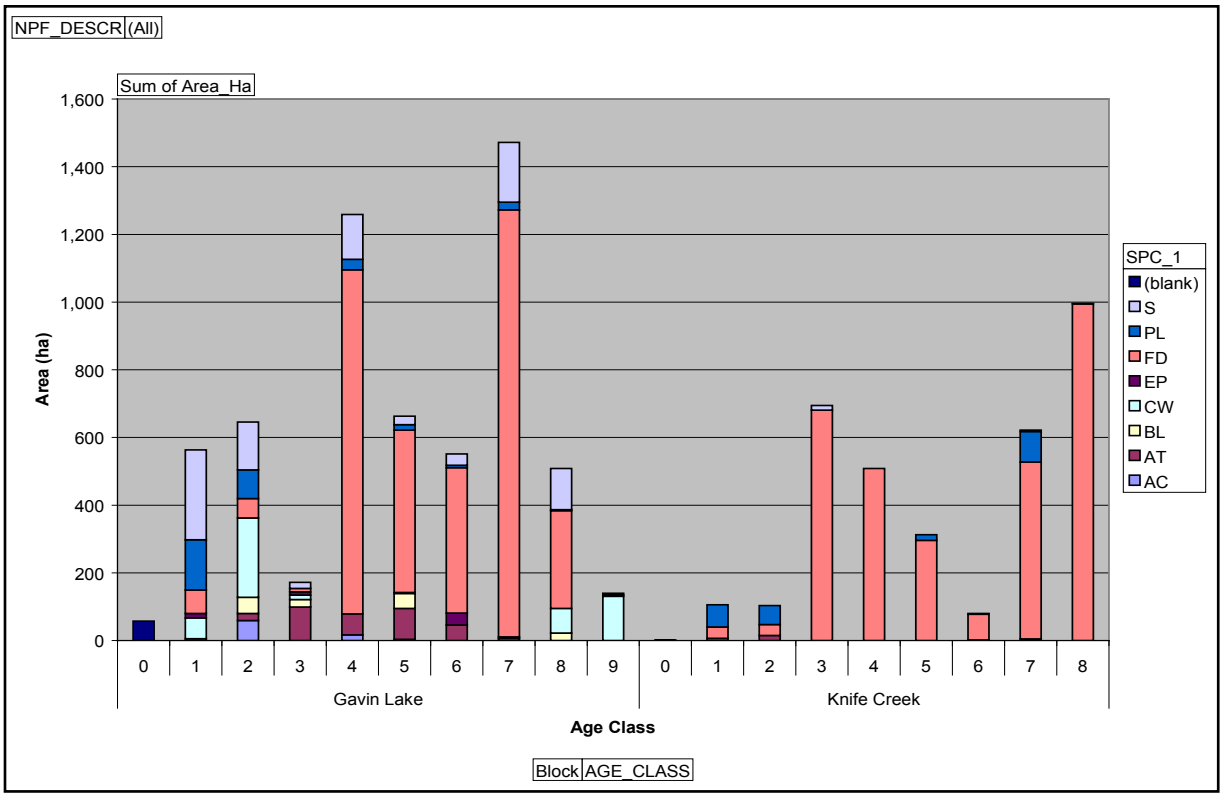


Figure 4: Leading species distribution (area) by age class for each block of the UBC Alex Fraser Research Forest according to the updated forest inventory (2004). Age Class 0 represents the area of land which has not yet been reforested.

2.4. History

The character of the forest on both blocks is, to a large measure, a product of natural and human history. Frequent wildfires in the Knife Creek block have created an uneven-aged stand condition, and in the Gavin Lake block have resulted in a predominance of mid-seral and mature stands.

Logging activity dates back to the mid 1940s (and certainly before) in the Knife Creek block, and to the early 1960s in the Gavin Lake block[2]. These logging practices and the resulting silviculture activities and road networks, combined with successful fire suppression activities, have changed the structure of the forest considerably. In addition, grazing and range management, trapping, hunting, fishing, and fish and wildlife management have helped to shape the forest.

All of these activities have altered the nature of the forest resources as they exist today. It is this modified resource base which will be managed to achieve Research Forest objectives as described in Chapter 1. Change is a feature of natural ecosystems, and results from both

2 History records and forest cover maps show logging as early as 1942 in the Knife Creek block. The earliest logging in the Gavin Lake block is probably from the 1950s, but maps and records do not show year of disturbance for the areas logged selectively on the Beaver Valley slopes and on the north shore of Gavin Lake.

natural processes and management activities. Management of an area is improved if we understand its history.

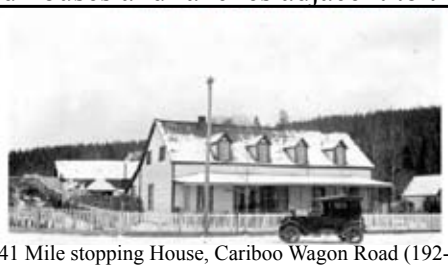
2.4.1. Knife Creek Block

The Knife Creek block is located between Knife Creek and Jones Creek, which flow westward to the San Jose River. The San Jose River valley was occupied by native villages before European settlement, and contains the Cariboo Wagon Road (later the Cariboo Highway) and the Prince George Eastern Railway (latterly BC Rail, now CN Rail). Due to its valley-bottom location, this block is in one of the most heavily travelled sections of the Cariboo Landscape. The old Wagon Road, and before that the Hudson's Bay Brigade trail, passes the west boundary of the forest. The oral history of the Williams Lake Indian Band indicates that the forest contains sacred ceremonial grounds, and the Jones Creek Valley was used as a travel route to summer camping areas. Its proximity to village sites assures us that the Knife Creek mule deer winter range has been an important winter hunting area.

Three periods of history have had significant impacts upon the forests of Knife Creek block, and are discussed below. Much of the background information on the current forest conditions is not referenced. It represents the author's interpretation of information from a wide variety of sources, from the popular press to oral history, and includes ample deduction and speculation.

The early period (before 1860) was important to the area, because the First Nations people apparently used fire to manage their environment. The most probable reasons for burning include fire hazard reduction, and management of forests for particular hunted animals or food plants.

Settlement of ranches (1860s to 1940s) started along the wagon road during the Cariboo Gold Rush, to supply miners with meat and other supplies. Road houses and ranches adjacent to the Knife Creek block included 141 Mile House (1861), 144 Mile House (1867) and 145 Mile House (1861) (Patenaude 1996). Jones Creek is probably named for Mrs. Jones, who operated 145 Mile House.


141 Mile stopping House, Cariboo Wagon Road (192-). Courtesy BC Archives E-09958.

The ranchers depended upon the forests for timber and for summer range for their cattle. Hay was cut from natural grasslands, meadows, and later from developed hay fields. Development of ranches adjacent to the Knife Creek block greatly altered the landscape, since natural grasslands and meadows in the valleys were expanded for production of feed crops under irrigation. Irrigation ditches are still in use on the southern and western boundaries of the Forest.

In 1913 and 1914 E.G. McDougall conducted reconnaissance surveys of the Lillooet and Cariboo Land Districts. The following passage from his report (McDougall 1913) describes the area around the Knife Creek block (brackets [ ] represent words that are not legible on the old carbon copy of his report):

"The San Jose River flows north-westerly from Lac La Hache to Williams Lake, descending from 2700 feet to 1950 feet elevation. The valley is about two miles wide, and is bounded by escarpments rising to [ ] elevation. That on the south-west is precipitous, and the plateau behind it is stony for some distance: while that on the N.E. is gentle, and the plateau is well supplied with meadows. There are three tributary valleys coming in from the east, those of Knife Creek, Jones Creek, and 150 Mile Creek. All contain considerable areas of good bottom land. The plain above the main valley slopes gradually up to the base of some rocky hills, 4200 feet in elevation, which [ ] east of the Horsefly Road, and supply the headwaters of Knife Creek. Although fairly level, the plain is very stony in parts. Some of the meadows at the higher elevations, partake of a muskeg character. Nearly [all] the best land throughout this block has been taken up years ago, the cultivated portions produce excellent crops. Cultivation [ ] is frequently neglected in favour of the road-house business, on plan [sic] of scarcity of labour.

The timber is distributed in belts along the sides of the main valley, and behind those belts lies the burned country, which [is] covered with a patchy Black Pine stand, from ten to fifty years [old]. The persistence of the old stands in positions so exposed to fire [must] be due to the former periodical removal of undergrowth and litter [by] light burning, and to some extent by the pasturing of horses and [ ]. Away from those influences, the forest would come into an extremely flammable condition, and when, at longer intervals, fire did reach [them,] the result would be total destruction.

Portions of the stony plateau country might serve for [ ] pasture, but in general the land unfit for agriculture would be [ ] in forest. This part of the country seems to be well adapted to [dry] farming. It is traversed by the Cariboo Road and the P.G.E. now under construction."

McDougall (1913) reported that only 16% of the area surveyed was timbered, and 69% had been burned. Presumably "patchy stands of Black Pine" were not considered timber, since there was pressure from ranchers to allow burning of pine stands to increase grass. This had been a common practise until a fire control law was introduced.

In his more complete report, McDougall (1914) describes the forest types of the area as follows:

"The Douglas Fir type formerly covered a large part of the interior; mostly above 3000 feet elevation; but it is now limited to certain strips and patches along the edge of the valley of the Fraser, San Jose, Bridge and Bonaparte Rivers, and to a few isolated patches elsewhere. It ascends to an elevation of 4000 to 5000 feet. The stand varies in density from 2000 to 6000 feet B.M. per acre.[3] Reproduction is usually good, taking place chiefly in openings, which are numerous. This forest is of some importance for local lumber supplies, but the poverty of the stand and the poor quality of the product would make it unavailable for outside markets.

The Lodgepole Pine type is the most extensively distributed in the Interior, but is probably of a transitory character. It comes in on burned areas formerly occupied by other types, especially the Douglas Fir type; it may also occupy areas that were formerly prairie. As a rule it is wind-thrown before reaching maturity, but sometimes attains saw size, and in favourable locations might yield 2000 feet B.M. per acre. The stand is very dense, and the trees well-formed, though small; they often show frost cracks and other defects. This forest is used locally for fencing, building logs, etc., and might be utilized for pulp."

PGE Tie Camp, 1921 (location unknown). Courtesy BC Archives D00072.

The earliest records of industrial timber harvesting on the Knife Creek block date from 1942. It is likely, however, that small hand-logging sales for hand-hewn railway ties began at about the time the railroad came to Williams Lake around 1920. Ties were hewn on two sides with a broad axe

3 1000 board feet per acre is approximately 10 m^3/ha. Such low volume estimates reflect the utilization standards in place at the time McDougall wrote his report. Lodgepole pine was not used, and only large logs of high quality would have been considered merchantable.

from Douglas-fir trees, skidded by horses to a landing for debarking and cutting to length. They were then hauled in a sleigh to the railroad, where they were stacked for pickup. A good tie cutter could cut 40 ties in a day, and would make $4.50 (Eagle 1979).

Thwaites (1964) states that:

> *"Lumbering in the Cariboo is almost entirely a post-World-War-II industry. It had its beginnings with local ranchers and others cutting timber on their lands and selling the logs or sawing them into cants or rough lumber."*

From the 1940s to the early 1960s (the Bush Mill era) the drybelt fir stands in the Williams Lake area were exploited for railroad ties and saw timber. Most of this logging was done with horses skidding to tractor roads, and tractors were used to forward the logs to the portable sawmills. Except along the tractor roads, most of the trees selected were of a diameter to allow one tie to be cut. The horses were able to skid the smaller logs fairly easily, and therefore greater distances. This type of cutting resulted in good stocking remaining in most size classes after logging, except close to the mills and adjacent to the tractor roads. Horses gave way to crawler-tractors and arch trucks[4] by the early 1960s.

G.W.J. Moore Sawmill 150 Mile House (date unknown). Courtesy BC Archives NA-04611.

According to Thwaites (1964) the bush mills were primarily established by loggers moving up from the coast, and since they were principally loggers, the milling operations were simple. Utilization was poor by today's standards, with up to 40% of each log lost to sawdust and shavings, and trim-ends were burned. Scattered bush mills meant that no utilization of the waste was possible (Thwaites 1964). Bush mills operated on the Knife Creek Block, in the east and north on Crown land, and in the west on private land.

Administration of the forest resource by the BC Forest Service was divided between the Kamloops Forest District and the Prince George Forest District. Mills in the Cariboo drew two-thirds of the volume from Kamloops Forest District (Thwaites 1964). Under the structure of the 1960s, the Forest District was analogous to the current title of Forest Regions. Between 1952 and 1962 the volume cut in the Kamloops Forest District increased by 126%, and in 1962 66% of the harvest volume was Douglas-fir (Thwaites 1964).

In the 1960s forest policy changed; sawmills were required to manufacture chips from sawmill waste, to feed a developing pulp industry in the interior. Very rapidly the bush mills began to shut down, and rights to public timber were bought up by the owners of planer mills in town. The planer-mill owners then used their new quota to build stationary sawmills. The centralized sawmill operators preferred to avoid logging, due to the expense of supervising the logging operations and the cost of owning and operating logging equipment, so contract loggers were used (Thwaites 1964).

With the advent of stationary sawmills in town, the technique shifted to diameter-limit cutting. All the trees within a cutblock over a certain diameter were harvested. Diameter-limits varied through time, from as low as ten inches (25 cm) in the mid-1960s to as high as 18 inches

4 Arch truck -- a truck with an A-frame on the deck, over which a mainline travelled to reach out to timber from the road. These trucks were apparently able to skid a large load.

(45.7 cm) in the late 1970s. In the mid- to late-1960s lodgepole pine became merchantable. Areas logged in Knife Creek before 1967 had lodgepole pine left standing, but after that time the pine was cut. Although the diameter-limit system was usually successful in maintaining advanced regeneration, it often failed to maintain a good representation of thrifty mature trees, particularly where diameter limits were low. Also, this system tended to produce a stand that was poorly distributed, with voids and patches of excessive density.

In the late 1970s it was recognized that the diameter-limit approach was not as successful as it should have been, and that signalled the onset of the faller-selection methods. The faller-selection method is based upon the principles of single-tree-selection management. It seeks to remove about 50% of the volume from all of the merchantable diameter classes, and leave the healthiest trees to regenerate openings and add increment. Little logging was done on the Knife Creek block during the period of faller-selection, probably due to increasing conflict over harvesting on mule deer winter range.

In the early 1980s an intensive study of mule deer ecology was initiated on the Knife Creek block by the Ministry of Forests. The study was born out of conflict; the forest industry wanted continued access to the Douglas-fir, and Ministry of Environment saw continued harvesting on winter range as a threat to mule deer habitat. That study has been led by Harold Armleder, Rick Dawson, and Michaela Waterhouse for more than twenty years, and they have sought methods of integrating timber harvesting with mule deer ecology. Their initial methods were based upon the faller-selection method, but restricted harvesting to low volumes and long re-entry periods. Their method was supported by many studies of mule deer ecology, generally including study sites in the Knife Creek Block.

Mule deer feeding experiment, RP 87-00. Stephen Walker photo.

In 1987 the Alex Fraser Research Forest was created and the first Resident Forester (the author of this plan) was hired. Little harvesting was carried out for the following decade, except the salvage of trees killed by Douglas-fir bark beetles. With funding from the Ministry of Forests, Research Forest staff have been able to focus on improving the condition of disturbed stands, through pre-commercial thinning and brushing. Starting in 1998, we began to harvest cutblocks due to the increasing infestation of mountain pine beetles. Harvesting of mountain pine beetle-driven cutblocks was completed in 2004, with a total of 247 ha harvested in that seven-year period. Additional areas were harvested by single-tree salvage operations.

2.4.2. Gavin Lake Block

The Gavin Lake Block is located on the north slope above Beaver Valley, northeast of 150 Mile House. First Nations people travelled through the area seasonally to gather food, and archaeological evidence and oral records indicate that the Gavin Creek drainage was an important area for food-gathering.

Travel routes from 150 Mile House to the Cariboo Goldfields passed by the western edge of the Gavin Lake Block. This was not the famous Cariboo Wagon Road, which ended at Soda

Creek, but was an unsurveyed road/trail that extended from Mountain House to Keithly Creek, and up over Yanks Peak to Barkerville. Evidence of this old road can be found east of the present Likely Road, and the old crossing on Gavin Creek is still visible.

A ranch and road house, known as Beaver Lake House, was operating as early as 1860 just west of the Gavin Lake Block. This operation served travellers as a provisioning stop, hotel, saloon, freight-wagon station, and guiding outfit (Patenaude 1995). The ranch is presently owned by Fred Tillotson, who has grazing rights on the Research Forest. Gavin Lake is probably named for Gavin Hamilton, who operated the road house in the early 1900s.

Gold Digger, BC by W.G.R. Hind, 1864. Courtesy of Royal BC Museum PDP00026.

In 1926 a large fire, reportedly started at a cabin on the north shore of Prouton Lake (Shelly Nicol, personal communications, 199_), burned the large majority of the area of the forest east of Prouton Lake.

Starting in the 1950s, bush mills began to operate in Beaver Valley and at Gavin Lake. The mill at Gavin Lake was operated on the present site of the Gavin Lake Forestry Centre, owned and operated by the Gavin Lake Forest Education Society. Following are excerpts of a written history of the camp (adapted from Anon (1988)).

All-Fir Lumber was owned by an American named Mr. Vandivanter. All-Fir operated a sawmill on crown land at the eastern end of Gavin Lake from the mid-1950s to the early 1960s, and the evidence of their early logging can be seen in the partially harvested stands west of camp on the north shore of Gavin Lake. The logs from this area were forwarded to the lake, probably by tractors, and the evidence of the tractor roads is still visible. Logs were boomed on the lake, as evidenced by the presence of old boom sticks at the outlet of Gavin Lake. The old de-watering spot can still be seen at the beach below the Forestry Centre fire pit.

The Pathfinder
Long years ago I blazed a trail
Through lovely woods unknown till then,
And marked with cairns of splintered shale
A mountain way for other men.

For other men who came and came;
They trod the path more plain to see,
They gave my trail another's name
And no one speaks or knows of me.

The trail runs high, the trail runs low,
Where wild flowers dance, or columbine;
The scars are healed that long ago
My axe cut deep on birch and pine.

Another's name my trail may bear,
But still I keep, in waste and wood,
My joy because the trail is there,
My peace because the trail is good.

J. N.J. Brown
(Klan 2004)

According to Tillie Robertson, who was employed by All-Fir Lumber as a camp cook, the cookhouse, cabins and garage were located on the upper bench. The cookhouse was quite rustic; it had wood heat but lacked running water, and the lighting was provided by gas and coal oil lamps. A small bedroom was provided for the cook. Meat was kept cool in two small propane fridges.

Of the cabins provided for the men, four were built to accommodate married couples, with the other three or four cabins shared by four men each. The cabins were heated by wood, with the men responsible for cutting their own firewood.

When Merrill-Gardner bought All-Fir Lumber in the mid 1960s, they were also operating a logging camp on Horsefly Lake, known as Camp #2. There had been new camp buildings erected at Camp #2 in 1961, including a cookhouse, washhouse, and seven or eight cabins. These buildings were moved to the new logging site at Gavin Lake, which became known as Camp #3.

The first year at Gavin Lake was a busy one, according to Joe Hopp, a longtime Merrill-Gardner employee. With the sawmill operating and the logging going on, the number of men in the camp rose from 45 to 95 at times. All of the cabins on the site were full and many men brought in trucks with campers to sleep in. Some of the men did commute as the bulk of the crew were local or within reasonable access to the camp. The work week was shortened from 6 days a week to 5 1/2 to accommodate those who had to commute.

Merrill-Gardner (later Merrill-Wagner) continued operating the sawmill for about one year after moving into the Gavin Lake site. With road conditions improving, providing easier access to the large mills in Williams Lake, it was decided that the mill would cease operations and be dismantled. At this time the old cookhouse, cabins and garage on the upper bench were burned, with a diesel generator being installed on the garage site.

The logging during this history was done in a checker-board fashion. The blocks were approximately 200 acres (80 ha) each in size with patches of reserve timber approximately 1,000 feet (300 m) wide being left between each block. These reserves were left to accommodate wildlife.

Some areas were logged leaving non-merchantable trees in place under “intermediate utilization standards”. Most logging, however, was done in a clear-cut manner with broadcast burning to follow, in preparation for re-planting. The area north of camp does not look as planned in 1967 due to some problems in burning. As a result of escaped slash burns and subsequent salvage logging, many of the reserve blocks were lost, and a total area of approximately 860 ha was logged in one opening north of camp.

Merrill-Wagner logged in the Gavin Lake area from the early 1960s until 1985. The terrain surrounding Gavin Lake produced Douglas-fir, spruce, and pine, with the fir being of prime interest to Merrill-Wagner. They let the cedar stand as the wood was not profitable to harvest at that time.

The merchantable cedar stands that remained unlogged and unburned in the Gavin Lake area were logged by Starline Cedar from about 1977 to 1984. In 1987 the UBC/Alex Fraser Research Forest was created in the Gavin Lake area.

In the late 1960s and 1970s Jacobson Bros. Forest Products (latterly Riverside Forest Products and now Tolko Industries) were harvesting on the Beaver Valley slopes, and in the mid 1980s Weldwood of Canada opened up harvest areas at Choate Lake and Fire Lake.

Plantations of Douglas-fir and spruce were established in the Gavin Lake area as early as 1972. Early plantations were established using seed of unknown origin, and with little understanding of the ecological conditions of the area or the silvical characteristics of the species. Hence we have a legacy of poorly stocked areas with frost-damaged Douglas-fir and tip-weevil-damaged spruce.

As the years passed, with more men commuting to work on improved roadways, it was decided that running the camp was no longer necessary or profitable and the camp was closed in the early 1970s. In 1975, Merrill-Wagner (later Weldwood of Canada and now West Fraser Timber) offered the camp to the Canadian Forestry Association of BC (later called the BC Forestry Association), which had been looking for a suitable location to build a camp to carry out its programs of education and recreation. In 1996 the BC Forestry Association reorganized, and became Forest Education BC. At that time the camp was taken over by a local non-profit society called the Gavin Lake Forest Education Society. The camp continues to operate and provides educational experiences to school children of the Cariboo.

Starting in 1987, with the creation of the Research Forest, third-year forestry students from UBC have also called Gavin Lake camp their own. In 2006, the twentieth class attended Fall Field School at Gavin Lake, and the history of the site contributes to the richness of their experience.

Student exercise conducted on an old road adjacent to Gavin Lake Camp.

2.5. History of UBC Management

The original concept of developing a research forest in the Cariboo came from an economic development study commissioned by the Cariboo Regional District (CRD) in 1983. That study identified that a research forest would be an economic development opportunity. In pursuing some of the recommendations in the plan, Glen Laubenstein (CRD) approached Van Scoffield of the Cariboo Lumber Manufacturers (CLMA) to discuss options in this regard. The Alex Fraser Research Forest was thus created by the will of the people of the Cariboo. The committee struck to create the Research Forest included the following members:

Glen Laubenstein	Manager, (CRD)
Van Scoffield, RPF	Manager, (CLMA)
Ethel Winger	Mayor, City of Williams Lake
John Szauer, RPF	Regional Manager, Cariboo Forest Region
Jack Leggett, RPBio	BC Environment
Laurie Wilson, RPF	Lignum Ltd.
John Mansell, RPF	Weldwood of Canada Ltd.
Gail Wallin	B.C. Forestry Association (BCFA)

The group approached Bob Kennedy, then Dean of Forestry at UBC, to determine if UBC was interested in participating. Kennedy accepted the invitation and Don Munro, Director of the UBC Research Forest, was given the task of representing UBC through the development.

The areas selected to become the Research Forest were picked from a variety of areas suggested by the committee. The principal consideration was to include a variety of climatic conditions. The area surrounding Gavin Lake was suggested because it includes two different biogeoclimatic zones, and because it was adjacent to the Gavin Lake Camp, operated by the B.C. Forestry Association. Members of the CLMA were quite keen to see the camp used more and the opportunities for UBC and BCFA to work together were viewed as being very positive. There was some concern about including the area south of the camp in the Research Forest because it is immediately surrounding environment for camp, and the earliest maps show a large exclusion from the Research Forest South of Gavin Lake.

The Knife Creek mule deer winter range was already heavily invested in research by the Ministry of Forests Research Section. Harold Armleder (Regional Habitat Ecologist) suggested that Knife Creek be included as part of the Research Forest because it was an area of particular interest to him, and he probably saw the Research Forest as an opportunity to extend and continue his research about mule deer.

There was also discussion of including a block in the Chilcotin, and a block in the high elevation forests in the east. Eventually, however, the committee settled on just two blocks, with the thought that more could be added in the future if needed for financial viability.

The Research Forest developed very rapidly, and by January 1, 1987 a Resident Forester (Ken Day, RPF) was in place to begin development of the forest. The committee was successful at securing start-up funds from the Government of BC in the form of a lottery grant. The long-time MLA for the Cariboo, Alex Fraser, was pivotal in acquiring that grant. Dean Kennedy committed to fund the wages of the Resident Forester for a period of three years. The intent was that the forest would remain Crown Land, and be managed according to the principles of integrated resource management.

Don Munro, Director of University Research Forests, presents a gift to Alex Fraser, MLA while Mrs. Gertrude Fraser looks on at the opening ceremony for the new UBC Alex Fraser Research Forest, April 1987.

Most of the effort of the new Resident Forester was devoted to "getting to know" the area, both literally in terms of the physical characteristics, as well as the less tangible concerns of working relationships, politics, and responsibilities. Never-the-less, six research files were opened in the first year, and the first timber harvest was accomplished in the second year of operation.

Since the inception of the Research Forest, the staff grew to more than 10 Full Time Equivalents in 2003. Declining external contracts, falling timber prices, and a failure to complete the annual harvest program in 2003/04 caused a financial crisis that led to a reduction of the Forest's permanent staff complement by 2.5 FTEs. The seasonal staff complement fell from 1.5 FTEs to 0.6 FTEs.

2.5.1. Significant events 1987-2005

- First fall field school for third year forestry students – 1987
- First timber harvest – 1988
- Tenure agreement established between UBC and the Crown – 1989
- First plantation established by the Alex Fraser Research Forest – 1992
- Management and Working Plan #1 submitted for approval – 1993
- Continuous mountain pine beetle infestation – 1993 to present
- Silviculture fund (accrued cash) converted to Endowment Account – 1995
- International interns program grew to a peak of 15 participants at two Research Forests – 1998
- 10th anniversary of the Alex Fraser Research Forest – January 1997
- 3 lightening strikes (first forest fires since establishment of Research Forest) - 1998
- Management and Working Plan #2 submitted for approval – 1998
- Snow breakage event at Gavin Lake – December 1998
- Purchased property at Knife Creek to build office complex - 1999.
- Ken Day becomes Director, University Research Forests 1999-2001
- Hosted a portion of UNBC field courses for 3rd year students – 1999-2002
- Samantha Hicks (researcher) memorial established at Gavin Lake – 1999
- Faculty budget support fell to zero – 2000
- International interns program was rationalized, and fell to a low of 2 participants – 2000
- Western Spruce Budworm infestation begins at Knife Creek – 2000
- Total Forest Renewal BC funding was $1,313,480.00 – 1995 - 2001
- The position of Director was eliminated; Research Forest Managers report to the Dean and take advice from the Research Forest Advisory Committee – 2001
- Appointed Canadian Overseas Log and Lumber as our log broker – 2001
- 50th anniversary of Faculty of Forestry alumni celebration at F351 – August 2001
- First block harvested by the Alex Fraser Research Forest declared free growing - 2001
- 30,000 m^3 harvested due to mountain pine and Douglas-fir bark beetles. Largest cut in history of Research Forest – 2001/02
- Spruce bark beetle infestation increasing – 2001
- Significant windthrow event – October 2003

- Mountain pine beetle attack nearing 100% mortality in 125 year old stands, causing substantial mortality in 70 year old stands, and also killing 40 year old trees at Knife Creek – 2004
- Unexpected revenue shortfall fiscal year 03/04 caused financial crisis, and resulted in layoffs and curtailed spending – 2004
- Endowment account principle liquidated to recover from revenue shortfall in 03/04 – 2005
- Mountain pine beetle mortality underway in 24 year old plantation at Gavin Lake – 2005
- Cooperated on committee to produce the *Williams Lake and Area Interface Fire Plan* – 2004/05

2.5.2. Full Time Staff Appointments (beginning – ending)

Don Munro, Director – 1987-1995

Ken Day, Resident Forester, Manager, Director, Manager – 1987-Present

Bev Atkins, Silviculture Administrator – 1989-2004

Claire Trethewey, Research Forester – 1992-2004

Don Skea, Operations Supervisor – 1994-Present

Dawn Lowe, Office Administrator – 1995-Present

Peter Sanders, Director – 1995-1999

Mircea Rau, Planner – 1996-Present

Laura Smith, Forestry Intern – 1999-2000

Beverley Moore, Administrative Assistant – 2000-2004

Matthew LeRoy, Forestry Intern – 2000-2001

Cathy Koot, Extension Coordinator, Research Coordinator – 2001-Present

Jeff Jensen, Forestry Intern – 2001-2002

Sean Seabourn, Forestry Intern – 2002-2003

Kim Menounos, Forestry Intern – 2002-2003

Jacqueline Cavill, Forestry Intern – 2003

Angela Cormano, Forestry Intern – 2003-04

2.5.3. Harvest History

Since 1987 we have concentrated our harvesting on stands at risk from attack by mountain pine beetle. Our first blocks in 1988 contained some pine beetle attacked trees, and since 1993 the large majority of our harvest has been directed towards pine beetle-attacked stands (Figure 5). In 1997 and again in 1998 we had winter storms that broke a lot of timber at Gavin Lake, and harvesting in 2000-2002 focused on that damage in addition to pine beetle attack.

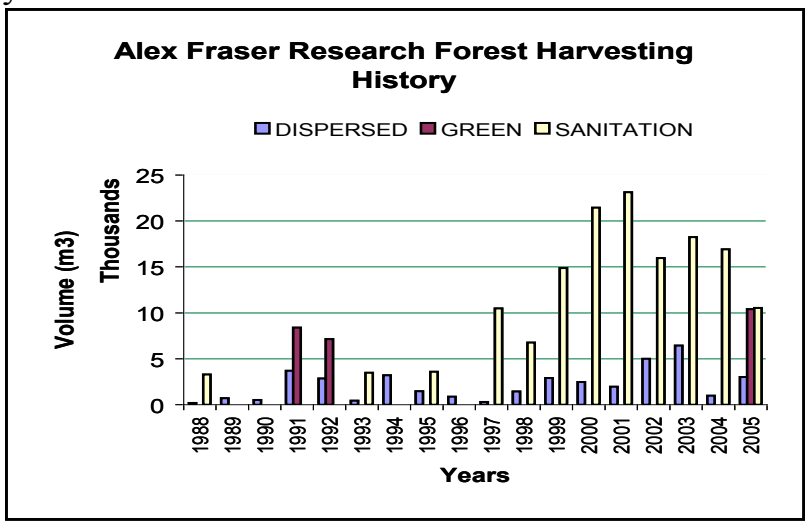


Figure 5: Annual harvest levels for the Alex Fraser Research Forest. Sanitation includes any cutblock aimed at damaged timber; dispersed includes timber harvested outside cutblocks; and green refers to cutblocks aimed at undamaged timber.

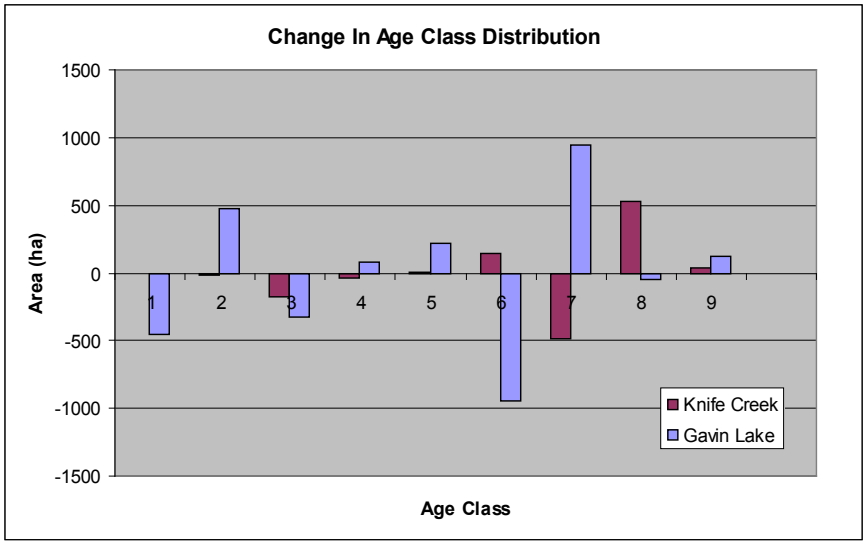
Management and Working Plan #1 established our annual allowable cut (AAC) at 5,435 m^3/year. In 1998 the AAC was increased to 6,200 m^3/year, to include deciduous and grade 3 sawlog volumes. In 1999 the Regional Manager waived our cut control, in effect giving us a free hand to harvest as much volume as necessary in order to manage our growing bark beetle infestation and to salvage damaged timber.

Figure 6 shows the change in inventory from 1997 to 2004. It shows that the Research Forest inventory has aged, with decreases in age class 6 (100-120 years) at Gavin Lake and age class 7 (120-140 years) at Knife Creek, and corresponding increases in age classes 7 and 8 respectively. At the same time the area occupied by lodgepole pine as the leading species has decreased and that of Douglas-fir has increased. These changes in the inventory are a direct result of our mountain pine beetle management strategy. It emphasized removal of lodgepole pine and retaining Douglas-fir. After partial cutting the age of the residual stand has not changed if the next harvest will be the residual Douglas-fir, but the species composition has changed. On this basis the inventory has been adjusted for the post-harvest condition.

Log selling prices and logging costs have varied over time, according to market forces in the interior sawmills and competitiveness in the logging industry respectively. Figure 7 shows the average market value of log sales since 1988, adjusted for inflation to 2005 values. Rising logging costs and falling selling prices have caused significant budgetary pressures, and these trends present a real risk to the financial stability of the Research Forest. Our responses to these trends have included

- Increasing production
- Appointing a log broker, to improve selling prices
- Increasing clearcutting in the annual harvest program to reduce production costs

- Focusing on higher-value products to increase average market values
- Working with loggers to improve their efficiency and reduce production costs



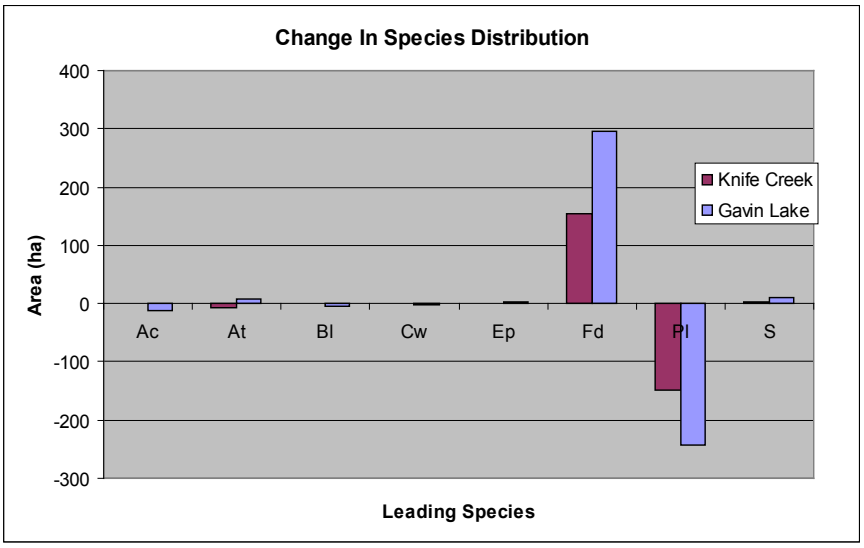


Figure 6: 1997 to 2004 change in age class and species distribution for the Alex Fraser Research Forest. Note changes in species composition resulting from partial-cutting to manage mountain pine beetle.

Additional steps are necessary to reduce our production costs and increase our average market value for log sales. We will continue to pursue opportunities to sell our high-grade logs for higher-value products.

Action 1: Seek ways to increase selling price and reduce production costs for timber harvesting.

Traditionally our harvest program has been concentrated into the winter season, to take advantage of frozen ground. This approach has several advantages and disadvantages:

Advantages

- Reduced road construction and maintenance costs
- Reduced soil degradation from logging equipment
- Reduced damage to residual trees in partial-cutting
- Selling logs when mills are short of inventory

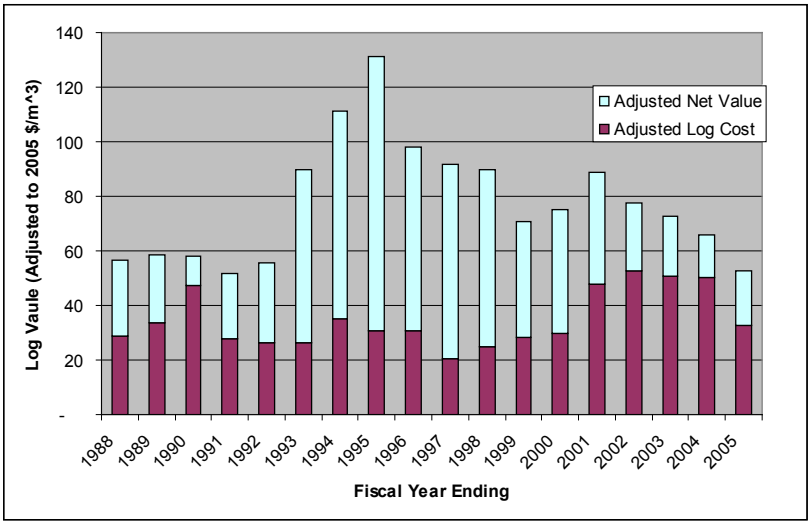


Figure 7: Average market value of log sales from the Alex Fraser Research Forest, comparing average production cost and net value, adusted to 2005 dollars.

Disadvantages

- Compressed operating season
- Shortage of loggers and truckers
- Risk of warm weather, lack of frost
- Road weight restrictions increase trucking costs
- Not logging when high-value markets may be available.

Since 2003 we have been working to increase our summer logging production, but in 2004/05 we only managed to produce 15% of our logs between May and October, and 85% from November through March. At the time of writing it appears that summer/fall production has increased to 33% for 2005/06. We need to actively pursue options for increasing our harvest during the summer/fall period.

Action 2: Find methods to increase log production during summer/fall months.

3. Context For Management and Working Plans

3.1. Tenure

The Research Forest is Crown Land held under tenure by The University of British Columbia. Tenure has two components:

A Special Use Permit[1] (SUP 15382), which designates the land area of the Research Forest, and requires that the forest resources be managed according to an approved Management and Working Plan -- the SUP is issued by the District Manager.

Two Licences To Cut[2] (L42641 – Knife Creek Block and L42502 – Gavin Lake Block) that authorize the forest management activities of the Research Forest within approved operational plans.

Together these documents provide the legal access for the University to the Research Forest, and the framework within which all activities must occur. These agreements are in effect until August 28, 2009. During the period of this plan, we will be seeking a new tenure agreement with the Crown, and when that agreement is reached we will amend this plan as necessary.

3.2. Legislation and Regulation

Under certain Forest Act tenures a Management Plan is a plan approved "which specifies proposed management to establish, tend, protect and harvest timber resources and conserve other resource values" (Province of BC 1996). The content of this plan generally complies with the content requirements specified[3] for a Management Plan written for a Tree Farm Licence.

This plan is written during the transition from the *Forest Practices Code of BC Act* (FPC) to the *Forest and Range Practices Act* (FRPA). FRPA requires that we write a Forest Stewardship Plan, which will replace the Forest Development Plan written and approved under the FPC. Forest Stewardship Plans are presently being written by other licensees, and are generally limited to legally required content but accompanied by a non-binding rationale document. In the case of the UBC/Alex Fraser Research Forest, this Management Plan will provide the rationale that will support the development of the Forest Stewardship Plan.

3.2.1. FRPA Values and Objectives

FRPA relies upon licensees to achieve government's stated objectives, as defined in the Forest Practices and Planning Regulation. Those include objectives set by government for (quoted from Forest Planning and Practices Regulation B.C. Reg. 14/2004):

1 Issued under the Provincial Forest Use Regulation of the Forest Practices Code of BC Act
2 Issued under the Forest Act of BC. Recent Revisions to the Forest Act provide several different types of Licences to Cut, and we deem our documents to be Occupant Licences to Cut (Section 47.4(2)(a)).
3 Forest Act section 35(1)(d)

1. Soils
   "without unduly reducing the supply of timber from British Columbia's forests, to conserve the productivity and the hydrologic function of soils."
2. Timber
   - to "maintain or enhance an economically valuable supply of commercial timber from British Columbia's forests,"
   - to "ensure that delivered wood costs … are competitive in relation to equivalent costs in relation to regulated primary forest activities in other jurisdictions, and"
   - to "ensure that the provisions of this regulation and of the Act that pertain to primary forest activities do not unduly constrain the ability of a holder of an agreement under the *Forest Act* to exercise the holder's rights under the agreement."
3. Wildlife
   "without unduly reducing the supply of timber from British Columbia's forests, to conserve sufficient wildlife habitat in terms of amount of area, distribution of areas and attributes of those areas, for
   - the survival of species at risk
   -the survival of regionally important wildlife, and
   - the winter survival of specified ungulate species"
4. Water, fish, wildlife and biodiversity within riparian areas
   "without unduly reducing the supply of timber from British Columbia's forests, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas."
5. Fish habitat in fisheries sensitive watersheds
   - not applicable to the UBC/Alex Fraser Research Forest because we are not situated in the watersheds listed in Schedule 2 of the Regulation.
6. Water in community watersheds
   "for water being diverted for human consumption through a licensed waterworks in a community watershed … to prevent (to the extent that it does not unduly reduce the supply of timber from British Columbia's forests) the cumulative hydrological effects of primary forest activities within the community watershed from resulting in
   - a material adverse impact on the quantity of water or the timing of the flow of the water from the waterworks, or
   - the water from the waterworks having a material adverse impact on human health that cannot be addressed by water treatment required" under an enactment or the pertinent waterworks licence."
7. Wildlife and biodiversity - landscape level
   "without unduly reducing the supply of timber from British Columbia's forests and to the extent practicable, to design areas on which timber harvesting is to be carried out that resemble, both spatially and temporally, the patterns of natural disturbance that occur within the landscape."
8. Wildlife and biodiversity - stand level
   "without unduly reducing the supply of timber from British Columbia's forests, to retain

wildlife trees."

9. Visual quality
   to manage visually sensitive areas according to the designated Visual Quality Objective, or according to the visual sensitivity class

10. Cultural heritage resources
    "to conserve, or, if necessary, protect cultural heritage resources that are
    -the focus of a traditional use by an aboriginal people that is of continuing importance to that people, and
    - not regulated under the *Heritage Conservation Act"*

In order to provide clarity of rationale, we have included Table 4 to cross-reference various parts of this Management and Working Plan which make explicit reference to the FRPA objectives.

Table 4: Cross reference listing of Management Plan components acting upon FRPA objectives.

FRPA Objective	**Cross Reference Location**	**Discussion**
1. Soils	Chapter 8	
2. Timber	Chapter 7	
3. Wildlife	Chapter 6	
4. Water, fish, wildlife and biodiversity within riparian areas	Chapter 6, Chapter 8	
5. Fish habitat in Fisheries Sensitive Watersheds	Not Applicable	AFRF is not contained in a Fisheries Sensitive Watershed listed under Forest Planning and Practices Regulation Section 8.1.
6. Water in Community Watersheds	Not Applicable	No Community Watersheds exist in AFRF
7. Wildlife and biodiversity - landscape level	Chapter 6	
8. Wildlife and biodiversity - stand level	Chapter 6	
9. Visual quality	Chapter 5	
10. Cultural heritage resources	Chapter 5	

3.3. Cariboo Chilcotin Land Use Plan

The Cariboo-Chilcotin Land Use Plan (Province of BC 1995) "presents the overall framework for land use, conservation and economic development." The Land Use Plan divides the Cariboo-Chilcotin into three Resource Development Zones depending on intensity of use -- Enhanced, Special, and Integrated.

