

**LAKES DISTRICT
LAND AND RESOURCE MANAGEMENT PLAN**

**PRELIMINARY SOCIO-ECONOMIC & ENVIRONMENTAL ANALYSIS
OF DRAFT LAND USE PLAN (“SCENARIO O”)**

by

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SOCIO-ECONOMIC EVALUATION SUMMARY

KEY ACCOUNTS	BASE CASE TRENDS (Includes TSR, FPC)	SCENARIO "O" (vs. BASE CASE)
ECONOMIC DEVELOPMENT SUMMARY	<ul style="list-style-type: none"> • Continued slow population & economic growth due to stable (165 yrs.) timber harvest level • Continued growth in tourism & service sector, higher value forestry activities & First Nations investment. • Continued decrease in % employed in goods-producing sectors, resulting in slight decline in average income. 	<ul style="list-style-type: none"> • 55-85 PYs (2.4%-3.4% of District employment) at risk after yr 35 due to timber supply impacts of Scenario. • Scenario somewhat more supportive of wilderness tourism & other nature-based livelihoods. • Consensus re Crown land use could encourage investment. • Otherwise similar to Base Case.
SECTOR SUMMARY		
Forestry	<ul style="list-style-type: none"> • Current harvest level of 1.5 million m³ sustainable for 165 years after which increase to long run harvest level of 1.8 million m³. • Increased timber utilization (including log salvage), more labour intensive harvesting, FRBC, growth in value-added would offset technological change / industry rationalization. • Will continue as dominant industry. 	<ul style="list-style-type: none"> • Harvest reduction of 100,000 m³ / yr & 40-55 direct PYs at risk due to new Protected areas (PAs), Special Management Zones (SMZs), changes in Visual Quality Objectives (VQOs); likely deferred for 35+ years, subject to Chief Forester decisions. • Negligible risk of mill closure. • Otherwise similar to Base Case.
Tourism / Recreation	<ul style="list-style-type: none"> • Continued growth in fishing lodges / guiding & wilderness tourism in the foreseeable future, but long term potential would be significantly diminished in the TSA by increased road access & harvesting pressure on fish / wildlife populations. • Tweedsmuir Park, one of the largest PAs in B.C. would still preserve some wilderness tourism opportunities. 	<ul style="list-style-type: none"> • 97% of the area around wilderness lakes & 83% of high value recreation sites in new PAs or SMZs. Somewhat more protection for & encouragement of investment in wilderness tourism. • Stricter access controls would reduce pressure on fish / wildlife. • Relaxed VQOs would reduce protection for scenic values but still similar to other areas in north-central B.C.
Commercial Fisheries / Trapping / Botanical Forest Products	<ul style="list-style-type: none"> • Increasing risk to salmon habitat & old growth dependent furbearers with continued timber harvesting / road access. FPC improves outlook. • BFP (e.g. mushrooms) opportunities may be lost without more intensive management. 	<ul style="list-style-type: none"> • Higher % of undeveloped watersheds in new PAs & more stringent access restrictions will slow decline in habitat important to trapping. • Increased protection of old growth is more supportive of botanical forest product potential
Agriculture / Range	<ul style="list-style-type: none"> • 13% of ALR in Special Mgt. and 56% in Agriculture/Settlement areas. • FPC limits grazing, but significant underutilized agricultural land for forage crop / ranching growth. • Market factors / historical trends suggest slow growth. 	<ul style="list-style-type: none"> • 5% of existing range tenures & 8% of range potential in new PAs. Existing tenures would be allowed to continue subject to PA management goals. • 18% of ALR in SMZs but 80% of ALR in ASZ. • Growth trend similar to Base Case.

SOCIO-ECONOMIC EVALUATION SUMMARY (cont.)