Both blocks of the Research Forest fall into Enhanced Development Zones:

Gavin Lake Block -- Polygon E5 Beaver Valley

Knife Creek Block-- Polygon E6 Williams Lake

Each Resource Development Zone is defined in the Land Use Plan, and then that definition is interpreted for each polygon. The Enhanced zone is defined (Province of BC 1995) as follows:

> *"The Enhanced Resource Development Zone includes areas where economic benefits and jobs will be increased through intensive resource management and development. In this zone, the plan challenges all local resource users and government to set targets for increased sustainable resource development. In particular, forest productivity will be maintained and enhanced through intensive reforestation, spacing, pruning, thinning, and new harvest practices."*

Resource targets were set for each polygon; the targets that apply to the Research Forest are shown at Appendix 1. These targets are stated for very broad areas, and the Research Forest is a very small part.

3.3.1. Compliance With CCLUP Timber Targets

Table 5 indicates how the Research Forest is performing with respect to the timber targets established in the Cariboo-Chilcotin Land Use Plan. It is important to note that "Modified Harvesting" is defined (Province of BC 1995) as

> *"..any management practice which is other than the industry norm and has been modified to recognize other resource values."*

Only the Timber Production Working Circle is deemed to be conventional harvesting. Areas of "No Harvest" include all categories of forest land in reserve or deferral described in Chapter 6.

3.3.2. Sub-Regional Plans

Two sub-regional plans affecting the Research Forest have been published (Anon 2005a, 2005b) and this plan takes direction from those sub-regional plans.

Resource Development Zones (from the CCLUP) are subdivided into Landscape Units, which are the basic unit for landscape level planning. While our management will not have a significant impact on the overall attainment of the resource targets, the status of the Landscape Units within which we are situated will have an impact on governments' objectives. Our commitments to those objectives will be reflected in our Forest Stewardship Plan.

Table 5: Compliance with Cariboo Chilcotin Land Use Plan (CCLUP) targets affected by Research Forest Management.

Timber Targets	Conventional Harv. (% by productive area)		Modified Harv.* (% by productive area)		No Harv.** (% by productive area)	
	CCLUP	MP#3	CCLUP	MP#3	CCLUP	MP#3
Gavin Lake Block	62	38	32	56	6	5
Knife Creek Block	45	0	50	95	5	5
Other Numeric Targets	Grazing (AUM)		Wildcraft (% Access)		Recreation (% Back-country)	
	CCLUP	MP#3	CCLUP	MP#3	CCLUP	MP#3
Gavin Lake Block	40,076	Unknown	80	100	5	0
Knife Creek Block	212,400	Unknown	80	100	5	0
Other Numeric Targets	Mule Deer Winter Range (% of Area)					
	CCLUP	MP#3				
Gavin Lake Block	18	45				
Knife Creek Block	50	100				

*Modified Harvesting refers to silvicultural systems other than clearcutting, modified in consideration of wildlife or visuals.

** Including Reserves and Old Growth Management Areas, but not including Wildlife Tree Patches or Riparian Management Areas.

3.4. Climate Change

Historic data and trends suggest that BC is experiencing climate change, and some of its impacts (Climate Change Division Task Team 2006). Hamann and Wang (in press) suggest that biological responses to these changes are already observed in British Columbia, and include the current mountain pine bark beetle outbreak, widespread damage caused by Dothistroma needle blight, and reforestation failures and wildfires attributed to drought and record high temperatures.

Climate, ecosystem, and species distributions are described as relating to "climate envelopes" that have been described by the Biogeoclimatic Ecosystem Classification system (Hamann and Wang in press). Hamann and Wang (in press) have modeled bioclimate envelopes for ecosystems and tree species, and have created maps of predicted shifts of the climatic envelopes for ecosystems through time, based on regional climate change predicutions from several Global Circulation Models (GCM). The results of Hamann and Wang (in press) are available in a rasterized map of biogeoclimatic subzones for three future time periods, which has been queried to demonstrate the possible shifts in biogeoclimatic subzone from the current condition (T. Wang, UBC, Personal Communications, October 26, 2006). The results of this query are presented in Table 6.

Table 6: Predicted shifts in bioclimate envelope (based upon CGCM A2x) for particular locations within the Alex Fraser Research Forest, according to T. Wang (Personal Communications 2006)				
Long., Lat. (decimal degrees)	Subzone	Future Subzone		
	2006	2031	2061	2091
121.80, 52.45	SBSdw1	SBSmh	SBSmh	SBSmh
121.70, 52.47	ICHmk3	ICHdw	ICHdw	SBSmh
121.88, 52.03	IDFxm	BGxw	BGxw	BGxh
121.83, 52.05	IDFdk3	IDFdk	BGxw	BGxh

These predictions must be viewed with some caution (S. Aitken, UBC, Personal Communications, November 23, 2006):

- they contain predictions for shifts in climates associated with ecological units and species distributions, not the actual movements of the organisms;
- the error in the model is greater for subzones than for zones; and
- there are many associated biological factors that will determine how quickly species decline in some areas and proliferate in others.

Climate change is expected to increase the incidence and severity of insect and disease outbreaks, forest fires, and wind, snow and ice events (Climate Change Division Task Team 2006). These disturbances will likely be the major agents of changes in distribution. However, management plans, and particularly reforestation decisions, should recognize the need to adapt around these potential changes (S. Aitken, UBC, Personal Communications, November 23, 2006).

Table 6 (above) indicates that the Knife Creek Block will become much hotter and dryer, and may be analogous to the bunchgrass grasslands currently occupying the lower elevations of the Fraser Valley (Steen and Coupé 1997). We could speculate that this shift may result in a gradual deforestation of the Knife Creek block as the incidence and severity of Douglas-fir bark beetle outbreaks and forest fires intensifies. It is possible that Douglas-fir and ponderosa pine may be capable of growing in a closed-forest condition, but Nicholson et al. (1991) indicate that only occasional ponderosa pine or Douglas-fir may be present in the BG zone.

Table 6 (above) indicates that the west side of the Gavin Lake Block may have a more moderate climate, with slightly moister and warmer conditions. Douglas-fir would still dominate on circa-mesic and dryer sites, but the participation of spruce in the forest composition will increase (Steen and Coupé 1997). Regeneration may be more difficult as a result of a shift to more productive conditions, but timber growth and forage production may also be more productive.

Table 6 (above) indicates that the east side of the Gavin Lake Block will be warmer and drier, and will be dominated by Douglas-fir and spruce (Steen and Coupé 1997). Western redcedar is not currently present in the SBSmh (Steen and Coupé 1997), indicating that our present management to regenerate and grow cedar may be risky.

The likelihood of a change in climate necessitates action, beginning now. Those actions include business management decisions, a research agenda, and forest management direction.

Action 3: Seek ways to reduce fossil fuel use in all business management decisions. Adopt a risk-averse business model where weather events may impact success.

Action 4: Encourage and participate in research on the effects of climate change on silvicultural and operational approaches to forest management; and development of bioenergy opportunities.

Action 5: Expect that unexpected events will happen, and may be repeated. Take lessons from each unexpected event, and amend forest management practices accordingly. Maintain a risk-averse approach to forest management decisions.

The likelihood of a change in climate necessitates action, beginning now.

Action 6: Continue to regenerate mixed-species stands, and take predicted climate changes into account when selecting species and seed-sources for reforestation.

4. Inventory

4.1. Ecological Inventory

Good forest management requires a detailed knowledge of the ecosystems under management. Kimmins (1987) tells us that we can only manage forests successfully if we understand their ecological characteristics. Smith *et al.* (1997) point out that the benefits that flow from forest management depend upon living processes, and our understanding of those processes clearly depends upon knowing the conditions under which the processes are operating. Ecological inventory is therefore extremely valuable in managing the forest. Until recently we collected that inventory at the stand level, during the preparation of site plans before harvesting.

We were very fortunate to receive an offer of help from Prof. Karel Klinka in 2002, to create an ecological inventory of the Alex Fraser Research Forest. In the summary to their final report, Klinka *et al.* (2004) wrote:

> *"Knowledge about ecosystems and their distribution across the landscape is essential for stand level forest management and research, as trees and associated vegetation develop according to the sites on which they grow. Following the initiative of K. Day, manager of the UBC Alex Fraser Research Forest (AFRF), this project was undertaken to provide an advanced and detailed ecological framework for supporting ecosystem-specific research, education, planning, and operations at the research forest. Products from this project include: (1) a large-scale site series map, (2) site identification tools specific to the forest, (3) silvicultural and forest nutrient status interpretations, (4) a printed report, (5) a CD-ROM (combining the report, maps, and linked digital images), (6) field demonstration sites and, (7) images of forest communities for each site series at different locations.*
>
> *"This project is a co-operative effort between the UBC Forest Sciences Department (K. Klinka, P. Varga), the Alex Fraser Research Forest (C. Trethewey, C. Koot, and M. Rau) and Forest Management Institute, Czech Republic (A. Kusbach and J. Macku, who as Visiting Scientists, contributed their expertise in site classification, mapping, and map and pamphlet production).*
>
> *"With some deviations, we followed the 1998 Standards for Ecosystem Mapping in British Columbia and used the classification system described in the 1997 Field guide for site identification and interpretation for the Cariboo Forest Region. Sites that were difficult to identify or had not yet been classified were additionally sampled. We introduced the concept of a transitional (interzonal) area between adjacent biogeoclimatic units, recognizing the fact that climate changes gradually along a longitudinal gradient in both Knife Creek and Gavin Lake blocks and, in consequence, vegetation and sites along the zonal boundary feature transitional properties. We described local site modifiers to further enhance environmental information at the site series level. The 1:10,000 mapping scale allowed for the delineation of a high proportion of single-site-series polygons thus reducing the need to group several site series within a polygon. We used a global positioning system (GPS) for locating 2,269 waypoints during reconnaissance and ground inspection phases. To ensure maximum map reliability, approximately 90% of the polygons were inspected in the field and, if required, polygon boundaries, site identification, and modifiers were revised. During the field inspection, 1,783 digital images were taken to develop a visual library of forest stands, plant species, and sites in the forest.*
>
> *"One of the interpretive maps shows the locations of old-growth stands and the location of western hemlock and western redcedar in the transition area between the SBS and ICH zones in the Gavin Lake block. Species suitability, site productivity (site index), and stand nutrient status interpretive maps have also been produced. Sample plot, and soil and foliar chemistry data are hyperlinked to polygons in a GIS to provide a spatial database for each site series; similarly, hyperlinked images of forest communities provide a virtual reference of vegetation in various stages of disturbance and succession for each site series. These tools are expected to improve understanding of site classification, identification, and interpretation, as well as the management and research activities in the forest.*

We are truly fortunate to have the wealth of information provided by this body of work, and we are still in the early stages of learning all the opportunities it provides us. Detailed ecosystem maps are available but are not provided in this plan. The area of the Research Forest is summarized by biogeoclimatic subzone and by site units in Table 7.

Interpretations from this ecological inventory provide:

- Species suitability and site index maps for three primary management species (Douglas-fir, lodgepole pine, and interior spruce);
- Location of old growth conditions, and rare western hemlock groups;
- Nutrient status for each of the three primary management species; and
- Teaching and extension materials

4.2. Timber Resources

4.2.1. Current Forest Inventory

The forest cover inventory was created by the Ministry of Forests in 1995, and has been updated periodically to reflect our harvest activities. Corrections have been made to the forest cover data based upon local knowledge, to correct species composition or other interpretation errors. The current forest inventory, updated to December 2004, is shown at Appendix 3. Updating is performed by introducing harvested polygons, which are established using GPS pre-harvest. The forest cover inventory is modified within the disturbed polygon, to reflect the post-harvest condition:

- If clearcut, species is blank and age is zero, until the stand is regenerated, at which time the forest cover data is modified once again;
- If partially harvested, species composition and volume are modified to reflect the post-harvest condition but age is left as the inventory age.

The current forest inventory has several weaknesses that need to be addressed:

- It is now ten years old
- It systematically underestimates site quality
- It inadequately classifies complex stands
- It relies heavily on age class, in a forest where only one third of the stands are managed for an even-aged condition.

Table 7: Alex Fraser Research Forest area by biogeoclimatic subzone and site series.

GAVIN LAKE BLOCK					
Site Series	**ICHmk3**	**ICHmk3/ SBSdw**	**SBSdw1**		**TOTAL**
01	944.8	209.7	1250.7		2405.2
02	2.6	12.7	100.1		115.3
03	66.3	69.7	325.5		461.4
04	312.1	138.4	23.5		474.0
05	249.1	56.5	19.5		325.1
06	359.7	228.4	550.5		1138.6
07	223.8	64.0	265.8		553.6
08	14.0	257.5	167.8		439.2
09	0.0	0.0	80.8		80.8
Subtotal Forest	**2,172.2**	**1,036.9**	**2,784.1**		**5,993.2**
Disturbed	23.8	1.3	17.4		42.5
Open Water	110.8	26.5	80.5		217.8
Non-forested Wetland	44.6	8.6	49.7		103.0
Subtotal Non-forest	**179.3**	**36.4**	**147.6**		**363.4**
Total Gavin Lake	**2,351.5**	**1,073.3**	**2,931.7**		**6,356.6**
KNIFE CREEK BLOCK					
Site Series	**IDFdk3**	**IDFdk3/ SBPS**	**IDFxm**	**IDFxm/ dk3**	**TOTAL**
01	1839.2	177.9	309.6	177.4	2504.1
02	27.0	0.0	6.6	8.2	41.8
03	6.9	0.0	16.3	6.3	29.5
04	170.8	0.0	43.4	112.5	326.6
05	87.2	0.0	1.5	0.7	89.4
06	0.0	0.0	9.4	6.1	15.5
07	110.7	26.8	30.4	22.2	190.1
08	173.6	0.0	22.7	1.5	197.9
09	10.3	0.0	2.2	0.0	12.5
10	14.9	1.8	0.0	0.0	16.8
Subtotal Forest	**2,440.6**	**206.6**	**442.1**	**335.0**	**3424.2**
Grassland	4.8		5.4	0.4	10.6
Disturbed	21.6	2.8	4.1	6.3	34.8
Non-Forest Wetland	10.5	2.2	0.3	0.0	13.1
Subtotal Non-forest	**36.9**	**5.0**	**9.8**	**6.7**	**58.5**
Total Knife Creek	**2,477.5**	**211.6**	**451.9**	**341.7**	**3,482.7**
Total Forest					9,417.4
Total Non-forest					421.9
Grand Total					**9,839.3**

4.2.2. New Forest Inventory

During the period of this plan we intend to create a new forest inventory based upon a stand ledger system. Stand boundaries will be taken from our total-chance-plan for cutblocks (Figure 8). Inventory data for each stand will be collected from opening records and from site visits. Stand descriptions will result from data collected during site visits, including:

- Species distribution by basal area
- Volume by species estimates
- Stand structure
- Stand age(s)
- Quality and size remarks
- Stand condition and prescribed entries

Action 7: Create new forest inventory based upon the stand ledger system.

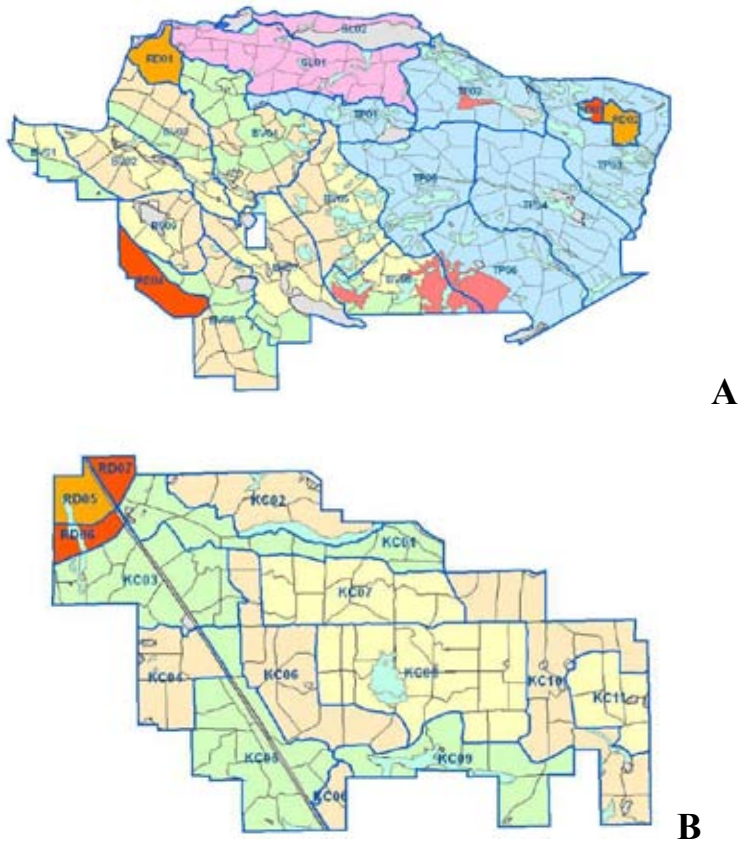


Figure 8: Map of tactical-plan-stand boundaries for the Alex Fraser Research Forest showing Gavin Lake (A) and Knife Creek (B) . The finest division shown indicates stand boundaries.

4.3. Riparian Inventory

In 1996 the Research Forest commissioned a riparian inventory, conducted by Hallam Knight Piésold Ltd. The survey work occurred between July 16th and 28th, 1996, and included field visits to 121 geo-referenced field sites (90 at Gavin Lake Block, and 30 at the Knife Creek Block) (Hallam Knight Piésold Ltd. 1996a, 1996b). The inventory focussed on streams only, and did not include measurements of lakes or wetlands.

Information collected included: fish species present (electrofishing), channel width, riffle depth, pool depth, reach gradient, valley:channel ratio, bank height, bed substrate, percent cover, aspect, crest height, crest slope, flow rate, pH, temperature, dissolved O_2, dissolved solids, alkalinity, total nitrates, and total phosphates. Most of the field sites also have photo records.

The inventory is displayed on paper maps, which were summarized into ArcView shape files by Research Forest staff in 2000. These shape files form the basic inventory tool we use to guide our management actions, and are depicted on the maps at Appendix 4. The results of that analysis are summarized in Table 8.

Table 8: Riparian features and their extent in the Alex Fraser Research Forest.

Feature	Riparian Class	Length (km)			Area (ha)		
		Gavin	Knife	Total	Gavin	Knife	Total
Streams	Non-Classified Drainage (no defined channel)	8.0		8.0			
	S3 (1.5-2 m wide)	5.3	1.2	6.5			
	S4 (<1.5 m with fish)	2.7		2.7			
	S5 (>3 m without fish)	1.5		1.5			
	S6 (≤3 m without fish)	85.2	0.8	86.0			
Total Streams		102.8	2.0	104.8			
Wetlands	Non-Classified Wetland (<1 ha)				13.1	5.8	18.9
	W1 (>5 ha)				65.8		65.8
	W3 (1-5 ha)				27.9	8.2	36.2
Total Wetlands					106.8	14.1	120.9
Lakes	Non-Classified Lake (<1 ha)				0.5		0.5
	L1-B (5-1000 ha)				214.3		214.3
	L3 (1-5 ha)				2.3		2.3
Total Lakes					217.1		217.1

Lakes were not sampled as part of the Riparian Inventory (Hallam Knight Piésold 1996a). However, we are able to deduce the presence or absense of fish by local knowledge, and this is shown in Table 9.

Table 9: Lakes inventory for the Alex Fraser Research Forest.		
Lake Name	**Area (ha)**	**Fish Presence (from direct and indirect evidence).**
Choate Lake	6.5	Rainbow Trout (privately stocked), Lake Chub, Longnose Sucker
Dorsey Lake	15.6	Rainbow Trout (stocked)
Fire Lake	16.3	Rainbow Trout (stocked)
Gavin Lake	98.9	Rainbow Trout
Little Gavin Lake	15.9	Rainbow Trout
Prouton Lake	40.8	Rainbow Trout, Lake Chub, Longnose Sucker
Timothy Lake	10.3	Unknown, breeding loons observed indicating fish presence.
Unnamed lake on Teasdale Creek mainstem	0.5	None
Unnamed lake on Watson Creek	2.3	None
West Lake	10.0	Rainbow Trout (word of mouth)
Total Lakes	**217.1**	

The riparian inventory has some shortcomings.

- We do not have survey information for any of our lakes.
- The extent of stream reaches was not mapped, so we do not know where reach breaks occur, and we therefore assume that all stream reaches above a survey site are classified like the survey site. Incorrect reach classification is corrected when field work indicates a mis-classification, typically from S6 to non-classified drainage or dry gullies.
- We have found two stream reaches that have fish present contrary to the inventory information.
- The inventory was prepared in a single year and each sample point was visited only once. Results may be skewed by the stream-flow conditions at that time.
- Riparian systems are not static, and change over time through the activities of beavers or people.
- The riparian inventory distinguished wetlands only by area. New classification systems are in place to describe wetland ecology.

Given the shortcomings noted above, we will undertake an update of our riparian inventory, and add missing information.

Action 8: Undertake an update of the riparian inventory and add missing inventory information.

4.4. Range Resources

Range resources include the forage resource and water sources upon which domestic livestock depend, and range structures such as fences and cattleguards. While an inventory of the forage resources is beyond the scope of this plan, range structures are a part of our operations. Appendix 5 shows the location of grazing tenures and the range structures that allow tenure holders to manage the movement of their stock.

4.5. Cultural Heritage Resources

Cultural heritage resources[1] are archaeological sites pre-dating 1846, culturally modified trees dating after 1846, traditional use sites reported by the Williams Lake and Soda Creek Indian Bands, and other sites of cultural or historic value.

Archaeological sites are identified by archaeologists under contract to the Alex Fraser Research Forest, and are reported to government as required under the terms of their permits. Archaeologists are employed to survey proposed cutblocks that have been assessed by government to have a high potential for archaeological sites. Appendix 6 provides a map of the Archaeological Overview Assessment provided by government. To date, only one archaeological site has been identified -- a lithic scatter.

Culturally modified trees have been identified on both blocks of the Alex Fraser Research Forest. These trees are lodgepole pines that have been stripped of their bark to use the cambium as an early spring food source.

A single traditional use site has been reported to us by the Williams Lake Indian Band.

Other sites of cultural or historical value include cabin foundations, old camps, and mill sites; these have been found on both blocks of the Research Forest.

Cultural heritage resources are not identified on the ground, and are not included in maps attached to this plan, but are identified in our spatial inventory data as resource features.

1 Cultural heritage resources: An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people. Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites. (http://www.for.gov.bc.ca/hfd/library/documents/glossary/C.htm accessed September 6, 2006)

5. Non-Timber Resource Values and Uses

Both blocks of the Research Forest have a wide diversity of forest values and uses to people that must be recognized in the planning process:

- recreation
- visual quality
- cultural values
- non-timber forest products
- domestic range
- fish & wildlife production for hunting, trapping, guiding, sport fishing
- water production
- mining

All of these uses are important, and all rights pertaining to these uses and values will be recognized in the operation of the Research Forest. The temporal and spatial integration of all uses will be addressed in the Forest Stewardship Plan.

5.1. Recreation

The Gavin Lake block surrounds Gavin Lake Forest Education Centre (owned and operated by the Gavin Lake Forest Education Society), which attracted approximately 8,200 user days in 2004. Recreation will be enhanced by considering the needs of this group in making forest management decisions, and by consulting with the society regarding activities adjacent to the camp area.


Gavin Lake Forest Education Centre.

In recognition of the recreational and educational use around Gavin Lake, this area has been designated as a unique working circle called the Gavin Lake Demonstration Area. Refer to Chapter 7 for a further description of the management of that working circle.


Canoeing lessons at Gavin Lake.

The Research Forest provides a variety of recreational opportunities for the general public. Walking, cross-country skiing, snowmobiling, fishing, hunting, firewood gathering, and other pursuits provide the general public with substantial benefits. In addition, two semi-primitive recreation sites have been developed by the B.C. Ministry of Forests and Range, and will remain the responsibility of the Forest Service. These are described below at Table 10. The Recreation Site at Gavin Lake is voluntarily maintained by the Gavin Lake Forest Education Society in order to maintain a suitable environment for their camp. The site at Dorsey Lake is self-maintained by users, and use has declined considerably over the past five years.

Table 10: Recreation facilities existing on the UBC/Alex Fraser Research Forest.

Facility	Location	Picnic Tables	Out-houses	Trails (km)	Other
Camp Sites	Gavin Lake	3	1		Boat Launch
	Dorsey Lake	2	1		Boat Launch
Armillaria Trail	Fire Lake Rd. 6.5 km to SR1 Rd. 3 km				Signs and brochures
Clumpy Spacing Trail	Big Meadow Road 4.5 km				Signs and brochures
Commercial Thinning Trail	West Road 4 km				Signs and brochures
Gavin Ski Trails	Gavin Lake	1	1	20	Warming Hut, Maps
Mule Deer Trail	Big Meadow Road 1.5 km	1	1	1.4	Signs and brochures
Intensive Silviculture of Lodgepole pine Trail	Fire Lake Road -- 1 km		1	3.7	Signs and brochures
Intensive Silviculture of Douglas-fir Trail	CL1 Road			1.6	Signs
Rainbow Trail	Honeybee Rd. 1.5 km/Gavin Lake S. Shore		1		Dock, signs, brochure
Shelterwood Trail	Gavin Lake Road 2 km			1.5	Signs and brochures
Soils Trail	Gavin Lake			1.0	Soil pits, signs and brochures
Walk of Doom	Teasdale Road 2.5 km		1	1.5	Signs and brochures

Recreational opportunities will be maintained and improved by management through cooperation with the Ministries of Forests & Range, and Environment and the Gavin Lake Forest Education Society. Specifically, this management will include:

- protection of aesthetics in critical areas;
- enhancement of fishing opportunities;
- access management;
- development of additional trails and other recreational features;
- maintenance of existing recreational sites and features.

5.1.1. Lake-Shore Management

Gavin Lake Block of the Research Forest contains eight lakes with recreational potential, and four lakes outside our boundaries are immediately adjacent (see maps at Appendix 4). The Sub-regional plan (Anon 2005a) describes the Crown's expectation for management of those lakes, as described in Table 11.

Table 11: Classification and objectives for the lakes within and adjacent to the UBC/Alex Fraser Research Forest. (Anon 2005a, 2005b).

Lake Name	**Lake Class**	**Visual Quality Class (see Table 12)**	**Lake Category**	**Development Objectives**
Lakes within AFRF				
Choate Lake	D	Modification	General	No objectives
Dorsey Lake	B	Retention	General	No objectives
Fire Lake	B	Retention	General	No objectives
Gavin Lake	B	Retention	Quality	Limited or no new development
Little Gavin Lake	B	Retention	Quality	Limited or no new development
Prouton Lake	C	Partial Retention	General	No objectives
Timothy Lake	D	Modification	General	No objectives
West Lake	E	Modification	General	No objectives
Lakes Adjacent to AFRF				
Beaver Lake	B	Retention	General	No objectives
Lake George	B	Retention	General	No objectives
Jones Lake (Knife Creek Block)	D	Modification	General	No objectives

General Lakes *"... provide public recreation in a predominantly rural or natural setting. Access is generally good. Land development is variable and the natural environment may be substantially modified." (Anon 2005a).*

Quality Lakes *"... provide quality natural features. Access may be limited. There are pristine surroundings and natural appearing environment. Commercial land development is limited or non-existent...Maintain or enhance the lake, the riparian reserve zone, the lakeshore management zone, and the surrounding area to provide a quality fishing experience." (Anon 2005a).*

The Gavin Lake system is a regionally significant fishery, in that it is a natural rainbow fishery which has never been stocked. In addition, fish in this system are mostly down-stream spawning.[1] Much of the spawning and rearing habitat in the Gavin system is within the Research Forest.

Jurisdiction over the sport fishery will remain with Ministry of Environment, Lands, & Parks, and continued stocking (except the Gavin Lake system) and monitoring programs on the Gavin Lake block will be encouraged.

5.1.2. Sub-Regional Plan Strategies for Timber Harvesting Near Lakes

According to the sub-regional plans (Anon 2005a, 2005b), lakeshore management (for lakes greater than 5 ha in surface area) will focus on:

- a lakeshore reserve zone (LRZ) at the shore which is 10 m wide, where no timber harvesting or access will be allowed; and
- a lakeshore management zone (LMZ) outside the reserve and extending 200 m, where timber harvest practices are modified to protect the recreational values of the lake.
- strategies for timber harvesting within the lakeshore management area vary depending upon the Lake Class, as follows:

Class B Lakes: 1. Clearcutting is not permitted. Cut less than 20% of the LMZ each 20 years; retain more than 50% of the original basal area 2. Locate new haul roads outside the LMZ. Locate skid trails more than 30 m away from the Lakeshore Reserve Zone (LRZ). 3. Backspar trails must be rehabilitated. ***Class C Lakes:*** 1. Partial Cutting is preferred. Cut less than 40% of the LMZ each 20 years; retain more than 50% of the original basal area. 2. If clearcutting, harvest less than 20% of the LMZ each 20 years in cutblocks smaller than 10 ha, and a maximum block width along the lakeshore is 400 m. 3. Locate new haul roads outside the LMZ; locate spur roads and landings more than 100 m and skid trails more than 30 m away from the LRZ; 4. Backspar trails must be rehabilitated.	***Class D Lakes:*** 1. Partial Cutting is preferred. Cut less than 60% of the LMZ each 20 years; retain more than 50% of the original basal area. 2. If clearcutting, harvest less than 30% of the LMZ each 20 years and a maximum block width along the lakeshore is 500 m. 3. Locate new haul roads more than 75 m, spur roads and landings more than 40 m, and skid trails more than 30 m away from the LRZ. ***Class E Lakes:*** 1. Partial Cutting is preferred. Cut up to 100% of the LMZ each 20 years; retain more than 50% of the original basal area. 2. If clearcutting, harvest less than 50% of the LMZ each 20 years and a maximum block width along the lakeshore is 500 m. 3. Locate new haul roads, spur roads, landings and skid trails more than 30 m, away from the LRZ.

1 Jack Leggett. MoE Fisheries Biologist. Personal Communications. 94-01-07.

5.1.3. Recreation Conflicts

Conflicts are on the horizon. Our current tenure arrangement gives us few tools to manage recreation on Crown Land. We have little opportunity to manage the recreational pursuits of the people who live here, and yet their pursuits will bring us problems. Some recreational uses are mutually incompatible, for example horseback riding and mountain biking, where high-speed mountain bikes can startle horses. Some recreational uses, such as unauthorized trail establishment (e.g. by motocross or mountain bikes) exposes research projects to damage or alteration in environmental conditions. All recreational uses expose our research installations to a risk of theft or vandalism.

While significant conflict has not yet arisen, intensive recreational use has created conflict on other Research Forests, and it may become a problem here, particularly at Knife Creek, which is closer to the population centres of the Central Cariboo. Local government is currently promoting the Central Cariboo as an outdoor recreation destination.

Off-road use of bicycles, motorcycles, all-terrain vehicles and snowmobiles threatens the security of research installations and is therefore contrary to our management objectives. We need to develop a strategy to protect our interests against this growing threat.

Action 9: Prepare a recreation plan to examine methods of controlling the impact of unorganized recreation on the Research Forest.

5.2. Visual Sensitivity

The Cariboo Chilcotin Land Use Plan states that forestry operations should avoid or minimize impact on scenic quality. Highway corridors are considered to be of importance to scenic quality, and both blocks of the Research Forest are visible from highway corridors. The Gavin Lake block is the principle view from the Likely highway for a long duration, and the Knife Creek Block is the secondary view for a long duration on Highway 97. In addition, the Gavin Lake Demonstration Area working circle (compartments GL01 and GL02) has visual quality as the dominant management objective. Finally, the Lakeshore Management Zones of our lakes also have visual quality objectives.

Digital visualization of Block 113, Little Gavin Lake; RP 1998-06.

The Ministry of Forests and Range has prepared a Visual Inventory of the Gavin Lake Block In addition, the Lakes Classification process under the subregional plans (Anon 2005a, Anon 2005b) provides us with visual quality objectives for the Lakeshore Management Zone of each lake (see Table 11 above). Visually sensitive polygons and visual quality objectives are shown on the maps at Appendix 5 and summarized in Table 12.

Visual quality will be managed by:

1. recognizing important visual elements;
2. employing techniques of good landscape design;
3. retain roadside vegetation to screen views from roads;

4. use of partial cutting systems to achieve visual quality objectives (where silviculturally feasible);
5. preparation of Visual Impact Assessments for blocks in visually sensitive locations.
6. supervision of visually sensitive harvesting from the important viewpoints.

We will manage for those visual quality objectives as outlined in Table 12.

Table 12: Area of visual quality objective class, subregional plan direction (Anon 2005a, 2005b) for those classes, and generalized management recommendations to achieve those objectives on the UBC/Alex Fraser Research Forest.

Visual Quality Objective Class	**SRP Direction**	**Area (ha)**	**Research Forest General Management Direction**
Modification	Alterations may dominate the view, but must borrow natural line, form and scale. 7.1-18% of the view may be without visually effective green-up.*	610	- visual quality will be protected by our standard forest management described in Chapter 7 - limit area without visually effective greenup to maximum 18%
Partial Retention	Alterations are visually subordinate, and repetition of line, form colour and texture is important to blend with dominant elements. 1.5-7% of the view may be without visually effective greenup.	780	- prepare visual impact assessments - utilize retention to soften or screen most sensitive sight-lines - standard forest management described in Chapter 7 may need to be modified -- partial-cutting silviculture systems required - limit area without visually effective greenup to maximum 7%
Retention	Alterations are not visually apparent. Repeat the line, form, colour and texture of the landscape. Less than 1.5% of the view may be without visually effective greenup.	281	- conduct visual simulation modelling to design harvest entries - partial-cutting silviculture systems are required, regeneration gaps should be sized to conform with landscape texture - limit area without visually effective greenup to maximum 1.5%

*Visually Effective Greenup is achieved when forest cover on a cutblock blocks stumps, logging debris, and bare ground from view (Province of BC 1995d).

5.2.1. Viewpoints

For the purposes of visual impact assessments and visual simulation modelling, viewpoints will be selected that provide the longest viewing time. At Gavin Lake, the critical viewpoint is the fire-pit at Gavin Lake Camp. For all other lakes, the boat launch is considered to be the principle viewpoint, and the lakeshore with maximum exposure to the development is considered to be the secondary viewpoint.

5.3. Cultural Values

The University of British Columbia, and the Faculty of Forestry in particular, have demonstrated an interest (Anon 2004, Prest n.d.) in working with First Nations communities to:

- ensure our programs are accessible to aboriginal students,
- expose our entire student population to aboriginal issues and perspectives, and
- explore means of developing closer relationships between UBC and First Nations communities.

Members of the Xats'ull First Nation talk to UBC students during Fall Field School.

The Alex Fraser Research Forest does not have a direct role in the government-to-government relationship between First Nations and British Columbia or Canada. However, we wish to participate with individuals and communities that pursue cultural values and traditional uses, in the interest of sharing and learning.

The Research Forest overlaps with asserted traditional territories of the *T'exelc* people (Williams Lake Band) and *Xats'ull/Cmetem'* people (Soda Creek Band). These two First Nations are affiliated with the Northern *Secwepemc te Qelmucw* (Northern Shuswap Tribal Council), and are presently at stage four[2] in the six-stage treaty negotiation process.

Cultural values ascribed to the land include:

- the archaeological and cultural sites and features that exist on the land, and
- the practise of traditional activities on the land.

Archaeological and cultural sites and features are identified according to the process discussed in Chapter 4. We will manage our development activities to prevent physical damage to these sites and features, in accordance with the Heritage Conservation Act.

Traditional activities historically practised by the Northern Secwepemc have been documented by Alexander (1997) and Turner (1997). Proprietary traditional-use information (owned by the Cariboo Tribal Council, Soda Creek Band and Williams Lake Band) may be available to us, and we should seek to adopt that information into our planning processes.

Action 10: Contact Cariboo Tribal Council, Soda Creek Band and Williams Lake Band to become acquainted with and respect traditional use information pertinent to the Alex Fraser Research Forest.

Our forest management activities may impinge upon the practise of traditional activities, and we will remain open to considering ways to manage the Research Forest that enhance the opportunities to practise traditional activities. We will:

- ensure that birch remains part of the mature forest cover;

2 http://www.gov.bc.ca/arr/negotiation/first_nations_in_the_process/cariboo_tribal_council.htm (accessed September 7, 2006)

- manage stand density and species composition to ensure berry crops are available in establishing and mature stands;
- recognize the value of species that occur at low densities; and
- manage the biological diversity of the Research Forest to ensure that plants and animals of traditional use remain viable and productive.

5.4. Domestic Range

Domestic range for agricultural use has been important to the beef sector since the ranchers followed the gold miners into the Cariboo. Since ranchers must grow hay to feed their cattle, the cattle must leave the hay fields during the growing season. Under tenure arrangements with the Crown, ranchers are able to turn their livestock (cattle and horses) out onto crown range to graze.

The Alex Fraser Research Forest provides domestic grazing for stock from six ranches.

We currently have six range permitees using the Research Forest and 100% of the area is available to their use, with the exception of several research exclosures. Appendix 5 provides maps of both blocks of the Research Forest which indicate the areas and season of use for each range permittee. Table 13 following describes range permits operating within the Research Forest.

Table 13: Range Agreements operating within the Alex Fraser Research Forest.

Stock Range	Range Unit	Name	Brand	Permit No.	Auth. AUM*
Big & Beaver	Gavin	U2 Cattle Co. Ltd (Fred Tillotson)	LHC U2	RAN075629	1,993
Horsefly	Edney	Howard J. Briscoe	RHC RB	RAN073705	855
150 Mile	Knife Ck.	Clint and Karen Thompson	RRC FR	RAN076621	350
		J.&S. Fletcher	RHC C/C	RAN075834	1225
		Don & Sylvia Fraser		RAN073476	399
		Cliff and Jo Hinsche	LHC C J LHC 141	Adjacent Private Land	
Total					3,643

* AUM (Animal Unit Month -- the forage required by one cow-calf pair for one month) figures represent totals for each permit, and do not represent allocations from the Research Forest alone.

Broadcast grass seeding will be carried out within one year of disturbance on all roadsides and landings within cut blocks, and on cut banks and ditch lines outside cutblocks. Seed mixes will differ from the Gavin Lake block to the Knife Creek block, to allow for the difference in biogeoclimatic conditions. The mix employed will be as suggested by Ministry of Forests District Agrologists. Trials are currently under way (Research Project 2006-11) to investigate the use of native species for revegetation after disturbance, and palatability will be an issue considered.

Any apparent conflicts which arise between range use and timber or wildlife management will be addressed by the Research Forest Manager and the rancher. If not resolved, the question will be referred to the District Manager of the Ministry of Forests.

Integration of timber and range management may result in some loss of productivity to either or both resources, but an overall gain in return to the public. A loss of trees due to range use is to be expected, but losses must be kept to reasonable limits through management practices.

Unacceptable losses due to cattle damage are assessed during a Silviculture Survey, and is defined to be:

1. Greater than 10% of the total conifers within an identifiable stratum damaged or killed by cattle (Erickson 1992);
2. A change in stocking status (from sufficiently restocked to not sufficiently restocked) caused by cattle damage; or
3. Failure to attain free growing status as a result of cattle damage.

Range structures are built to control the movement of livestock within the range. Substantial investments in range structures require periodic maintenance, according to the following principles:

1. Drift fences existing on the Research Forest will be maintained by the rancher;
2. Any damage done to any fence during Research Forest activities will be repaired by the Research Forest;
3. Research Forest activities which remove natural barriers to cattle movement will be mitigated by fencing operations performed by the Research Forest;
4. New drift fences and other range projects may be built on the Research Forest as required to enhance range management activities, but the location must be agreed upon to protect research and teaching sites;
5. Research trials may be fenced by the Research Forest as required;
6. All new fences built in mule deer winter range areas (identified in Appendix 8) will have a maximum height of 106 cm (42 in), a bottom strand at 45 cm (18 in) from the ground, and top rails will be placed where warranted.

Planning for forest and range management will seek input from ranchers and Research Forest staff, and forestry operations will account for grazing in design:

1. Management and Working Plans, Forest Stewardship Plans, and Site Plans will be discussed with ranchers to explore areas of impact and arrive at solutions;
2. Research Forest staff will review and provide input to Range Use Plans;
3. Planted trees should be placed within 10 cm of debris such as logs and stumps or on raised mounds whenever possible, and planting on skid trails will make use of the raised edges of the trail;

4. Cattle use will be considered when prescribing site preparation -- if disc-trenching is prescribed, the trenches should be oriented along the contours, and trees should be planted high on the hinge of the trench; and
5. The Research Forest Manager may allow new plantations a period of time to become established before being subjected to grazing, and temporary fencing may be erected to achieve this period of rest if it is not achieved by riding and salt placement.

Grass seeding will be used to reduce soil erosion, reduce the spread of noxious weeds, and provide forage for domestic grazing:

1. Grass seeding will be carried out using a mix of species and rate prescribed by the district agrologist;
2. Roads and landings to be rehabilitated will be ripped to 30 cm depth and grass seeded to provide forage and ground cover -- trees will generally be planted;
3. Roads and landings which are being temporarily deactivated will be grass seeded without surface ripping;
4. Roadsides, ditches, cut banks and fill slopes will be seeded with grass to reduce erosion and provide forage;
5. Intensively managed grazing by cattle or sheep may be utilized to complement silvicultural objectives for vegetation control.

One Forester's Beliefs About Managing A Forest With Cows

1. Cows don't eat seedlings, but will happily step or lie on them.

2. Cows need water and salt every day.

3. A place to lie down in the breeze is a happy place.

4. Cows will camp over if they have water, salt and a breeze.

5. Old cows have a plan, and will execute it.

6. Fences are expensive, need annual maintenance, and sometimes trap stock on the wrong side.

Ken Day, RPF
2006

5.5. Fish and Wildlife For Hunting, Trapping, Guiding, Sport Fishing

Mule deer and moose are the main focus of the annual hunting season in the central interior; both of these species are abundant on the Research Forest. Several of the lakes on the Gavin Lake Block are popular for trout fishing. The Ministry of Environment will continue to administer the hunting and fishing season on both blocks of the Research Forest.

Guiding tenures operate on both blocks of the Research Forest, and input of guides will be sought during the planning process. Administration of guiding rights remains the responsibility of the Ministry of Environment.

Active traplines are currently operated on both blocks of the Research Forest. Administration of trapping rights will continue to rest with Ministry of Environment. Consultation with trappers, maintenance of biodiversity, and the spatial distribution of timber management activities will ensure continuation of productive traplines.

5.6. Mineral Exploration

Mineral tenures overlap nearly all of the Gavin Lake Block, (Figure 9) which is rated as having high metallic mineral potential[3]. No mineral tenures presently exist on the Knife Creek

3 See: http://www.maps.gov.bc.ca Mineral Tenures Online Viewer (accessed September 19, 2006)

Block. Placer claim designations encompass both Gavin Lake Block and Knife Creek Block, and several placer tenure reserves exist on or adjacent to the Gavin Lake Block.

Claim staking and mineral exploration is disruptive to forestry planning and research installations, because:

- Flagging tape used in claim designation is not colour-coded, and is often in the same colours we use for harvest planning;
- Blazed lines and survey sight-lines are located without consideration of research installations.

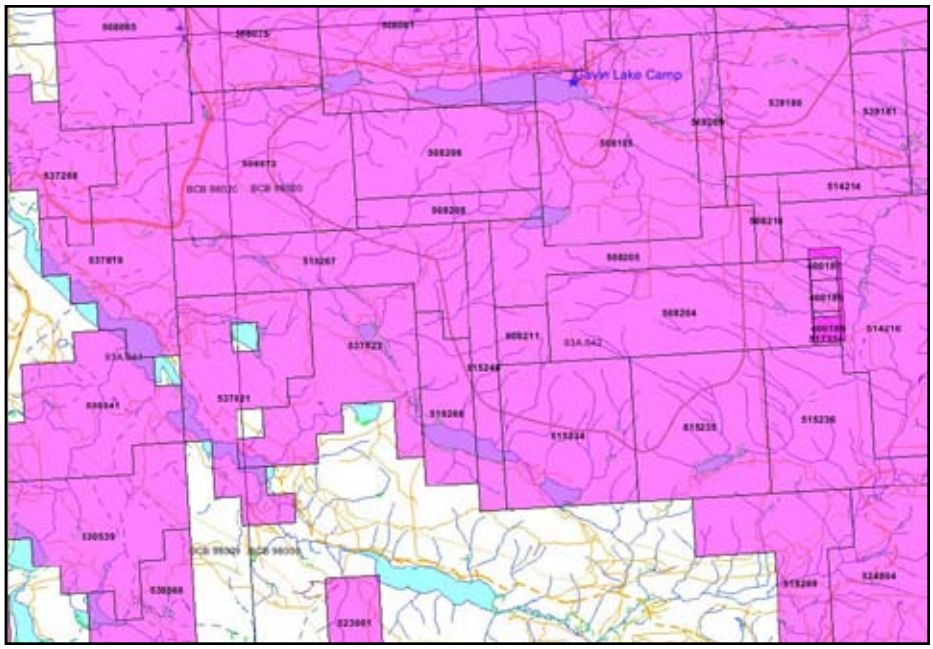


Figure 9: Screen capture from the Mineral Tenures Online Viewer (See: http://www.maps.gov.bc.ca accessed September 19, 2006) showing the Gavin Lake Block is nearly 100% staked in mineral tenures (pink shading).

In spite of the value to the provincial economy, and in spite of the land-use plan commitment to the mining industry to maintain access to 100% of the landbase outside of protected areas (Anon 2005a, 2005b), mineral exploration and potential development are contrary to our management goals and objectives as currently conceived. The development of a mineral property on the Research Forest is not in our best interests. If a mineral development should come to pass, it would eliminate the values we have developed on the Research Forest over the past two decades, and require the replacement of that portion of the Research Forest with a similarly situated area of forest land.

Action 11: Seek means of cooperating with mineral exploration interests to ensure the protection of Research Forest values during the staking and exploration process.

Action 12: During the development of a new tenure arrangement for the Research Forest, seek to reserve the area of the Research Forest from claim staking.

5.7. Non-timber Forest Products

Non-timber forest products (NTFPs) are a wide range of plants, fungi and services of the forest. Examples might include wild mushrooms used for food, floral greens, craft products, and herbs[4]. We are supportive of developing opportunities for harvest of NTFPs, but we

4 See: http://www.royalroads.ca/programs/faculties-schools-centres/non-timber-resources/ntfp/ (accessed September 7, 2006).

are concerned about uncontrolled harvesting within the Research Forest, because there are potential conflicts with:

- silvicultural investments;
- traditional cultural practices
- established research sites
- timber harvesting operations

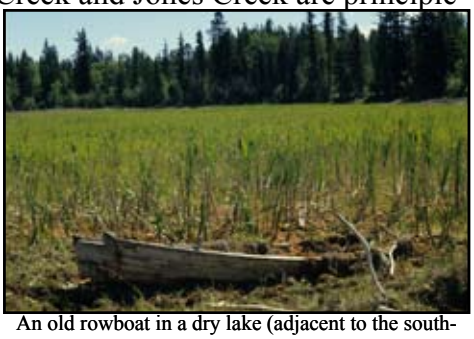
Our position is that the Research Forest must be directly involved in commercial harvest of non-timber forest products, to ensure that our interests are protected. We are interested in pursuing NTFPs as an opportunity for additional economic activity, and as an area for research and extension.

5.8. Water Production

Water from the Research Forest is important for domestic use, stock watering, agricultural irrigation, fisheries, and conservation values. Licensed water intakes for domestic and irrigation use are shown on the maps at Appendix 5. Road construction and maintenance is our greatest hazard to water quality, and is discussed in Chapter 8. Management of riparian areas, harvest rates and harvest intensity are our principle tools to influence water production and stream temperature.

The CCLUP (Province of BC 1995a) stipulates that both the Williams Lake and Beaver Valley Resource Development Zones (Knife Creek Block and Gavin Lake Block respectively) require planning to address competing needs for fisheries flows and agricultural uses. To our knowledge such planning has not been initiated.

The condition of the San Jose watershed (of which Knife Creek and Jones Creek are principle tributaries) is discussed in a provincial government report (Nagpal 1993). That report indicates that the water quality of the San Jose River, particularly phosphorus loading from agricultural uses, has resulted in unacceptable water quality for domestic water uses, primary-contact recreation, and fisheries of Williams Lake. The fisheries resource is believed to have declined because of low flows, riparian habitat losses, urbanization, beaver dam obstructions, and reduced water quality.



An old rowboat in a dry lake (adjacent to the south-east corner of the Knife Creek Block) indicates the hydrology of the area has changed through time. Photo taken in 1987.

Action 13: Seek input from hydrologists on measures to increase stream flows.

6. Conservation of Biodiversity

Biodiversity is "the diversity of plants, animals, and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them." (Ministry of Forests 2006). Our vision, goals and forest management objectives (page 1) make reference to the importance of biodiversity to our management.

> *"If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."*
>
> *Aldo Leopold (1966)*

We generally subscribe to the philosophy described by Lindenmayer and Franklin (2002), who point out that a network of reserves is imbedded in a matrix of managed lands. In their view, the management of the matrix (the landscape) is more important to the conservation of biodiversity than the selection of the reserves. The matrix is the land we are actively managing to produce all the goods and values that flow from the Research Forest; our management must therefore respond to the ecosystems, their function, and protection of key attributes and rare life forms or ecosystems within the matrix.

Reserves fulfill important conservation functions. Large-scale reserves (parks) are outside the scope of our management activities. Smaller reserves at the landscape level protect important attributes and provide important functions at the landscape level. Practices at the stand level maintain attributes that are important to the conservation of biodiversity. Because each block of the Research Forest is too small to be considered a unique landscape, landscape level conservation is directed from outside the Research Forest; each block of the Research Forest is a part of a larger landscape.

6.1. Landscape Level Biodiversity

6.1.1. Seral Stage Distribution


SBSdw1 landscape, viewed from the Gavin Lake Block.

The UBC/Alex Fraser Research Forest is too small to be considered a landscape, and we are therefore a component of larger areas being managed by the Crown and forest companies under contract to the Crown. Hence we respond to the Crown's direction to fulfill our share of the management of biodiversity in the landscapes within which we operate.

Subregional plans under the CCLUP (Anon 2005a, Anon 2005b) have produced targets for seral stage distribution, which are summarized for the Research Forest and presented below in Table 14 and on maps at Appendix 7.

Table 14: Seral stage distribution for the UBC/Alex Fraser Research Forest, comparing sub-regional plan targets (Anon 2005a, Anon 2005b) to the unadjusted 2004 forest inventory.

		Gavin Lake Block		**Knife Creek Block**	
		NDT 2 ICHmk3	**NDT 3 SBSdw1**	**NDT 4 IDFxm, dk3**	
				Fir	**Pine**
Definition (years)	Early	<40	<40	<40	<40
	Mature	>100	>100	>100	>100
	Old	>250	>140	>250	>140
	Interior Old	Minimum distance from the edge of a patch at which interior forest conditions occur is: 50 m from a mature patch, 100 m from a mid-seral patch, 200 m from an early seral patch, or 100 m from a non-forest patch or feature.			
Target	Mature+Old	>15%	>11%	>43%	>23%
	Old	>9%	>11%	>21%	>11%
	Interior Old	≥0.9%	>1.1%	>10.5%	>5.5%
	Early Guideline	n/a	n/a	<12%	<54%
Alex Fraser Research Forest Status	Mature+Old	39%	48%	51%	40%
	Old	6%	7%	0%	0%
	Interior Old	0	0	0	0
	Early	61%	52%	49%	60%

Analysis of Table 14 shows shortfalls in "old forest" in all NDT/BEC types. This is in part a result of harvest history, and in part a result of a dysfunctional forest inventory. For example, the age class information in the fir group at Knife Creek is unreliable, because of the inaccuracy of assessing stand age in an uneven-aged stand. In spite of the indication to the contrary in the inventory, we are certain that old trees do exist in many stands at Knife Creek. Similarly, in the ICHmk3 at Gavin Lake we have many old stands that are uneven-aged, and have not been disturbed for more than 300 years, but many of the trees in those stands are less than 250 years old. We presume that such stands contain the attributes of an old forest, but the classification system limits their contribution to "mature". The inaccuracy of the inventory has been recognized by government (Biodiversity Conservation Strategy Committee 2001). There is an inherent flaw in the assessment of oldness based upon inaccurate inventory classification, and we support current research efforts aimed at defining the attributes deemed to be desirable in stands defined as "old". We will ensure that new forest inventory information will reflect the variables used to describe attributes of oldness. We will not manage the Research Forest to achieve the "old"

Old cedar forest, Gavin Lake Block, Alex Fraser Research Forest.

target based upon the current forest cover information. We will, however, steward our oldest forest to maintain those values through reserves and deferrals discussed below.

Action 14: Include attributes of "oldness" in the information captured by the new forest inventory ledger.

6.1.2. Distribution of Cut and Leave Areas

Sub-regional plans (Anon 2005a, Anon 2005b) seek a range of cut and leave patterns, both in time and space, with the objective of achieving the target range of patch sizes for all seral stages. Direction for the Research Forest is shown in Table 15.

Table 15: Direction for patch size distribution from Sub-Regional plans (Anon 2005a, Anon 2005b) as applied to the UBC/Alex Fraser Research Forest.

	Gavin Lake Block		**Knife Creek Block**	
	NDT 2 ICHmk3	**NDT 3 SBSdw1**	**IDFxm, dk3**	
			Fir	**Pine**
A. Target for patch size > 250 ha (% of M+O)	10%	10%	50%	25%
B. Target M+O (% of Land-base) from Table 14	>15%	>11%	>43%	>23%
C. Product of A*B = % of Landbase	1.5%	1.1%	21%	5%
D. Forested Area within AFRF	3,209	2,784	3,184	231
Product of C*D (ha)	48 ha	31 ha	669 ha	12 ha

The strategy to implement this patch-size direction is as follows:

- In the ICHmk3, SBSdw1, and the IDF pine group, we have insufficient area of forest to produce patches of mature and old forest in excess of 250 ha on 1.5% of our landbase, and we will seek a patch size of 50 ha.
- In the IDF fir group, we intend to achieve this objective by considering that all of the area managed to a high mule deer habitat objective (see Appendix 9), reserves, or deferrals will achieve the attributes of an old forest, and we therefore have a contiguous gross area of 1,356 ha of old forest (with the exception of the pipeline which transects the area).

Cottonwood and devil's club, Gavin Lake Block, Alex Fraser Research Forest

6.1.3. Reserves and Deferrals

A network of reserves and deferrals has been established in this Management and Working Plan,

and in consideration of direction from government. Reserves and deferrals like those at the Alex Fraser Research Forest are described by Lindenmayer and Franklin (2002) as "protected habitats within the landscape matrix." Other parts of the land-base are outside the productive forest but still provide habitat values, such as:

- forested areas classified by the forest inventory as Environmentally Sensitive Areas because of shallow soils or very wet soils
- non-forested grass-lands, wetlands and lakes

They are described below, depicted on maps located in Appendix 8, and summarized in Table 16.

Table 16: Area of the Alex Fraser Research Forest as classified by management for the conservation of biodiversity.

Land Type	Gavin Lake Block		Knife Creek Block		Total Research Forest	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Environmentally Sensitive Areas	508.1	8.0	125.5	3.6	633.6	6.4
Non-Forest (including lakes)	299.1	4.7	49.3	1.4	348.4	3.5
Management Plan Reserves	129.9	2.0	64.4	1.8	194.3	2.0
Old Growth Management Areas (Perm. and Temp.)	331.4	5.2	84.1	2.4	415.5	4.2
Potential Harvest Area	5,086.3	80.0	3,162.3	90.7	8,248.6	83.8
Total	6,354.8	100.0	3,485.6	100.0	9,840.4	100.0

Management Plan Reserves

Each Biogeoclimatic zone represented in the Research Forest has designated areas outlined as Management Plan Reserves which will generally remain unmanaged. Research Reserves are established to preserve research and educational opportunities in each of the biogeoclimatic zones represented on the Research Forest. These reserves will be managed only to the extent required to protect the Research Forest as a whole (see Chapter 6 for particulars). In addition to providing an unmanaged area for research and teaching, these reserves also contribute to the area retained to develop old forest attributes.

Old Growth Management Areas

Old Growth Management Areas (OGMAs) are designated by the Crown for the Gavin Lake Block (Anon 2005a) and for the Knife Creek Block (Anon 2005b), with locations amended under this Management and Working Plan by agreement with the Integrated Land Management Bureau of the Ministry of Agriculture and Lands.

OGMAs are established to achieve short- and long-term objectives for the extent of old forest areas (Anon 2005a, Anon 2005b). Transition OGMAs have also been designated by

the Crown "...in biogeoclimatic subunits where there is insufficient old forest ...to meet the short-term old forest objectives..." (Anon 2005a, Anon 2005b). These transition OGMAs will be managed as OGMAs until recruitment areas in permanent OGMAs have achieved old condition, or for one rotation period (120 years). OGMAs are managed as no-harvest areas[1] except in the case of the following circumstances (Anon 2005a, Anon 2005b):

1. Insect control essential to curtail severe damage to the no-harvest area or to other forest values at the landscape level,
2. Salvage of dead timber (non-infectious) resulting from severe natural disturbance that has destroyed the ecological, wildlife or cultural values for the area, [E.G. catastrophic loss of an OGMA to wildfire.]
3. Control of wildfire,
4. Seed cone collection, provided trees are not felled,
5. Road construction where there is no other practicable location available,
6. Thinning to enhance old forest attributes within OGMAs inside mule deer winter range in Knife Creek,
7. Ecological restoration activities approved by statutory authorities,
8. Exploration and development for minerals and coal, or placer mines in designated placer areas.

6.1.4. Landscape Connectivity

Landscape Connectivity describes "...the degree to which late-succession ecosystems are linked to one another to form an interconnected network." (Anon 2005a, Anon 2005b). Lindenmayer and Franklin (2002) suggest the strategies to maintain connectivity include:

- Riparian and other corridors
- Protection of sensitive habitats
- Vegetation retention within harvest areas
- Careful planning of roads

Direction from the Crown regarding the level of connectivity varies by ecosystem, as described in Table 17.

1 "...parcels of land ...designated to conserve special ecological and cultural values. Protection of those values is paramount and encompasses the maintenance of natural process such as endemic levels of natural disturbance. Therefore, with the exception of mining, industrial development, including timber harvesting is permitted only under [prescribed] circumstances.' (Anon, 2005a).

Table 17: Sub-regional plan direction for landscape connectivity for the UBC/Alex Fraser Research Forest (from Anon 2005a, 2005b)				
	Frequency of Connectivity			
Landscape Elements	NDT 2 ICHmk3	NDT 3 SBSdw1	IDFxm	IDFdk3
Upland to Upland	High	Low	High	Mod-High
Upland to Stream	Mod	Low	High	Mod-High
Upland to Wetland	Mod	Low	High	Mod-High
Cross-elevational	High	Low	High	Low
Wetland Complex	Low	High	Low-Mod	High
Stream Riparian	High	Low	High	Low
Island Remnants	Low	High	Low	Mod.

Within the Research Forest, connectivity is provided by our maintenance of the matrix we are managing. We have developed an image over time that connectivity is provided by corridors or linkages (Day 1997) protected for some time from timber harvesting. This image works well if our mental picture is of animals walking from reserve to reserve, but works less-well if we consider soil-borne fungi, or slow-moving plants. A corridor for some species may be a barrier to another (Harrison and Voller 1998). Some species are so slow-moving that the only practical means of maintaining them is to provide refuges in most stands where they presently reside.

> *"Although establishing corridors or stepping stones will be valuable for some taxa, maintaining connectivity for other species requires retaining appropriate vegetation cover throughout the entire matrix."*
>
> *Lindenmayer and Franklin (2002)*

Our strategy to retain connectivity is undertaken at the landscape level by the creation and protection of reserves and OGMAs, and by the protection of important stand-level attributes, discussed further in Section 6.2. The arrangement of those protected attributes is a matter of chance according to their location, but the result over time and space is a matrix of protected elements that create multi-directional connectivity. Finally, our reliance on partial cutting in pursuit of our land-use objectives, plus planned retention, provides connectivity throughout our matrix stands.

6.2. Stand-Level Biodiversity

Management for stand-level biodiversity concentrates on the identification and protection of stand-level attributes during forest development:

- Riparian ecosystems,
- Wildlife features such as dens, stick nests, trees with cavities, and mineral licks
- Sensitive sites such as forest with shallow soils or high watertable, and
- Other important attributes.

During the preparation of Site Plans we take care to identify each of these attributes. Research Forest staff are cognizant of the importance of these attributes; when the attributes are encountered, we take a GPS reference, and determine the appropriate management action to protect the attribute. Management actions may include no-machine zones, modification to the treatment, placement of wildlife tree patches, or boundary modifications.

6.2.1. Wildlife Tree Patches

Wildlife Tree Patches (WTPs) are a primary tool for managing stand-level biodiversity. WTPs are required under sub-regional plans (Anon 2005a, 2005b), to occupy a part of each cutblock, according to Table 18.

Table 18: Wildlife Tree Retention targets from Sub-Regional plans (Anon 2005a, Anon 2005b) as applied to the UBC/Alex Fraser Research Forest.

	Gavin Lake Block		**Knife Creek Block**	
	NDT 2 ICHmk3	**NDT 3 SBSdw1**	**IDFxm, dk3**	
			Fir	**Pine**
Target Minimum Wildlife Tree Patch area (% of gross harvest area)	8%	8%	8%	9%

Since their requirement was introduced by the Forest Practices Code, we have been using WTPs as our primary means to protect important attributes in stands, and to avoid difficult reforestation problems. Our strategies for WTP location generally agree with recommendations by the Biodiversity Conservation Strategy Committee (2005). WTPs are located within cutblock boundaries, and generally at the boundary of the block to enhance their wind-firmness. We do not seek to include areas that represent the stand average condition, because there is an abundance of the average condition available outside the boundaries of the block. Instead, WTPs are allocated to riparian areas, sensitive sites, sites with special features, or sites with excellent potential for habitat development (e.g. mid-aged or mature aspen types). This strategy distributes WTP area by site series with an emphasis on hydric and xeric sites, as indicated in Table 19. Over time this strategy means that zonal sites will be under-represented in the WTP area, but we are satisfied that our approach empahsizes protection of biologically richer (riparian areas) and more sensitive sites, while still representing the mesic condition.

6.2.2. Riparian Management Strategies

Riparian areas are a critical component of biodiversity and wildlife habitat.

> *"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 areas frequently contain the highest number of plant and animals [sic] species found in forests, and provide critical habitats, home ranges, and travel corridors for wildlife. Biologically diverse, these areas maintain ecological linkages throughout the forest landscape..."*
>
> *(Province of BC 1995)*

Table 19: Wildlife Tree Patch allocation by site series for the Alex Fraser Research Forest, as of 2005, for those cutblocks harvested since 1995.

Zone	Cutblock Area	WTP Area Retained		WTP Area Required (%)	Site Series Distribution (%)										
		(ha)	(%)			01	02	03	04	05	06	07	08	09	10
IDF	346	46	13	8	Total	73.1	1.2	0.9	9.5	2.6	0.5	5.6	5.8	0.4	0.5
					WTP	70.3	0.0	2.8	0.9	3.7	2.6	18.4	1.0	0.3	0.0
ICH	324	35	11	8	Total	36.0	0.5	4.2	14.0	9.5	18.3	9.0	8.5		
					WTP	12.5	0.0	17.9	14.2	11.7	31.8	26.9	8.0		
SBS	360	49	14	8	Total	44.9	3.6	11.7	0.8	0.7	19.8	9.5	6.0	2.9	
					WTP	17.7	18.1	17.2	0.2	2.0	7.3	8.6	16.3	3.2	

Riparian ecosystems serve several critical functions:

- contribute to the conservation of biodiversity outlined;
- protect water quality and stabilize streambanks;
- regulate stream temperatures;
- provide woody debris and nutrient inputs to streams;
- provide habitat for a great number of life forms.

Riparian ecosystem maintenance is a core part of our strategy to conserve biodiversity, because the linear nature of riparian features provides effective connections amongst stands (Lindenmayer and Franklin 2002). Riparian ecosystems are, in effect, the bridge between the landscape and the stand level. Further, riparian areas are very productive, and therefore often contain large trees. Finally, the wet nature of riparian ecosystems means that natural disturbance by fire is less likely, so there are old trees and structures, and uncommon plants living in those areas.

Streams

A riparian inventory was completed in 1996 for all of the Research Forest. This inventory included descriptions of each stream reach below barriers to fish (within the Research Forest), and classifies each stream according to the Riparian Management Area Guidebook (Province of BC 1995b), and is further described in Chapter 4. Table 8 (Chapter 4) shows the total length of streams by riparian class. Table 20 below briefly describes all the streams in the Research Forest which were found to be fish-bearing. Table 22 (page 66) describes the restrictions on harvesting within Riparian Management Areas.

Table 20: Streams found to have fish present within the Alex Fraser Research Forest (bracketed site numbers refer to sample sites from Hallam Knight Piésold 1996a, 1996b).

System	Stream Name	Location	Ripar-ian Class	Fish Presence	Riparian Management Area (Distance from high water (m))	
					Reserve Zone (m)	Mngmt Zone (m)
Gavin	Gavin Creek	Mainstem Creek west of Gavin Lake (sites 81, 83, 85)	S3	Rainbow Trout	20	20
	unnamed creek	Tributary to Gavin Lake which drains Fire Lake (site 6)	S4	Rainbow Trout	0	30
	unnamed creek	Tributary to Gavin Lake on N. shore at West end. (Reported by Research Project 96-02.)	S4	Rainbow Trout	0	30
Prouton	Prouton Creek	Mainstem creek between Choate and Prouton Lakes (site 45)	S3	Rainbow Trout Lake Chub Longnose Sucker	20	20
Teasdale	unnamed creek	Teasdale Creek Tributary N. of L 2052, E. Boundary of Gavin Block (site 86)	S3	Rainbow Trout	20	20
Jones	Jones Creek	Mainstem creek at each point where it contacts the Research Forest (site 18, 19, 20)	S3	Rainbow Trout	20	20
Knife	Knife Creek	Mainstem creek at each point where it contacts the Research Forest (unsurveyed)	S3 assumed	Unknown	20	20

Lakes

The Gavin Lake Block of the Research Forest contains ten lakes ranging in size from 0.5 ha to 98.9 ha (Table 21). Fish presence or absence is derived from local knowledge and implication of fish presence in tributary creeks. Riparian classification and management classification are presented in Chapter 4 and Chapter 5. Sub-regional plans have prepared lake classifications (Anon 2005a, 2005b), and state expectations for development in lakeshore management zone (LMZ), and Table 22 (page 66) describes the restrictions on harvesting within Riparian Management Areas.

Table 21: Riparian management for lakes within the UBC/Alex Fraser Research Forest.

Lake Name	Area (ha)	Riparian Class.	Fish Presence	Riparian Management Area (Distance from high water (m))		
				Reserve Zone	Mngmt Zone	Lake-shore Mngmt Zone
Choate Lake	6.5	L1-B	Rainbow Trout (privately stocked), Lake Chub, Longnose Sucker	10	10	200
Dorsey Lake	15.6	L1-B	Rainbow Trout (stocked)	10	10	200
Fire Lake	16.3	L1-B	Rainbow Trout (stocked)	10	10	200
Gavin Lake	98.9	L1-B	Rainbow Trout	10	10	200
Little Gavin Lake	15.9	L1-B	Rainbow Trout	10	10	200
Prouton Lake	40.8	L1-B	Rainbow Trout, Lake Chub, Longnose Sucker	10	10	200
Timothy Lake	10.3	L1-B	Assumed, breeding loons observed	10	10	200
unnamed lake on Teasdale Ck. mainstem	0.5	Non-classified	None	0	0	
unnamed Lake on Watson Ck.	2.3	L3	None	0	30	30
West Lake	10.0	L1-B	Rainbow Trout (word of mouth)	10	10	200
Total Lakes	**217.1**					

Wetlands

The Research Forest contains many wetlands which range widely in area. Wetlands were not classified in the Riparian Inventory, but have been classified according to their area, which is shown in Table 8 in Chapter 4. A wetland inventory is presently underway, and will classify wetlands according to MacKenzie and Moran (2004). Until that inventory is complete, we have classified wetlands by area, and their riparian classification and management

classification are presented in Chapter 4. Wetlands will be protected by appropriate forest practices within Riparian Management Areas (RMAs) as described in Table 22.

Fish

No salmon stocks use the streams in or adjacent to the Research Forest. Salmon habitat is well buffered from development activities on the Research Forest due to large lakes (Beaver Lake and below) between the Research Forest and downstream salmon habitat. Department of Fisheries and Oceans has little concern with activities on the Research Forest, provided water quality is maintained.[2]

Fresh-water fisheries may be impacted by activities on the Research Forest, since many streams and lakes do contain fish habitat. The generally fine texture of the soils in the Gavin Lake Block could give rise to siltation, and road maintenance and drainage control are therefore of importance to fisheries. Restrictions on harvesting in riparian management areas (discussed below) and road construction and maintenance discussed in Chapter 8 will help to maintain productive fisheries.

Restrictions on Harvesting within Riparian Management Areas

Development activity adjacent to riparian areas is restricted (see Table 22), to maintain the ecological and recreational values associated with those ecosystems. Riparian areas are a focus for retention as wildlife tree patches. Where they are not protected in WTPs, riparian areas have no-machine reserves applied to protect the soil, vegetation and water. Riparian management zones are generally partially cut, and deciduous trees and shrubs are retained. Lakeshore management zones have special restrictions to protect the aesthetic value of lakes. Many of the ten lakes encompassed by the Gavin Lake block are valued as sport fishing waters. This value will be recognized, and timber management activities will reflect a concern for both water quality and aesthetics on adjacent forested lands. These issues are discussed in detail in Chapter 5.

Gavin Creek, IChmk3 subzone, UBC/Alex Fraser Research Forest.

2 Pat Harvey, Department of Fisheries and Oceans. Personal Communications (Interim Five Year Development Plan Review) December 1993.

Table 22: Restrictions on harvesting according to Riparian Classification from sub-regional plans (Anon 2005a, 2005b)

Class	Defining Character		Riparian Reserve Zone (m)	Riparian Mngmt. Zone (m)	Lakeshore Mngmt Zone (m)	Total Riparian Mngmt Area (m)	Extent in AFRF
Streams	Avg. Channel Width (m)	Fish Presence					
S3	1.5-5.0	Yes	20	20		40	6.5 km
S4	< 1.5	Yes	0	30		30	2.7 km
S6	≤ 3	No	0	20		20	86.1 km
Non-Classified Drainage	Undefined Channel	No	0	0		0	8.0 km
Wetlands	Area (ha)						
W1	> 5.0		10	40		50	65.8 ha
W3	1.0-5.0		0	30		30	36.2 ha
Non-Classified Wetland	< 1.0						18.9 ha
Lakes	Area (ha)						
L1-B	> 5.0		10	10	200	210	214.3 ha
L3	1.0-5.0		0	30		30	2.3 ha
Non-Classified Lake	< 1.0 ha		0	0		0	0.5 ha

Harvesting within a riparian management area will proceed (except in the case of research designed and executed in accordance with our Research Use Policy) according to the following guidelines:

S3 Stream:

- Retain all trees within reserve zone.
- Retain at least 50% of basal area and wildlife trees that do not pose a risk to workers within management zone.
- Where windthrow risk is moderate to high in the reserve zone, retain a sufficient number of trees within the management zone to reduce windthrow within the reserve zone to acceptable levels.

S4 Stream:

- Establish machine-free zones at the slope break or on wet ground adjacent to streams
- Retain wildlife trees, non-commercial conifer trees, understorey deciduous trees, shrubs, and herbaceous vegetation to the fullest extent possible.
- Retain at least 25% of basal area within RMZ.

S6 Stream:

- Establish machine-free zones at the slope break or on wet ground adjacent to streams
- Retain at least 5% (basal area) of the codominant conifers within the RMA of streams. Consider leaving 3 m stubs.
- Remove windthrow-prone trees with roots embedded in the streambank.
- Remove slash and debris deposited into the stream at the time of harvest.
- Retain wildlife trees, non-commercial conifer trees, understorey deciduous trees, shrubs, and herbaceous vegetation within the RMZ to the fullest extent possible.

Wetlands and Lakes ICH:

- Establish machine-free zones at the slope break or on wet ground adjacent to wetlands or lakes
- Retain at least 40% (basal area) of the codominant windfirm conifers and all deciduous trees concentrated near the reserve zone or in RMZ where no reserve zone is required.
- Retain wildlife trees, non-commercial conifer trees, understorey deciduous trees, shrubs, and herbaceous vegetation within the RMZ to the fullest extent possible.

Wetlands and Lakes SBS:

- Establish machine-free zones at the slope break or on wet ground adjacent to wetlands or lakes
- Retain at least 10% (basal area) of the codominant windfirm conifers and 30% (basal area) of the deciduous trees concentrated near the reserve zone or in RMZ where no reserve zone is required.
- Retain wildlife trees, non-commercial conifer trees, understorey deciduous trees, shrubs, and herbaceous vegetation within the RMZ to the fullest extent possible.

Prouton Lake, SBSdw1 subzone, UBC/Alex Fraser Research Forest.

6.2.3. Protection of Important Attributes

Wildlife Trees and Their Recruitment

Deciduous trees (particularly aspen) form an integral component of wildlife habitat. Cavity-nesting birds comprise 30-50% of the vertebrates in northern temperate forests (Martin *et al.* 2002 citing others). Studies in the vicinity of the Research Forest by Martin *et al*. (2002) have documented that aspen is a critical component of the landscape for cavity-nesting species, and a long list of species use cavities in aspen trees, including woodpeckers, songbirds, ducks, owls, fur-bearing mammals, bats and squirrels. Some cavity-nesting species rely upon other species to excavate cavities, so that suitable nest sites excavated by primary cavity-nesters (e.g. Northern Flicker) serve a wide range of other species through time. Martin et al. (2002) report that 96% of nests studied occurred in aspen, while aspen only comprised about between 10 and 20% of the trees available for nest excavation. Furthermore, dead and live unhealthy trees contained more cavities, while less than 10% of the cavities were in live healthy aspen trees. Edges have a strong positive effect for woodpeckers and secondary cavity-nesters (Martin et al. 2002), although some cavity-nesters (e.g. nuthatches) avoid edges.

Wildlife Tree Patches will be the primary means of protecting mature forest with present or potential wildlife trees. Staff are certified as Wildlife and Danger Tree Assessors, and wildlife trees can be retained after assessment in some other situations, particularly along road edges and in stand tending operations.

Stocking standards will allow for the future recruitment of aspen and other suitable wildlife trees.

Sensitive Sites

We recognize and manage small infrequent forested sites that are very wet or very dry, so as to protect their soils and forest cover. These sites are sensitive to harvesting treatments, primarily because their soils cannot support harvesting equipment; very wet soils tend to rut and puddle, and very dry soils tend to be displaced.

Forested sensitive sites have low timber productivity, and are very difficult to regenerate. Where sensitive sites have been identified in the ecological inventory (Chapter 3) they have been described as Environmentally Sensitive Areas (ESAs) and are shown on the maps in Appendix 8.

Some non-forested sites may be smaller than the minimum type size in the forest inventory, and so have not been noted on forest cover maps. Many wetlands, rocky sites and grasslands fall into this situation. Their contributions to ecological diversity are, in our opinion, significant.

The soil conditions, silvicultural difficulty, and unique vegetation communities of these sensitive sites will be recognized in the preparation of Site Plans, and will be protected during operations by placing in Wildlife Tree Patches or designating as no-machine zones.

Wildlife Features

Wildlife features (raptor nests, heronries, mineral licks, and dens) are habitat elements that are uncommon but important to one or more wildlife species. We report these features to a GIS database, which we use to track their presence and use. We protect these features as described below, in accordance with recommendations from Price (2001).

Raptor nests are visited annually, late in the nesting season, to determine their use. We have found that some nests are inhabited by different species from one year to another. We have also found that nests or nest trees fall over in storms, but we suspect that the vicinity is important and may soon have another nest in place. The sensitive time for raptor nests is the period from March through September, except owls which begin their breeding season in February. We will refrain from mechanised activity within proximity of nests during the time when they are occupied, as follows:

1. Northern Goshawk -- 500 m radius from the nest
2. Bald Eagle, Osprey -- 400 m radius from the nest
3. Red-tailed, Sharp-shinned, Cooper's Hawk -- 300 m radius
4. Owls -- 300 m radius

Heronries (ranging from one to eight nests per site) are also visited annually late in the nesting season, to determine their use. Two heronries we have been visiting recently went vacant without any reason we are aware of. Forest-nesting herons appear to exhibit less site-fidelity than at coastal sites, and apparently move more frequently. We have observed locally that herons often nest in the vicinity of Osprey nests (four times out of four heronries). Herons are on the nest from early March to mid-August, and we will refrain from mechanised activity within 500 m of the heronry during that time.

Sandhill cranes are uncommonly observed on the Research Forest during breeding season and migration, and occupy their nest sites between March and September. We will refrain from mechanised activity within 400 m (Gebauer 2004) of a nest site during that time. Our general approach to riparian management will provide wetlands with forested margins, preferred by this species.

Mineral licks are infrequent on the Research Forest, and the only licks we are aware of at this time are tufa springs exposed at the time of logging and road construction. We have documented these locations, and will follow their use by wildlife. If we find additional mineral licks in a forested situation, they will be protected by being placed in a Wildlife Tree Patch.

Bear dens are frequent on the Research Forest, and are generally excavated dens. Research under way[3] indicates that excavated dens are generally used only once. If an excavated den is occupied at the time of logging, harvest within 100 m will be deferred. If it is unoccupied at the time of logging, the den is generally either placed in a Wildlife Tree Patch, or protected by a No-Machine Zone sufficiently large to avoid disturbing the woody structure with which it is

3 Research Project 2004-01: Interior University Research Forests Bear Den Inventory. D. Hodder and C. Koot.

associated. Rock dens are much less frequent, and are apparently re-used through time. These dens will be protected by a Wildlife Tree Patch or another type of permanent set-aside.

Coarse Woody Debris

Coarse woody debris is critical component of a forest ecosystem. It provides habitat for a myriad of bacteria, fungi, plants, and animals (Stevens 1997, Lofroth 1998), all of which are important constituents in an ecosystem. It provides a sink for moisture and nutrients, and forms a preferred seedbed for Douglas-fir and spruce in many ecosystems (Burton et al. 2000).

Direction from subregional plans (Anon 2005a, Anon 2005b) is summarized as:

1. leave as much as practicable;
2. leave larger pieces (in both diameter and length)
3. leave the coarse woody debris scattered across the harvest area.

Management strategies must be tempered by concerns for bark beetle management. Strategies we use that contribute to the retention of coarse woody debris include the following:

Leave cull trees standing on the block.

Leave windthrown trees unsalvaged in Wildlife Tree Patches and Riparian Management Areas.

Process at the stump to leave tops, branches, and cull logs on the block.

Green Douglas-fir and spruce trees or chunks greater than 20 cm diameter should not be left down as coarse woody debris.

Cutblock 113 (strip shelterwood with reserves) has substantial coarse woody debris resulting from retention of cull logs, processing at the stump, and unsalvaged losses of residual stems (not pictured).

Partial cutting prescriptions retain residual stands that will suffer unsalvaged losses, contributing to future coarse woody debris.

6.3. Conservation of Species and Ecosystems at Risk

6.3.1. Managing Identified Wildlife Species

BC Ministry of Water, Land and Air Protection (2004) sets out procedures and measures for managing identified wildlife[4] -- species which are endangered, threatened, vulnerable, sensitive, or regionally important. Species and communities which are not sufficiently protected by the "coarse filter" approach (landscape and stand level biodiversity strategies) require specific management (a "fine filter" approach) (BC Ministry of Water, Land and Air Protection 2004). This means that those species must be identified and managed in a

Great blue herons on nest, Gavin Lake block.

4 "Wildlife" refers to:
raptors, threatened species, endangered species, game, and other species of vertebrates prescribed as wildlife by regulation. (http://www.for.gov.bc.ca/hfd/library/documents/glossary/W.htm accessed August 2, 2006.)

specific way. Strategies for managing Identified Wildlife will include direction from higher level plans, creation of wildlife habitat areas[5], or general wildlife measures[6]. The Research Forest is committed to following such guidance as it emerges. Measures have been set out for particular Identified Wildlife, including vertebrates, invertebrates, and vascular plants, and will be updated periodically as new species are listed as Identified Wildlife. Accounts and measures for managing Identified Wildlife are found at
http://www.env.gov.bc.ca/wld/identified/species_table_of_contents.htm

All species that are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) are included as Identified Wildlife if they are found in BC, negatively affected by forest and range practices on Crown land, and require protection other than that afforded by other measures (BC Ministry of Water, Land and Air Protection 2004). There is a time delay between listing by COSEWIC and inclusion as Identified Wildlife.

Table 23 lists all red and blue-listed species possibly or confirmed to be inhabiting the Alex Fraser Research Forest. Appendix 2 provides a complete list of wildlife species identified by COSEWIC and potentially existing[7] in the Alex Fraser Research Forest. Some species are presently on the COSEWIC list but are not listed as Identified Wildlife species, as indicated in Appendix 2. Information on known presence on the Research Forest is also presented in Appendix 2.

In conducting all resource management operations, we recognize that many species may be significantly impacted by our forest management activities. In this light, it is obvious that management of forest resources will have strong impacts (either beneficial or detrimental) on wildlife species; further, operations will favour some species while negatively affecting other species. We are obliged to understand the habitat needs of each listed species in Table 23, and ensure that our management practices suit their habitat needs.

Action 15: Prepare a habitat management plan that considers the habitat requirements of all the listed species in Table 23 and provides direction to our planning and operations.

5 Wildlife habitat areas: mapped areas determined to be necessary to meet the habitat needs of one or more species. [Source: Operational Planning Regulation]

6 General wildlife measure: a management practice determined to maintain the habitat of one or more species. [Source: Operational Planning Regulation]

7 A species is considered to potentially inhabit the Research Forest if it is listed by COSEWIC as inhabiting the Central Cariboo Forest District in the biogeoclimatic subzones encompassed by the Research Forest.

Table 23: Red and blue listed species possibly or confirmed to be inhabiting the Alex Fraser Research Forest.

English Name	Scientific Name	BC Status	Possible/Confirmed AFRF
American Bittern	*Botaurus lentiginosus*	BLUE	possible GL (confimed Beaver Valley), possible KC
Fisher	*Martes pennanti*	RED	confirmed GL, possible KC
Flammulated Owl	*Otus flammeolus*	BLUE	possible KC
Fringed Myotis	*Myotis thysanodes*	BLUE	possible KC - it would be good to monitor Bluffs
Great Blue heron, herodias subspecies	*Ardea herodias herodias*	BLUE	confimed GL, possible KC
Grizzly Bear	*Ursus arctos*	BLUE	tentatively confirmed GL
Northern Long-eared Myotis	*Myotis septentrionalis*	BLUE	confimed GL (Dorsey Lk.)
Peregrine Falcon, anatum subspecies	*Falco peregrinus anatum*	RED	possible KC (migration)
Sandhill Crane	*Grus canadensis*	BLUE	confimed GL, KC
Sharp-tailed Grouse, columbianus subspecies	*Tympanuchus phasianellus columbianus*	BLUE	Confirmed GL, possible KC
Short-eared Owl	*Asio flammeus*	BLUE	possible GL, KC
Spotted Bat	*Euderma maculatum*	BLUE	possible KC - it would be good to monitor Bluffs
Western Small-footed Myotis	*Myotis ciliolabrum*	BLUE	possible KC - it would be good to monitor Bluffs
Wolverine, luscus subspecies	*Gulo gulo luscus*	BLUE	possible GL, KC

6.3.2. Ungulate Winter Range

Winter range carrying capacity is the major limiting factor for mule deer and moose in the Cariboo. Ungulate management areas and key wetlands for moose have been mapped for the Cariboo (Anon 2005a, Anon 2005b), and have identified substantial areas of mule deer winter range on each block of the Research Forest. Those values will be protected and improved where feasible and appropriate.

Mule deer winter range, Knife Creek block, where Douglas-fir provides food, snow interception, and hiding cover.

Since management for mule deer winter range implies particular stand structural objectives, these winter ranges have been identified as unique working circles (see Chapter 7). This ensures that winter range values are recognized in the yield analysis and the silvicultural approaches.

6.3.3. Invasive Alien Species

Invasive alien species are plants, animals and microbes that are not native to British Columbia and threaten its biodiversity (C. Rankin and Associates 2004). Considerable attention has been focused on alien insects and pathogens in forestry, but little control has been effected. For example, poplar-willow borer (*Cryptorhynchus lapathi*), a weevil native to Europe, became established on the Research Forest in the mid-1990s and has killed much of the mature willow back to the root collar. It has also caused significant damage in aspen, and will be a substantial negative influence on our ability to manage aspen as a commercial crop in the future.

Invasive Plants

Invasive plants are plant species that have the potential to cause detrimental impacts on humans, animals or ecosystems (Perry n.d.) We have an extensive list of invasive plants already established on the Research Forest, some of which are already ubiquitous.

Invasive alien plants have received attention over many years as an agricultural problem, to the extent that the Province has enacted legislation (the *Weed Control Act of British Columbia* and the *Weed Control Regulation*) which lists some (but not all) of the invasive plant species as noxious weeds (Table 24) and imposes a duty upon occupiers of land (such as the Alex Fraser Research Forest) to control those noxious weeds. However, weed control on forest land is difficult and expensive, and spread of weeds is only partially within our control.

The Forest and Range Practices Act establishes another list of invasive plants under the Invasive Plants Regulation, which includes the species listed in Table 25.

Table 24: Provincial (P) and Cariboo regional (C) noxious weeds listed in the Weed Control Regulation (as of September 21, 2006) and their occurrence on or near the Alex Fraser Research Forest.