KEY ACCOUNTS	BASE CASE TRENDS	SCENARIO "O"
Mining / Energy	<ul style="list-style-type: none"> No operating or proposed mines but some promising developed prospects (Lindquist / Deerhorn in Tweedsmuir Recreation Area & Mac deposit). Government considering options for resolution of mining/caribou conflicts in Tweedsmuir Rec Area; likely to involve more mining constraints. Uncertain outlook due to cycles in world prices & "hidden" resource. 	<ul style="list-style-type: none"> 0.8% of current metallic exploration areas & 14% of high metallic potential areas precluded by new PAs. Mac deposit (could create 150 jobs) in new SMZ which could increase costs of development. Tweedsmuir Rec Area issue would be resolved as in the Base Case. Outlook similar to Base Case.
COMMUNITY STABILITY / QUALITY OF LIFE	<ul style="list-style-type: none"> Population likely to continue growing slowly. FRBC & gradual diversification of the forestry sector & economy may dampen disruptions. Resolution of land claims could stimulate economic diversity & development but potential impacts on third parties. FPC would better protect fish / wildlife, scenic beauty, & recreation values important to local residents. There would still be erosion in these values in long term. 	<ul style="list-style-type: none"> Consensus among key stakeholder groups on land use plan could enhance sense of community & investor certainty. Scenario somewhat more supportive of key outdoor recreation features & opportunities than the Base Case, although still some erosion of these values in long term. Otherwise similar to Base Case.
FIRST NATIONS ISSUES	<ul style="list-style-type: none"> High dependency on social assistance; somewhat less after claims settled. Concerns re impacts of continued timber harvesting on cultural/heritage sites & fish wildlife resources. Resolution of land claims would likely provide larger resource base, funding for investment / training, & more input into resource management. 	<ul style="list-style-type: none"> Scenario could place some First Nations forestry jobs at risk, but because impacts are prorated among licensees, effects would be minor. Scenario provides somewhat better protection for cultural / heritage resources, fish & wildlife and wilderness tourism opportunities, but would still be some erosion in these opportunities over time
GOVT REVENUE		
Local	<ul style="list-style-type: none"> Slow increase / diversification in tax base due to increase in population & economic growth. FRBC could result in region getting greater share of timber revenues. 	<ul style="list-style-type: none"> Scenario would not result in any mill closures. Would be somewhat more supportive of tourism component of tax base. Otherwise similar to Base Case.
Provincial	<ul style="list-style-type: none"> Stable revenues from timber but possible long term decline in resource revenues due to higher harvesting costs associated with FPC & land claims settlements. Increase in revenues from tourism. 	<ul style="list-style-type: none"> Scenario would result in potential loss of up to \$5 million / yr in forestry-related revenues, but would be somewhat more supportive of tourism component of tax base. Otherwise similar to Base Case.

ENVIRONMENTAL EVALUATION SUMMARY

KEY ACCOUNTS	BASE CASE TRENDS	SCENARIO “O”
Ecosystem Representation/ Protected Areas	<ul style="list-style-type: none"> • Tweedsmuir Provincial Park (TPP) and Recreation Area account for virtually all of existing protected areas within the plan area (29% of Forest District). • TPP provides adequate representation in 2 of 5 ecosections and 6 of 10 subzone variants. • No large existing protected areas in Lakes Timber Supply Area (TSA). • Bulkley Basin ecosection significantly under represented. • SBSdk and SBPSmc subzones under represented. 	<ul style="list-style-type: none"> • Significant increase in TSA land base allocated to new protected areas (9.2%, net of water); total existing and proposed protected areas total 36% of Forest District. • Three proposed parks would provide increased representation in all 4 ecosections within the TSA including the Bulkley Basin. • TPP and proposed Protected Areas would provide representation in all 5 ecosections and 9 of 10 subzone/variants. • Significant increased representation of the SBSdk (Sutherland R. and Uncha) and SBPSmc subzones (Entiako).
Biodiversity	<ul style="list-style-type: none"> • 63% of Timber Harvesting Land Base (THLB) allocated to IRM/High Intensity development; remaining land base allocated to Special RMZ's. • Species dependent on large contiguous areas of old growth anticipated to decline as mature and old forests are harvested over time (50-100 years). • Moderate-high risk of fragmentation in IRM zones. Landscape-level planning and recommendations (patch size, distribution, connectivity) outlined in <i>Biodiversity Guidebook</i> may mitigate impacts. 	<ul style="list-style-type: none"> • 57% of THLB allocated to GMZ (33%) and ITM Areas (24%). • Slight reduction in risk to some components of biodiversity (sensitive species, riparian connectivity) due to less area managed as IRM/High Intensity, as well as <i>Management Strategies</i> that provide explicit direction to maintain FEN's ('Strong Links') during lower level planning processes. • Otherwise, similar to Base Case.
Habitat Linkages	<ul style="list-style-type: none"> • Implementation of TSR management guidelines & FPC <i>Riparian Management</i> and <i>Lakeshore Management Reserve Zones</i> will provide adequate protection for “strong links; “upland riparian and “soft links” remain vulnerable. 	<ul style="list-style-type: none"> • Explicit direction to lower level plans to manage riparian corridors ('Strong Links') as FENs reduces risks and provides more certainty that habitat linkages and riparian landscape connectivity will be maintained.
Riparian Wetlands	<ul style="list-style-type: none"> • 94% of the large riparian complexes in Special Management areas. • Reduced impact anticipated with TSR management guidelines as well as FPC <i>Riparian Management</i> and <i>Lakeshore Management Reserve Zones</i>. However, due to discretionary management practices in the <i>Riparian Management Zones</i>, moderate levels of risk remain for species and ecosystem processes dependent on riparian habitat attributes. 	<ul style="list-style-type: none"> • 72% of large riparian wetlands in Special Management; additional 15.6% in Protected Areas. • Management strategies provide direction to maintain ecosystem connectivity through the application of FEN's ('Strong links'). • Risks to riparian habitats, reduced largely due to increase in Protected Area (15%) and management strategies that provide direction to lower level planning processes.