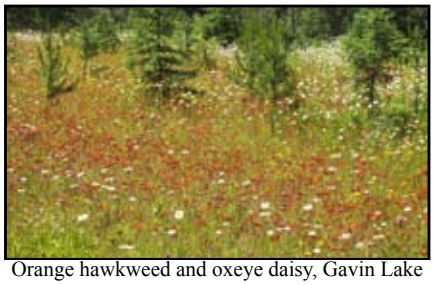
Name	**List**	**Occurrence**		
		Knife Ck.	**Gavin Lk.**	**Nearby**
Annual Sow Thistle *(Sonchus oleraceus)*	P			
Blueweed *(Echium vulgare)*	C			
Burdock *(Arctium spp.)*	C	Yes	Yes	Yes
Canada Thistle *(Cirsium arvense)*	P	Yes	Yes	Yes
Common Crupina *(Crupina vulgaris)*	P			
Common Toadflax *(Linaria vulgaris)*	P			
Dalmatian Toadflax *(Linaria dalmatica)*	P			Yes
Diffuse Knapweed *(Centaurea diffusa)*	P	Yes		Yes
Dodder *(Cuscuta spp.)*	P			
Gorse *(Ulex europaeus)*	P			
Hound's-tongue *(Cynoglossum officinale)*	P			
Jointed Goatgrass *(Aegilops cylindrica)*	P			
Leafy Spurge *(Euphorbia esula)*	P			
Orange Hawkweed *(Hieracium aurantiacum)*	C	Yes	Yes	Yes
Oxeye Daisy *(Chrysanthemum leucanthemum)*	C	Yes	Yes	Yes
Perennial Sow Thistle *(Sonchus arvensis)*	P			Yes
Purple Nutsedge *(Cyperus rotundus)*	P			
Rush Skeletonweed *(Chondrilla juncea)*	P			
Scentless Chamomile *(Matricaria maritima)*	P		Yes	Yes
Spotted Knapweed *(Centaurea maculosa)*	P	Yes	Yes	Yes
Tansy Ragwort *(Senecio jacobaea)*	P			
Velvetleaf *(Abutilon theophrasti)*	P			
Wild Oats *(Avena fatua)*	P			
Yellow Nutsedge *(Cyperus esculentus)*	P			
Yellow Starthistle *(Centaurea solstitialis)*	P			

Table 25: Plants listed in the Invasive Plants Regulation (as of November 8, 2006) and their occurrence on the Alex Fraser Research Forest.

Weed Species	***Scientific name***	**Occurrence**		
		Knife Ck	**Gavin Lk.**	**Nearby**
Anchusa	*Anchusa officinalis*			
Baby's breath	*Gypsophila paniculata*			Yes
Black knapweed	*Centaurea nigra*			
Blueweed	*Echium vulgare*			
Brown knapweed	*Centaurea jacea*			
Bull Thistle	*Cirsium vulgare*	Yes	Yes	Yes
Canada Thistle	*Cirsium arvense*	Yes	Yes	Yes
Common Burdock	*Arctium minus*	Yes	Yes	Yes
Common Tansy	*Tanacetum vulgare*		Yes	
Dalmatian Toadflax	*Linaria dalmatica*			Yes
Diffuse Knapweed	*Centaurea diffusa*	Yes		Yes
Field Scabious	*Knautia arvensis*			
Giant Knotweed	*Polygonum sachalinense*			
Gorse	*Ulex europaeus*			
Hoary Alyssum	*Berteroa incana*			
Hoary Cress	*Cardaria draba*			
Hound's-tongue	*Cynoglossum officinale*			
Japanese Knotweed	*Polygonum cuspidatum*			
Leafy spurge	*Euphorbia esula*			
Marsh Thistle	*Cirsium palustre*			
Meadow Hawkweed	*Hieracium pilosella.*	Yes	Yes	Yes
Meadow Knapweed	*Centaurea pratensis*			
Nodding Thistle	*Carduus nutans*			
Orange Hawkweed	*Hieracium aurantiacum*	Yes	Yes	Yes
Oxeye Daisy	*Chrysanthemum leucanthemem*	Yes	Yes	Yes
Perennial pepperweed	*Lepidium latifolium*			
Plumeless Thistle	*Carduus acanthoides*			
Puncture vine	*Tribulus terrestris*			
Purple Loosestrife	*Lythrum salicaria*			
Rush Skeletonweed	*Chondrilla juncea*			
Russian Knapweed	*Acroptilon repens*			
Scentless Chamomile	*Matricaria maritima*		Yes	Yes
Scotch broom	*Cytisus scoparius*			
Scotch Thistle	*Onopordum acanthium*			
Spotted Knapweed	*Centaurea maculosa*		Yes	Yes
St. John's-wort	*Hypericum perforatum*			
Sulphur Cinquefoil	*Potentilla recta*			
Tansy ragwort	*Senecio jacobaea*			
Teasel	*Dipsacus fullonum*			
Yellow Iris	*Iris pseudacorus*			
Yellow starthistle	*Centaurea solstitialis*			
Yellow toadflax	*Linaria vulgaris*			Yes

Management of invasive plants is important, but is beyond our capacity alone. We must rely on the participation of all to have an impact on these species. Perry (n.d.) indicates that, as a "land user group with information and land ethic principles" we have a role to play in preventing the spread of invasive plants.

Measures for management of invasive plants include:



Orange hawkweed and oxeye daisy, Gavin Lake Block. Both species are Regionally Listed Noxious Weeds.

- Develop awareness of invasive plants and their identification amongst staff, contractors, and equipment operators.
- Direct control of restricted occurrences of invasive plants.
- Track the locations and extent of invasive plants on the Research Forest.
- Identify best management practices for the invasive plant species existing on the Research Forest.
- Cooperate with neighbours and ranchers to control the spread of invasive plants.
- Participate in or follow the progress of the Invasive Plant Council of BC.
- Promote research on invasive plants, particularly in the area of control methods and best management practices.
- Pursue the use of native ground-cover seed for rehabilitation purposes.

7. Forest Management

7.1. Organizing the Land Base

7.1.1. Definitions

Management Unit: Geographically distinct areas of the Research Forest
Gavin Lake Block
Knife Creek Block

Working Circles: Portions of a Management Unit with unique primary forest management objectives:
Knife Creek Mule Deer Winter Range
Beaver Valley Mule Deer Winter Range
Gavin Lake Demonstration Area
ICH Timber Production Area
Reserves and Deferred Areas

Compartments: Groups of stands within a Working Circle, having relatively uniform ecological conditions and uniform Use Priorities. Resource values are identified, and considered in the context of social, economic, and environmental needs. Compartment boundaries are located on geographic features such as roads and creeks.

Use Priorities: Use Priority is assigned by the Manager, based upon local knowledge and input from concerned users.

Priority
1 - the forest management objective of the working circle
2 - secondary forest management objectives, which can be pursued providing the primary objective is not jeopardized
3 - tertiary forest management objectives, which can be pursued providing the primary and secondary objectives are not jeopardized

7.1.2. Units and Objectives

By dividing the forest land into areas with unique management objectives, we are able to describe areas that will be managed with a particular silvicultural system. This process facilitates the development of stand-level strategies; improves the accuracy of yield estimates; and supports the calculation of annual allowable cut. Appendix 9 presents maps of the land units and their objectives. Table 26 shows the area allocated to each Working Circle, and the silvicultural system and implementation details for each Working Circle.

Table 26: Summary of Research Forest area (hectares) for Management Units and Working Circles of the Alex Fraser Research Forest.

Management Unit	Working Circle	Gross Area (ha)	Gross Area (%)	General Silvicultural System
Knife Creek Block	Knife Creek MDWR	3,333	34	Single Tree Selection
	Reserves and Deferrals	152	1	N/A
Knife Creek Block Total		3,486	35	
Gavin Lake Block	Beaver Valley MDWR	2,846	29	Group Selection
	Gavin Lake Demo Area	706	7	Shelterwood
	Reserves and Deferrals	270	3	N/A
	Timber Production Area	2,532	26	Clearcut
Gavin Lake Block Total		6,355	65	
Grand Total		9,840	100	

7.2. Forest Protection

7.2.1. Fire

The Research Forest will comply with The Wildfire Act, and will prepare a Fire Preparedness Plan by April 1 each year. UBC will have the objective of preventing, controlling, and extinguishing wildfires within the context of the Fire Preparedness Plan. The Ministry of Forests and Range will retain the responsibility for wildfires within the Research Forest and UBC will co-operate with the Ministry of Forests and Range to detect and extinguish wildfires.

Forest Service Protection Branch Staff conduct initial attack on a small lightning-caused fire, Knife Creek Block, May 2006.

Fire hazard created by the activities of the Research Forest will be abated by breaking up, burning, or burying accumulations of slash to reduce the hazard of a wildfire. This includes the following conditions:

- Pre-commercial Thinning -- slash depth should not exceed 1 m and all slash should be lopped so as to lie flat;
- Harvesting -- landing debris piles to be burnt according to the conditions of a burning permit within one year of harvesting and extinguished completely;

- Roads -- debris will be buried or burnt to reduce fuel accumulations at the roadside.
- Cutblocks -- will be assessed immediately post harvest and appropriate measures to dispose of hazardous slash conditions will be planned and executed within one year.

7.2.2. Forest Health

UBC will take all actions necessary to prevent and control the spread of insects and diseases on the Research Forest. Accepting that endemic levels of pest populations are always present in forest ecosystems, the objectives of pest management will be to salvage mortality wherever possible, to suppress the expansion of endemic populations to epidemic levels, to improve productivity by reducing the impact of endemic pest problems such as dwarf-mistletoe, and to minimize the potential for problems in managed stands through good planning.

Mountain pine beetle and Armillaria root disease affecting the overwood of block 91-C, Gavin Lake Block, Summer 2005.

Recognizing that forest health is a direct function of tree and stand vigour, stand management will consider the maintenance of good tree vigour as a principle objective.

Annual detection flights by fixed wing aircraft combined with frequent field visits will allow the identification of pest problems and other stand damage such as windthrow. When problems are identified, ground reconnaissance will be carried out to assess the level of damage and potential for further damage. Remedial management strategies will be devised within the context of this plan and the Management and Working Plan, based on the ground reconnaissance.

Harvesting priorities (Section 7.3) require that infested or damaged timber to be harvested as highest priority, by either salvage logging or development of cutblocks to address the damage. Since 1989, approximately 16% of the timber harvested from the Research Forest has come from single-tree salvage directed at bark beetle control activities, windthrow and broken timber. In the same time period 86% of our harvest volume (including single-tree salvage) has been directed to stands with bark beetles or windthrown and broken timber.[1]

Our ability to react swiftly to emerging forest health issues has been constrained, at least in part, by lack of access. Good access to all parts of the Research Forest is an important consideration in managing forest health. Roads to access this harvesting will follow the tactical plan for roads described in Chapter 8.

Bark Beetle Strategies

The most significant pest problem confronting the Research Forest continues to be bark beetles. Intensive management of bark beetles requires vigilant detection and aggressive harvesting to control the spread during periods of high beetle pressure. Prevention is the best long term management option. It requires significant conversion of forest cover over

1 This percentage includes the volume cut from rights-of-way, most of which were cut to provide access to stands where we were focused on priority harvesting infested, dead, or damaged timber.

long time periods, increasing average stand vigour and decreasing average stand age, and therefore increasing resistance to bark beetle outbreaks. Silvicultural systems and re-entry cycles prescribed in this chapter will improve the Research Forest's resistance to bark beetle outbreaks in the future.

Bark beetle control harvesting takes two forms:

- single tree salvage, administered under Beetle Management Prescriptions or Exemptions from Silviculture Prescriptions, and applying to contiguous areas < 1 ha in extent throughout the Research Forest; and
- development of small cut blocks under site plans, which are compliant with Forest Stewardship Plan requirements.

During minor salvage operations all forest resources must be protected in a consistent manner, following the same commitments as for cutblocks under site plans.

Annual operations required for managing bark beetles and other contingencies such as windthrow are as follows:

- prompt detection through aerial mapping in August
- prompt harvest of current and old attack
- access developed and maintained
- thorough ground reconnaissance
- deploy traps, baits, or trap trees as necessary
- thorough cleanup

Douglas-fir and Spruce Bark Beetles

Douglas-fir and spruce beetle pressure appear to be rising, but are not yet in epidemic populations. Heavy snow in the winter of 1998 and 2003 have caused significant breakage in Douglas-fir and spruce, and consistently mild winters have lead to an outbreak. Depending upon weather conditions, Douglas-fir and spruce bark beetle populations will continue to rise. Strategies for management of Douglas-fir and spruce bark beetle focus on:

- **suppression** during periods of high beetle pressure, by harvesting infested areas while the beetles are still under the bark; and
- **maintaining a low population** by anticipating bark beetle activity, and planning direct control through harvesting each year.

Mountain Pine Bark Beetle

The mountain pine beetle epidemic has killed virtually all of the lodgepole pine in all mature stands, and we have harvested nearly all of the available pine inventory. We are proud of our record of addressing mountain pine beetle through strategies devised in our Management and Working Plan #1 and #2 (Day 1993, Day 1997). Those strategies helped us to see the risk of loss to our inventory of mature lodgepole pine, and to ramp up our reaction to the outbreak of mountain pine beetle very early.

We are proud of our record of addressing mountain pine beetle through strategies devised in our Management and Working Plan.

In 2004-5 mountain pine beetle caused significant mortality in immature stands. At present it appears that immature pine less than 10 cm DBH is not susceptible.[2] MacLauchlan (2006) sampled stands throughout the central interior in the summer of 2005. She found that 65% of the juvenile pine stands sampled in the Central Cariboo Forest District had suffered average attack rates of 25%. Ninety-three percent of the stands from 50-55 years of age (the oldest stands sampled) were attacked with an average of 43% of the stems lost. Forty-five percent of the stands from 20-25 years of age (the youngest sampled) were attacked with an average of 5% of the stems lost. Surveys we conducted in selected stands in 2005 show similar results to MacLauchlan (2006), with mortality rates ranging from 48-98%, and the minimum DBH of unattacked stems ranging from 9.1 to 12.2 cm.

We assume that mountain pine beetles are attacking young stands out of desperation for habitat, since virtually all the mature host has already been killed. We do not, therefore, infer that this is a new adaptation, putting all stands at risk as they pass through the 10 cm DBH threshold. Rather, we expect that this is a symptom of the collapse of the pine beetle population. We will continue to manage lodgepole pine stands, and pine will continue to be a component of our regeneration in mixed-species stands.

Strategies for management of mountain pine beetle focus on:

- **Salvage of dead volume** where the volume is economically available and it's harvest does not impair the natural recovery or conservation values extant (Burton 2006);
- **Management of impacted juvenile stands** to recruit stocking and improve yield prospects;
- **Maintaining a low population** by developing stands of mixed species and high average vigour.

Western Spruce Budworm

Western spruce budworm is a significant defoliator of Douglas-fir in the IDF biogeoclimatic zone, and has recently become a significant pest in Douglas-fir stands in the Cariboo. Budworm has the ability to cause widespread mortality and top-kill in Douglas-fir.

Western spruce budworm on Douglas-fir at Knife Creek, showing pupa and foliar damage.

A relationship between tree vigour, stand density and damage to Douglas-fir has been demonstrated. As the vigour of trees declines, they are more susceptible to damage since: their ability to recover foliage biomass suffers; they have smaller crowns and therefore suffer greater proportional defoliation (Wulf and Cates 1985); and they have fewer resources to allocate to production of anti-feedant compounds (Oliver and Larson 1996), thus favour budworm survival and growth (Cates et al. 1991).

Stand structure also plays a significant role in the level of damage suffered from spruce budworm. Multi-layered stand structures intensify budworm defoliation (Carlson et al. 1985, Wulf and Cates 1985) since the dispersing larvae must land on host foliage to continue

2 Data from re-survey of RP 1992-02 (Sullivan et al.) permanent plots and damage surveys of selected openings.,

maturation feeding. Stands with an intimate mixture of size classes provide more host material in subordinate positions for dispersing larvae to descend upon (Wulf and Cates 1985, Carlson et al. 1985).

Strategies for managing western spruce budworm include:

- maintain tree and stand vigour through density control
- monitor populations and level of damage
- cut stands in such a way as to move size classes apart into groupings by diameter class
- spray with Btk in cooperation with the Ministry of Forests and Range

Root Disease (Armillaria, Laminated, and Tomentosus)

Root diseases, particularly armillaria and laminated, are considered to be site factors. Our aim is to minimize the impact of these factors on our management objectives. Root disease centres tend to be very diverse, with multiple age classes and increased species diversity.

Direct control is expensive and should be avoided where ever possible; instead we favour the application of silvicultural controls. Where root disease centres must be harvested they should be regenerated to mixtures of tolerant or immune species. Table 27 shows the relative susceptibility of our commercial species to the three principle root diseases we encounter.

Table 27: Relative susceptibility of tree species growing at the AlexFraser Research Forest to three principle root diseases. From Province of BC (1995c).

	Relative Host Susceptibility			
Disease	**High**	**Moderate**	**Tolerant**	**Immune**
Armillaria Root Disease (*Armillaria ostoyae*)	Fd, Bl, Sx	Cw, Pl, Hw	Py, Lw, At, Ac, Ep	
Laminated Root rot (*Phellinus weirii*)	Fd, Bl,	Hw, Sx, Lw	Pl	At, Ac, Ep, Cw
Tomentosus Root Rot (*Inonotus tomentosus*)	Sx	Pl	Bl, Cw, Fd, Hw, Lw, Py	At, Ac, Ep

The strategies for root rot are:

- identify disease centres before harvesting
- regenerate mixed-species stands
- favour root disease centres as wildlife Tree Patches
- undertake direct control where necessary; through stumping, or the application of *Hypholoma fasiculare* as a biological control

Damage and Decay

The following material is modified from Day (1998).

Despite the best efforts of personnel to reduce logging damage, some will occur. It is important to consider the results of the damage that does occur, and develop a strategy to minimize its impact.

Top damage is the most critical type of damage, since the resulting wounds appear to be very attractive to bark beetles, based upon our informal observations. Scars in the upper bole had a higher incidence of infection by decay fungi (Craig 1970). A tree with a broken top or limbs sheared off will not contribute well to the desired stand, and should be cut.

Basal scarring is of less concern than top damage, since Douglas-fir are quite resistant to decay after injuries (Craig 1970). Craig (1970) found that over 60% of the scars sampled in the central Cariboo were infected with decay fungi, and showed that decay will account for 1-5% of the gross volume of scarred Douglas-fir. Craig's (1970) study sampled from a wide geographic area of the drybelt, and concluded that moister regions had significantly higher rates of volume loss than drier regions. The central Cariboo was the moistest region studied. Decay and resin-soaked wood caused by wounds result in loss of volume and quality in the bottom log -- the most valuable portion of the tree. The losses in value are therefore greater than the decay volume alone would indicate.

Trees of small diameter at the time of logging will have only a small volume of rot. Decay resulting from basal scars only affects the wood that exists at the time of injury (Craig 1970; Allen and White 1997), and does not expand into new stemwood over time.

Allen and White (1987) report that only 7.8% of scars on lodgepole pine result in decay. Aho et al. (1983) suggest that trees with resinous wood (including lodgepole pine and Douglas-fir) are less-readily infected by decay fungi than trees with non-resinous wood (true firs and hemlock). The exception to their rule of thumb is the spruces, which despite being resinous are very susceptible to infection by decay fungi. Province of BC (1997) report that redcedar is classified with spruce in relation to its resistance to decay after wounding. Our experience agrees with the literature, but further research would be welcome.

The following guidelines are offered based upon local experience and four pertinent reports (Craig 1970; Aho et al. 1983; Allen and White 1997; Province of BC 1997):

- large scars are more likely to cause decay than small scars;
- scars that gouge the wood are more likely to cause decay than scars which do not;
- a scar on a large tree will cause much greater volume loss to decay than a similar scar on a small tree;
- wounds in contact with the ground are more likely to result in decay than higher wounds, and the decay progresses more rapidly;
- decay is established relatively quickly, and 5% losses can occur in just 10 years;
- scarred Douglas-fir or lodgepole pine may be left;
- scarred spruce, subalpine fir and redcedar should be cut;
- scarred aspen, birch and cottonwood should be cut if their contribution to timber values is important.

Not all trees can be protected, however, and damage will occur. Damaged trees should be addressed by re-marking the stand for a final clean-up pass before logging is complete, if the stand will not be entered again over the next ten years. Farrar (1996) recommends that 3 to 5% of the harvest be retained unmarked until this final cleanup pass, to hedge against over-

cutting the prescription at the end of the logging. Logging damage during salvage harvesting should not be cut, however, to ensure that harvesting concentrates on the objective of the salvage.

Since damage to residual trees can be attractive to bark beetles, monitoring of partial cutting is important for several years after logging. Routine bark beetle detection and management activities, as described earlier, are sufficient to manage outbreaks resulting from selection harvesting.

Live trees (particularly Douglas-fir and spruce) with decay that are intended to be cut must be removed to roadside; merchandising such trees in the woods can lead to the development of a bark beetle problem where the green cull pieces are attacked by bark beetles, which then emerge to attack the residual stand.

Wind, Snow and Ice Damage

When designing cutblocks, windthrow assessment is required during site planning. The result of this assessment will support decisions on residual stand density, leave tree characteristics, location of block boundary, and location and size of Wildlife Tree Patches.

Windthrown spruce at Gavin Lake Block, resulting in the creation of cutblock 152. This stand was pre-disposed to wind damage by tomentosus root disease and decay caused by logging damage from frequent salvage entries.

In the winter of 1998-99 strong winds combined with heavy snow, resulting in extensive damage to mature stands on the north slopes facing Gavin Lake Road and on the ridges south of Gavin Lake. Based on the extent of this damage, we have developed cutblocks (113, 114, 115, 122, 125 and 136). Another significant windstorm occurred in October 2003, causing substantial damage in the overwood of many of our partially harvested stands.

We expect windthrow, and accept it to be a part of managing for retention of mature trees. In our site plans, we consider the probability of catastrophic damage, and the consequences should windthrow occur. Damage in Riparian Management Areas and Wildlife Tree Patches will remain unsalvaged. Damage outside those areas will be considered for salvage on a site-by-site basis depending upon the value of the timber, the volume of losses, the difficulty of recovering the losses, and the probability of the windthrow or breakage causing an expanding bark beetle outbreak.

The strategies for wind, snow and ice damage are:

- identify catastrophic damage during beetle flights
- prompt salvage of accessible damage
- conduct windthrow assessments during site planning field work
- consider windthrow in designing block boundaries and wildlife tree patches
- consider windthrow in prescribing residual stand density and leave tree characteristics

Strategies for Forest Health Factors Affecting Regeneration

Spruce Terminal Weevil Strategies

- encourage moderate over-topping by other species
- establish spruce with other species
- do not pre-commercially thin or brush spruce stands
- do not prune spruce stands

Root Collar Weevil Strategies

- accept as endemic in all stands
- allow for mortality in initial densities

Stem Rust Strategies

- regenerate to species other than lodgepole pine
- remove infected trees at thinning

Dwarf Mistletoe Strategies

- identify infected stands prior to harvesting
- devise harvest boundaries to reduce perimeter and use infection-safe edges
- regenerate to species other than lodgepole pine
- slash all lodgepole pine taller than the lowest observed height (or 0.5 m, whichever is lower) after logging infected stands

Growing Season Frost Strategies

- identify frost prone sites before and after harvest
- plant Douglas-fir only on frost-shedding sites unless under a shelter
- plant frost tolerant species such as lodgepole pine in frosty sites

Rodent Damage Strategies

- regenerate sites promptly
- establish and maintain low stand densities
- regenerate mixed species
- avoid peak population cycles for stand tending

Cattle Damage Strategies

Cooperation and good relationship with ranchers can solve most of the issues of forest-cattle conflict. As a guide to mitigate this conflict:

- regenerate sites promptly
- use obstacle planting to reduce trampling of seedlings
- recognize cattle use patterns in reforestation planning
- do not locate salt blocks on landings
- recognize cattle use patterns in reforestation planning

7.3. Timber Harvest Priorities

In general, harvesting efforts will be directed in the following order of priority:

1. imminent or expanding losses;
2. salvage of dead timber;
3. regeneration cuts in even-aged partial-cut systems
4. timber at risk of infestation by insects;
5. timber of declining vigour;
6. timber affected by disease;
7. healthy vigorous timber.

Table 28 following interprets the harvesting priorities outlined above by forest cover type. The contents of Table 28 are depicted on maps at Appendix 10.

Table 28: Harvesting priority and rank as a function of forest cover for the Alex Fraser Research Forest, including the distribution of past and future harvest volume by those priorities.

Priority	Rank	Species Composition	Age Class	Harvest Vol.	
				Past	Future
1		All conifers -- imminent or expanding losses			
	1	Timber with bark beetles under the bark	4+	31%	10%
	2	Windthrown Douglas-fir or spruce		5%	5%
2		Salvage of dead timber	4+	5%	5%
3		Regeneration cuts in even-aged partial-cut systems	5+	1%	20%
4		Timber at risk of infestation by insects			
	1	Pl leading or secondary	6 & 7	24%	
	2	Pl leading or secondary	5		
	3	Pl leading or secondary	4		
	4	Sx or Fd	7+	12%	20%
5		Timber of declining vigour			
	1	Sx or Fd	6	20%	35%
6		Timber affected by disease			
	1	Pure or leading Cw	7+		
	2	Pure or leading Bl	6+		
	3	Ac, At, or Ep leading	4+		
7		Healthy vigorous timber			
	1	Any species	5		
	2	Any species (Commercial Thinning)	3 & 4	2%	5%
8		Not available for harvest			
	1	Any species	1 & 2		

*Tree Species **Symbols**:*

Ac -- cottonwood	*At -- trembling aspen*	*Bl -- subalpine fir*
Cw -- western redcedar	*Ep -- white birch*	*Fd -- Douglas-fir (interior form)*
Hw -- western helmlock	*Pl -- lodgepole pine (interior form)*	*Sx -- hybrid white x Engelmann spruce*

7.4. Silviculture

7.4.1. Generalized Approaches by Working Circle

Working Circles are depicted on maps at Appendix 9, and are used to designate areas of differing management objectives which necessitate differing silvicultural systems. Each working circle is discussed below, in an effort to clearly describe our intended management approach and some of the constraints we face.

Knife Creek Mule Deer Winter Range

This working circle is primarily composed of uneven-aged Douglas-fir stands, with significant components of lodgepole pine and minor components of spruce, aspen and birch. The dominant management objective is for mule deer winter habitat, and target stand structures are well described by Dawson *et al*. (2002). Management direction was fully described by Day (1998). We will manage this working circle by the uneven-aged silvicultural system, using BDq[3] regulation. Due to the habitat needs of mule deer and the silvical characteristics of Douglas-fir, we intend to manage the stands in a clumpy fashion, such that the maximum diameter class is distributed amongst groups of 2-5 trees.

Under the direction of the CCLUP, habitat ecologists have provided detailed management direction for mule deer winter range habitat. This direction takes three parts:

- Dawson et al. (2002) published a management plan for all winter ranges in the shallow and moderate snowpack zone (IDF winter ranges including Knife Creek), which generally describes the long-term habitat objectives and compares those objectives to current winter range condition, setting out a transition strategy.
- Mapping of long-term objectives as three target habitat classes (High, Moderate, and Low), defined as target stand structures described by Dawson and Armleder (2000). The distribution of those classes is depicted in Appendix 9.
- A transition strategy specific to the Knife Creek mule deer winter range (CCLUP Mule Deer Strategy Committee 2003) for implementing the management direction.

This is a dry forest, and forest fires are a major concern. Researchers are in unanimous agreement that fire interval has increased since approximately 1900. Writing in 1955, Benteli comments that:

> *"It seemed as if there had been a maximum of fire occurrences in the past 50 years, with a sudden decrease in the past 20 years."*

This change coincides with settlement history in most studies, and Steele *et al.* (1986) attribute it to the:

1. cessation of aboriginal use of fire as First Nations communities were moved to reserves and reservations and use of fire was stopped by European settlers intent on protecting buildings, livestock and timber;
2. beginning of organized wildfire suppression; and

3 BDq regulation describes management to a target Basal area, maximum Diameter, and diminution quotient. See Day (1998) for further discussion.

3. unregulated grazing by livestock which reduced fuel loads.

In a study on the Knife Creek block, Daniels *et al.* (1995) found that two stands in the IDFdk3 demonstrate a pre-settlement fire interval of 16.6 to 18.0 years, which ceased in 1915. Parminter (1978) found, in his study nearby at Riske Creek (in the IDF biogeoclimatic zone[4]), a fire interval of 9.8 years, which ceased in 1926. Further work in the IDFdk3 by Feller and Klinka (1998) and Iversen *et al.* (2002) indicates that mean fire intervals have been extended in the last century.

There is little doubt that cessation of natural fires has led to significant changes in stands and forests. Parminter (1978), Kilgore (1981), and Arno (1991) all conclude that cessation of fires in uneven-aged forests has resulted in an increase in the proportion of smaller stems. Iversen *et al.* (2002) conclude that these changes have resulted in increased densities of saplings, reduced diversity and abundance of understory vegetation, increased forest floor and standing fuels, and increasing fire severity when fires do start.

The change in fire regime and stand structure has significant implications:

- a community of species adapted to the ecosystem is displaced;
- accumulation of fuel and changes in fuel structure create a much higher risk of crown fire;
- crown fire would have a catastrophic effect on the mule deer winter range, and could potentially cause significant property loss to adjacent private-land owners.

A portion of the Knife Creek Block is overlaid by the community fire plan (Williams Lake and Area Interface Fire Committee 2005). The Interface Fire Plan created two boundaries: the core area (including the NW corner of Knife Creek), which contains the majority of the property and infrastructure values; and the management area, within which interface management is planned (Figure 10). Most of the area of Knife Creek Block is classified as moderate, high or very high fire hazard based upon stand structure (Williams Lake and Area Interface Fire Committee 2005).

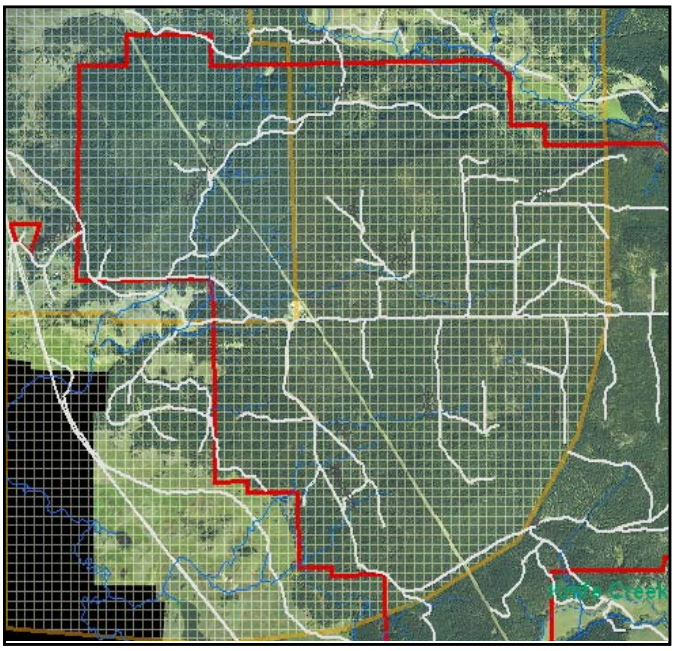


Figure 10: Portion of the Williams Lake and Area Interface fire Plan overlapping Knife Creek Block (red line); square boundary represents the core and rounded boundary represents the buffer of the fire planning area.

This working circle abuts and encloses areas of grassland, including several grassland benchmark areas established under the CCLUP (Cariboo-Chilcotin Grasslands Strategy Working Group 2001). The Grasslands Working Group concludes that forest encroachment onto

4 Parminter classified the area as the Cariboo Aspen Lodgepole Pine zone after Krajina. This area has now been included in the IDF (Hope *et al.* 1991).

grasslands has significantly reduced the area of open grasslands over the past century. They further conclude that forest ingrowth in adjacent forests has had a further negative impact on grassland values for domestic forage and biodiversity. The Grasslands Strategy directs us to re-establish grasslands and low-density forests in those areas they have identified as benchmark areas (as shown on the map of Knife Creek at Appendix 6).

Management Strategies for the Knife Creek Mule Deer Winter Range Working Circle

Mule Deer Winter Range is the primary objective of management on all compartments in this working circle. We have interpreted the habitat ecologists' direction under BDq regulation for selection management. Target stand structures for those three habitat classes are shown in Table 29 and Figure 11.

Table 29: Target stand structures for uneven-aged management of Douglas-fir on the Knife Creek Mule Deer Winter Range, interpreted from Dawson and Armleder (2000).

Habitat Class Objective	Residual Basal Area (B) (m^2/ha)	Maximum DBH (D) (cm)	Diminution quotient (q) (5 cm classes)	Cutting Cycle (years)
High	29	60	1.25	30
Moderate	22	55	1.25	30
Low	16	50	1.30	30

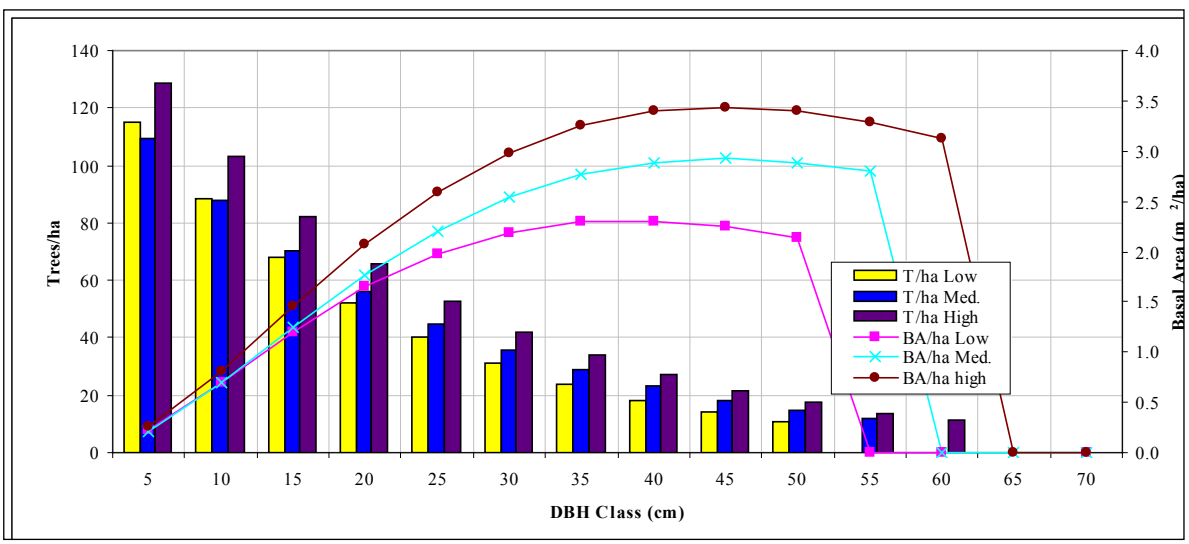


Figure 11: Target stand structures by habitat class for the Knife Creek Mule Deer Winter Range, comparing density (stems/ha on left, basal area on right axis) by diameter class.

The innate productivity of this ecosystem, coupled with previous harvest history and the management direction from the CCLUP, serves to severely constrain harvesting opportunities in this working circle. Since most stands with a lodgepole pine component have already been cut, our harvest opportunities here are limited to Douglas-fir bark beetle salvage and thinning stands, concentrating on the trees less than 37.5 cm DBH. Thinning treatments will typically produce about 50 m^3/ha. Logging costs are relatively high due to the small piece size and low

volume per hectare. Currently this timber has relatively low value due to the abundance of sawlogs on the market. However, when the current province-wide outbreak of mountain pine beetle subsides, we expect this timber supply to become more valuable.

Interface Fire Hazard is the secondary management objective for those compartments included within the core and management areas of the Williams Lake and Area Interface Fire Plan (Figure 10). Forest management in these compartments will consider all the recommendations of the Williams Lake and Area Interface Fire Committee (2005), which advanced 22 general recommendations plus six recommendations specific to the 150 Mile interface fire planning unit, which contains the Knife Creek Block. Activities at Knife Creek will focus on three activities to reduce fire-hazard and risk:

1. maintain a low-fuel zone between the Big Meadow Road and the Rodeo Drive subdivision, to reduce the risk of a wildfire destroying private property or a backyard fire destroying stands on the Research Forest;
2. reduce stand density and fuel ladders by harvesting and thinning;
3. investigate methods to reduce surface-fuel accumulations after treatment
   - gradual re-introduction of low-intensity surface fires
   - whole tree harvest methods
   - other burning and mechanical treatments

Grassland Restoration will focus on benchmark areas, which have been identified as grasslands that are now encroached upon by forest (shown on the map of Knife Creek in Appendix 6). The grassland strategy established for grassland restoration, and those benchmark areas mapped within the Knife Creek Working Circle will be scheduled for harvest during the period of this Management Plan, and will be treated in accordance with the following recommendations:

1. remove 95% of the current number of trees in older encroachment
2. retain 90% of the large veteran trees
3. retain trees in groups <0.5 ha
4. protect the existing grass and forb community – harvest in winter on frozen soil or snow
5. employ fire or cutting to restrict regeneration on benchmark areas.

Beaver Valley Mule Deer Winter Range

This working circle is primarily composed of even-aged Douglas-fir stands, with significant components of lodgepole pine, spruce, and aspen. The dominant management objective is for mule deer winter habitat, and target stand structures are well described by Dawson et al. (2006). The Beaver Valley Mule Deer Winter Range is located in an area described as the "transition snowpack zone" (Dawson et al. 2006) which will be managed according to the group selection silvicultural system.

Under the direction of the CCLUP, habitat ecologists have provided detailed management direction for mule deer winter range habitat. This direction takes two parts:

- Dawson et al. (2006) published a management plan for all winter ranges in the transition and deep snowpack zones (SBS and ICH winter ranges, including Beaver Valley).
- Mapping of long-term objectives as three target habitat classes (High, Moderate, and Low), defined as target stand structures described by Dawson and Armleder (1999). The distribution of those classes has been adjusted slightly to coincide with our total chance harvest blocks, and is depicted in Appendix 9.

Management Strategies for the Beaver Valley Working Circle

Mule Deer Winter Range is the primary objective of management in all compartments on this working circle. Habitat is managed by the group selection silvicultural system with a 40-year re-entry period. Harvest intensity is controlled by habitat class objective, with a smaller percentage of the stand scheduled for harvest where habitat class objective is high, such that stands with a high habitat objective have a smaller proportion of area cut in each pass, and therefore greater maximum age, as described in Table 30.

Table 30: Target age structures for uneven-aged management of Douglas-fir on the Beaver Valley Mule Deer Winter Range, Dawson et al. (2006).

Habitat Class Objective	Area Harvested per Pass (%)	Cutting Cycle	Number of age cohorts in a stand	Maximum Age of oldest cohort
High	33	40	3	120
Moderate	25	40	4	160
Low	20	40	5	200

Regeneration strategies will favour Douglas-fir except on site series 07 or 08 (where suitability is limited) or 09 (where it is not viable) (Klinka 2003). Regeneration strategies may include the use of nurse crops of lodgepole pine, aspen or birch on sites where the likelihood of frost limits early survival of Douglas-fir. Strategies will favour natural regeneration but may employ some planting too.

Except in unusual circumstances, maximum group size will be 0.4 ha on warm aspects, and 0.7 ha on other aspects. Group size may be manipulated to shelter regeneration from frost, or to recognize windthrow risk or other limitations of site and stand conditions.

Mature stands of Douglas-fir tend to be very tall (individuals up to 40 m in height) and trees tend to be slender in natural stands. These stand and tree factors, coupled with predominance of luvisolic soils, create a situation where windthrow can be problematic. Harvesting treatments will allocate groups for clear felling to the most susceptible topographic positions first. Preparatory thinning will generally precede group selection harvest by at least ten years, and will focus on cutting those trees with the largest height to diameter ratio. Windthrow will be monitored and salvaged promptly to avoid consequent mortality of adjacent trees from Douglas-fir bark beetle.

Gavin Lake Demonstration Area

This working circle is composed of mixed-conifer stands surrounding Gavin Lake, Little Gavin Lake, and Gavin Creek. The primary management objectives are recreation and visual

quality in support of the use and mandate of the Gavin Lake Forest Education Society. To that end, we seek to demonstrate natural resources and integrated resource management practices for a wide audience. We provide signed demonstration areas of classical and experimental forestry and addresses ecological, visual, recreational and range values within the most frequently travelled area of the Forest. This area also provides opportunities for nature interpretation along a network of trails and roads in both managed and unmanaged forest.

The stands south of Gavin Lake to the height of land (Compartment GL01) form the principle views for Gavin Lake and Little Gavin Lake. Recreational and educational trails travel throughout the Working Circle, and particularly between the north shore of Gavin Lake and the Gavin Lake Road (Compartment GL02). The secondary management objective is timber production, and tertiary objective is domestic range.

Management Strategies for the Gavin Lake Demonstration Working Circle

Recreation and visual quality objectives are generally managed by the use of shelterwood silvicultural systems with retention for screening. All harvesting will have visual impact assessments completed, and particularly visible harvesting will have simulations completed to model the visual impact of harvest proposals. This working circle has a recommended visual quality objective of "Partial Retention" (Anon 2005a), which indicates that

> *"...alterations remain visually subordinate to the characteristic landscape. Repetition of the line, form, colour, and texture is important to ensure a blending with the dominant elements. 1.5-7% of the forested area can be in a non-visually effective greenup condition from the perspective view of the viewpoints."*

For the purposes of this discussion, the viewpoints are assumed to be the fire-pit at Gavin Lake Camp, and the waterline at the boat launch at Little Gavin Lake.

Timber Production Area

This working circle is dominated by conifer plantations resulting from logging between the late 1960s and 1987, and also has a significant component of mid-aged stands resulting from a fire in 1926. Remnant stands of old cedar and spruce exist but are significantly constrained by the lack of old forest in the landscape unit as a whole.

The primary management objective is (as the name suggests) production of high-value timber. The secondary management objective is wildlife habitat, and the tertiary management objective is domestic forage for range values.

Spruce, Douglas-fir and lodgepole pine have been the principle regeneration species, and all have suffered damage during plantation establishment and early growth. Spruce terminal weevil is ubiquitous in spruce plantations, and has significantly diminished the productivity and value of those plantations. Douglas-fir has suffered damage by growing-season frost on the gently sloping terrain, and in some particular areas where cold air pools Douglas-fir is not a viable regeneration species in a clearcut situation. Lodgepole pine suffers significant snow damage, often resulting in very poor form, and mature lodgepole pine shows significant levels of damage with a consequent reduction in volume and value. *Dothistroma* needle disease is also present on lodgepole pine in this working circle, and we have persistent trouble with damage by hares and voles on lodgepole pine in particular.

Management Strategies for the Timber Production Area Working Circle

Production of high value and high volume stands through even-aged management will be the dominant management strategy. Clear cutting will be employed, coupled with commercial thinning when and where it is economically viable, to capture mortality and to initiate regeneration of high-value species. Douglas-fir and redcedar will be the target regeneration species, with a significant participation by hybrid spruce. Lodgepole pine is generally not considered a target crop species due to its susceptibility to snow damage and depredation by rodents. Nurse crops and shelterwoods may be used to shelter regeneration from growing-season frost and to foil spruce leader weevil. Regeneration will be at high density to reduce knot size on crop trees.

Reserves and Deferred Areas

This working circle is composed of:

- Teaching and Research Reserves that we established in each biogeoclimatic zone, to preserve un-manipulated conditions for research and education opportunities; and
- Old Growth Management Areas (OGMAs) designated by government under the CCLUP
  - Permanent OGMAs that are designated as separate compartments, and
  - Transitional OGMAs that are designated as deferrals within larger compartments.

The Horsefly Sub-Regional Plan (Anon 2004a) tells us old-forest objectives are achieved in the short and long term through a combination of permanent Old Growth Management Areas (OGMAs), transitional OGMAs, and no-harvest areas.

Management Strategies for the Reserves and Deferred Areas Working Circle

Teaching and Research Reserves will remain un-manipulated except in the following situations:

1. Trees that threaten health and safety will be felled, and utilized where they can be extracted without creating new access.
2. Forest fires will be controlled.

Old growth management areas will be protected in accordance with the direction of the Sub-Regional Plans (Anon 2004a,b) by limiting harvest of forest resources within them to the following:

1. Insect or disease control essential to curtail severe damage to the old growth management area or to other forest values at the landscape level
2. Control of wildfire
3. Seed cone collection, provided trees are not felled
4. Road and fence construction, where there is no other practicable location available
5. Thinning to enhance old forest attributes within OGMAs at Knife Creek in accordance with the direction in “Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin: Part 1a: Management Plan for Shallow and Moderate Snowpack Zones.”

7.4.2. Stocking Standards

Stocking is a measure of the adequacy of tree density to achieve the management objectives (Smith et al. 1997, Dunster and Dunster 1996). Stocking standards have been devised for the Cariboo Forest Region (Province of BC 2002) which are generally adopted as the default stocking standards unless a variance is warranted. However, we have well-developed and articulated management objectives for the Research Forest, and we must therefore articulate stocking standards that respond to those specific objectives. Under current regulation, stocking standards must be included in the Forest Stewardship Plan. This document will guide the development of those stocking standards by setting out issues critical to achieving our management objectives.

Maintaining Deciduous Trees and Shrubs on the Landscape

Martin et al. (2002) have documented that aspen is a critical component of stand- and landscape-level biodiversity. Aspen, cottonwood, birch and willows are also a critical resource for beavers. Birch and many woody shrub species have significance for First Nations people as traditional-use plants (Anon 2005a). The presence of birch in conifer stands is beneficial to ecosystem health and productivity (Simard et al. 2001), and birch, aspen and many shrubs are important browse species for moose. Inventory data from the Research Forest indicate that aspen provide about 25% of the nest sites for stick-nesting birds. We therefore consider it to be critical that our stocking standards allow for the maintenance of these species in our harvested areas.

Based upon the foregoing discussion, stocking standards will seek a higher target density, to provide for the retention of deciduous trees on the landscape through time.

- Standards units adjacent to riparian features will have aspen, cottonwood, and birch as a preferred species.
- Aspen, birch, and cottonwood will be acceptable species in all standards units where they are ecologically suitable (as denoted by the presence of mature individuals) and where regeneration is prescribed.
- Aspen, birch, and cottonwood should be retained as a minor component of the residual stand after partial cutting.
- Brushing treatments will retain deciduous trees and shrubs where they are not over-topping the species under management.

Ameliorating Root Disease

Standards units with root disease will have all commercial species as preferred, to allow regeneration of a diverse stand where trees have limited opportunities to form root grafts, and to take advantage of disease immunity and resistance amongst species.

Managing for Timber Quality In Overwood and In Regeneration

We will deliberately manage the forest to ensure that the growing stock has increasing economic value and minimum risk of loss. After considering the context of management

objectives and ecological conditions, we will ensure that:
Species composition for residual stands and for regeneration will pursue the following rank order of preference:

- Beaver Valley Mule Deer Winter Range: Douglas-fir, spruce, lodgepole pine, birch, aspen, subalpine fir, cottonwood.
- Gavin Lake Demonstration Area: Douglas-fir, spruce, redcedar, lodgepole pine, birch, aspen, subalpine fir, cottonwood.
- Knife Creek Mule Deer Winter Range: Douglas-fir, lodgepole pine, spruce, aspen, birch.
- Timber Production Area: Douglas-fir, redcedar, spruce, lodgepole pine, birch, aspen, subalpine fir, cottonwood, hemlock.

High-quality and high volume Douglas-fir and spruce stand, block 115 Gavin Lake; approximately 120 years of age.

Locally Rare Species will be conserved when they are identified during harvesting, brushing, or thinning activities. These species include black hawthorn, pin cherry, mountain ash, water birch, and rocky mountain juniper.

Stand Density will be managed for production of high-value products by

- Growing juvenile stands at high density -- existing natural stands indicate that high-density stands of mixed species at Gavin Lake are sufficiently productive to stratify if left uncut, leading to Douglas-fir, lodgepole pine, or spruce being dominant.
- Thinning from below or crown thinning to keep closed stands while removing poor quality or low vigour individuals and attending to direction for species composition. Full stocking is estimated to be at a relative density[5] of 0.55. Beyond a relative density of 0.55 is the zone of imminent mortality (Smith et al. 1997, Farnden 1996) and the zone of maximum current annual increment is approximated by this line (Farnden 1996). Stand density management diagrams (Farnden 1996) provide a suitable tool for contemplating thinning regimes.
- Commercial thinning will be emphasized in crop planning, while pre-commercial thinning will receive little emphasis in the Gavin Lake Block.
- Pre-commercial thinning in the Knife Creek Mule Deer Winter Range will focus on removing trees that have poor form or have suffered long periods of suppression. Densities after pre-commercial thinning will be high enough to inhibit the production of epicormic branches.

A Generic Crop Plan for Gavin Lake has been devised using TIPSY[6] Version 3.2b and stand density management diagrams (Farnden 1996), assuming Douglas-fir, site index 23 m

5 Relative density is the number of trees actually in a stand, divided by the maximum number of trees of that size that could exist (Smith et al. 1997)

6 **T**able **I**nterpolation **P**rogram for managed **S**tand **Y**ield © Province of British Columbia 1991-2005.

(height at age 50). This generic crop plan is predicated upon the assumption that there will be a significant demand for coniferous sawlogs in the wake of the current mountain pine beetle infestation.

- Establish a mixed-species stand at 2,400 stems/ha by a combination of planting and natural regeneration. Including some pine in the mixture will reduce the frost sensitivity and improve the early piece size, thereby improving the efficiency of the subsequent thinning harvest.
- Thin at age 35-40, reducing the stand density to 1100 stems/ha, generating approximately 85 m^3/ha merchantable volume, with an estimated average piece size of 0.1 m^3/tree.
- Final harvest at age 90-100, cutting approximately 950 stems/ha generating approximately 600 m^3/ha merchantable volume, with an estimated average piece size of 0.67 m^3/tree.
- If the commercial thinning entry does not occur, then the final harvest will cut approximately 1200 stems/ha, generating approximately 520 m^3/ha merchantable volume, with an estimated piece size of 0.53 m^3/tree. Trees in the stand will be more prone to windthrow because of their slenderness (average Height:Diameter ratio of 1.28).

7.4.3. Regeneration

We employ both natural and artificial regeneration, depending upon the environmental conditions we have created through our harvesting, and the risk of failure for natural regeneration. Generally, partial-harvest systems are intended to result in natural regeneration. However, until we gain sufficient experience with all silvicultural systems in the variety of environments in which we employ them, we continue to hedge our bets by planting in those stands in the ICH where harvesting creates gaps. Plantations are established according to the following general guidelines:

Bev Atkins with a planted lodgepole pine tree five years of age, Block 108, Gavin Lake Block.

- Use native species from local seed sources unless improved seed is available[7] (see Table 31 for a listing of registered seedlots owned by the Alex Fraser Research Forest).
- Comply with the Chief Forester's Standards for Seed Use (Snetsinger 2004), including his prohibition against using tree seeds that have been genetically modified
- Prompt planting is crucial to success of artificial regeneration, and we seek to plant within one year of harvest or site preparation.
- Trees should be planted in the protection of stumps or logs, to provide shelter from insolation, frost, vegetation press and cattle trampling.

Natural regeneration of redcedar under a Douglas-fir canopy, Block 122, Gavin Lake Block.

7 Compliance with these general guidelines does not limit our opportunity to conduct research with other species or provenances.

- Sites in the ICHmk3 that are sub-hygric and rich (site series 04, 05, 06, 08 according to Klinka et al. (2004)) often generate the mixed shrub complex described by Swift and Turner (2004), which generally requires either aggressive site preparation or early brushing treatments.
- Sites in the ICH and SBS where aspen is a component of the initial stand will probably need brushing treatments.
- Brushing may be by cutting or by herbicide treatments.

Table 31: Summary of seedlots registered by the Alex Fraser Research Forest in the Seed Planning and Registry (SPAR) database, as of January 2006.

Seedlot #	Species	Seed Class	Col-lected	Seed Planning Zone	BEC Subzone	Elevation Range (m)	Potential Seedlings (000s)
47826	Douglas-fir	B	2002	BB	IDFdk3	780-1080	140.0
45247	Douglas-fir	B	1999	QL	ICHmk3	920-1220	75.7
45249	Redcedar	B	1999	QL	ICHmk3	790-1290	522.4
45246	Subalpine fir	B	1999	QL	ICHmk3	790-1290	199.3
31029	Douglas-fir	B	1992	CT	SBSdw1	860-1160	127.3
31030	Lodgepole pine	B	1993	CT	SBSdw1	800-1200	38.4

7.5. Forest Level Regulation

Forest regulation is a concept of organizing a forest estate to provide an even flow of forest products (Davis and Johnson 1987). The desire for even flow comes from the historical European concepts of forestry, and was imported to North America by early foresters who were trained in Europe (Davis and Johnson 1987). Regulation of timber harvest is desirable for a number of biological, social, and economic reasons (Davis and Johnson 1987). These are:

- create a stable basis upon which to plan business, to;
- ensure approximately equal expenses and receipts from year to year;
- facilitate improved forest health and fire protection, as the forest is kept vigorous and well distributed in size and condition;
- incorporate wildlife, range, and recreation uses into the harvest planning on a rational basis;
- provide continuity of jobs in harvesting and silviculture.

Full regulation is an ideal condition that will probably never be attained, but which provides a standard by which management progress can be measured. The ideal is a forest in which size and age classes grow at rates and are represented in proportions that provide approximately equal annual or periodic yields of the desired goods and services, in perpetuity (Davis and Johnson 1987). Hence forest regulation is the planned approach to sustainability.

Strategies for forest regulation are numerous (Davis and Johnson 1987), but fall into two broad categories: area control, and volume control. Area control achieves a fully regulated forest in one rotation or cutting cycle, but does not provide an even harvest flow from year to year until regulation is achieved. Volume control provides a uniform volume harvest, but delays attainment of regulation (Davis and Johnson 1987) beyond the first rotation or cutting cycle.

The objectives of management for the Alex Fraser Research Forest (section 1.2 above) include "to regulate the harvest of timber and non-timber forest products to minimize the periodic variation in revenue." This suggests that volume control would be the best method of achieving regulation. However, a rapid approach to regulation, particularly on mule deer winter ranges, is necessary to improve stand vigour and promote forest health, which suggests that area control would be the preferable method of achieving regulation. Further, we are presently in the situation where growth and yield of residual stands is poorly understood and, if we manage by volume regulation, our reaction to that uncertainty must be conservative management. However, management by area allows good management with timber volume to be a direct result.

The Research Forest will be guided by area regulation with a volume check.

7.5.1. Allowable Annual Cut

The Research Forest will be guided by area regulation with a volume check. Such hybrid approaches are supported by Davis and Johnson (1986) as being a framework for considering the complexities of setting allowable harvest rates in order to make decisions. The steps employed are:

1. divide the Research Forest into management areas that have similar climatic and ecological conditions, and management objectives (working circles);
2. remove the working circles that do not contribute to timber harvest (Lakes, Reserves and OGMAs) (Table 32);
3. reduce the area of each timber-harvest working circle to remove non-forest land, and non-productive forest land, and Environmentally Sensitive Areas (ESAs) designated in the forest inventory (Table 32);
4. determine the silvicultural system that applies to each working circle, the forest product objectives, and the cutting cycle or rotation length[8] for that system (Table 33);
5. reduce the harvest area to allow for set-aside areas such as Wildlife Tree Patches (WTPs), road access (for second entry and for thinnings only), research and teaching sites which are deferred from harvesting, and estimated annual salvage area (Table 34);
6. determine the proportion of the harvest area that will be clearcutting vs. partial cutting, according to the requirements of the silvicultural system, including the use of intermediate cutting treatments in even-aged systems (Table 34);
7. calculate an indicated annual harvest by area for each working circle, according to Equation 1 (Table 34);

8 Rotation length was determined by analysis using TIPSY for spruce, Douglas-fir, and redcedar given the range of site indices and product objectives in place.

8. employ yield models for each working circle to estimate growth and mortality rates;
9. employ a simulation model to schedule individual cutting units (blocks) to provide a relatively even flow of timber volume over time;
10. implement a harvest queue to maximize the flow of timber value over time.

Equation 1

$$\text{Indicated Annual Harvest Area (ha/year)} = \frac{\text{Productive Area (ha)}}{\text{Cutting Cycle (years)}}$$

Steps 1-7 in the process outlined above are detailed in Tables 32 to 34, and the Allowable Annual Harvest is summarized in Table 35. Steps 8-10 (above) remain to be done.

Action 16: Prepare a volume check and develop a harvest queue to verify the volume production estimates from Table 34.

Table 32: Summary of productive and non-productive area (hectares) for Management Units and Working Circles of the Alex Fraser Research Forest.

Manage. Unit	Working Circle	Gross Area	Non-Prod.	Environ-mentally Sensitive Areas	Reserve	OGMA Perm	OGMA Trans.	Net Area
Knife Creek Block	Knife Creek MDWR	3,333	91	126	0	0	0	3,117
	Reserves and Deferrals	152	4	0	64	84	0	0
Knife Creek Block Total		3,486	94	126	64	84	0	3,117
Gavin Lake Block	Beaver Valley MDWR	2,846	177	154	0	0	102	2,413
	Gavin Lake Demo Area	706	143	32	0	0		532
	Reserves and Deferrals	270	0	0	130	140		0
	Timber Production Area	2,532	144	322	0	0	89	1,978
Gavin Lake Block Total		6,355	463	508	130	140	191	4,922
Grand Total		9,840	558	634	194	225	191	8,039

Table 33: Silvicultural systems as applied to the timber-harvest Working Circles of the Research Forest

Working Circle	Silvicultural System	Variant	Cutting Cycle (years)
Beaver Valley MDWR	Group Selection		40
Gavin Lake Demonstration Area	Clearcut or shelterwood	Reserves for visual quality	100
Knife Ck. MDWR	Single Tree Selection	Small Groups (2-5 trees at maximum D)	30
Reserves and Deferrals (OGMAs only)	Salvage Only	Single tree or small groups	NA
Timber Production Area	Clearcut	With group reserves	100

Table 34: Calculation of area-based allowable harvest rate for each harvesting working circle of the Alex Fraser Research Forest.

Working Circle		Beaver Valley MDWR	Gavin Lake Demo Area	Knife Creek MDWR	Timber Production Area	Grand Total
Total Net Area (ha)		2,413	532	3,117	1,978	8,039
Reductions	WTP	8%	8%	8%	8%	
	Research	2%	2%	2%	2%	
Net Harvest Land-base (ha)		2,172	478	2,806	1,780	7,235
Annual Salvage Harvest	(%)	0.3%	0.5%	0.4%	0.3%	
	(ha)	6.5	2.4	11.2	5.3	25.5
Cutting Cycle (years)		40	100	30	100	
Indicated Annual Harvest Area (ha) (Eq. 1 less Salvage Area)		47.8	2.4	82.3	12.5	144.9
Access Harvest	(%)	0.1%	0.0%	0.0%	0.1%	
	(ha)	1.4	-	-	1.0	2.4
Prep Cut	(%)	49.9%	100.0%	0.0%	0.0%	
	(ha)	23.9	2.4	-	-	26.2
Final Harvest	(%)	24.9%	100.0%	0.0%	99.9%	
	(ha)	11.9	2.4	-	12.5	26.8
Single-Tree Selection Harvest	(%)	0.0%	0.0%	99.6%	0.0%	
	(ha)	-	-	82.0	-	82.0
Commercial Thinning Harvest	(%)	0.0%	24.6%	0.0%	32.7%	
	(ha)	-	0.6	-	4.1	4.7
Est. Final Harvest	m^3/year	4,660	837	-	4,035	5,497
Est. Partial Cut	m^3/year	3,037	803	4,660	1,534	8,500

Notes To Calculation of Allowable Annual Cut:

1. Reductions for WTP (Wildlife Tree Patches) are as per Sub-Regional Plan Direction (refer to Chapter 6). Reductions for research are estimates.
2. There are no area reductions (net-down areas) for non-timber objectives -- these land-use implications are explicitly dealt with under the silvicultural system employed, and the harvest rate by cut phase for each working circle.
3. Salvage of scattered trees under a salvage plan, is directed at groups of trees under one hectare, and will not be tracked in history records. However, this harvest contributes to the AAC at the same rate as the thinning harvest, on the basis of volume harvested by

salvage, and average thinning harvest volume per hectare. The area of salvage is deducted from the net harvest land base to account for the imputed area treated.

4. Access harvest is based upon clearing access to complete the planned road access (estimated at 35.8 ha) within 15 years (refer to Chapter 5 for a discussion of total chance road plans). Existing roads have been deducted from net productive forest. One hectare of access harvest area is equivalent to 670 lineal metres of road right-of-way given a 15 m average clearing width. The area of temporary roads is included in the area of final harvest.
5. If more than one type of harvest will occur within a single cutting cycle (e.g. commercial thinning and final harvest in the Timber Production Area), then total area harvested will be greater than 100% of the Indicated Annual Harvest Area.
6. In the Beaver Valley MDWR we expect to harvest an average of 25% of the area in groups, and we expect that only half of the area will need preparatory cutting over a 40 year cutting cycle. The allowable harvest area is therefore less than 100% of the indicated annual harvest.
7. Commercial thinning is a soft target, and will not be undertaken unless it is profitable.
8. Estimates of resulting volume are for information only. Values used to calculate harvest volumes are based upon our experience not analysis, and are conservative averages of volume per hectare cut in similar treatments.

Table 35: Allowable Annual Cut for the Alex Fraser Research Forest.

Harvest Type	Annual Harvest Area (ha)
Salvage	25.5
Roads	2.4
Preparatory Cut	26.2
Final Harvest	26.8
Single Tree Selection	82.0
Commercial Thinning	4.7

7.5.2. Cut Control[9]

We have been harvesting without cut control since 1999, when the Regional Manager relieved us of that requirement. Hence, cut control will re-commence upon the approval of this plan, according to the following provisions:

- No annual cut control is required, to allow flexibility in harvest scheduling.
- Periodic cut control will be measured for each harvest type, but will not constrain the harvest by working circles.

9 Cut control is "a set of rules and actions ... that describes the allowable variation in the annual harvest rate either above or below the allowable annual cut ..." http://www.for.gov.bc.ca/hfd/library/documents/glossary/C.htm

- Cut control will be measured by the rolling average of the past five years, starting January 1, 2007.
- The rolling average harvest area should not exceed the allowable annual harvest by more than 10% in any year.
- A cut control statement will be prepared annually, for the calendar year.
- Cut control will be accounted for each Management Unit.

7.5.3. Harvest History

Harvest levels since the Research Forest was created in 1987 are shown in Figure 12 (net area harvested) and Figure 13 (volume scaled) for each management unit. Harvesting began in 1988, and rapidly increased in area through the 1990s in response to mountain pine bark beetle starting in 1993, and ice and snow damage in 1997 and 1998 respectively.

Since we do not have area measurements at the end of the year, cutblocks initiated in one calendar year and completed in a later year have been allocated to the year in which harvest commenced. The impact of this on harvesting history is an apparent redistribution of cut to 2004, which is the year we began logging block 138 (a large block that was completed in 2006). The result is an overstatement of harvest in 2004 (about 30% by volume), and an understatement in 2005. For consistency, we have followed the same procedure for reporting both area and volume in the following charts. In the future we will measure the area harvested in each active cutblock in late December each year, to eliminate this error.

Action 17: Institute a process to measure the area harvested by the end of the calendar year for each active cutblock.

Area harvested by salvage activities is imputed by dividing the harvest volume by the average volume per hectare for partial cutting treatments in the management unit. This is important since the substantial harvest volumes attributed to dispersed salvage need to be considered part of the area harvested. Area harvested for road right-of-way is calculated by multiplying road length by estimated clearing width.

Figure 14 and Table 36 compare our average annual net harvest area to our Allowable Annual Cut, showing that our harvest rates must decline after the completion of our harvesting focused on mountain pine beetle.

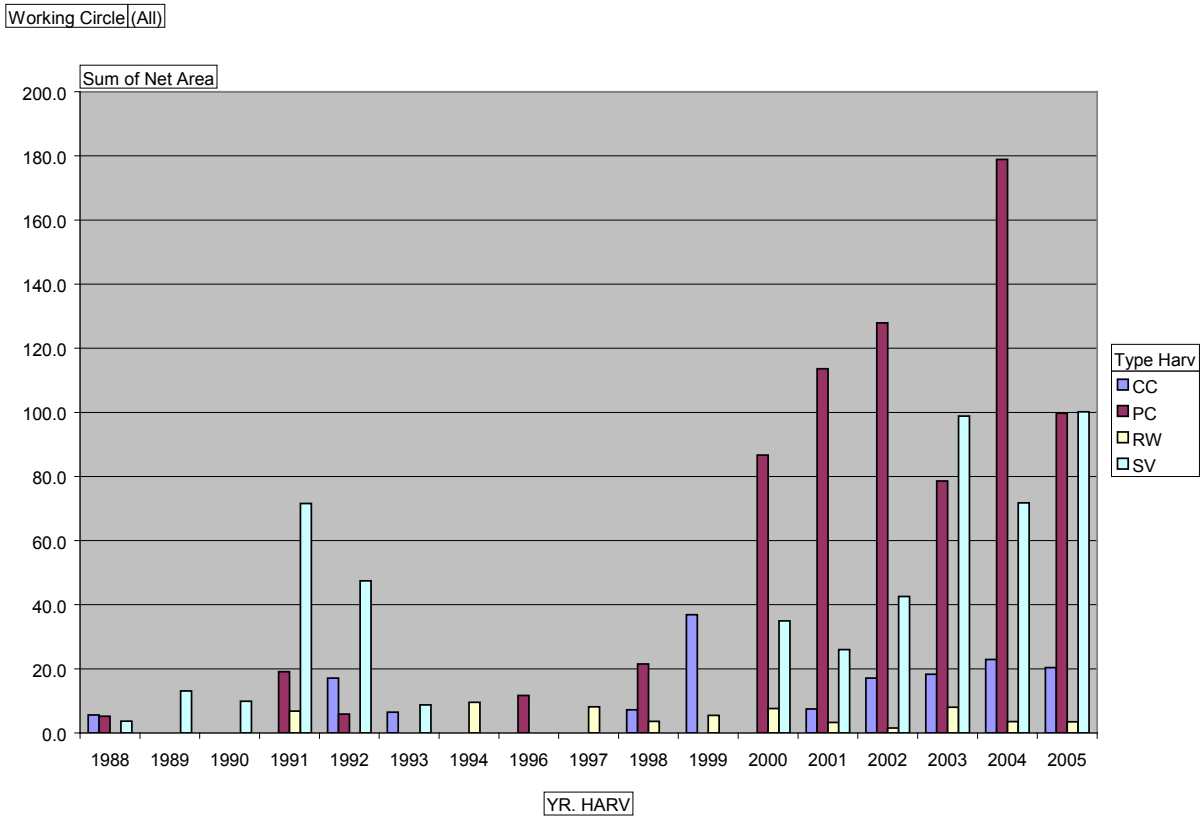


Figure 12: Net harvest area (ha) by year and by harvest type (CC = Clearcut, PC = Partial Cut, RW = Road Right-of-Way, SV = Salvage) for the Alex Fraser Research Forest.

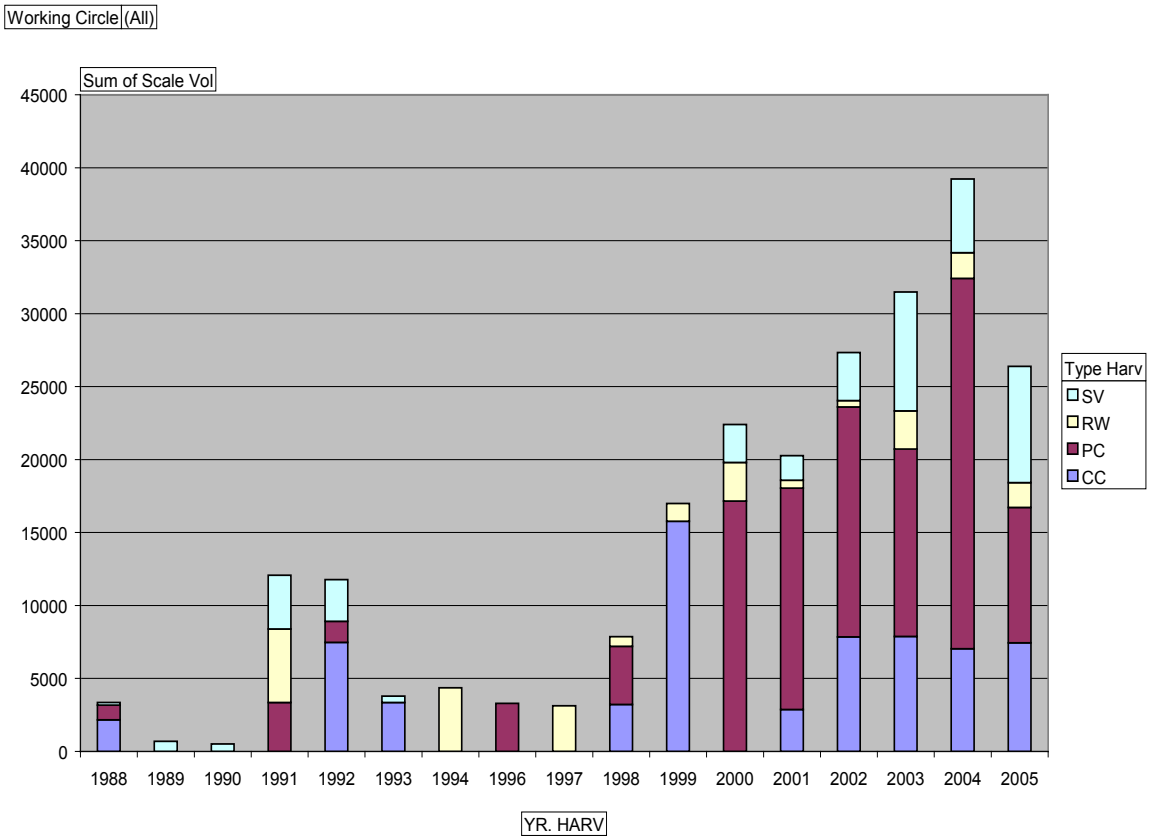


Figure 13: Harvest volume (m3 scaled) by year and by harvest type ((CC = Clearcut, PC = Partial Cut, RW = Road Right-of-Way, SV = Salvage) for the Alex Fraser Research Forest.

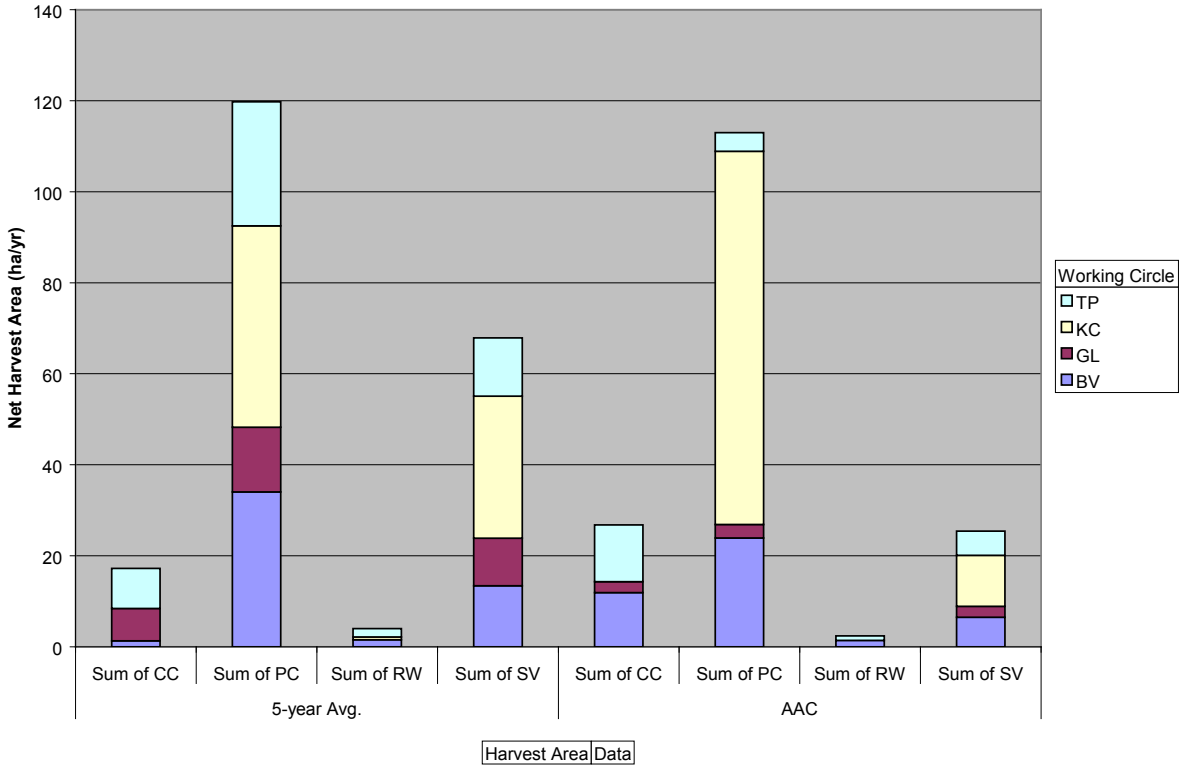


Figure 14: Average annual harvest area (ha/yr) for the period 2001 to 2005 compared to Allowable Annual Cut (AAC) by working circle (TP = Timber Production Area, KC = Knife Creek Mule Deer Winter Range, GL = Gavin Lake Demonstration Area, and BV = Beaver Valley MDWR) and by harvest type (CC = Clearcut, PC = Partial Cut, RW = Road Right-of-Way, SV = Salvage) for the Alex Fraser Research Forest.

Table 36: Allowable Annual Cut (AAC) compared to average annual net harvest area (ha) during the period from 2001 to 2005 for the Alex Fraser Research forest. Comparison is shown by working circle (BV = Beaver Valley MDWR, GL = Gavin Lake Demonstration Area, KC = Knife Creek Mule Deer Winter Range, and TP = Timber Production Area) and by harvest type (SV = Salvage, RW = Road Right-of-Way, PC = Partial Cut, CC = Clearcut)

			Harvest Area (ha)	
Management Unit	**Working Circle**	**Data**	**2001-2005 Avg.**	**AAC**
Gavin	BV	Clear Cut	1.3	11.9
		Partial Cut	34.0	23.9
		Right-of-Way	1.5	1.4
		Salvage	13.4	6.5
	GL	Clear Cut	7.1	2.4
		Partial Cut	14.2	3.0
		Right-of-Way	0.0	0.0
		Salvage	10.5	2.4
	TP	Clear Cut	8.8	12.5
		Partial Cut	27.2	4.1
		Right-of-Way	1.8	1.0
		Salvage	12.8	5.3
Total Gavin			132.7	74.4
Knife	KC	Clear Cut	0.0	0.0
		Partial Cut	44.3	82.0
		Right-of-Way	0.6	0.0
		Salvage	31.2	11.2
Total Knife			76.1	93.2
		Total Clear Cut	17.2	26.8
		Total Partial Cut	119.7	113.0
		Total Right-of-Way	4.0	2.4
		Total Salvage	67.9	25.4
Grand Total Research Forest			208.8	167.6

8. Forest Operations

8.1. Timber Harvesting

8.1.1. Timber Harvest Systems

Ground-based harvest systems dominate our operations, since less than 5 % of our net area exceeds 30% slope. Figure 15 following shows the portions of the Gavin Lake Block where harvest system is restricted by slope. The minor area of steep slopes at Knife Creek have all been allocated to environmentally sensitive areas (ESAs) and reserved from harvest. For blocks at Gavin Lake with substantial area exceeding 30% slope, we anticipate using cable harvest systems, and areas exceeding 60% slope are generally considered inaccessible.

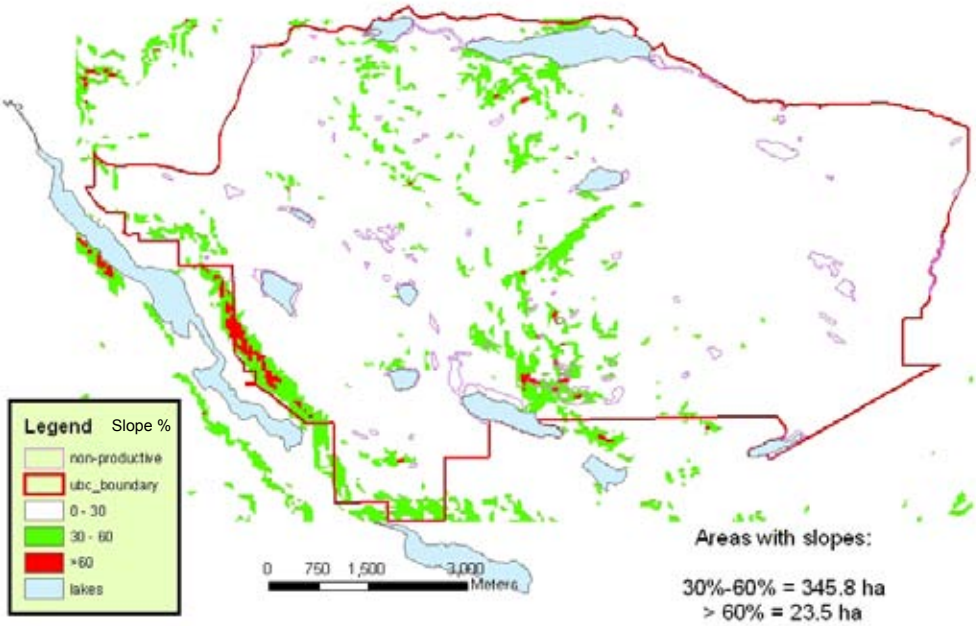


Figure 15: Areas of the Alex Fraser Research Forest Gavin Lake Block where slope exceeds 30%.

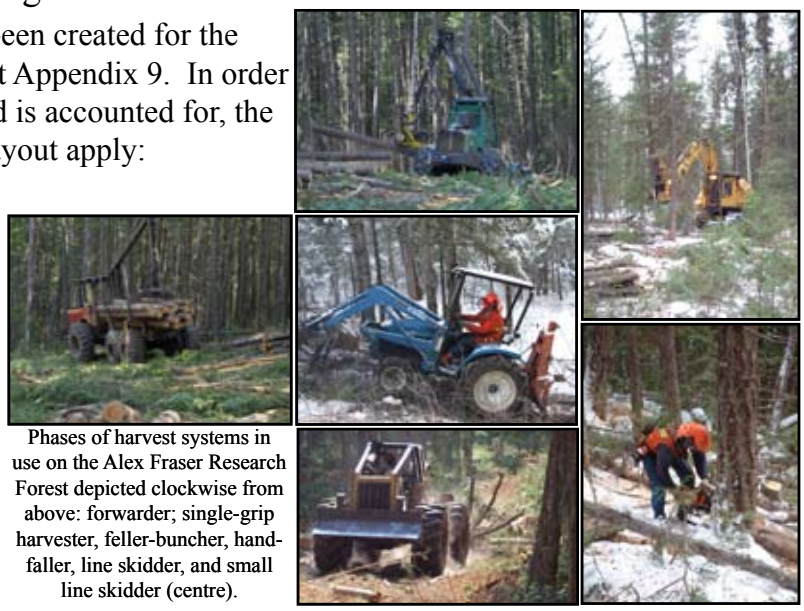
Ground-based harvest systems presently in use on the Research Forest include;

- shortwood harvester/forwarder combination for shortwood harvesting, particularly well suited for thinning;
- feller-buncher/grapple skidder/processor combination for shortwood or long-log harvesting, best suited to clearcutting; and
- hand falling/cable skidder/hand bucking combination for shortwood or long log harvesting, best suited to stands with large piece size, high value, or salvage harvesting.

8.1.2. Block Harvesting

A paper plan for cutblocks has been created for the Research Forest, and is shown at Appendix 9. In order to ensure that all productive land is accounted for, the following principles for block layout apply:

- Block boundaries are located at geographic features, such as ridges, streams, or road centre-lines;
- Deletions from the harvest area for stand-level reserves are made within cutblock boundaries
- Target access limits are assessed at the cutblock level;



Phases of harvest systems in use on the Alex Fraser Research Forest depicted clockwise from above: forwarder; single-grip harvester, feller-buncher, hand-faller, line skidder, and small line skidder (centre).

8.1.3. Salvage Harvesting

Salvage harvesting contributed 18% of our average annual harvest volume from 2001-2005 (ranging from 8-30% over the same period), and is directed to remove timber damaged by wind, snow, or insects. This program is particularly important in the mature stands that are partially harvested, since breakage or windthrow leads to significant bark beetle infestations in the residual Douglas-fir and spruce stands. We expect that our salvage operations will continue at the same pace throughout the period of this plan.

8.1.4. Timber and Boundary Marking

Timber and boundaries are marked according to the following protocol:

- Block boundaries are painted in blue paint on the first tree outside the cutblock.
- Where partial cutting will be directed by timber marking, orange paint denotes a tree to be cut, and blue paint denotes a tree to be left, and timber may be marked to cut or marked to leave;
- Flagging tape is used for marking as follows:
  - orange denotes a falling boundary
  - pink denotes access
  - yellow and blue denote survey or cruise lines and plots
  - yellow/black candy stripe denotes research installations

8.2. Access

8.2.1. Roads

Good access to the Research Forest is critical to achieve our objectives; without it we cannot fulfil our research and education mandates, or our forest management objectives. On the other hand, land set aside for access is removed from timber production, so we seek to balance our expectations.

We calculate that each percentage point of our productive land area given up to roads implies an annual cost of approximately $75,000 when lost timber productivity, cost of capital employed, and maintenance costs are considered. This is not considering the environmental risks or impacts of roads, which we seek to minimize.

West Road, Knife Creek Block, AlexFraser Research Forest.

On the other hand, public and worker safety demand an adequate road system, and increasing road density improves the efficiency of logging, hauling, fire control, silviculture, research and teaching.

Techniques are available to optimize road density, and we will undertake such an analysis through the period of this plan.

Action 18: Undertake an optimization analysis for road density.

Master Road Plan

A paper plan for complete access development has been created for the Research Forest, and is included at Appendix 11. This plan lays out all of the roads which will be required on each block of the Forest, based upon the following assumptions:

- Maximum sustained favourable grade = 12%
- Maximum sustained adverse grade = 8%
- Maximum skid distance = 400 m
- No circular routes

The paper plan is only a small-scale examination of our road needs and opportunities, and must be updated frequently as new road projects are contemplated. Table 37 provides a statement of the current area and our plans for the future access. According to this plan, we need to build an additional 24 km of road at Gavin Lake, and we are over-built at Knife Creek by about 9 km. We will continue to add road at Gavin Lake, but at Knife Creek we do not expect to remove existing roads. Instead, we have permanently deactivated some road segments, and we hope that they will be reclaimed naturally over time.

Table 37: Roads as a proportion of Management Unit and total area of the Alex Fraser Research Forest, as of 2006.

	Access Density	Gavin Lake	Knife Creek	Total
Net Area (ha)		4,922	3,117	8,040
Existing Roads	Length (km)	112.2	86.2	198.4
	R/W Area (ha)	168.3	129.3	297.6
	km/km^2	2.28	2.76	2.47
	% by area	3.4 %	4.1 %	3.7 %
Total Chance Planned Roads	Length (km)	136.1	77.2	213.3
	R/W Area (ha)	204.1	115.9	320.0
	km/km^2	2.77	2.48	2.65
	% by area	4.1 %	3.7 %	4.0 %
Planned Change in Road Density	Length (km)	+23.9	-9.0	+14.9
	R/W Area (ha)	+35.8	-13.4	+22.4
	km/km^2	+0.49	-0.28	+0.18
	% by area	+0.7 %	-0.4 %	+0.3%

Road Construction and Maintenance

Road construction is a capital investment, and requires annual maintenance to ensure that the roads are serviceable. An annual road construction program of 0.5 - 3 km of new road is anticipated throughout the period of this plan, and we intend to build all planned new roads in a 15-year period. New roads will be designed and built according to the specifications in Table 38.

Table 38: Road construction specifications for the Alex Fraser Research Forest (adapted from BC Ministry of Forests 2002)

Surface Width (m)	Design Speed (km/hr)	Min. Sight Distance (m)	Min. Radius of Curve (m)	Maximum Road Grades (%)				
				Favorable		Adverse		Switch-backs
				Sustained	Short Pitch	Sustained	Short Pitch	
4	20	40	15	16	18	9	12	8
5-6	30	65	35	12	14	8	10	8
	40	95	65	12	14	8	10	8

Our roads are generally built to a permanent standard, because they are necessary for the education, research and protection functions of the Research Forest, as well as ongoing harvesting operations. Partial cutting silvicultural systems require extensive permanent road systems to accommodate repeated harvest entries, and 70% of the Research Forest will be harvested by partial cutting. All roads will be inspected annually to ensure that drainage and surface conditions are maintained.

Stream crossings will be constructed in accordance with Provincial standards and best practices (Province of BC 2004) and will comply with timing windows established by Bings et al. (2004).

Due to the cost of ballasting and surfacing, most of our roads are built from native materials with spot surfacing as required. This leads to roads that are seasonally unserviceable due to wet conditions. We will continue a planned program of upgrading our main roads as revenues allow, to ensure that our permanent roads are durable, serviceable, and present limited environmental risk.

Temporary roads and landings, accessing land within final harvest areas in the Timber Production Area and the Gavin Lake Demonstration Area, will be built to a minimum standard and then rehabilitated, generally within two years of harvest completion.

Particular attention is required to avoid negative impacts on water quality, especially since most of the soils within the Research Forest are fine textured and subject to erosion.
Construction and maintenance will include:

- maintaining natural surface-drainage patterns
- digging out sumps, where water can sit to allow sediments to drop out of suspension
- ensuring adequate cross drains which drain to the forest floor
- armouring cross-drain inlets and outlets

Road rehabilitation Block 136, Gavin Lake Block.

Road Deactivation

Roads are generally not deactivated, except in the case of temporary roads that will not be rehabilitated within two years of construction.

8.2.2. Landings

One significant issue that we presently face is the area of landings used during logging. As with roads, landing space constitutes a permanent removal from the productive land base, and their restoration is expensive and uncertain. Table 39 following provides a statement of present landing area.

Landing requirements vary by each harvest system. Cable and shortwood harvesting systems, use the road right-of-way to process, inventory, and load logs and do not require landing space. Feller-buncher systems can work on roadside or landings in a clearcut situation, but only on landings if a residual stand is being retained. Hand-falling systems typically require landings as they are generally lower in productivity and thus less capitalized, and tend to use wheeled loaders. The principle impediment to shifting to roadside logging is the loading phase. Roadside logging requires a high-cost butt-and-top loader capable of high productivity.

Table 39: Landings as a proportion of Management Unit and total area of the Alex Fraser Research Forest, as of 2006.

	Landing Density	Gavin Lake	Knife Creek	Total
Net Area (ha)		4,922	3,117	8,040
Existing Landings	ha	24.1	34.2	58.3
	% by Area	0.5 %	1.1%	0.7 %

We have the objective to reduce the area of new landings to zero over time. As a first step to that end, we will use the following strategies to reduce our landing requirements in the short- to mid-term.

1. Favour shortwood harvester/processor harvest systems in partial cutting
2. Place landings strategically to serve more than one cutblock.
3. Place landings at road junctions as much as possible
4. Each landing should serve 30 ha.
5. Maximum landing area should be 0.25 ha
6. Allow skidding through adjacent cutblocks to improve the utilization of landing space.
7. Landings on temporary roads should be rehabilitated in phase with the road.

8.2.3. Skid Trails

Skid trails are a feature of partial cutting. We do not consider trails to be a withdrawal from the productive landbase if the soils beneath the trail remain fully productive, and if:

- they are narrower than our target inter-tree distance at final harvest; or
- they don't occupy too much of the site.

In order to protect the residual stand and the productive capacity of the land we manage, it is important to establish skid trails in an efficient manner, according to the following guidelines and the concepts presented in Figure 16:

1. Aim for a target density[1] of 10% of the productive area of a stand to be occupied by trails;
2. Re-use existing trails;
3. Lay out and mark trails in advance of logging to minimize trail density and reduce skidding damage (Nyland 1996);
4. Minimize trail width;
5. Maximize inter-trail distance;
6. Trail junctions at angles of 35˚ or less;
7. Utilize ghost trails to reduce the density of skid trails;

1 Measured by the outside edges of the travelled area of the trail, and counting only those trails that have been used to skid or forward logs (i.e. ghost trails used for felling only do not contribute to trail area). Trails with a running surface 4 m wide and spaced 40 m apart occupy 10% of the productive area.