ENVIRONMENTAL EVALUATION SUMMARY (cont.)

KEY ACCOUNTS	BASE CASE TRENDS	SCENARIO “O”
<p>Woodland Caribou (<i>Tweedsmuir-Entiako Herd</i>)</p>	<ul style="list-style-type: none"> • Timber harvesting activities anticipated to eventually occur in all caribou migration corridor zones. Increased risks to caribou population due to future road development (access) and altered predator-prey relationships. • Core winter range (Entiako Lake) assumed protected (i.e., no-harvest zone). 65% of winter range lies within the current THLB. • Special management anticipated along south shores of Tetachuk Lake. Value of core winter range compromised due to new road access in surrounding areas. Increased risks to caribou. Moderate potential for decline. • Overall, future resource development in the caribou migration corridor and winter range significantly increases the risks to caribou. Although the relatively low levels of activity anticipated in these areas minimizes the impact, the long term viability of the Tweedsmuir-Entiako caribou herd remains vulnerable. 	<ul style="list-style-type: none"> • Significantly reduced risks to Entiako caribou herd due to: <ul style="list-style-type: none"> ⇒ 100% of caribou migration corridor (very high, high and moderate use subzones) in SMZ’s ⇒ LRMP management strategies (i.e., <i>Cheslaslie Caribou Migration Corridor Management Strategy</i>) further reduce potential risks; overall, risk considered low. ⇒ Enhanced protection for caribou winter range: 100 % of winter range allocated to new protected area (Entiako); ⇒ significantly reduces risks to winter habitat. However, calving habitat remains at risk due to potential mineral development.
<p>Moose Winter Range</p>	<ul style="list-style-type: none"> • 36% of high value moose winter range in IRM zones. Moderate potential for decline in long term due to increased access and loss of mature forest cover. • Management guidelines outlined in TSR expected to mitigate potential impacts on moose winter ranges. • Overall, moderate-low risk. 	<ul style="list-style-type: none"> • Proposed Plan suggests both positive and negative implications due to: <ul style="list-style-type: none"> ⇒ greater percentage (41%) of moose winter range to allocated to Special Management; overall, riparian moose habitats expected to be maintained ⇒ however, increased risks to 19% of high capability moose winter range due to Agriculture Zone. High potential for local declines due to loss of mature forest cover and native browse. ⇒ <i>LRMP Objectives & Strategies</i> (i.e., strategies 4.2-4.6; 5.1-5.4 designed to incorporate wildlife concerns in the Agriculture/Settlement zones may partly mitigate potential long term impacts.

ENVIRONMENTAL EVALUATION SUMMARY (cont.)