8. Avoid soil compaction by armouring skid trail surface with non-merchantable logs, limbs and tops; or use under dry or frozen conditions;
9. Retain rub trees at trail junctions, and leave uncut if the next harvest entry will be in less than 10 years.
10. Plan skid trail location to avoid wet soils, and if it is necessary to cross wet ground prepare temporary crossings at the best locations with corduroy and/or snow.
11. Plan skid trail locations to avoid shallow soils with a high risk of soil displacement.

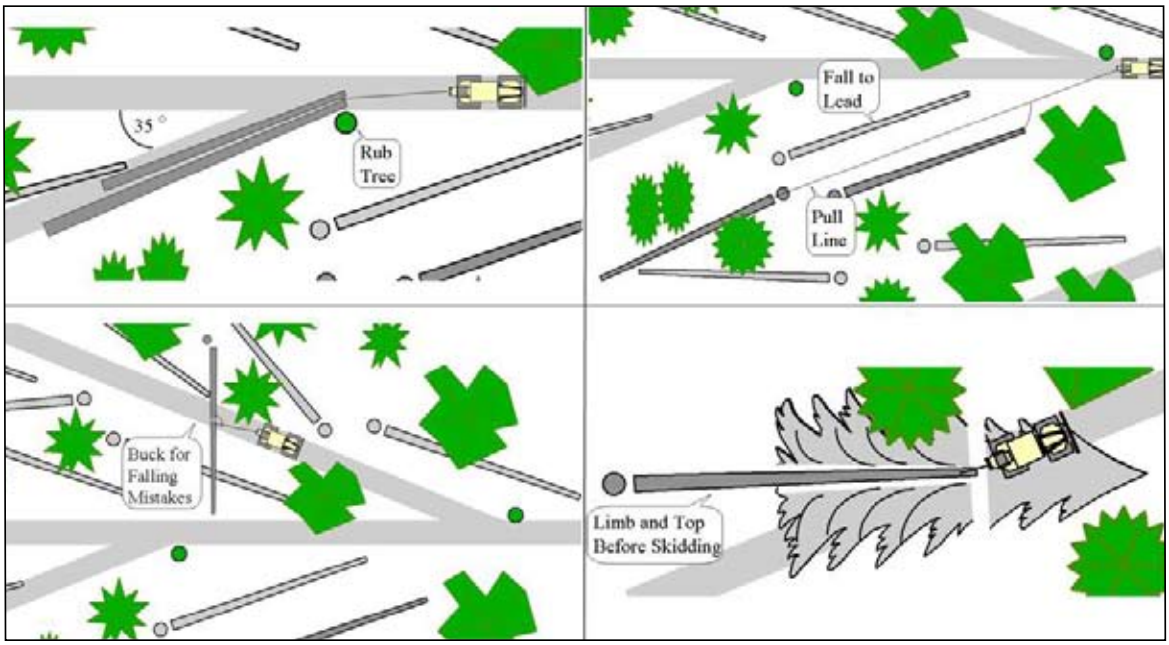


Figure 16: Logging work practices to reduce damage to the residual stand (from Day 1998), assuming a hand-falling/line skidder operation.

9. Research and Education

The goals of the Alex Fraser Research Forest commit us to pursuing research and education as our *raison d'être*. Research creates teaching opportunities, and teaching highlights new research. It follows, therefore, that a vibrant research program is a key element of our success, and we allocate significant resources to ensuring that our environment, information, and management systems are all conducive to new research and teaching opportunities.

> *The excellent research environment provided within the ... Research Forest encourages experiments to be repeated under different conditions, and enables innovative research to be undertaken outside the normal constraints placed on field-based experimental work on crown lands.*
>
> *Dr. John Innes, 2004*
> *Then-Chair, UBC Research Forests Advisory Committee*
> *(Forward to UBC Faculty of Forestry 2004)*

9.1. Research Strategies

We seek to provide an optimal environment for research, particularly in the area of integrated resource management. Research installations contribute directly to education and demonstration initiatives as well. We are committed to creating and maintaining research opportunities within the management and planning framework of the Research Forest. Various individuals and organizations, including federal and provincial government ministries, universities and colleges, forest licensees, outside research institutions, private companies and consultants conduct projects on the Forest. Research is developed on the Forest in three principle ways:

1. The Research Forest facilitates research projects that are brought to the Forest with funding. There are few limitations to the types of projects that can be hosted, however, research may not be classified and must pass a screening process for compliance with ethical, environmental, and safety standards.[1] Services that the Forest provide to researchers include: securing accommodation, assisting with site selection, ensuring compliance with relevant legislation, preparing operational plans, obtaining experimental exemptions, obtaining permits, advertising, securing contacts and resources required for project treatments, and providing access to maps, photos, GIS databases, and office resources. We also participate in the Regional Research Advisory process and encourage projects that have been developed in response to local, regional or provincial priorities regarding integrated resource management. This category includes about 65% of the research projects conducted. Some projects may not relate directly to management, but require a forest environment in their design. This category comprises about 5% of research projects conducted.

> *I meant to do my work today,*
> *but a butterfly flitted across a field,*
> *and a brown bird sang in an apple tree,*
> *and all the trees were calling me.*
> *And the wind went sighing over the land,*
> *tossing the grasses to and fro.*
> *And a rainbow held out its shining hand.*
> *So what could I do*
> *but laugh and go.*
>
> 
>
> *Sam Hicks*
> *1969-1999*
> *Research Project 98-04*

2. Increasingly, the Research Forest participates as a partner in a multi-disciplinary team, helping to secure project funding and install and monitor experiments. These collaborative efforts result in projects and extension/demonstration products that combine the expertise of

1 See Researcher Use Policy and Guidelines, UBC Alex Fraser Research Forest.

various partners, including those of the Research Forest. They comprise about 15% of the total number of projects.

3. The Research Forest operates an in-house research program, whereby staff or contractors carry out research that focuses on issues or problems of specific importance to the management of the Research Forest. This category comprises about 15% of the research projects conducted.

Research installations may be of two types: replicated experiments and demonstrations or case studies. While both types are important, those projects using statistically robust processes are preferred, since stronger inferences can be deduced from research results and demonstration values are simultaneously produced.

The Forest staff is directly involved with project site selection, once a screening process has been passed. Research installation locations are mapped in a GIS (Appendix 12) and subsequently protected from disturbance for the duration projects are active. Each development proposal is screened for conflicts with existing research projects, and if conflicts might arise then principle investigators are contacted for comment. Development projects are amended as necessary, to avoid negative impacts on research installations.

The University Research Forests in British Columbia (Malcolm Knapp RF, Aleza Lake RF, John Prince RF, and AFRF) share an integrated, fully searchable, geographically explicit on-line database of all projects, investigators, measurement and maintenance histories, extension products and events, ensuring efficient documentation and management of projects over time. Additionally, an extensive forestry reference collection, including research project reports, is housed at the Research Forest office.

Effective communication of past research activities often leads to the creation of new projects that build upon previous efforts. Long-term cooperative projects pertinent to sustainable forest management in the Interior of B.C. are encouraged. Potential research opportunities are considered wherever possible when operational activities, especially harvesting, planting and stand tending are conducted. Operations can be conducted specifically for research trials if sufficient notice and input are provided by researchers. Opportunities for research present themselves continuously; it is our responsibility to identify research opportunities, assess their priority, promote the development of projects, and protect projects once they are installed.

Jaromir Macku and Karel Klinka analysing soils for ecosystem classification, RP 2002-10.

This process of identifying and promoting research opportunities sometimes leads to Research Projects that fail to get underway. Figure 17 shows that about 30% of the total projects initiated become inactive. Of the projects that are active or complete, 69% result in a physical research site installed, but 31% do not have an installed site. Of those projects that have installed sites, 64% are intended to examine the effects of management treatments.

The information presented in Figure 17 indicates the importance of our management processes to our research programs. Nearly half of the active or completed research projects to this point in time examined forest management activities.

It is also our task to protect future opportunities for research. This includes maintenance of sufficient untreated control areas where treatments are conducted. To that end, Wildlife Tree Patches, Reserves, and Old Growth Management Areas may be useful, but specific untreated areas may need to be designated to ensure that they represent the same conditions as treated areas.

Future research opportunities also depend upon maintenance of supporting infrastructure, such as weather records, treatment records, road access, and research data (where it is provided to us).

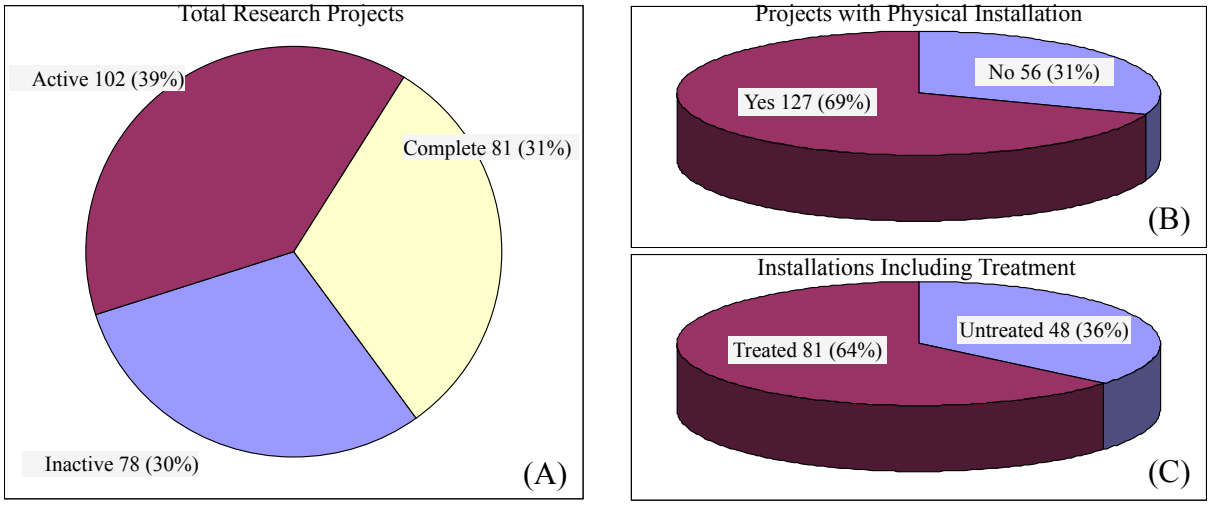


Figure 17: Summary of research projects opened between 1987 and July 2006 at the Alex Fraser Research Forest, showing: (A) the ratio of research projects by completion status; (B) the ratio of active and completed projects that are physically installed; and (C) the ratio of installed projects that use or require a treatment.

9.1.1. Research Facilities and Services

We maintain accommodation for researchers at Gavin Lake, where a two-bedroom house provides kitchen, bathroom and laundry facilities for researchers, students, and visitors for a nominal nightly charge. The cabin is provided with a computer and satellite internet connection. Researchers may also arrange to have access to our office facilities in Williams Lake.

Field support such as daily check-in, site selection, maps and GIS data are provided to all researchers without charge. Other support is available upon request, and may involve cost-recovery charges, as detailed in the Researcher Use Policy and Guidelines.[2]

9.2. Education Strategies

We seek to provide excellent opportunities for education, by creating good teaching and extension conditions in the field, and providing information and staff time to faculty and students in their course and project work. We are committed to maintaining effective teaching

2 See, http://www.forestry.ubc.ca/resfor/afrf/research_index.htm

opportunities by being familiar with emerging issues in natural resources management, and focusing resources on those issues.

Our extension activities address target audience's information and experiential needs and improve the two-way transfer of knowledge necessary for sustainable use and conservation of forests. The goal of the Research Forests' extension strategy is for the Forests to be recognized and supported for their role in increasing understanding of natural resource sciences, management and stewardship (Turner et al. 2004).

The Forest provides an outdoor classroom to graduate and undergraduate students from UBC and other universities, colleges, secondary and elementary schools. Each year we host the required third year field course for undergraduate students in Forest Management, Forest Sciences, and Forest Operations programs, and Research Forest staff play an active role in the instruction of that course.

Dr. Bruce Larson prepares UBC Forestry students for a field exercise.

We employ undergraduate students and new graduates in summer positions where students gain valuable practical experience. We also host international students who complete volunteer internships with us, as a requirement of their university program or out of personal interest. We also provide opportunities to professional and technical audiences for continuing education, as well as demonstration and recreational values to the general public.

Fourteen trails provide opportunities in the field for the extension of research results to technical and non-technical audiences. Interpretive signs describe research projects and results in general terms so that most audiences, including the general public, can understand them. More detailed, technical brochures accompany the signs for more advanced audiences. "Quicksheet" extension notes and reports are also typically used by AFRF to transfer new knowledge.

Leo Rankin (Ministry of Forests and Range) and Ken Day lead a tour for government staff to examine bark beetle damage in young pine stands.

Harvesting and silviculture operations also provide demonstration opportunities. Signs indicating dates of activities and project objectives are visible from roads and trails and target the general public as an audience. The Research Forest is frequently used by resource students and practitioners for field tours to observe "before", "during" and "after" scenarios in forestry operations."

Maintaining our relevance to our clients requires that we continuously maintain and develop our research and education sites, and develop new opportunities to extend the knowledge gained through research activities on the Research Forest.

The Duck
(as recounted by Rupert Walker)

Rupert Walker, the son of an English military chaplain, was a forestry student at the University of North Wales in Bangor, UK. He came to us as an international intern, and spent a good deal of time at Gavin Lake. Rupert was one in a long line of young Englishmen who measured our spruce weevil project (91-03). His ambition was to become a lumber baron.

During the time that Rupert was staying at Gavin Lake, he shared the cabin with a married couple, who were both wildlife biologists. Rupert did not always see eye-to-eye with them on things that would concern a wildlife biologist. In fact, Rupert used to take some delight from baiting them. Concepts like making slippers from a matched pair of bear cubs were enough to get an argument going.

One night a duck arrived, wanting to find a tree in which to roost. Being a duck of apparently low intelligence (even for a tree-nesting duck), it mistook the chimney of the cabin for an appropriate roost. Upon investigating the racket the duck set up in the chimney, the biologists set about to rescue the bird. Sensing the rapidly developing marital tension, Rupert went to bed.

The first ploy was to lower a rescue rope from the top of the chimney. This attempt was quickly abandoned. The next ploy was to coax the bird out through the thimble of the chimney into the cabin. For this the rescuers employed a tiny makeshift ladder and a can of sardines. Rupert listened from his bed as preparations were made and failure was met. The third line of reasoning was to float the duck out. This ambitious gambit involved silicone to seal the cleanout at the bottom of the chimney, and many trips from the sink to the thimble, to pour the water into the chimney. Rupert listened to the hustling back and forth. The urgent warnings not to slow down and cries of anguish that accompanied spilled water, convinced Rupert that staying in bed was a good course of action. If the water carriers missed even one beat, they lost the water in the chimney and the duck settled. The rescuers redoubled their efforts.

Time moved slowly (at least for Rupert), but eventually the floating technique was abandoned. Perhaps it was frustration that caused an axe attack against the cement chimney, but still success eluded them. Finally the biologists abandoned the duck at about 2:00 a.m. Rupert slept soundly after that. Sometime through the night, when the cabin was quiet, the duck saw the error of its ways. It was waiting, in the kitchen sink, when Rupert awoke.

Rupert considered duck à l'orange, *but opted for cereal instead.*

10. Consultation

10.1. Principles for Meaningful Consultation

Halseth and Booth (2003) have described a set of principles that make public consultation successful by ensuring that it is a positive experience for all involved. They go on to say that positive consultation experiences help to achieve positive outcomes beyond the successful implementation of a plan: new community visions; and a renewed sense of confidence in the economy, environment, and institutions. Halseth and Booth (2003) listed the key principles for a successful consultation process.

- Consultation is important, and the public is coming to expect to provide significant input to planning processes.
- Processes should be clear, with equity amongst participants and a clear mandate. Clear terms of reference and clearly defined decision-making powers are important.
- Public should be involved in the process, by providing publicity around the planning process and recognizing that special interest groups don't necessarily represent the "Public." Plan proponents should explicitly value public participation, and recognize problems in public involvement – representation across divisions in the community, and community boundaries that don't fit with jurisdictional boundaries.
- Information needs to be accessible, and needs to flow throughout the consultation process.
- Processes need to be open and welcoming, with clear time lines and milestones.
- Caution is important, with cooperation and common sense being exercised. Real or imagined problems stand in the way of effective processes.

10.2. Customers and Constituents

The Research Forest is managed for a complex of purposes that impact on different customers and constituents in different ways. A critical step in understanding the publics' interests is to understand which "publics" are impacted by our actions, and how their interests are affected (Professional Practice Committee 2002).

Researchers, professors and students: Faculty and students from UBC and other post-secondary institutions have particular needs and expectations from the Research Forest. They want to see and study a wide range of practices; they are not directly affected by the environmental impacts of operations; they have no particular interest in the economic well-being of the region, but they are directly affected by the financial well-being of the Research Forest. They are generally supportive of our activities.

First Nations communities: Two First Nations Communities (Williams Lake (*T'exelc*), and Soda Creek (*Xats'ull/Cmetem'*)) are directly affected by our activities, and the Northern Shuswap Tribal Council (Northern *Secwepemc te Qelmucw* (NStQ)) is also directly affected through the treaty-making process. Currently these communities are at stage 4 in the treaty process with British Columbia and Canada. The Research Forest lies within the traditional territories outlined by the two communities, and as such the land area we occupy is subject

to the land claims process. In addition, we provide a service to the communities and the Tribal Council regarding land use planning and land claims by providing information on archaeological impact assessments that we conduct. Involvement of band members in our teaching activities helps our students to understand the social, historical, and traditional context within which we operate.

Neighbours, licensed users, First Nations traditional users, recreationists, and other directly affected individuals: People who live adjacent to or have a licensed or non-licensed use of the Research Forest are directly impacted by our plans and operations. They have no particular interest in the financial well-being of the Research Forest, but are directly impacted by the practises we employ, and by the economic well-being of the region. They are generally indifferent to our activities until they feel directly affected.

Forest industry, government agencies, and natural resource professionals: The Research Forest provides services to the natural resource management community, and people involved in those pursuits have an interest in our financial well-being. They are indirectly affected by our plans and operations. They are generally supportive of our activities.

Communities and interested public:
The communities of the Cariboo (particularly Williams Lake, Horsefly, Likely, and portions of the Cariboo Regional District) have a direct interest in our activities. They have an interest in our financial well-being, and in the economic well-being of the region. They are not directly affected by our plans and operations, but they are interested in our environmental performance. We provide a service to these communities by linking them with UBC, and by providing a source of technical information outside of the forest industry or government. They benefit directly from our involvement in local causes and activities such as planning for wildfire at the urban interface.

10.3. Consultation Processes

Four separate processes are necessary to provide meaningful consultation.

10.3.1. First Nations Consultation

It is clearly in our best interests to establish and maintain an effective relationship with First Nations communities who have expressed an interest in the area which we occupy.

We recognize that First Nations consultation and accommodation is a legal obligation of Government that cannot be delegated to us as a licensee (Olynyk 2005), although procedural aspects may be delegated (Olynyk 2005, Anon 2005c). At the time of writing, Government consultation with First Nations is guided by five documents: FRPA Administration Bulletin Number 1,[1] the Provincial Policy for Consultation with First Nations,[2] the Ministry of Forests Policy On Aboriginal Rights And Title (May 14, 2003)[3] and the Ministry of Forests

1 See http://www.for.gov.bc.ca/rco/pfit/Bulletins/FN_InfoSharing%20June%2010%202005.pdf (accessed October 12, 2006)
2 See http://www.gov.bc.ca/bcgov/content/docs/@2QS7M_0YQtuW/consultation_policy_fn.pdf (accessed September 21, 2006)
3 See http://www.for.gov.bc.ca/haa/Docs/finalconsultationpolicy03.pdf (accessed September 21, 2003

Consultation Guidelines (2003)[4], and Consultation and Accommodation Guidelines for Government and Third Parties (2003).[5] This policy guidance is likely to change as British Columbia's "New Relationship" initiative[6] is developed.

BC has delegated the procedural aspects of consultation to licensees by requiring proponents to undertake a review and comment process with First Nations in relation to Forest Stewardship Plans (Anon 2005c). We consider our task in this procedure to be limited to gathering information on aboriginal interests[7] and modifying our practices to ensure that those interests are accommodated.

We do not want to insert ourselves into consultations between BC and the Williams Lake and Soda Creek Indian Bands. Instead we hope that, by discussing our plans and methods with the Williams Lake and Soda Creek Indian Bands, we will be able to understand the aspirations of the people of *T'exelc*, and *Xats'ull/Cmetem'*, and the work we do here will become a valued resource to those communities. We also hope that our discussions with the people of *T'exelc*, and *Xats'ull/Cmetem'* will lead us to a better understanding of the historical development of the forests we manage, the values now in place on the Research Forest, the values that have been lost, and how to modify our practices to provide those values.

> ...we hope ... we will be able to understand the aspirations of the people of *T'exelc,* and *Xats'ull/Cmetem'*, and the work we do here will become a valued resource to those communities.

We do not know yet what form these discussions will take, nor do we know how we will develop an abiding positive relationship with these people. We do know that critical ingredients to success include: open-minded discussion, respectful sharing of knowledge, and a willingness to consider differing world views and values. We will seek guidance from the recent careful work of Garth Greskiw, who is currently completing his PhD thesis dealing with communications between Norther Secwepemc First Nations and British Columbia (Greskiw 2006).

Action 19: Begin discussions with the Natural Resources Directors, Elders, and others in the communities of Williams Lake and Soda Creek Bands, to establish and continue a meaningful relationship.

10.3.2. Public Review and Comment Required by Statute

Under the Forest Planning and Practices Regulation, licensees who prepare Forest Stewardship Plans are required to provide 60 days public notice that a Forest Stewardship Plan is available for review and comment. In addition licensees may be required to refer plans to government agencies, and provide opportunities to licensed users and First Nations

4 See http://www.for.gov.bc.ca/haa/Docs/MOF_Consultation_guidelines_final.pdf (accessed September 21, 2006)
5 See http://www.nstq.org/nstc/PDF/Consultation%20Guildlines%20without%20bibliography.pdf (accessed November 14, 2006)
6 See http://www.gov.bc.ca/arr/down/new_relationship.pdf (accessed November 15, 2006)
7 "Aboriginal interests" refers to "potentially existing but unproven aboriginal rights and /or title" (Anon 2005c quoting others).

communities for review and comment. Comments received through this review process must be acted upon in a substantive way.

The Alex Fraser Research Forest will carry out public review and comment of Forest Stewardship Plans written under this Management Plan, as stipulated in the regulation.

10.3.3. Research Forest Advisory Committee (UBC Forestry)

As tenure holder, the University of British Columbia must provide meaningful input to the management of the Research Forest. This process is performed by the Research Forest Advisory Committee, whose members serve at the pleasure of the Dean of Forestry. The Advisory Committee is intended to meet quarterly, to provide input to the Research Forest Manager. A draft of this plan will be reviewed by the advisory committee, and input we receive will be considered in final drafting of the plan. The advisory committee also represents the Research Forest to the Faculty of Forestry as a whole. Informal communication with individual professors and students provides us with further input. This plan will be available in the library collection at UBC, and also in digital form on our web site.

10.3.4. Alex Fraser Research Forest Community Advisory Group

During the period of this plan, we intend to create a new Community Advisory Group. We intend that this group will provide us with input from local neighbours, licensed users, non-licensed users, interested community members, and First Nations communities. The principles for the action of this board are:

- Seven to nine members
- The first four members to be selected by the Manager
- The remaining three to five members to be recommended by the group to the Manager
- The group will represent a range of interests local to the Alex Fraser Research Forest; and could include neighbours, ranchers, trappers or guide outfitters, recreationists, First Nations, environmentalists, local government, and natural resources managers
- The group will meet semi-annually or quarterly, to discuss current issues and provide input to the Manager with respect to plans and practices
- The group will not have decision-making authority, but their input will be respected and valued during decision-making
- This will be a standing group with members selected for a two-year term
- The group will be appropriately supported by the Research Forest, to ensure that it has necessary resources to carry out its purpose.

Action 20: Establish and maintain a Community Advisory Group.

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12. Appendices

Appendix 1: CCLUP Resource Targets Pertaining To The Research Forest

CARIBOO-CHILCOTIN LAND USE PLAN IMPLEMENTATION
COMPARING RESOURCE TARGETS

III. ENHANCED RESOURCE DEVELOPMENT ZONE

(5) Beaver Valley

Total Area: 425,331 ha Total Forest Area: 328,329 ha

OVERLAPS

Mule deer winter range management will overlap with visual quality objectives over most of the key tourism areas.

GRAZING

To maintain the current authorized level of 40,076 AUMs in the polygon.

To maintain the existing proportion of AUMs by Range Unit.

WILDCRAFT

To maintain roaded access to 80% of the polygon.

Access to the rest of the polygon will be walk-in off permanent main roads, or temporary in conjunction with any forest industry development or mineral exploration.

MINING

To maintain access to 100% of the polygon outside of those areas currently reserved from activity.

RECREATION

To maintain 5% of the polygon in a backcountry condition, portions of the Quesnel and Horsefly Rivers and around key lakes.

To maintain the visual quality in the viewshed of highway corridors and key lakes.

TOURISM

To maintain the visual quality in the viewshed surrounding existing tourism operations.

(5) Beaver Valley

FISH AND WILDLIFE

To manage the Horsefly, Beaver, Hazeltine and Edney River watersheds for salmon stocks (approximately 70% of the polygon), through riparian area protection and controls on the rate of harvest.

To manage for the biodiversity targets that will be developed in the Regional Biodiversity Conservation Strategy (see Biodiversity Conservation section). The following seral stage targets will be used in the development of that strategy:

- "old forest" category: 7% to 19% range

- "mature/old forest" category: 17% to 36% range

The actual proportions in this polygon will be dependent on the natural disturbance types and the Biodiversity Guidelines which are developed under the Forest Practices Code. The seral stage targets will be adjusted as the regional Biodiversity Conservation is developed concurrently with the Short Term Timber Availability Plan.

To maintain riparian habitats through the establishment of riparian management zones on all streams, lakes and wetlands as specified under the Forest Practices Code and Riparian Guidelines.

To manage for moose, furbearer, species at risk and other sensitive habitats within the areas identified as riparian buffers, recreation areas, mule deer winter range and lakeshore management zones and throughout the polygon under the biodiversity conservation strategy, including key deciduous stands.

To initiate water allocation planning to address fisheries flow requirements and agricultural needs for competing water uses in this area.

To manage approximately 2 lakes as quality lakes for wilderness fisheries.

To maintain mule deer winter range values through modified harvest regimes over approximately 18% of the forest in this polygon.

TIMBER

The following targets apply to the entire productive forest land base in this polygon.

Polygon	Conventional Harvest	Modified Harvest	No Harvest
5 Beaver Valley	62%	32%	6%

The primary restrictions to timber development will be in the more-populated areas of the polygon due to the considerable interactions with the rural public.

CARIBOO-CHILCOTIN LAND USE PLAN IMPLEMENTATION
COMPARING RESOURCE TARGETS

III. ENHANCED RESOURCE DEVELOPMENT ZONE

(6) Williams Lake

Total Area: 285,225 ha Total Forest Area: 212,400 ha

OVERLAPS

Mule deer winter range management will overlap with visual quality objectives over most of the key recreation and tourism areas.

GRAZING

To maintain the current authorized level of 34,501 AUMs in the polygon.

To maintain the existing proportion of AUMs by Range Unit.

WILDCRAFT

To maintain roaded access to 80% of the polygon.

Access to the rest of the polygon will be walk-in off permanent main roads, or temporary in conjunction with any forest industry development or mineral exploration.

MINING

To maintain access to 100% of the polygon outside of those areas currently reserved from activity.

RECREATION

To maintain 5% of the polygon in a backcountry condition, along the Fraser River.

To maintain the visual quality in the viewshed of highway corridors.

TOURISM

To maintain the visual quality in the viewshed surrounding existing tourism operations.

(6) Williams Lake

FISH AND WILDLIFE

To manage the habitats along the Fraser River mainstem and banks for salmon stocks.

To manage for the biodiversity targets that will be developed in the Regional Biodiversity Conservation Strategy (see Biodiversity Conservation section). The following seral stage targets will be used in the development of that strategy:

- "old forest" category: 7% to 19% range

- "mature/old forest" category 17% to 36% range

The actual proportions in this polygon will be dependent on the natural disturbance types and the Biodiversity Guidelines which are developed under the Forest Practices Code. The seral stage targets will be adjusted as the regional Biodiversity Conservation is developed concurrently with the Short Term Timber Availability Plan.

To maintain riparian habitats through the establishment of riparian management zones on all streams, lakes and wetlands as specified under the Forest Practices Code and Riparian Guidelines.

To manage for grizzly bear, moose, furbearer, species at risk and other sensitive habitats within the areas identified as riparian buffers, recreation areas, mule deer winter range and lakeshore management zones and throughout the polygon under the biodiversity conservation strategy.

To initiate water allocation planning to address fisheries flow requirements and agricultural needs for competing water uses in this area.

To maintain key White Pelican habitat surrounding Natsy Lake.

To maintain mule deer winter range values through modified harvest regimes over approximately 50% of the forest in this polygon.

TIMBER

The following targets apply to the entire productive forest land base in this polygon.

Polygon	Conventional Harvest	Modified Harvest	No Harvest
6 Williams Lake	45%	50%	5%

The primary control on timber development will be mule deer winter range management.

Appendix 2: Identified Wildlife Potentially Inhabiting the UBC/Alex Fraser Research Forest

Notes to Tables:

1. Global Rank and Provincial Rank explained:

CDC CONSERVATION STATUS RANKS (**S** = Provincial, **N** = National, **G** = Global) (From Harcombe et al. 2002)

X Presumed Extirpated or Extinct
Not located despite intensive searches and no expectation that it will be rediscovered.

H Historical
Not located in the last 50 years, but some expectation that it may be rediscovered.

1 Critically Imperiled
Because of extreme rarity or some factor(s) making it especially susceptible to extirpation or extinction. Typically 5 or fewer existing occurrences[1] or very few remaining individuals, e.g., fewer than 1000 Spotted Owl.

2 Imperiled
Because of rarity or some factor(s) making it very susceptible to extirpation or extinction. Typically 6 to 20 existing occurrences or few remaining individuals, e.g., 1000 to 3000 White Sturgeon.

3 Vulnerable
Because rare and local, found only in a restricted range (even if abundant at some locations), or because of some other factor(s) making it susceptible to extirpation or extinction. Typically 21 to 100 existing occurrences, e.g., Gopher Snake.

4 Apparently Secure
Because uncommon but not rare, and usually widespread in the province. Possible cause for long-term concern. Typically more than 100 existing occurrences, e.g., Olive-sided Flycatcher.

5 Secure
Because common to very common, typically widespread and abundant, and not susceptible to extirpation or extinction under present conditions, e.g., Red-osier Dogwood.

? Unranked -- Rank not yet assessed.

U Unrankable -- Due to current lack of available information.

RANK MODIFIERS (From Harcombe et al. 2002)
E Exotic – a species introduced by man to the province.
? Inexact or uncertain due to limited information; qualifies the immediately preceding rank character.
Q Taxonomic status is not clear or is in question.
T Designates a rank associated with a subspecies or variety.
B Designates a rank associated with breeding occurrences of mobile animals.
N Designates a rank associated with non-breeding occurrences of mobile animals

2. COSEWIC status (from http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5 accessed August 24, 2006)

Extinct (X) - A wildlife species that no longer exists.
Extirpated (XT) - A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E) - A wildlife species facing imminent extirpation or extinction.
Threatened (T) - A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC) - A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Data Deficient (DD) - A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.
Not At Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

1 Occurrence: a location representing a habitat which sustains or otherwise contributes to the survival of a population, e.g., a south-facing slope that provides winter range for ten elk would be considered a single occurrence, not ten.

Table 40: BC Conservation Data Centre Listed Animal Species for the Former Horsefly and Williams Lake Forest Districts

English Name	Scientific Name	Global Rank	Sub-National (Provinicial) Rank	COSEWIC Status	BC Status	Identified Wildlife Order	Former Horsefly FD	Former Williams Lake FD	Possible/Confirmed AFRF
American Bittern	*Botaurus lentiginosus*	G4	S3B,SZN		BLUE		√	√	possible GL (confimed Beaver Valley), possible KC
American White Pelican	*Pelecanus erythrorhynchos*	G3	S1B,SZN	NAR (1987)	RED	(JUNE 2006)		√	
Badger	*Taxidea taxus*	G5	S1	E (MAY 2000)	RED	I - JEFFERSONII SSP. (MAY 2004)		√	
Bighorn Sheep	*Ovis canadensis*	G4	S2S3		BLUE	(JUNE 2006)		√	
Bobolink	*Dolichonyx oryzivorus*	G5	S3B,SZN		BLUE		√	√	
Brewer's Sparrow, breweri subspecies	*Spizella breweri breweri*	G5T4	S2B		RED	(JUNE 2006)		√	
Bull Trout	*Salvelinus confluentus*	G3	S3		BLUE	(JUNE 2006)	√	√	
Caribou (southern population)	*Rangifer tarandus pop. 1*	G5T2Q	S1	T (MAY 2000)	RED	I (MAY 2004)	√		
Cutthroat Trout, clarki subspecies	*Oncorhynchus clarki clarki*	G4T4	S3S4SE		BLUE	(JUNE 2006)	√	√	
Dolly Varden	*Salvelinus malma*	G5	S3S4		BLUE		√	√	
Fisher	*Martes pennanti*	G5	S2		RED	(JUNE 2006)	√	√	confirmed GL, possible KC
Flammulated Owl	*Otus flammeolus*	G4	S3S4B,SZN	SC (NOV 2001)	BLUE	I - IDAHOENSIS SSP. (MAY 2004)		√	possible KC
Fringed Myotis	*Myotis thysanodes*	G4G5	S2S3	DD (MAY 2004)	BLUE	I (MAY 2004)		√	possible KC - it would be good to monitor Bluffs
Great Basin Spadefoot	*Spea intermontana*	G5	S3	T (NOV 2001)	BLUE	I (MAY 2004)		√	
Great Blue heron, herodias subspecies	*Ardea herodias herodias*	G5T5	S3B,S4N		BLUE	(JUNE 2006)	√	√	confimed GL, possible KC
Grizzly Bear	*Ursus arctos*	G4	S3	SC (MAY 2002)	BLUE	I (MAY 2004)	√	√	tentatively confirmed GL
Hagen's Bluet	*Enallagma hageni*	G5	S3S4		BLUE			√	
Lewis's Woodpecker	*Melanerpes lewis*	G4	S3B,SZN	SC (NOV 2001)	BLUE	I (MAY 2004)		√	
Long-billed Curlew	*Numenius americanus*	G5	S3B,SZN	SC (NOV 2002)	BLUE	I (MAY 2004)		√	

English Name	Scientific Name	Global Rank	Sub-National (Provinicial) Rank	COSEWIC Status	BC Status	Identified Wildlife Order	Former Horsefly FD	Former Williams Lake FD	Possible/Confirmed AFRF
Northern Long-eared Myotis	*Myotis septentrionalis*	G4	S2S3		BLUE		√		confimed GL (Dorsey Lk.)
Painted Turtle	*Chrysemys picta*	G5	S3S4		BLUE			√	
Pallid Bat	*Antrozous pallidus*	G5	S1	T (MAY 2000)	RED			√	
Peregrine Falcon, anatum subspecies	*Falco peregrinus anatum*	G4T3	S2B,SZN	T (MAY 2000)	RED			√	possible KC (migration)
Prairie Falcon	*Falco mexicanus*	G5	S2B,SZN	NAR (1996)	RED	(JUNE 2006)	√	√	
Sandhill Crane	*Grus canadensis*	G5	S3S4B,SZN	NAR (1979) G. CANADENSIS TABIDA ASSESSED	BLUE	(JUNE 2006)	√	√	confimed GL, KC
Sharp-tailed Grouse, columbianus subspecies	*Tympanuchus phasianellus columbianus*	G4T3	S2S3		BLUE	(JUNE 2006)		√	Confirmed GL, possible KC
Short-eared Owl	*Asio flammeus*	G5	S3B,S2N	SC (1994)	BLUE	I (MAY 2004)	√	√	possible GL, KC
Spotted Bat	*Euderma maculatum*	G4	S3S4	SC (MAY 2004)	BLUE	I (MAY 2004)		√	possible KC - it would be good to monitor Bluffs
Swainson's Hawk	*Buteo swainsoni*	G5	S2B,SZN		RED			√	
Townsend's Big-eared Bat	*Corynorhinus townsendii*	G4	S2S3		BLUE			√	
Upland Sandpiper	*Bartramia longicauda*	G5	S1S2B,SZN		RED			√	
Western Grebe	*Aechmophorus occidentalis*	G5	S1B,S3N		RED			√	
Western Small-footed Myotis	*Myotis ciliolabrum*	G5	S2S3		BLUE			√	possible KC - it would be good to monitor Bluffs
White Sturgeon (Lower Fraser River population)	*Acipenser transmontanus pop. 4*	G4T2Q	S2	E (NOV 2003)	RED			√	
White-throated Swift	*Aeronautes saxatalis*	G5	S3S4B,SZN		BLUE			√	
Wolverine, luscus subspecies	*Gulo gulo luscus*	G4T4	S3	SC (2003) WESTERN POPULATION ONLY	BLUE	I (MAY 2004)	√	√	possible GL, KC
Yellow-breasted Chat	*Icteria virens*	G5	S1B	E (NOV 2000)	RED	I (MAY 2004)		√	

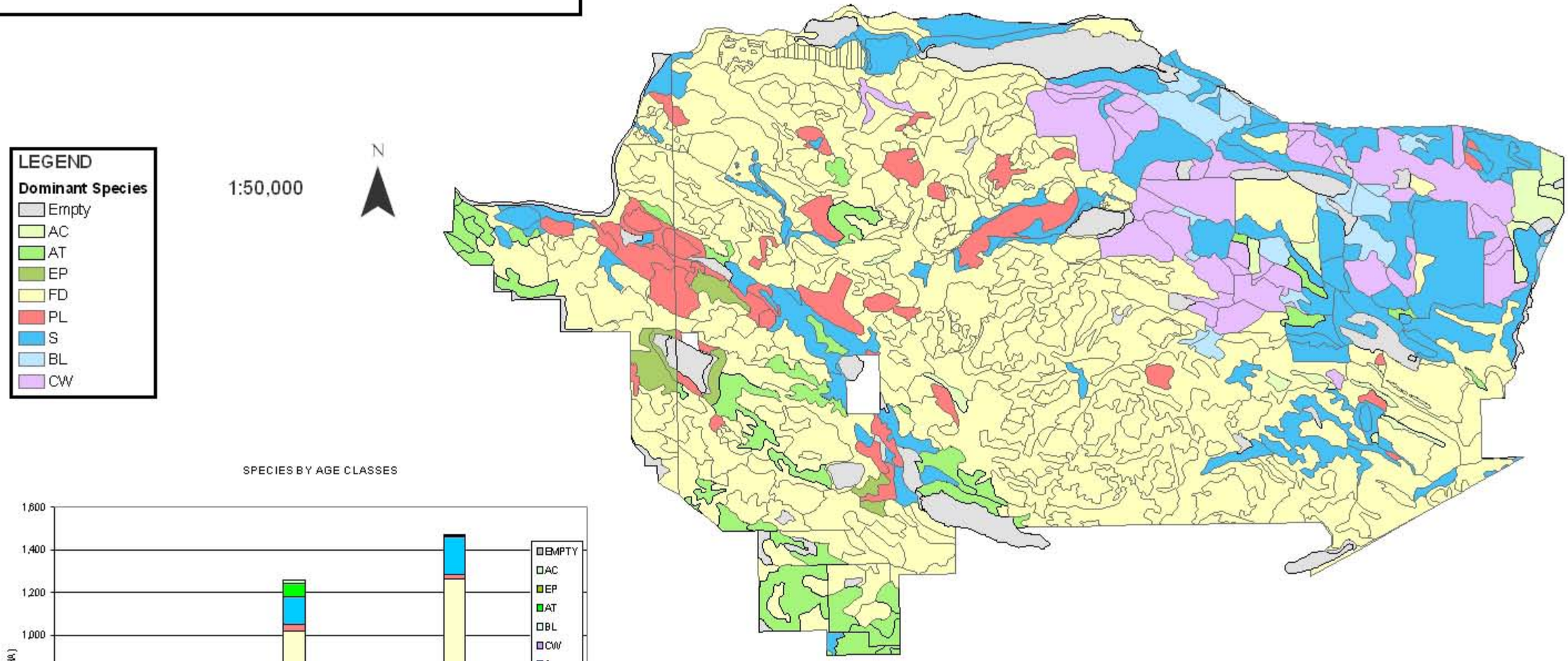
Table 41: BC Conservation Data Centre Listed Plant Species for the Former Horsefly and Williams Lake Forest Districts

English Name*	Scientific Name	Global Rank	Sub-national (Provinicial) Rank	BC Status	Identified Wildlife Order	Former Horsefly FD	Former Williams Lake FD	Possible/Confirmed AFRF
American chamaerhodos	*Chamaerhodos erecta ssp. nuttallii*	G5T5	S2S3	BLUE			√	
autumn willow	*Salix serissima*	G4	S2S3	BLUE			√	
birdfoot buttercup	*Ranunculus pedatifidus ssp. affinis*	G5T5	S2S3	BLUE			√	
Booth's willow	*Salix boothii*	G5	S2S3	BLUE			√	
Carolina draba	*Draba reptans*	G5	S1	RED			√	
Drummond's campion	*Silene drummondii var. drummondii*	G5T5	S3	BLUE			√	possible but unlikely**
five-leaved cinquefoil	*Potentilla nivea var. pentaphylla*	G5T4	S2S3	BLUE			√	
fragile sedge	*Carex membranacea*	G5	S2S3	BLUE		√		
Geyer's onion	*Allium geyeri var. tenerum*	G4G5TNR	S2	RED			√	
Hall's willowherb	*Epilobium halleanum*	G5	S2S3	BLUE		√	√	
Holboell's rockcress	*Arabis holboellii var. pinetorum*	G5T5?	S2S3	BLUE			√	confirmed KC (RP# 00-14)
Hudson Bay sedge	*Carex heleonastes*	G4	S2S3	BLUE		√		
meadow arnica	*Arnica chamissonis ssp. incana*	G5TNR	S2S3	BLUE			√	
multi-flowered bedstraw	*Galium multiflorum*	G5	S1	RED			√	
porcupine sedge	*Carex hystricina*	G5	S2S3	BLUE			√	
porcupinegrass	*Hesperostipa spartea*	G5	S2	RED			√	
purple-leaved willowherb	*Epilobium ciliatum ssp. watsonii*	G5TNR	S2S3	BLUE			√	
Regel's rush	*Juncus regelii*	G4?	S3	BLUE			√	
rivergrass	*Scolochloa festucacea*	G5	S2	RED			√	
short-beaked fen sedge	*Carex simulata*	G5	S2S3	BLUE			√	
sickle-pod rockcress	*Arabis sparsiflora*	G5	S1	RED			√	
silvery orache	*Atriplex argentea ssp. argentea*	G5T5	S1	RED			√	
slender hawksbeard	*Crepis atribarba ssp. atribarba*	G5T5	S1	RED			√	possible but unlikely**
slender mannagrass	*Glyceria pulchella*	G5	S2S3	BLUE			√	
small-fruited willowherb	*Epilobium leptocarpum*	G5	S2S3	BLUE			√	
Sprengel's sedge	*Carex sprengelii*	G5?	S1	RED			√	
white wintergreen	*Pyrola elliptica*	G5	S2S3	BLUE			√	

*None of these species have been mapped specifically in either GL or KC by the Conservation Data Centre.
**Personal communication, Ray Coupe, Research Ecologist, MOF Southern Region, January 2005.

Appendix 3: Forest Cover by Leading Species

GAVIN LAKE BLOCK
Management Plan # 3 and Forest Srewardship Plan
SPECIES COMPOSITION BY AGE CLASS
December 2004



DISTRIBUTION OF SPECIES BY AGE CLASSES

	SPECIES										
AGE_CLASS	AC	AT	BL	CW	EP	FD	PL	S	EMPTY	TOTAL	%
0									83.3	83.3	1.4
1	5.4			61.6	13.1	69.0	148.5	265.6		563.1	9.3
2	58.8	21.0	47.7	234.8		57.1	84.8	141.1		645.3	10.7
3		98.8	22.1	13.5	9.6	10.1		17.9		172.0	2.8
4	16.8	61.8				1,016.5	31.3	132.5		1,258.8	20.8
5	3.8	91.0	44.3	2.9		479.9	16.1	24.9		662.7	10.9
6		45.9			35.3	429.3	7.5	33.2		551.1	9.1
7	6.2	4.7				1,261.7	22.3	176.9		1,471.9	24.3
8			22.1	72.5		289.0	2.9	121.6		508.1	8.4
9				130.6		4.7		4.1		139.3	2.3
TOTAL	91.0	323.2	136.2	515.7	58.1	3,617.2	313.3	917.7	83.3	6,055.7	100.0

KNIFE CREEK BLOCK
Management Plan # 3 and Forest Srewardship Plan
SPECIES COMPOSITION BY AGE CLASS
December 2004

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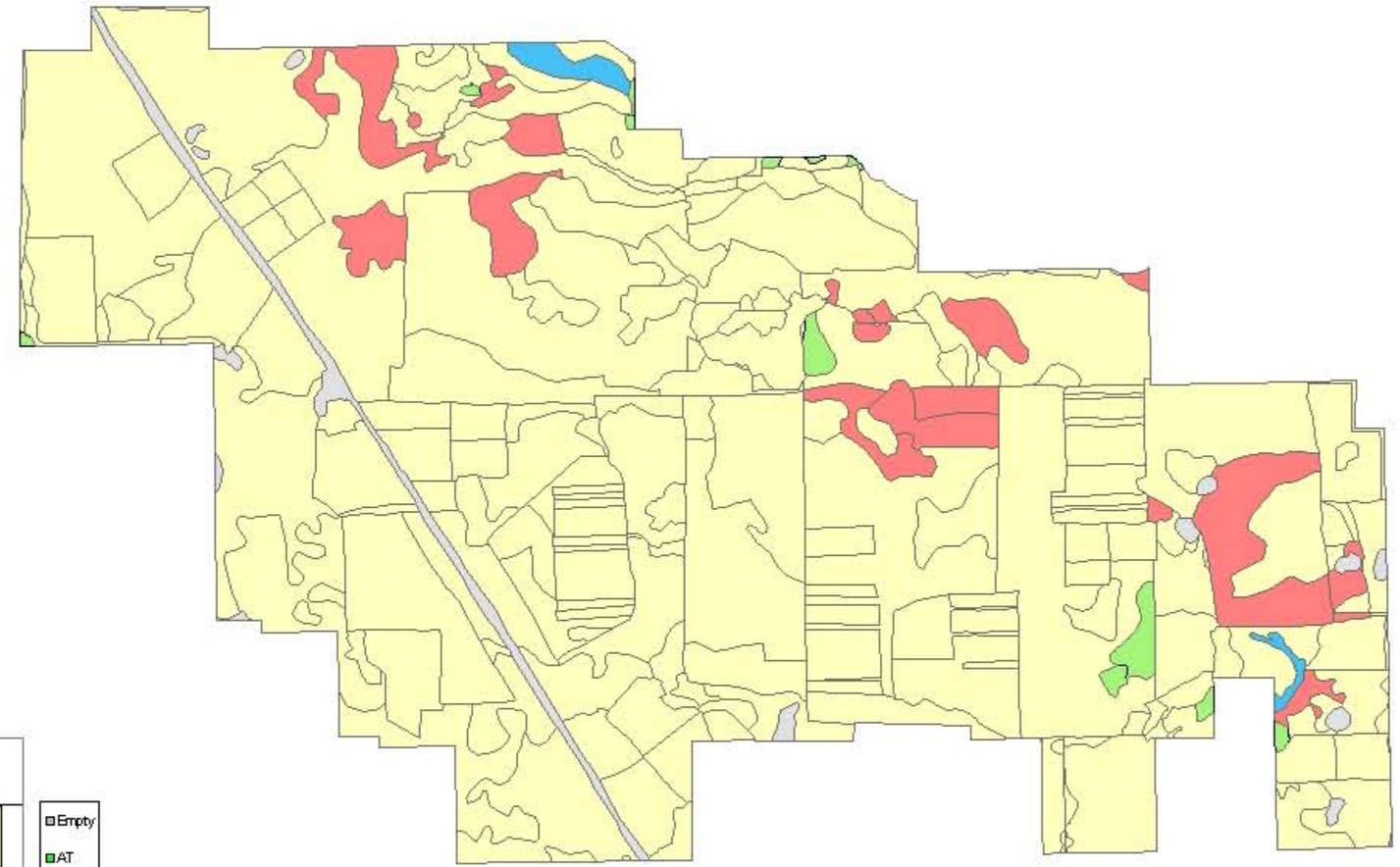
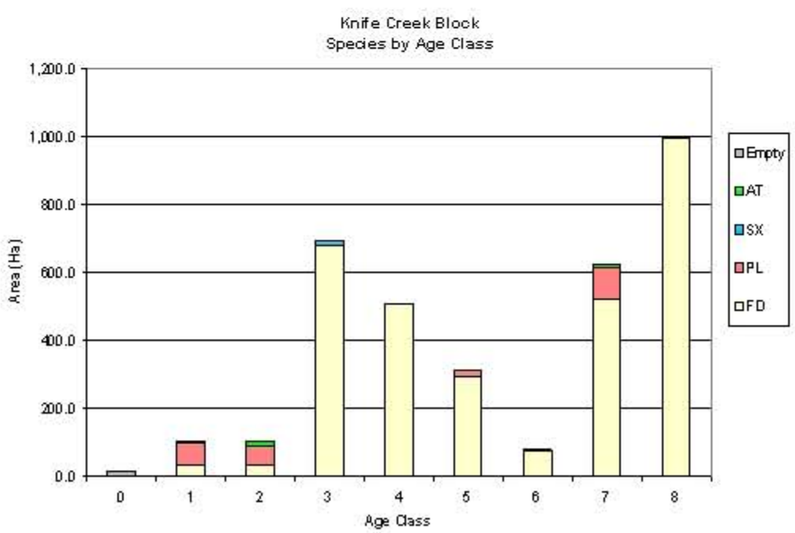
N

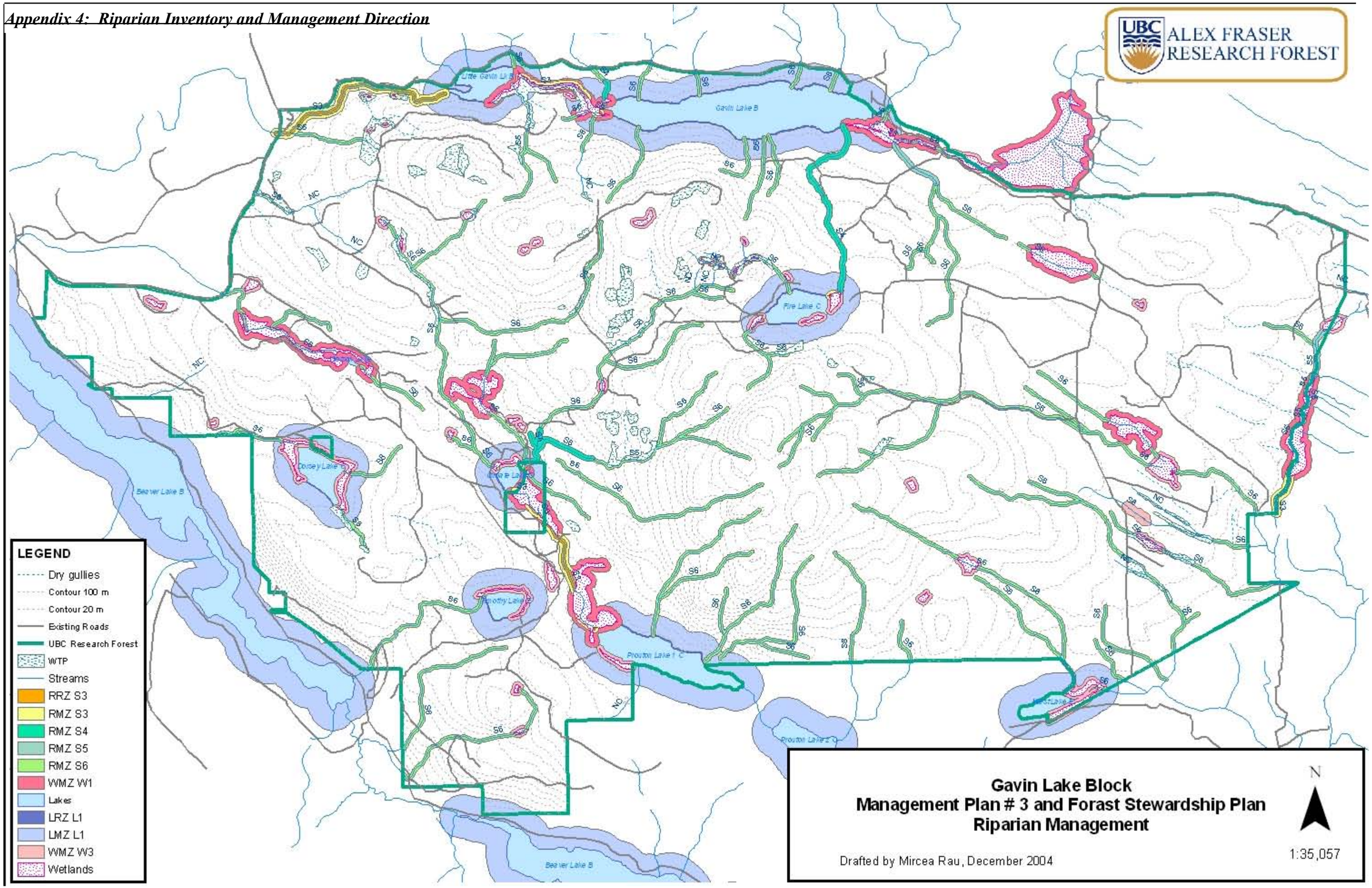


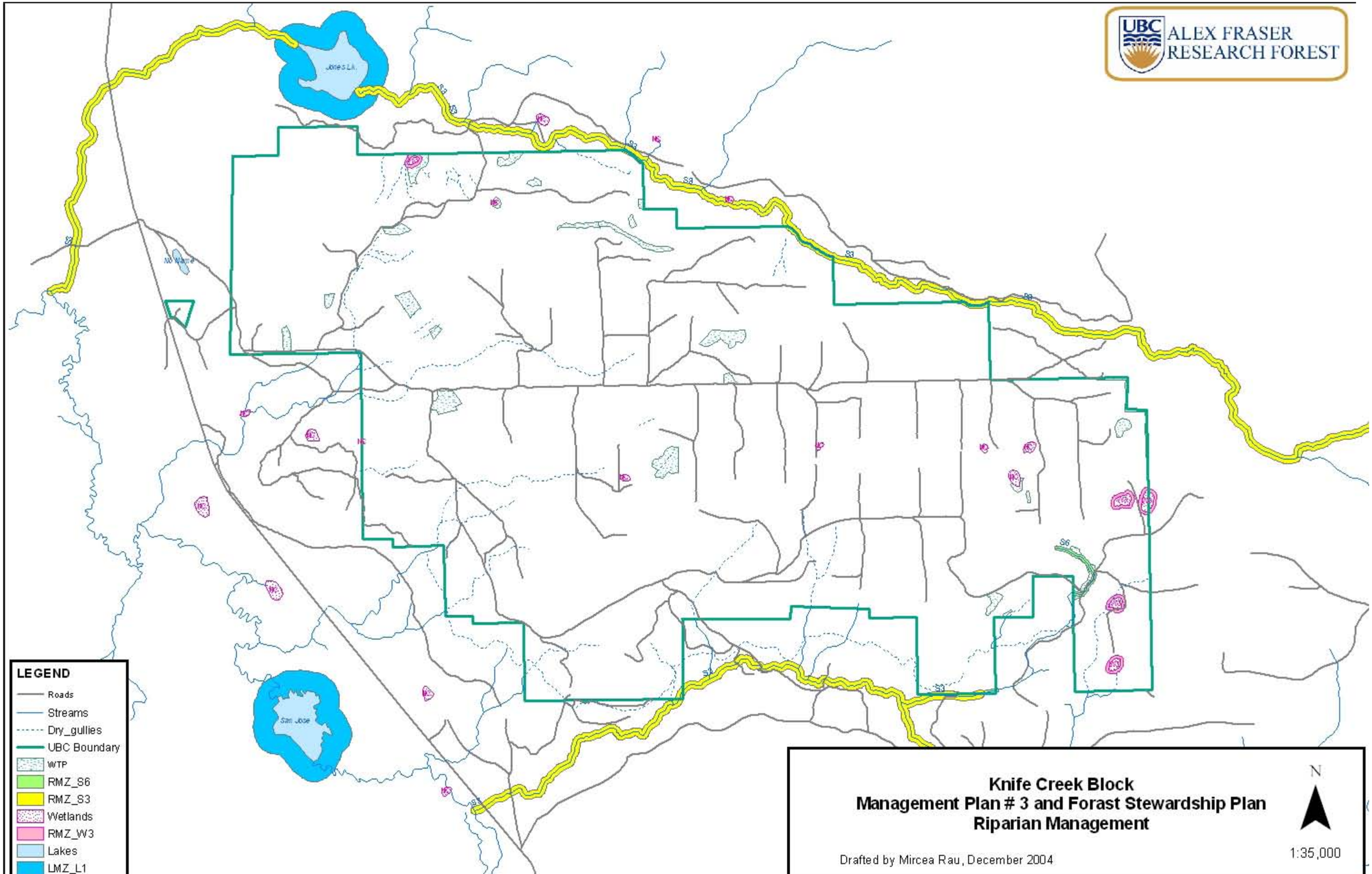


DISTRIBUTION OF SPECIES BY AGE CLASS

	SPECIES						
Age Class	AT	FD	PL	SX	Empty	TOTAL	%
0					15.3	15.3	0.4
1	6.6	33.4	65.8			105.8	3.1
2	14.9	32.2	56.1			103.1	3.0
3		680.9		13.3		694.2	20.2
4		508.1				508.1	14.8
5		295.8	17.1			312.9	9.1
6	2.0	75.5	2.2			79.7	2.3
7	4.9	522.4	90.2	4.4		621.8	18.1
8		995.3	0.1			995.4	29.0
TOTAL	28.3	3,143.6	231.4	17.7	15.3	3,436.3	100.0

Appendix 4: Riparian Inventory and Management Direction




UBC ALEX FRASER RESEARCH FOREST
Jones L.k.
Mc Ware
San Jose
S6
S3
LEGEND
Roads
Streams
Dry_gullies
UBC Boundary
WTP
RMZ_S6
RMZ_S3
Wetlands
RMZ_W3
Lakes
LMZ_L1
Knife Creek Block
Management Plan # 3 and Forast Stewardship Plan
Riparian Management
Drafted by Mircea Rau, December 2004
N
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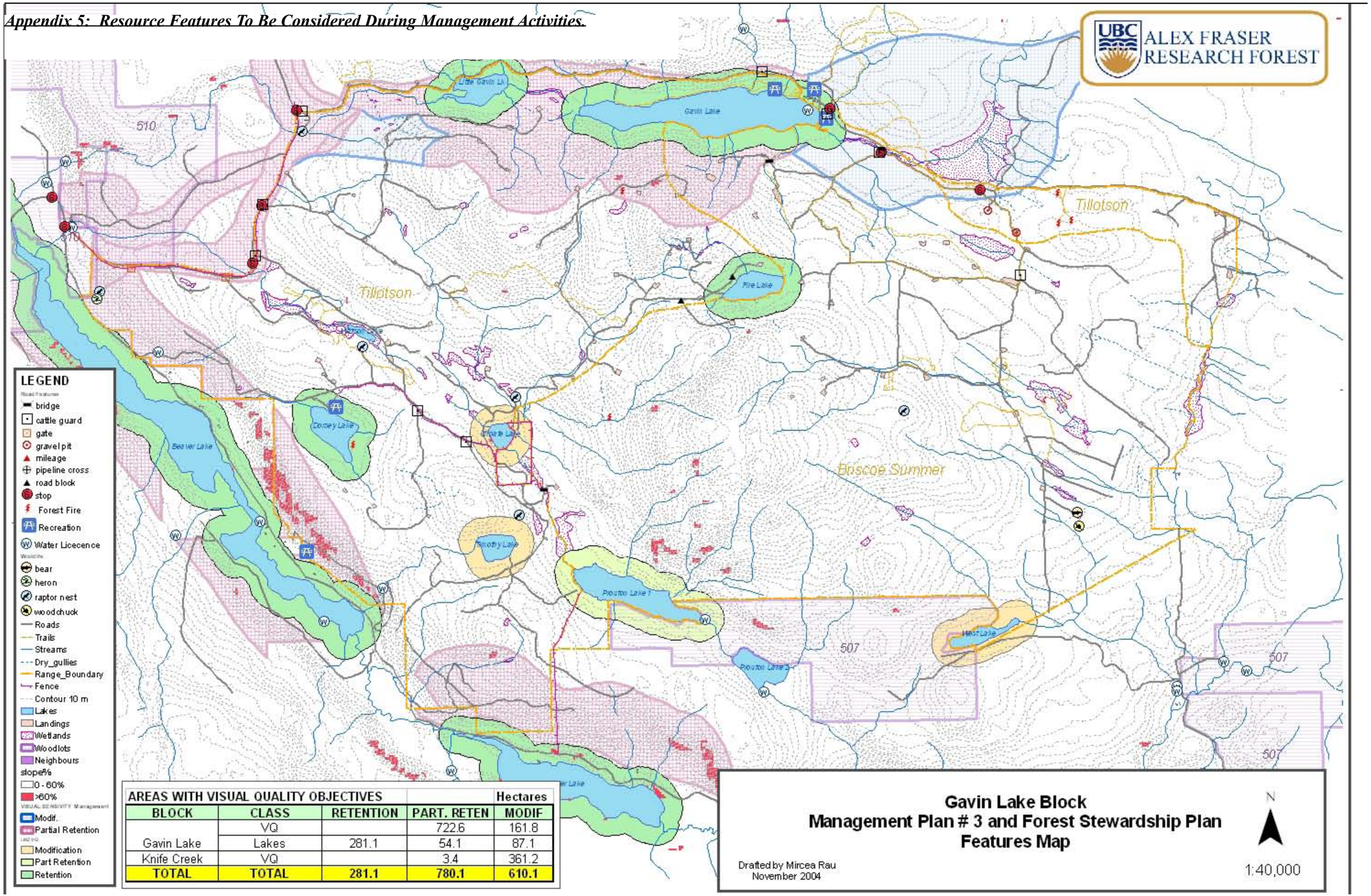
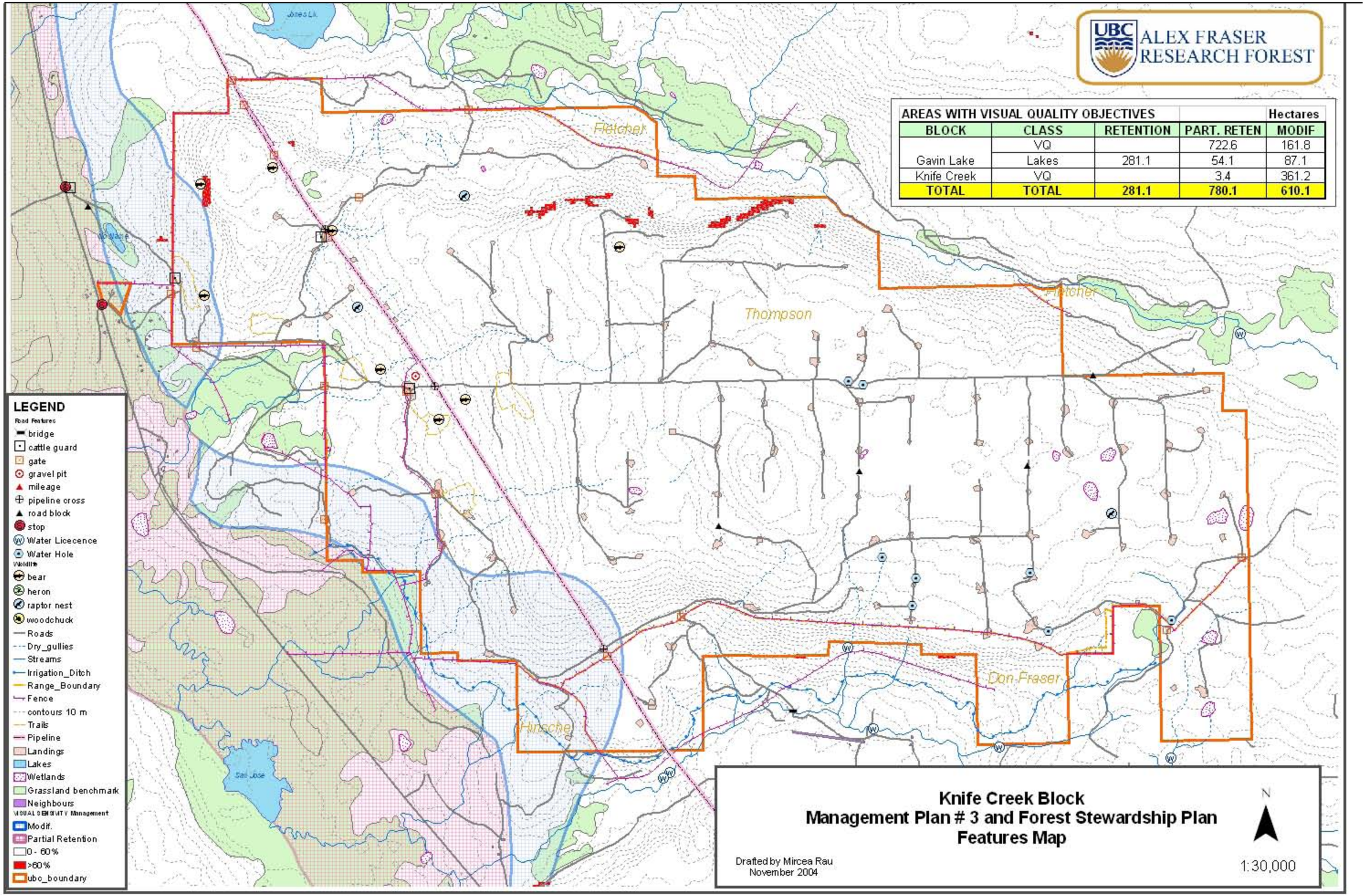
Appendix 5: Resource Features To Be Considered During Management Activities.

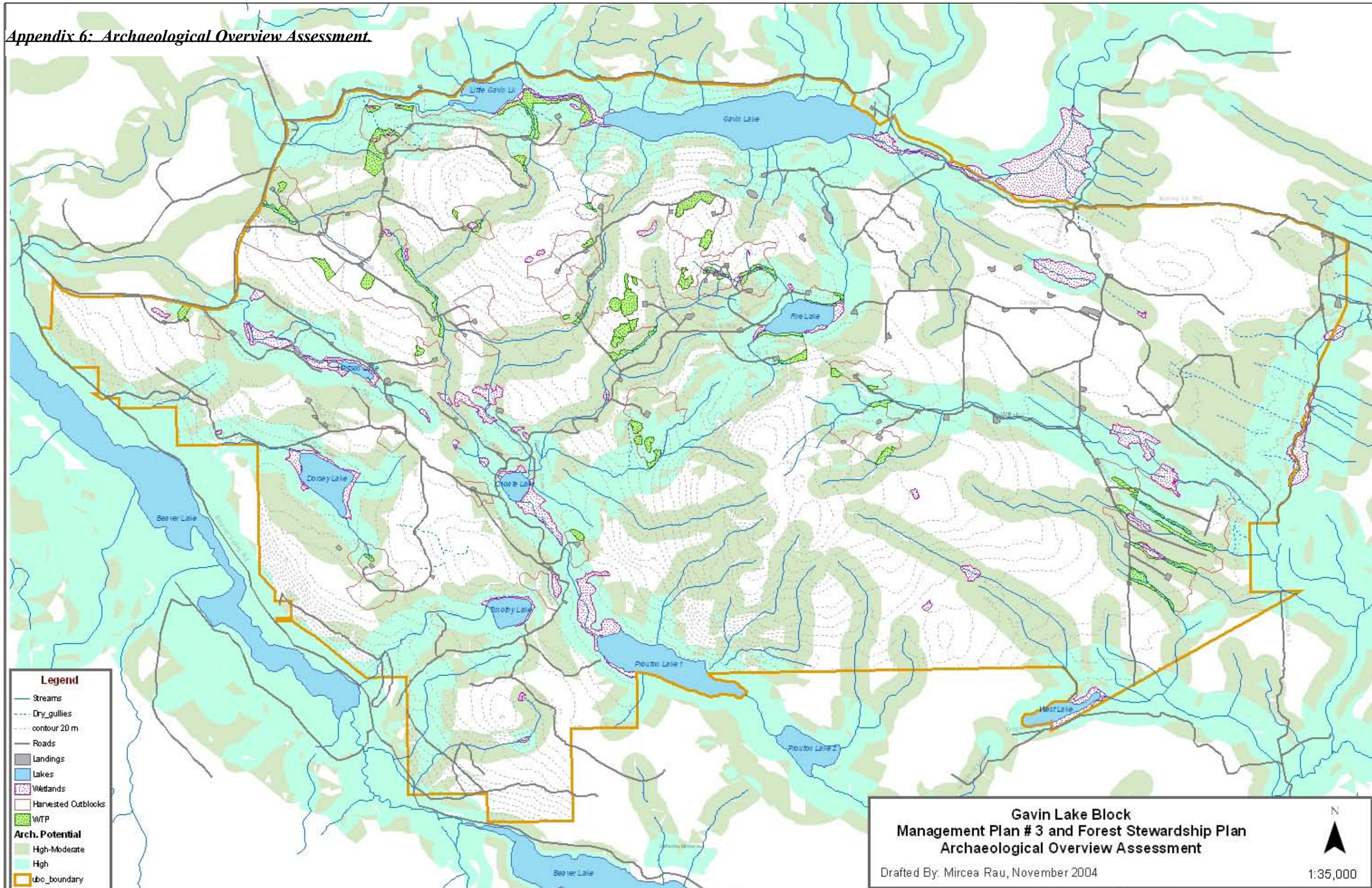


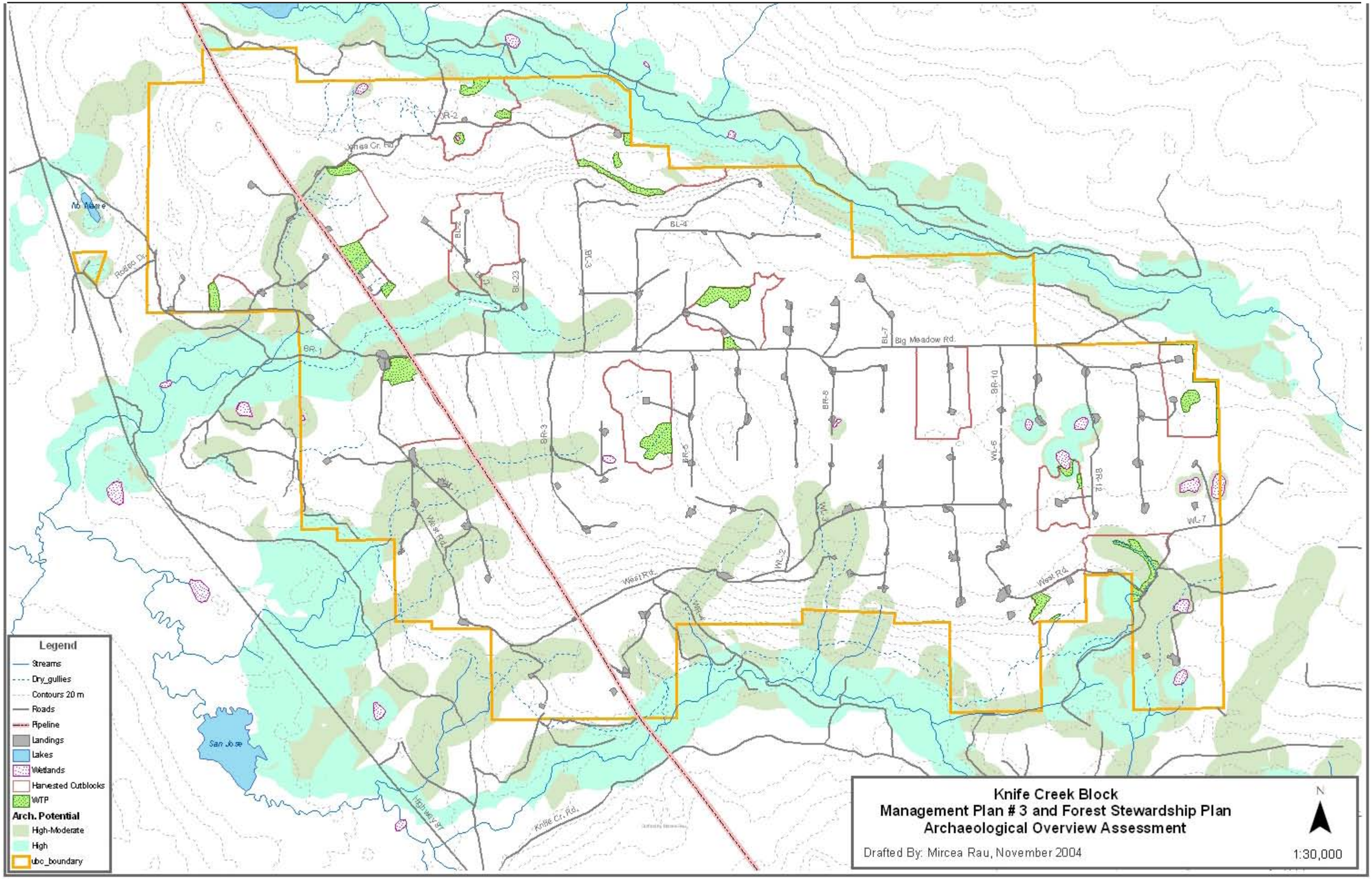
AREAS WITH VISUAL QUALITY OBJECTIVES				Hectares
BLOCK	CLASS	RETENTION	PART. RETEN	MODIF
	VQ		722.6	161.8
Gavin Lake	Lakes	281.1	54.1	87.1
Knife Creek	VQ		3.4	361.2
TOTAL	**TOTAL**	**281.1**	**780.1**	**610.1**



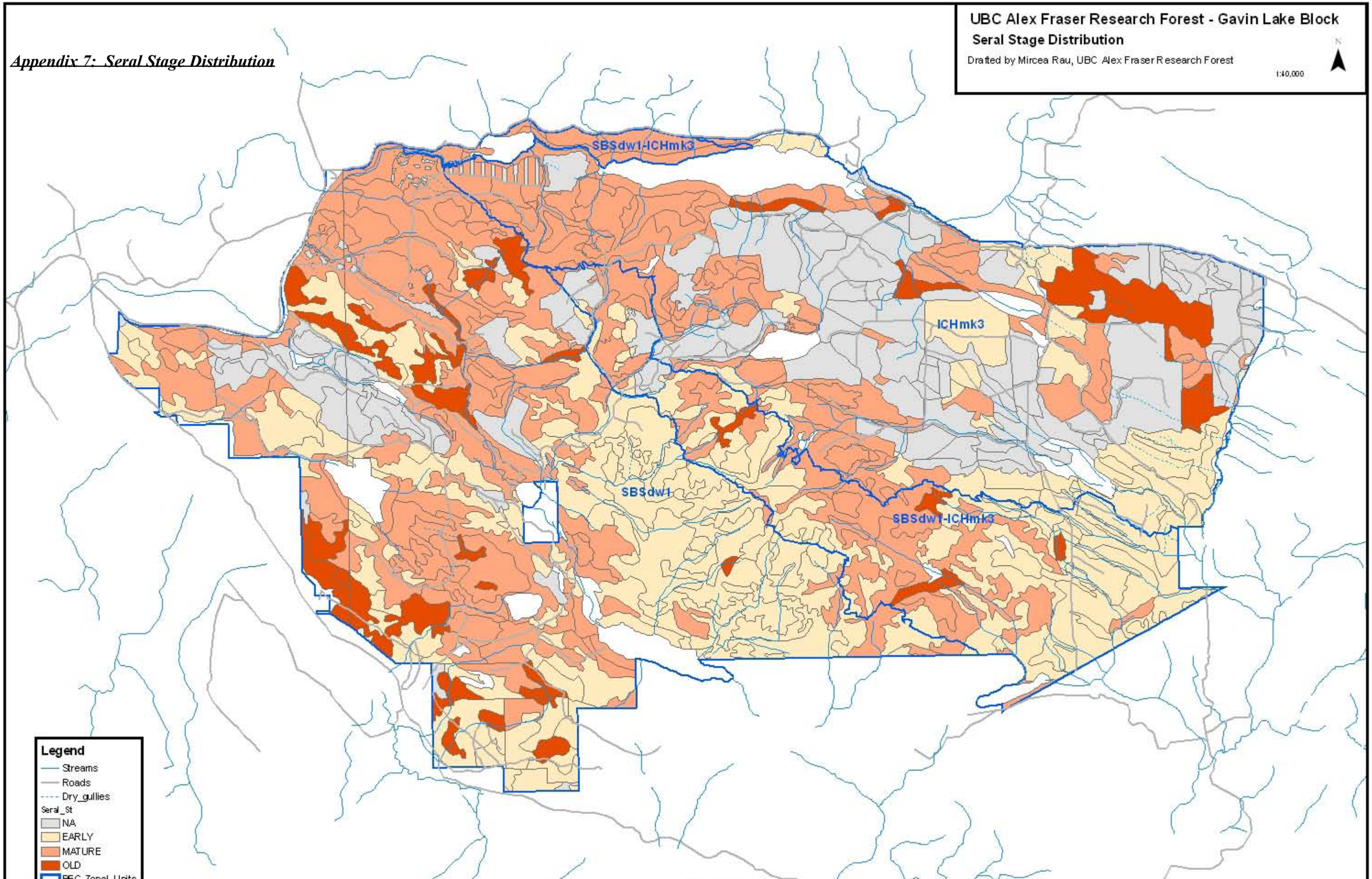
AREAS WITH VISUAL QUALITY OBJECTIVES				Hectares
BLOCK	CLASS	RETENTION	PART. RETEN	MODIF
	VQ		722.6	161.8
Gavin Lake	Lakes	281.1	54.1	87.1
Knife Creek	VQ		3.4	361.2
TOTAL	**TOTAL**	**281.1**	**780.1**	**610.1**

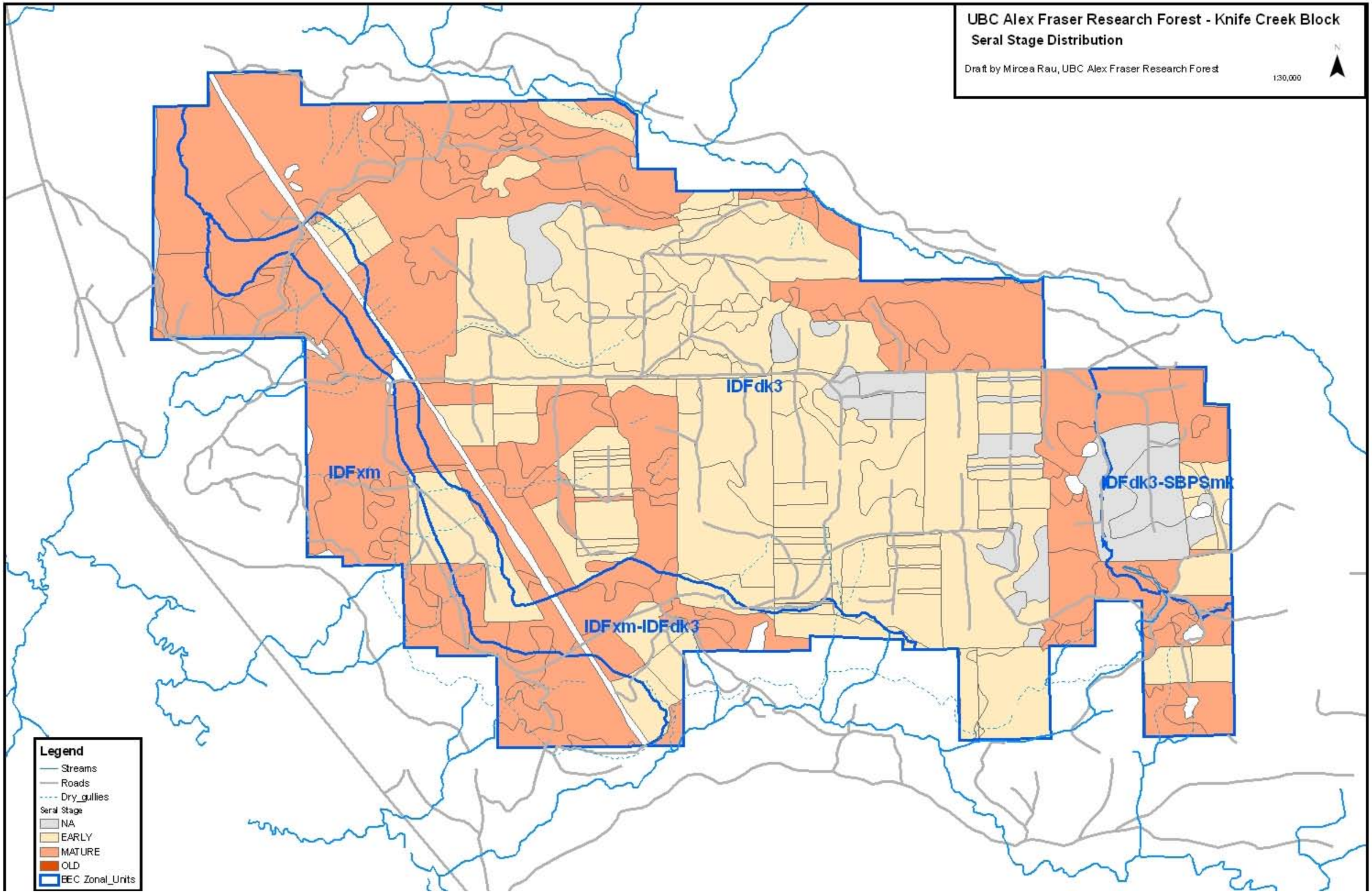
Appendix 6: Archaeological Overview Assessment



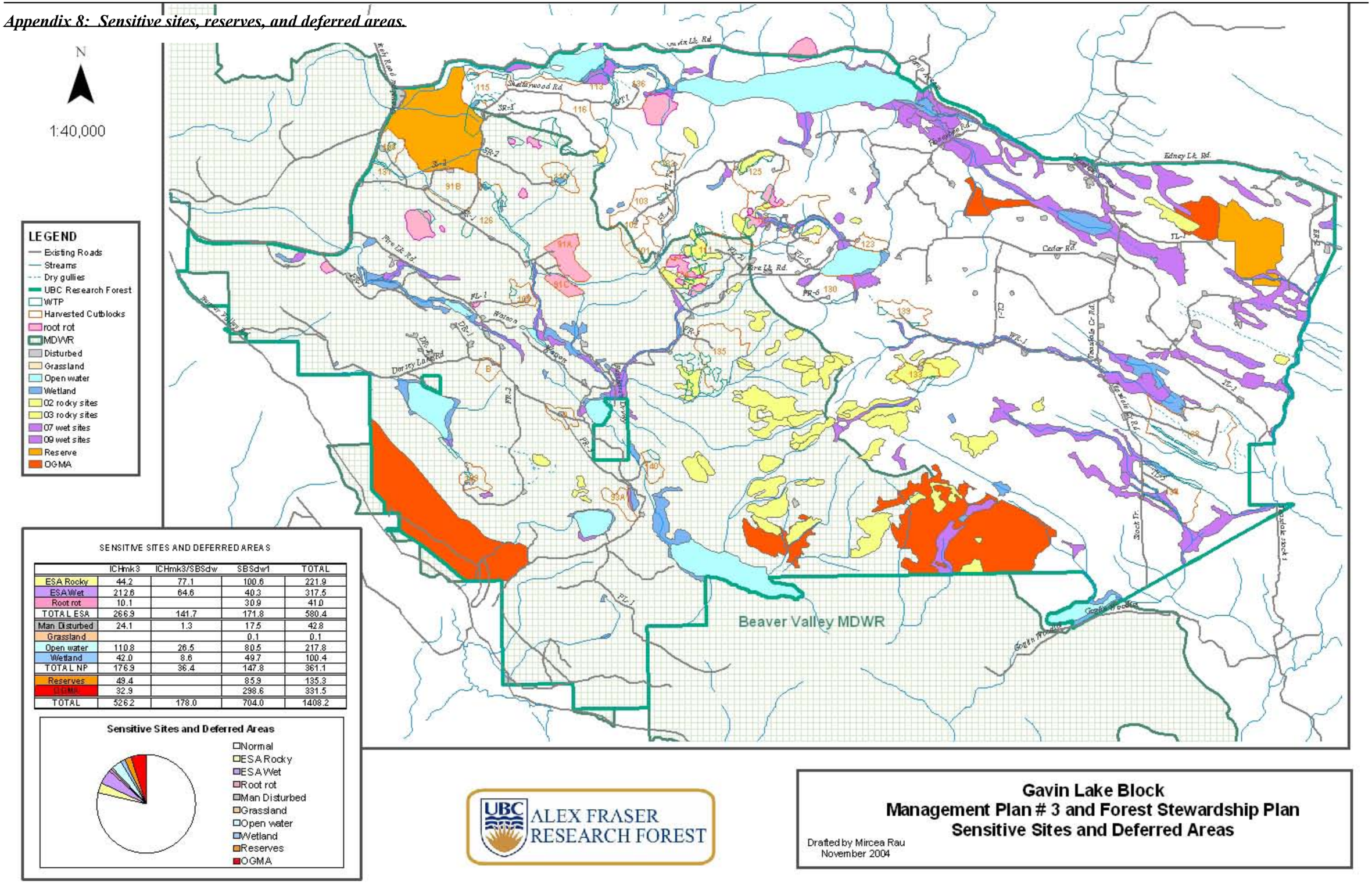

Knife Creek Block
Management Plan # 3 and Forest Stewardship Plan
Archaeological Overview Assessment
Drafted By: Mircea Rau, November 2004
1:30,000
N
Legend
Streams
Dry_gullies
Contours 20 m
Roads
Pipeline
Landings
Lakes
Wetlands
Harvested Cutblocks
WTP
Arch. Potential
High-Moderate
High
ubc_boundary
Big Meadow Rd.
West Rd.
Knife Cr. Rd.
Highway 97
San Jose
No Name
Rodeo Dr.
BR-1
BR-2
BR-3
BR-5
BR-6
BR-8
BR-10
BR-12
BL-2
BL-3
BL-4
BL-7
WL-1
WL-2
WL-6
WL-7

Appendix 7: Seral Stage Distribution



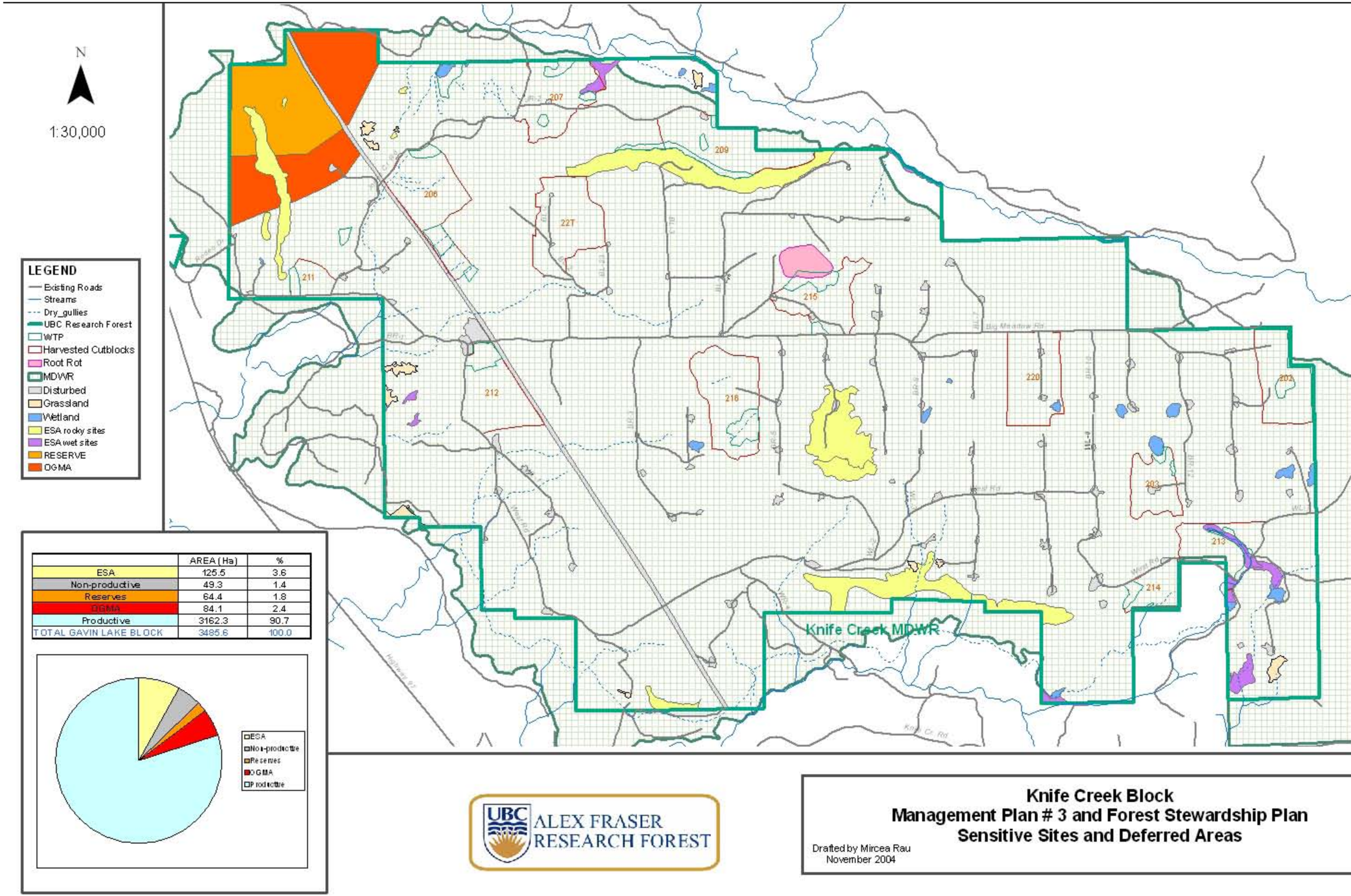

UBC Alex Fraser Research Forest - Knife Creek Block
Seral Stage Distribution
Draft by Mircea Rau, UBC Alex Fraser Research Forest
1:30,000
N
IDFdk3
IDFxm
IDFdk3-SBPSmk
IDFxm-IDFdk3
Legend
Streams
Roads
Dry_gullies
Seral Stage
NA
EARLY
MATURE
OLD
BEC Zonal_Units

Appendix 8: Sensitive sites, reserves, and deferred areas.