KEY ACCOUNTS	BASE CASE TRENDS	SCENARIO “O”
Deer Winter Range	<ul style="list-style-type: none"> • Half of high capability deer winter range on private settlement land. Past practices and future development limits mature forest cover over the long term in these areas. • Deer winter range occurring in special management RMZ's expected to be maintained; however, mature forest cover anticipated to become limiting in IRM zones over the long term. • Overall, low risk on Crown Land; however, deer winter range on private land remains vulnerable. 	<ul style="list-style-type: none"> • 51% in Settlement; 5.9 % in Protected Area due to Uncha proposed park. • <i>Management Objectives & Strategies</i> outlined by Lakes District LRMP (i.e., strategies 4.2-4.6; 5.1-5.4) designed to incorporate wildlife concerns in the Agriculture/Settlement zones may partly mitigate potential long term impacts.
Mountain Goat	<ul style="list-style-type: none"> • 76% of mountain goat winter range in IRM zones. • Increased access into Upper Tildesley increases risk to small mountain goat population. Access management strategies and LEH hunting regulations partly mitigate potential negative impacts. 	<ul style="list-style-type: none"> • Enhanced protection for mountain goat winter range. • 86% in Special Management; 13% in Protected Area. • <i>Management Objectives & Strategies</i> outlined by Lakes District LRMP (e.g., establishment of <i>Wildlife Habitat Areas</i> in upper Tildesley) reduce risks to mountain goat winter range by providing direction to lower level planning processes.
Grizzly Bear	<ul style="list-style-type: none"> • Majority (80%) of high value grizzly bear habitat in Special Mgt. areas. • Seasonal grizzly bear habitats in Klaytahnkut and Sutherland Valley maintained in short-term (10 years); however, increased risks from road access over the long term. • Access management strategies may partly mitigate increased risks of bear-human conflicts. • Overall, lack of higher level planning objectives to maintain grizzly bear habitat over large areas increases risk to grizzly bear populations over the long term. 	<ul style="list-style-type: none"> • Enhanced protection for grizzly bears due to Protected Area designation in Sutherland River valley and LRMP <i>Management Objectives & Strategies</i> • 81% of high value grizzly bear habitat in Protected Areas; 17 % in SMZ's. • Protection of Sutherland R. Valley minimizes risks to seasonal habitat. • GMZ and ITM areas immediately adjacent to proposed park do not provide desired buffer to improve value of Protected Area. • Development of <i>Park Master Plans</i> will likely address park boundary issues which should enhance value of Protected Area. Overall risks are low. • Seasonal grizzly bear habitats in Klaytahnkut Creek remain in Special Resource Management similar to Base Case, but GMZ/ITM areas adjacent to riparian areas partly diminish reduced risks from SMZ's. • Overall, Scenario reduces the risks to grizzly bears compared to the Base Case. Risks considered low-moderate

ENVIRONMENTAL EVALUATION SUMMARY (cont.)

KEY ACCOUNTS	BASE CASE TRENDS	SCENARIO “O”
Red and Blue-listed Species	<ul style="list-style-type: none"> Reduced impact on wading birds anticipated with FPC <i>Riparian Management</i> and <i>Lakeshore Management Areas</i>. Adherence to recommendations outlined in the <i>Managing Identified Wildlife Guidebook</i> will reduce risks to some red and blue-listed species. However, Higher Level Plan (HLP) species, (e.g. woodland caribou, grizzly bear, northern goshawk) remain vulnerable. 	<ul style="list-style-type: none"> Reduced risks to two key large mammal species (caribou, grizzly bears) that require management direction from <i>Higher Level Plan</i>. General management direction to protect and conserve habitat for rare, threatened and endangered plant and animal species (e.g., establish <i>Wildlife Habitat Areas</i>) provides increased certainty red and blue listed species will be addressed during landscape unit planning.
Remote (Wilderness) Lakes	<ul style="list-style-type: none"> Majority of fish bearing lakes and remote lakes in Special Mgt. RMZ’s. Adherence to FPC <i>Riparian Management Area</i> and <i>Regional Lakeshore Classification Guidebook</i> will reduce impacts to freshwater fish and habitats. Wilderness values of remote lakes expected to be maintained. 	<ul style="list-style-type: none"> 10 of 10 Remote Lakes in Special Management Areas. <i>Management Objectives & Strategies</i> outlined by Lakes District LRMP provide increased certainty wilderness values will be maintained in undisturbed lake ecosystems. Otherwise, similar to Base Case.
Significant Fish Streams	<ul style="list-style-type: none"> High value spawning, rearing and migration habitat that occurs in the timber harvesting land base equally split between Special Management (51%) and IRM zones (49%). FPC <i>Riparian Reserve Zones</i> will significantly reduce impacts on fish habitat. However, moderate risks remain due to IRM allocation and fish streams present on private land. 	<ul style="list-style-type: none"> 61% in Special Management; 9% in PA’s. Management strategies to develop a <i>Strategic Fisheries Plan</i>, including identification and establishment of <i>Wildlife Habitat Areas</i> for sensitive fish habitats reduce risks to fisheries habitat over the long term. Overall, 10% additional area in Special Management combined with <i>Management Objectives and Strategies</i> reduce risks from moderate to low.
Salmon Spawning Habitat	<ul style="list-style-type: none"> 40% in Special Management areas Future road and resource development have the potential to negatively impact fish habitat. FPC <i>Riparian Management Areas</i> will reduce impacts on Crown Land. However, salmon spawning habitat on private land (20%) remains at risk. 	<ul style="list-style-type: none"> 37% in SMZ’s; 12% in PA’s. Potential benefits of Protected Areas partly offset by increase (14%) in Agriculture zone. <i>Management Objectives & Strategies</i> outlined by Lakes District LRMP may mitigate potential negative impacts. Spawning habitat on settlement lands (20%) remains vulnerable.
Water Quality	<ul style="list-style-type: none"> Current management & FPC riparian zones and watershed assessments will reduce impacts on water quality. Water quality anticipated to be maintained. 	<ul style="list-style-type: none"> <i>LRMP Management Objectives & Strategies</i> provide increased certainty water management plans will be prepared in high conflict areas. Otherwise, similar to Base Case.