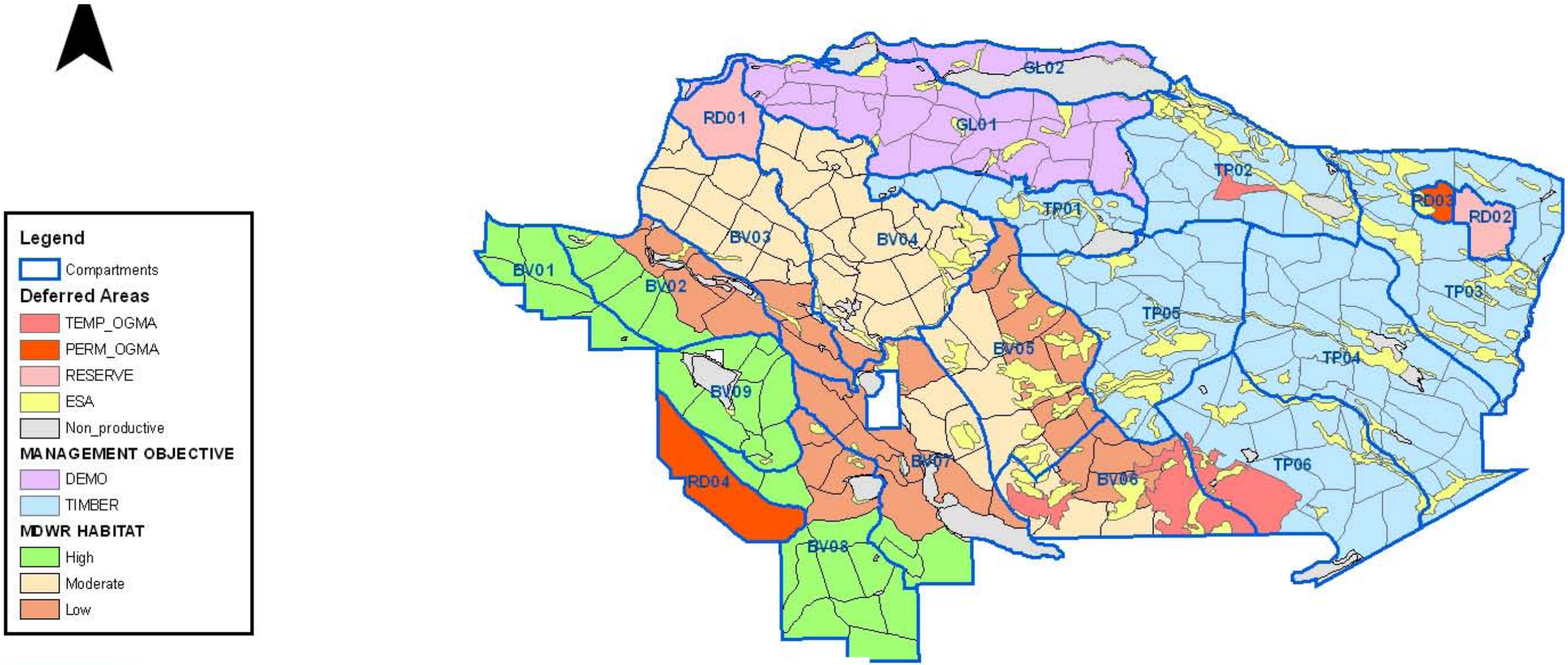
SENSITIVE SITES AND DEFERRED AREAS

	ICHmk3	ICHmk3/SBSdw	SBSdw1	TOTAL
ESA Rocky	44.2	77.1	100.6	221.9
ESA Wet	212.6	64.6	40.3	317.5
Root rot	10.1		30.9	41.0
TOTAL ESA	266.9	141.7	171.8	580.4
Man Disturbed	24.1	1.3	17.5	42.8
Grassland			0.1	0.1
Open water	110.8	26.5	80.5	217.8
Wetland	42.0	8.6	49.7	100.4
TOTAL NP	176.9	36.4	147.8	361.1
Reserves	49.4		85.9	135.3
OGMA	32.9		298.6	331.5
TOTAL	526.2	178.0	704.0	1408.2



	AREA (Ha)	%
ESA	125.5	3.6
Non-productive	49.3	1.4
Reserves	64.4	1.8
OGMA	84.1	2.4
Productive	3162.3	90.7
TOTAL GAVIN LAKE BLOCK	3485.6	100.0

Appendix 9: Compartments and Management Objectives

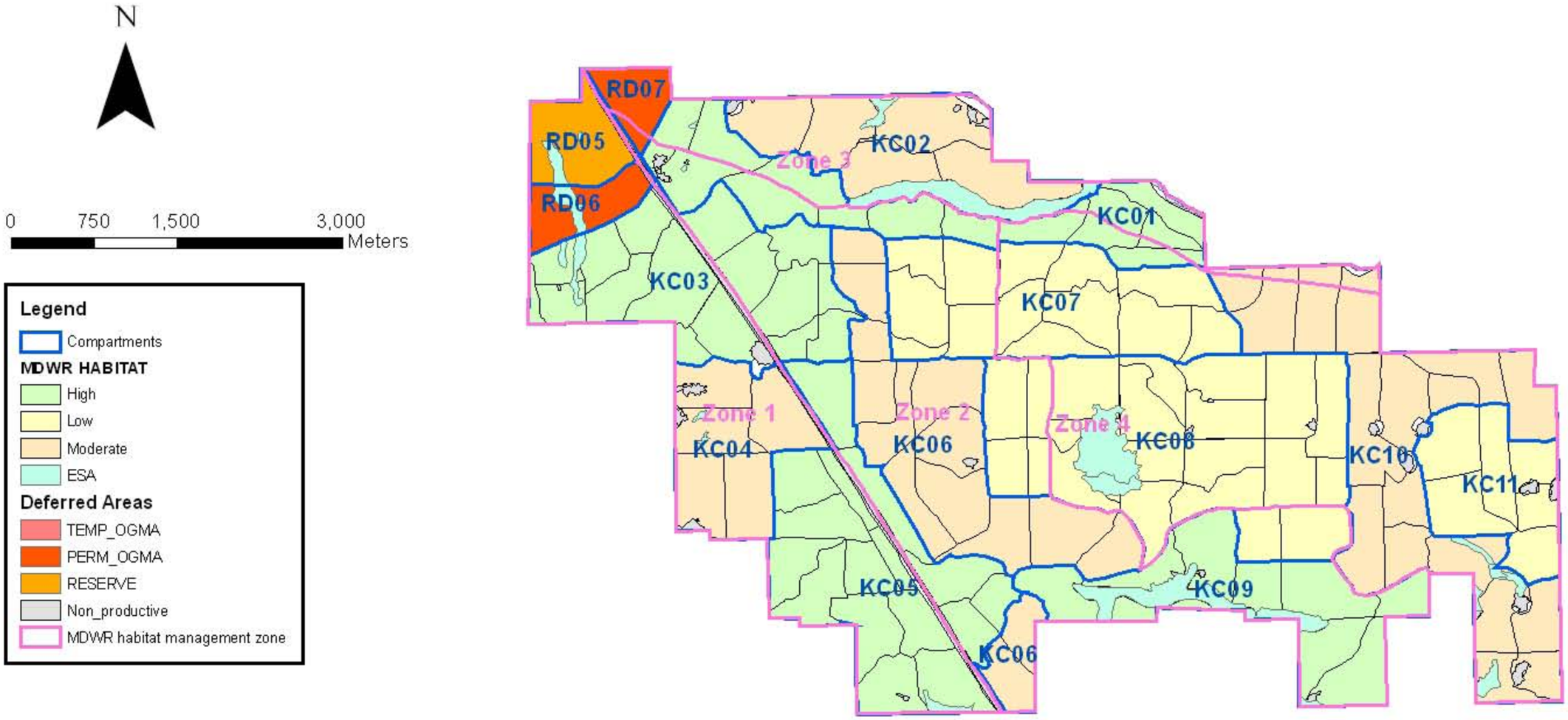


GAVIN LAKE BLOCK

COMPART	USE1	USE2	USE3	PROD_MODIF	GROSS AREA	Non_Produc	ESA	RESERVE	OGMA	OGMA_TEMP	NET AREA
BV01	DEER	TIMBER	RANGE	MDWR	134.3	0.2	0.0	0	0		134.1
BV02	DEER	TIMBER	RANGE	MDWR	251.5	15.0	3.6	0	0		232.9
BV03	DEER	TIMBER	RANGE	MDWR	322.5	2.0	4.9	0	0		315.6
BV04	DEER	TIMBER	MOOSE	MDWR	457.9	8.4	26.5	0	0		423.0
BV05	DEER	TIMBER	MOOSE	MDWR	377.5	0.0	75.7	0	0		301.8
BV06	DEER	TIMBER	MOOSE	MDWR	283.6	0.5	22.8	0	0	102	158.3
BV07	DEER	RANGE	TIMBER	MDWR	435.0	64.9	15.4	0	0		354.7
BV08	DEER	TIMBER	RANGE	MDWR	373.6	12.5	4.2	0	0		356.9
BV09	DEER	RECREAT	RANGE	MDWR	210.4	2.5	1.2	0	0		206.7
TP01	TIMBER	RANGE		TIMBER	194.7	18.3	18.1	0	0		158.3
TP02	TIMBER	RANGE		TIMBER	359.7	17.8	63.8	0	0	12.6	265.5
TP03	TIMBER	RANGE		TIMBER	464.8	4.9	93.5	0	0		366.4
TP04	TIMBER	MOOSE	RANGE	TIMBER	607.8	13.2	55.0	0	0		539.6
TP05	TIMBER	RANGE		TIMBER	432.2	0.0	53.6	0	0		378.6
TP06	TIMBER	MOOSE	RANGE	TIMBER	472.8	17.7	37.9	0	0	76.4	340.8
GL01	VIEW	TIMBER	RANGE	DEMO	511.2	5.4	26.9	0	0		478.9
GL02	RECREAT	TIMBER	RANGE	DEMO	194.9	115.8	5.0	0	0		74.1
RD01	DEER			RESERVE	83.4	0.0	0.0	83.4	0		0.0
RD02				RESERVE	46.5	0.0	0.0	46.5	0		0.0
RD03				OGMA	20.1	0.0	0.0	0	20.1		0.0
RD04	DEER			OGMA	120.3	0.0	0.0	0	120.3		0.0
TOTAL					6354.8	299.1	508.1	129.9	140.4	191.0	5086.3

GAVIN KAKE BLOCK
MANAGEMENT PLAN # 3 and Forest Stewardship Plan
Compartments and Planned Harvest Units

Meters
0 1,000 2,000 4,000



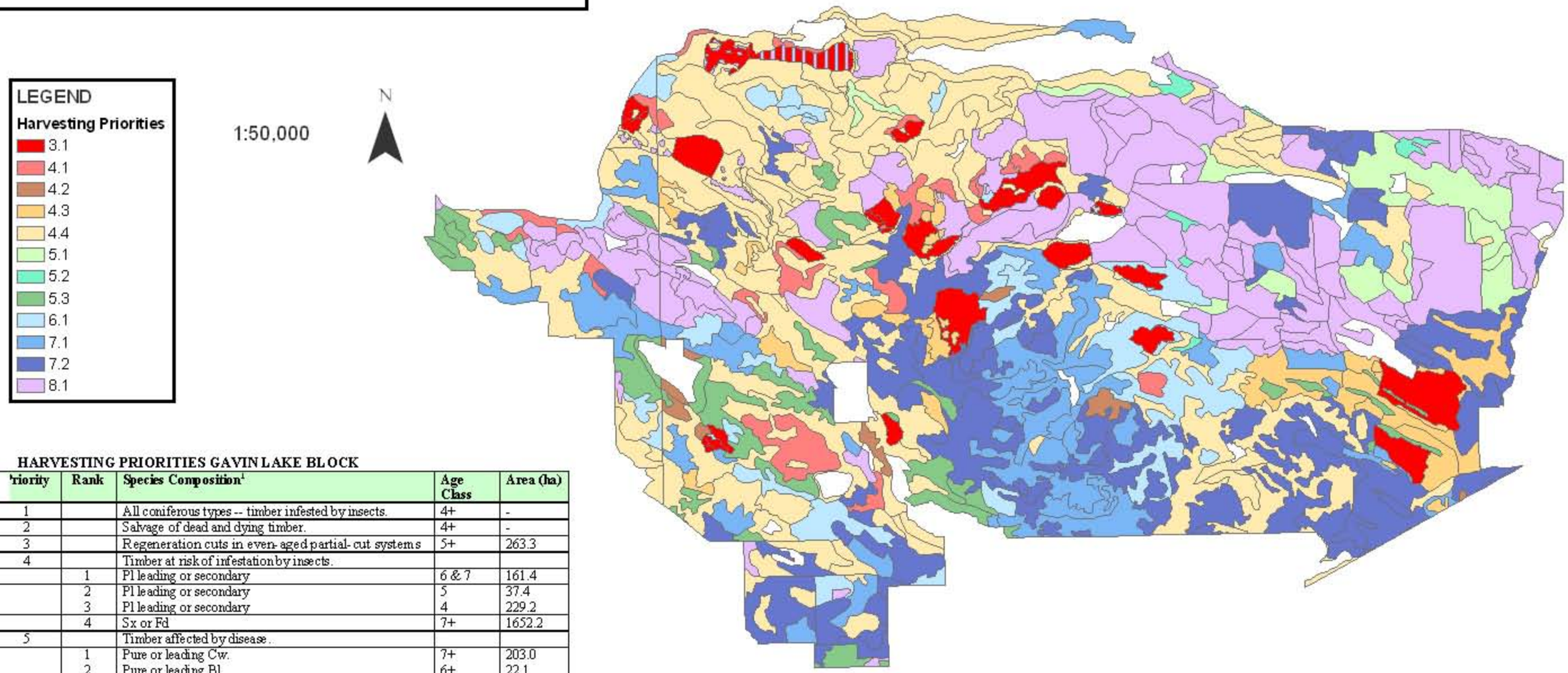
KNIFE CREEK BLOCK											
COMPART	USE1	USE2	USE3	PROD_MODIF	GROSS AREA	Non_Produc	ESA	RESERVE	OGMA PERM	OGMA_TEMP	NET AREA
KC01	DEER	TIMBER	RANGE	MDWR	254.3	1.7	0.0	0	0	0	252.6
KC02	DEER	TIMBER	RANGE	MDWR	222.6	3.1	36.4	0	0	0	183.1
KC03	DEER	TIMBER	RANGE	MDWR	326.3	8.3	8.8	0	0	0	309.2
KC04	DEER	TIMBER	RANGE	MDWR	164.0	8.1	1.1	0	0	0	154.8
KC05	DEER	TIMBER	RANGE	MDWR	375.5	11.3	3.2	0	0	0	361.0
KC06	DEER	TIMBER	RANGE	MDWR	345.8	0.8	0.0	0	0	0	345.0
KC07	DEER	TIMBER	RANGE	MDWR	298.3	0.0	0.0	0	0	0	298.3
KC08	DEER	TIMBER	RANGE	MDWR	513.1	1.3	31.3	0	0	0	480.5
KC09	DEER	TIMBER	RANGE	MDWR	247.3	1.3	33.7	0	0	0	212.3
KC10	DEER	TIMBER	RANGE	MDWR	439.8	7.5	11.0	0	0	0	421.3
KC11	DEER	TIMBER	RANGE	MDWR	146.4	2.2	0.0	0	0	0	144.2
RD05	DEER			RESERVE	67.3	2.9	0.0	64.4	0	0	0
RD06	DEER			OGMA	49.4	0.8	0.0	0	48.6	0	0
RD07	DEER			OGMA	35.5	0.0	0.0	0	35.5	0	0
TOTAL					3485.6	49.3	125.5	64.4	84.1	0.0	3162.3

KNIFE CREEK BLOCK BLOCK
MANAGEMENT PLAN # 3 and Forest Stewardship Plan

Compartments and Planned Harvest Units

Appendix 10: Timber Harvest Priorities

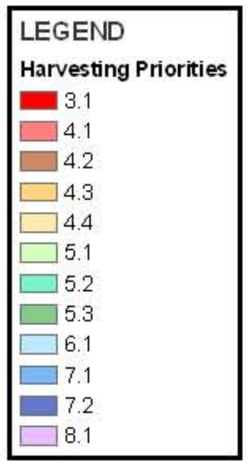
GAVIN LAKE BLOCK BLOCK
Management Plan # 3 and Forest Srewardship Plan
HARVESTING PRIORITIES
January, 2005



HARVESTING PRIORITIES GAVIN LAKE BLOCK

Priority	Rank	Species Composition[1]	Age Class	Area (ha)
1		All coniferous types -- timber infested by insects.	4+	-
2		Salvage of dead and dying timber.	4+	-
3		Regeneration cuts in even-aged partial-cut systems	5+	263.3
4		Timber at risk of infestation by insects.		
	1	Pl leading or secondary	6 & 7	161.4
	2	Pl leading or secondary	5	37.4
	3	Pl leading or secondary	4	229.2
	4	Sx or Fd	7+	1652.2
5		Timber affected by disease.		
	1	Pure or leading Cw.	7+	203.0
	2	Pure or leading Bl.	6+	22.1
	3	Ac, At, or Ep leading	4+	265.5
6		Timber of declining vigour.		
	1	Sx or Fd	6	364.7
7		Healthy vigourous timber.		
	1	Any species	5	542.2
	2	Any species (Commercial Thinning)	3 & 4	1028.4
8		Not available for harvest		
	1	Any species	1 & 2	1549.6

KNIFE CREEK BLOCK
Management Plan # 3 and Forest Srewardship Plan
HARVESTING PRIORITIES
January, 2005



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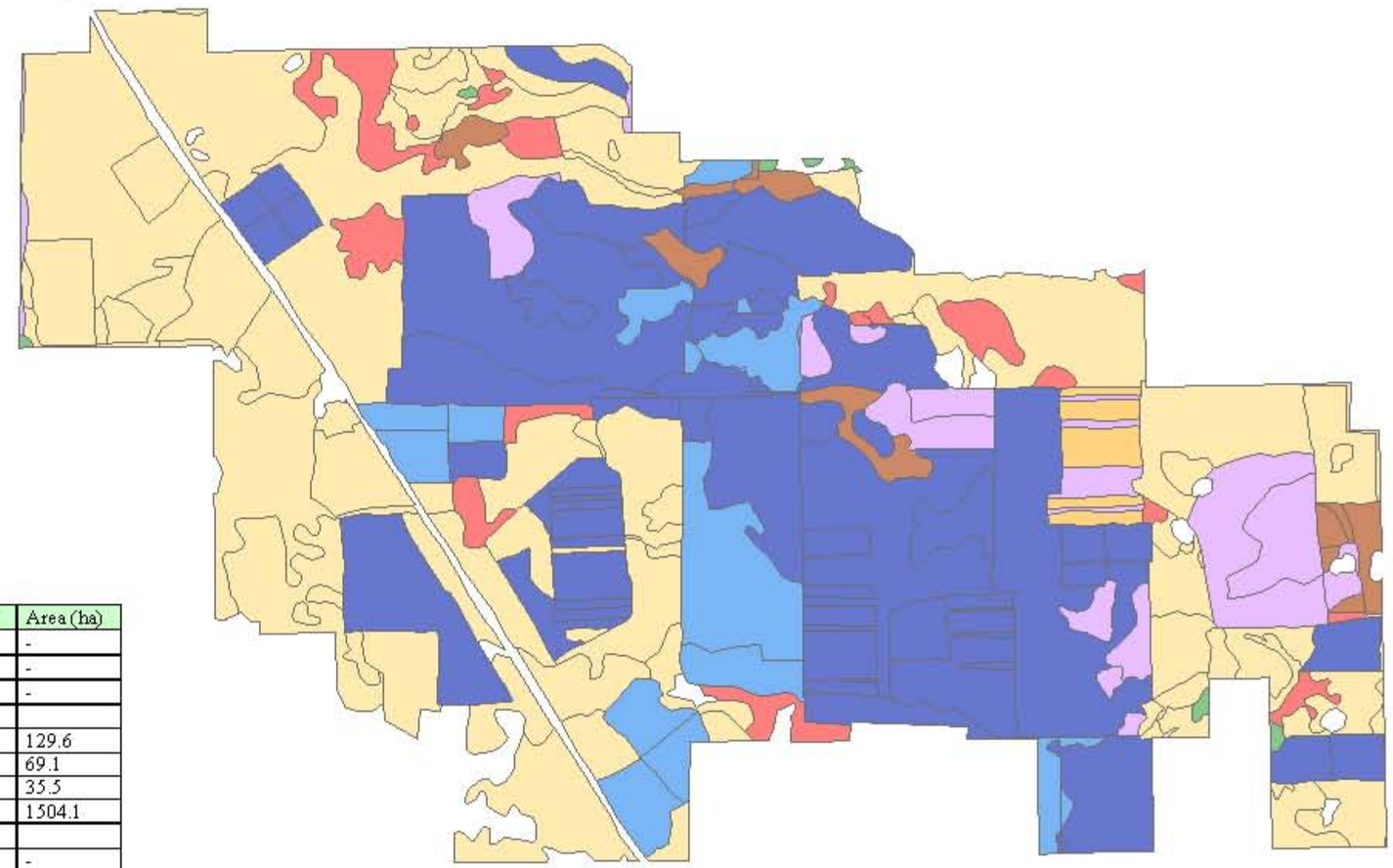
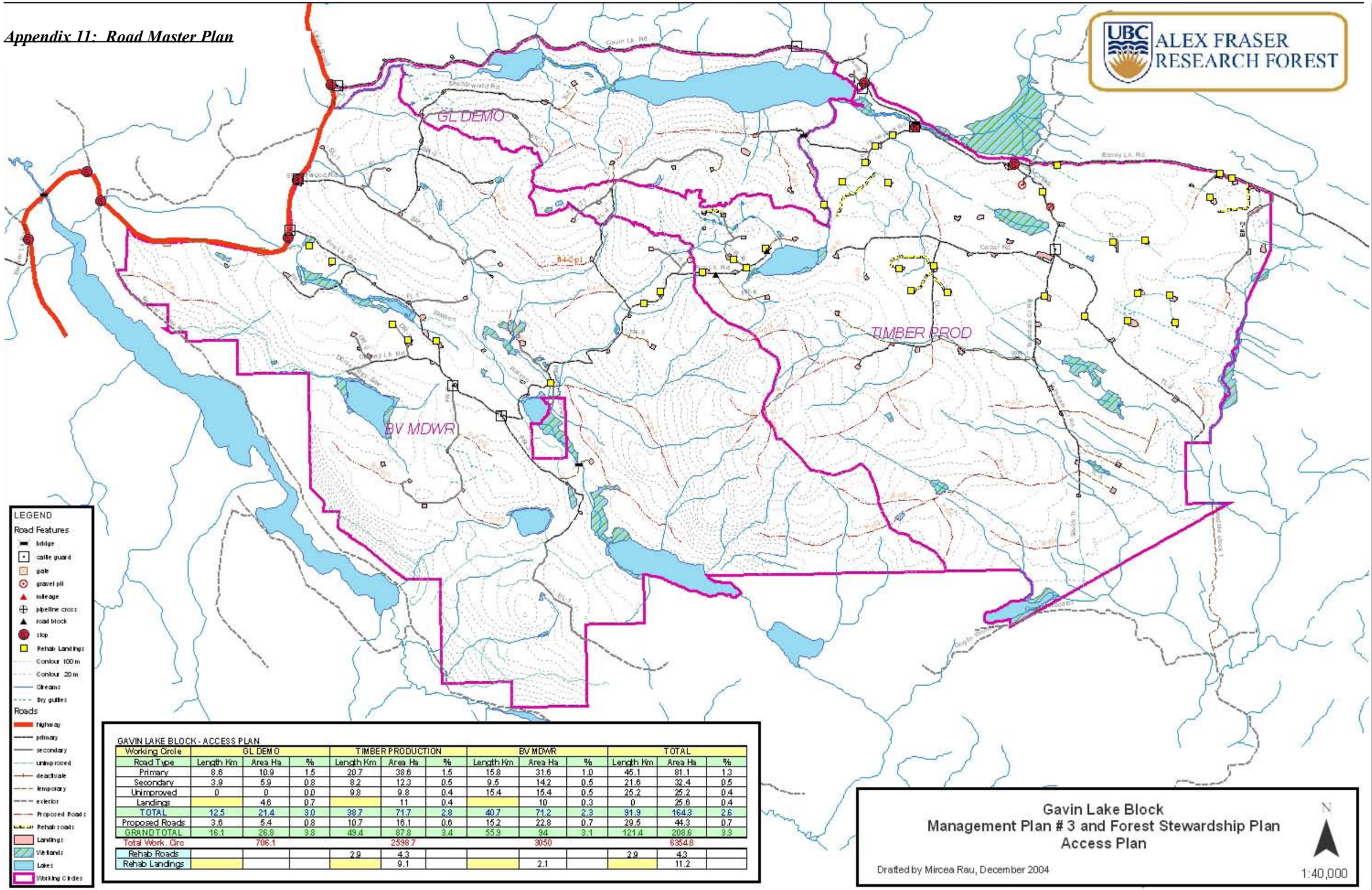


HARVESTING PRIORITIES KNIFE CREEK BLOCK

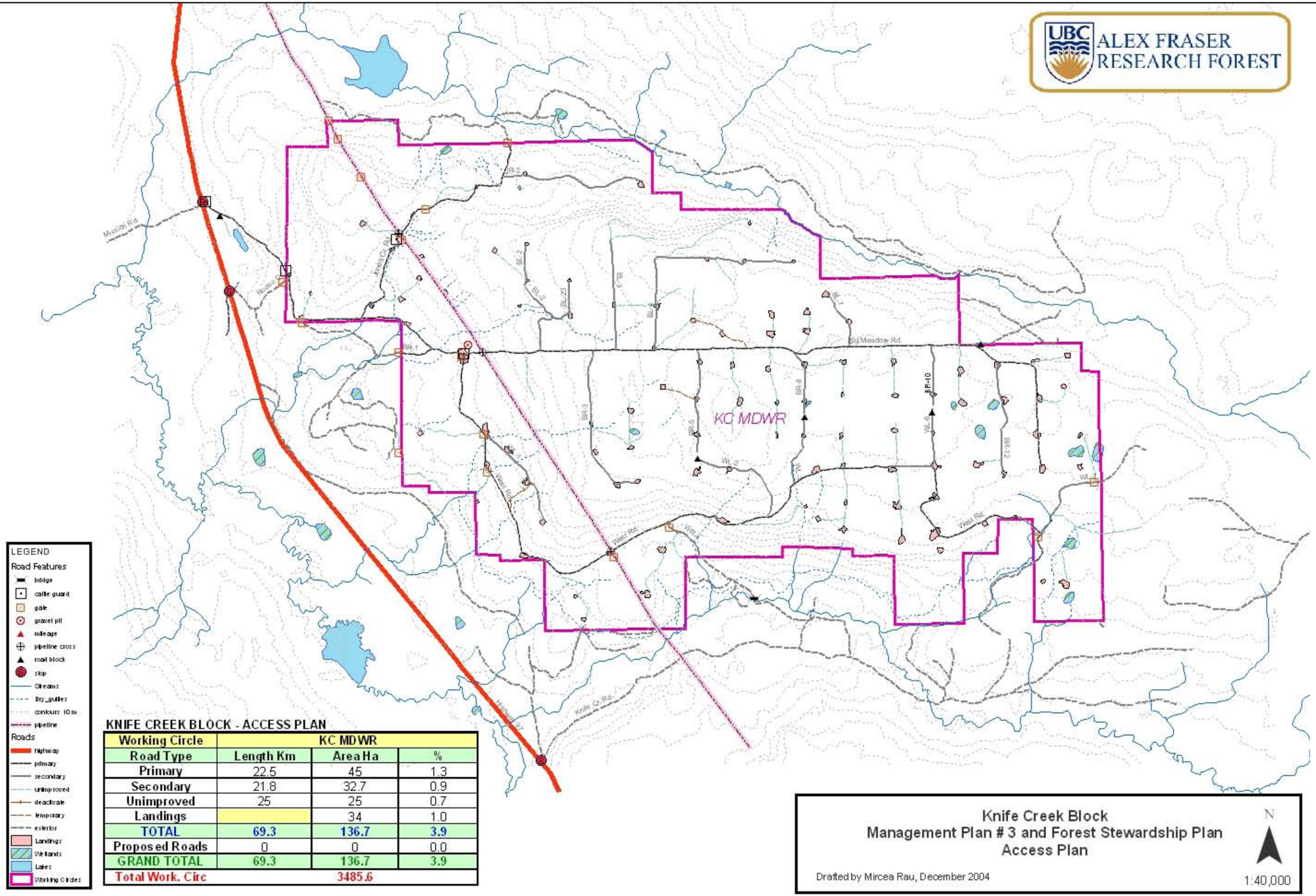
riority	Rank	Species Composition[1]	Age Class	Area (ha)
1		All coniferous types -- timber infested by insects.	4+	-
2		Salvage of dead and dying timber.	4+	-
3		Regeneration cuts in even-aged partial-cut systems	5+	-
4		Timber at risk of infestation by insects.		
	1	Pl leading or secondary	6 & 7	129.6
	2	Pl leading or secondary	5	69.1
	3	Pl leading or secondary	4	35.5
	4	Sx or Fd	7+	1504.1
5		Timber affected by disease.		
	1	Pure or leading Cw.	7+	-
	2	Pure or leading Bl.	6+	-
	3	Ac, At, or Ep leading	4+	6.9
6		Timber of declining vigour.		
	1	Sx or Fd	6	75.5
7		Healthy vigourous timber.		
	1	Any species	5	243.7
	2	Any species (Commercial Thinning)	3 & 4	1167.3
8		Not available for harvest		
	1	Any species	1 & 2	148.1

Appendix 11: Road Master Plan



GAVIN LAKE BLOCK - ACCESS PLAN

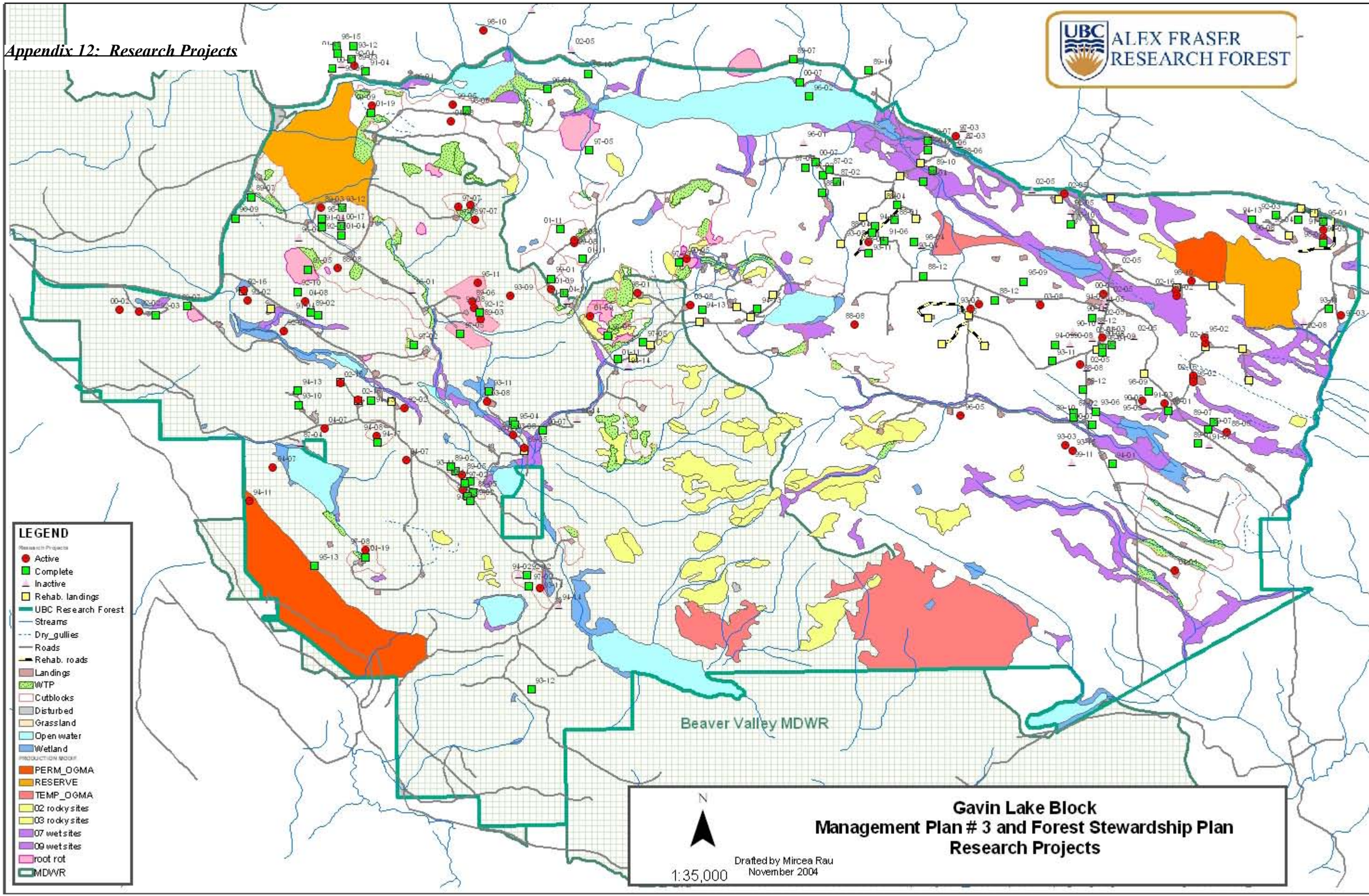
Working Circle	GL DEMO			TIMBER PRODUCTION			BV MDWR			TOTAL		
Road Type	Length Km	Area Ha	%	Length Km	Area Ha	%	Length Km	Area Ha	%	Length Km	Area Ha	%
Primary	8.6	10.9	1.5	20.7	38.6	1.5	15.8	31.6	1.0	45.1	81.1	1.3
Secondary	3.9	5.9	0.8	8.2	12.3	0.5	9.5	14.2	0.5	21.6	32.4	0.5
Unimproved	0	0	0.0	9.8	9.8	0.4	15.4	15.4	0.5	25.2	25.2	0.4
Landings		4.6	0.7		11	0.4		10	0.3	0	25.6	0.4
TOTAL	12.5	21.4	3.0	38.7	71.7	2.8	40.7	71.2	2.3	91.9	164.3	2.6
Proposed Roads	3.6	5.4	0.8	10.7	16.1	0.6	15.2	22.8	0.7	29.5	44.3	0.7
GRAND TOTAL	16.1	26.8	3.8	49.4	87.8	3.4	55.9	94	3.1	121.4	208.6	3.3
Total Work. Circ		706.1			2598.7			3050			6354.8	
Rehab Roads				2.9	4.3					2.9	4.3	
Rehab Landings					9.1			2.1			11.2	

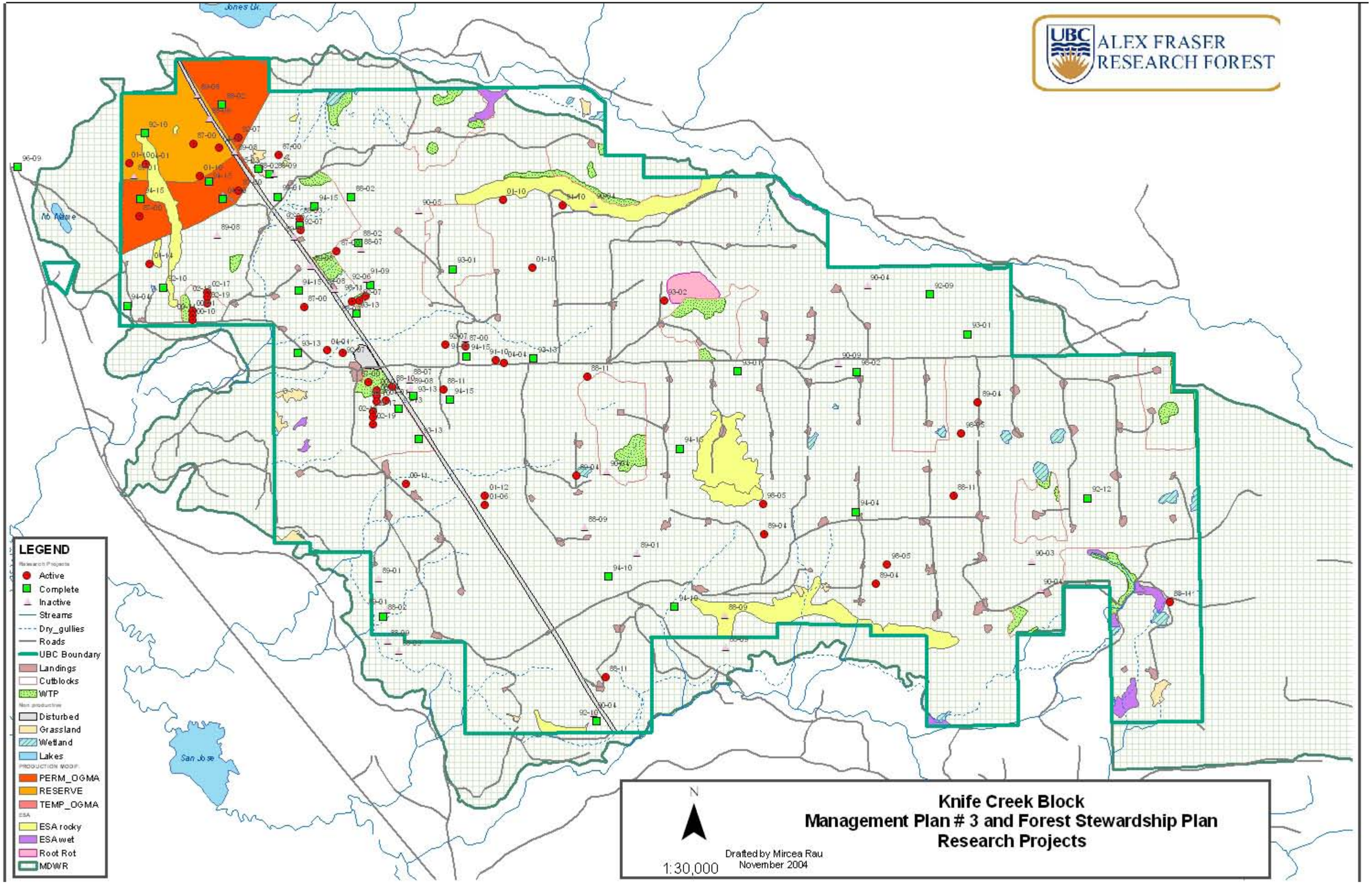


KNIFE CREEK BLOCK - ACCESS PLAN

Working Circle	KC MDWR		
Road Type	Length Km	Area Ha	%
Primary	22.5	45	1.3
Secondary	21.8	32.7	0.9
Unimproved	25	25	0.7
Landings		34	1.0
TOTAL	69.3	136.7	3.9
Proposed Roads	0	0	0.0
GRAND TOTAL	69.3	136.7	3.9
Total Work. Circ		3485.6	

Appendix 12: Research Projects




UBC ALEX FRASER RESEARCH FOREST
Jones Cr.
No Name
San Jose
LEGEND
Research Projects
Active
Complete
Inactive
Streams
Dry_gullies
Roads
UBC Boundary
Landings
Cutblocks
WTP
Non productive
Disturbed
Grassland
Wetland
Lakes
PRODUCTION WOOF
PERM_OGMA
RESERVE
TEMP_OGMA
ESA
ESA rocky
ESA wet
Root Rot
MDWR
N
1:30,000
Knife Creek Block
Management Plan # 3 and Forest Stewardship Plan
Research Projects
Drafted by Mircea Rau
November 2004