1. Introduction

This draft document provides a cumulative socioeconomic and environmental assessment of the implications of the “Base Case” land use regime and the “Scenario O” proposed land use plan generated by the Lakes Land and Resource Management Planning (LRMP) Resource Council. It is a qualitative (i.e., descriptive) and quantitative (i.e., numeric) analysis of as complete a range of the key implications as possible, given the available information and existing knowledge of the cause/effect relationships between crown land use changes and various socioeconomic/environmental values. Given that the LRMP document is a “strategic plan” that provides direction to lower level planning, the analysis also takes a similar “broad-brush” approach and thus assesses only *the key trade-offs at a plan area level that are inherent in the Base Case vs. Scenario O.*

The assessment utilized the Geographical Information System (GIS) area analysis supplied by the Ministry of Forests (MoF) and resource analysis/information for timber, mining, etc. values provided by government agencies on the Inter-agency Planning Team (IPT). The analysis is comprised of two levels: the first is an assessment of the (evolving and forward-looking) “Base Case” management regime within the area in the absence of a land use plan, and second is the analysis of the likely effects (over and above the Base Case) of Scenario O. The Base Case includes evolving initiatives and anticipated trends because if one were to compare Scenario O only to the “status quo” regime in place as per the MoF Timber Supply Review (i.e., the TSR, which does not include the Forest Practices Code) the impacts of the proposed LRMP plan would be exaggerated.

The Base Case, therefore, is the best characterization of present/future socioeconomic and environmental implications of the land use regime that would exist if there were no LRMP. It includes the TSR, Forest Practices Code, and other “current management” initiatives, e.g. MoF’s “paired-plot analysis” and management constraints being imposed to protect caribou winter range habitat in the Entiako area. The impacts of new protected areas and LRMP management strategies are therefore attributed to Scenario O.

Scenario O has divided the land base into 5 broad zones: Protected Areas (PA), Special Resource Management Zones (SMZ), General Resource Management Zones (GMZ), Intensive Timber Management Zones (ITM), and an Agriculture/Settlement Zone (ASZ). In order to have the appropriate “benchmark” to compare the Scenario to, the Inter-agency Planning Team (IPT) labeled current management zones (using the same designations as contained in the Scenario) based upon what level of management would most likely prevail in this “Base Case” regime, i.e. if the LRMP did not exist. (In the Base Case, the 40.7% of the planning area considered to be “Special Management” is comprised of retention and partial retention VQOs, riparian zones, the Entiako herd caribou migration corridor, caribou winter range in the Entiako area, and the Sutherland Valley.) Table 1 provides a summary of the distribution of these land use designations

for the Base Case and Scenario O. The implications of these changes in zoning between the Base Case and the Scenario are the subject of the remainder of this report.

Table 1: Land Use Zones a % of TSA* (Net of Water)

	Protecte d Areas	Special Resource Management	General (Integrated) Resource Management	Intensive Timber Management	Agriculture/ Settlement
Base Case	-	40.7%	52.2%	-	7.1%
Scenario O	9.2%	32.3%	27.3%	19.7%	11.5%

* TSA (net of water) estimated at 1,007,000 ha. and excludes Tweedsmuir Park.

The Lakes District LRMP area, with equivalent boundaries to the Lakes Forest District, actually comprises some 1,424,000 million hectares (net of water) and includes north Tweedsmuir Park which accounts for 417,000 ha. (net of water), or 29.2% of the planning area. Therefore, including Tweedsmuir Park / Recreation area and the 92,375 ha. in new protected areas, the overall amount of the plan area that would be fully/partially protected in Scenario O is 35.8% (net of water). It should be noted that since the focus of the Resource Council was on the Lakes TSA and there was a lack of inventory data for Tweedsmuir, virtually all of the GIS summary statistics are presented as a percentage of the TSA (net of water) rather than for the entire Plan area.

2. Summary of Socio-Economic Implications of LRMP’s “Scenario O”

The quantifiable socio-economic implications of "Scenario O" on existing activities arise primarily from timber supply impacts associated with new protected areas and management designations that differ from the "Base Case" (i.e. the "default" land use scenario without the LRMP). The socio-economic implications for other sectors are more difficult to quantify, and are generally less significant, because they mainly relate to potential opportunities, rather than existing economic activities. The impacts for all sectors are likely to occur over several decades. This assessment is based on the resource and Geographic Information System (GIS) analysis provided by government's Inter-Agency Planning Team (IPT) for the Lakes LRMP Resource Council.

Timber harvest levels in the Base Case¹ are estimated to continue at the current level of 1.5 million m³/yr. for 165 years, at which time harvest levels could increase to a long term rate of about 1.8 million m³/yr. After 35 years, Scenario O could potentially result in timber harvest reductions of about 100,000 m³/yr., and could place 55-80 person-years (PYs) of employment at risk (2.4%-3.4% of 1991 planning area employment) in the Lakes Forest District. This likely 35-year “deferral” occurs because the timber supply analysis by the Ministry of Forests indicates that harvest reductions could be delayed for

¹ The “base case” timber supply forecast for the LRMP takes into account the Timber Supply Review, the Forest Practices Code, the paired plot analysis and special management in the Entiako caribou winter range. See *Lakes LRMP Timber Supply Impacts*, G. Hoehne, April 14, 1997.

up to 35 years, depending on decisions by the Chief Forester in future Allowable Annual Cut (AAC) determinations. If harvest reductions were deferred, forestry-related impacts would comprise a smaller proportion of a slowly growing regional economy. Also, salvaging of submerged timber, growth in value-added and Forest Renewal BC initiatives likely mean that planning area employment in forestry as a whole will not decline.

New protected areas and special management for remote lakes and high value recreation sites in Scenario O preserve more opportunities for a growing wilderness tourism sector than in the Base Case. Visual quality constraints have been relaxed somewhat in Scenario O, but are still comparable to other regions in north-central B.C., and will not likely have significant effects on tourism activity. There is still some risk of longer term declines in some fish and wildlife populations in Scenario O (as in the Base Case), which could constrain activities such as guide-outfitting, commercial fishing and trapping. Agricultural land in the District is currently underutilized, but the creation of an Agriculture Zone in Scenario O means better protection of growth opportunities on Crown land. The Scenario places less than 1% of current metallic mineral exploration areas in new protected areas. It does not address potential mining / wildlife conflicts in the Tweedsmuir Recreation Area.

Population and economic growth, and the gradual trend to a more service-based economy will likely continue in Scenario O as in the Base Case. The Scenario should create more certainty with respect to Crown land use, and may encourage investment in some sectors.

3. Forestry

Base Case²

The Base Case is defined as the land use and resource management regime that could reasonably be expected in the absence of the LRMP, and includes the implications of Provincial initiatives such as the Timber Supply Review (TSR) process, the Forest Practices Code (FPC), the new growth and yield data for pine stands in IRM zones (i.e., the “paired-plot analysis”), and restricted harvesting in the Entiako caribou winter range.

The Ministry of Forests' (MoF) analysis of the Base Case indicates that the current Lakes harvest level of 1.5 million m³/yr. could be sustained for 165 years, and then increased to a long run harvest level of 1.8 million m³/yr. While harvest levels in the Base Case are expected to remain at current levels for many years, forestry employment can be affected by other factors, many of which suggest an increase in forestry employment, as follows:

- rationalization in the timber processing sector
- more non-TSA licensee purchases of timber allocated for Small Business sales
- more labour intensive harvesting due to FPC requirements
- the availability of salvaged timber in the Nechako Reservoir

² Discussion of the Base Case for all sectors based on the *Draft Socio-Economic Base Case for the Lakes Land and Resource Management Planning Process*, G. Holman, et al, December, 1996.

- policies to encourage greater utilization and increase timber availability for small, local processors (e.g. small scale salvage, commercial thinning, woodlot program)
- growth in the value-added sector
- Forest Renewal B.C. activities

However, over the longer term, it is likely that forestry would continue to gradually decline as a proportion of total regional employment.³

Land Use Scenario

The net effect of new protected areas (PAs) and management strategies in Scenario O, including a relaxation of visual quality (VQO) constraints, are expected to result in timber supply reductions of about 100,000 m³/yr. However, MoF assessment indicates that these impacts could be deferred for up to 35 years, depending on future AAC decisions by the Chief Forester. Harvesting in Scenario O would continue at the lower level of about 1.4 million m³/yr. until year 165, and then increase to a long term level of 1.7 million m³/yr.

As shown in Table 2, the Scenario could place about 45-60 direct forestry jobs and 10- 20 indirect and induced jobs at risk in the Lakes District. The total potential employment impact represents about 2.4% - 3.4% of 1991 employment in the District. However, if harvest reductions were deferred for 35 years, employment impacts at that time would comprise a lower proportion of a slowly growing regional economy.

It is assumed in this analysis that timber harvest reductions are likely to be pro-rated among timber licensees and that up to 35% of the current AAC is exported for processing outside the Forest District. It is thus estimated that about 15 additional person-years of employment in forestry outside the District, primarily in the Fraser Lake area (see footnote “e” in Table 2),⁴ could be affected by timber harvest reductions within the Lakes District. Ministry of Finance and Corporate Relations' (MFCR) economic dependency data indicate that about 25% of direct and indirect forestry employees in the Lakes District live in Burns Lake, with the remainder living in rural areas or smaller communities. Most of the induced effects (i.e. related to respending of household incomes) would occur in Burns Lake. It is estimated that 50%-60% of any Lakes District employment impacts (i.e. 30-50 PYs taking into account indirect and induced effects) will be distributed throughout rural areas of the District, with the remainder (i.e. up to 25-30 PYs) occurring in the Burns Lake area.

³ See *Draft Socio-Economic Base Case for the Lakes Land and Resource Management Planning Process*, op. cit., Table 2 for historical trends.

⁴ See *Lakes TSR Socio-Economic Analysis*, Crane Management Consultants for MoF, June 1995.

Table 2: Potential Forest Sector Socio-Economic Implications

	TSR	Base Case^a	Scenario O^a
Harvest Impact Yrs 0-35 ('000 m3)	0	0	0
Harvest Impact Yrs 36-65 ('000 m3)	0	0	-100
Harvest Impact Yrs 80-165 ('000 m3)	-200	0	-100
	Potential Impacts after 35 Years		
Lakes Forest District			
Direct Jobs at Risk (PYs/yr) ^b	0	0	45-60
Total Jobs at Risk (PYs/yr) ^c	0	0	55-80
Employment Income at Risk (\$m/yr) ^d	0	0	1.7-2.4
Jobs at Risk as % of District Total	0	0	2.4%-3.4%
Income at Risk as % of District Total	0	0	2.7%-3.8%
Provincial (incl. Lakes F.D.)			
Direct Jobs at Risk (PYs/yr) ^e	0	0	60-75
Total Jobs at Risk (PYs/yr) ^f	0	0	100-160
Employment Income at Risk (\$m/yr) ^d	0	0	3.0-4.4
Potential BC Revenues (\$m/yr) ^g	0	0	2.6-4.9

(a) Scenario impacts estimated relative to the LRMP Base Case defined as including the implications of the Timber Supply Review, Forest Practices Code, Lakes District paired-plot analysis and special management in Entiako caribou winter range. Impacts of Scenario O arise from new protected areas, management strategies and relaxation of VQO constraints.

(b) Direct jobs at risk in the District based on local person -years (PYs) per '000 m3 harvested in logging / hauling / silviculture and sawmilling of .46-.59 PY/'000 m3. Range of estimates based on with and without silviculture and value-added. Current forestry sector PYs in District estimated at 880, including 95 silviculture and 100 value-added. (Sources: *TSR SEA, op. cit., Burns Lake Chamber of Commerce*)

(c) District indirect & induced impacts derived with economic base employment multipliers (i.e. total direct + indirect + induced employment divided by direct employment) averaging 1.18 - 1.31 for both woodlands and processing. Multiplier estimates adjusted for log hauling and reflect range of assumptions re social safety net / worker migration. Total District employment estimated at 2,320 in 1991. (Source: Ministry of Finance & Corporate Relations (MFCR), *BC Local Area Economic Dependencies & Impact Ratios, 1995*)

(d) Average after tax wages and salaries for forestry estimated at \$33,000/PY. Indirect and induced income impacts based on average after tax wages and salaries of \$23,000/PY. (Source: *Lakes TSR SEA*). Total 1991 after tax income in District estimated at \$63.1 million. (Source: MFCR)

(e) Includes 15 of the 235 PYs outside the District supported by District timber that is harvested / processed by non-resident contractors / employees, i.e. Fraser Lake sawmill in Vanderhoof District. (Source: *Lakes TSR SEA*) Assumed that alternative fibre supplies available to mitigate provincial pulp and paper impacts.

(f) Based on average employment multipliers of 1.68 - 2.16 for logging and sawmilling. (Source: MFCR B.C. Input-Output Model). Low multiplier based on BCIOM adjusted for social safety net.

(g) Potential B.C. revenue impacts include: stumpage / royalties / rents ranging from about \$16/'000 m³ (without FRBC, 1990-94) to \$39/'000 m³ (with FRBC, 1995), and about \$10/'000 m³ for personal, corporate, and logging income taxes. (Sources: MoF Valuation Branch and *Lakes TSA SEA*)

It is highly unlikely that either of the two larger sawmills in the District will experience any significant employment impacts from Scenario O, unless large quantities of Lakes SBFEP wood are bid away from the Lakes area, which would have occurred in the Base Case anyway. There are several smaller sawmills in the region that are operating at less than full capacity which are more vulnerable to reductions in SBFEP wood. However, prorated impacts on these facilities will be very small and MoF initiatives such as the woodlot program, the issuing of licenses for salvage timber and commercial thinning should help to offset any impacts arising from Scenario O. Value-added producers may also be affected, but they use output from sawmills, not raw timber, and therefore could potentially substitute for any lost timber volumes by purchases from other sawmills. The woodlot program and other initiatives to increase timber utilization should also assist value-added facilities.

Despite longer term harvest reductions, growth in certain sectors of forestry (e.g. value-added, forestry-related services, intensive silviculture) would likely mean that employment in forestry will not decline in absolute terms, but will decline as a proportion of total regional employment. The sector will continue as the dominant force in the local economy well into the foreseeable future, however. Overall, slow population and economic growth, and the gradual trend to a somewhat more service-based economy, will likely continue in the District.

4. Tourism and Recreation

Base Case

The Base Case would place about half of high value recreation sites, 45% of tourism use areas, 72% of remote (wilderness) lakes and 84%-88% of high visually sensitive areas in the Forest District in some form of special or visual quality management (see Table 3). Although 70% of the area surrounding wilderness lakes are in some kind of special management in the Base Case, more and more of the freshwater lakes in the District would come under steadily increasing fishing pressure as a result of an expanding network of logging roads. Populations of big game species such as grizzly and possibly moose and black bear may become increasingly vulnerable in the long term, as critical habitat in the timber harvesting land base becomes increasingly fragmented and as increasing road access results in additional hunting pressures.

Recreation and tourism values are recognized by current management, and continued growth in activity is expected in the short to medium term. In the long term, opportunities for wilderness or primitive recreation in the Forest District would disappear and semi-primitive opportunities will be significantly diminished.⁵ However, Tweedsmuir Park, one of the largest protected areas in B.C. in the southwest corner of the Lakes planning area, would continue provide such opportunities.

⁵ "Primitive" (non-motorized) areas are defined by MoF as areas > 5,000 ha and > 8 km from a 4-wheel drive road, and "semi-primitive" (non-motorized) as > 1,000 ha and > 1 km from a 4-wheel drive road.

Land Use Scenario

The four new protected areas (PAs) in Scenario O, with an area of about 92,000 hectares, would preserve some opportunities for primitive and wilderness recreation in the Forest District. For example, about 22% the area surrounding of remote lakes and backcountry potential will be placed in new PAs. The new PAs, particularly those with road access and existing recreation use, over time would likely attract and encourage longer stays in the region by tourists, and would protect opportunities for growth in outdoor recreation (e.g. camping and hiking) by residents.⁶

The new PAs may eventually also stimulate additional investments in commercial backcountry tourism facilities and activities (e.g. resorts, lodges, guiding). Provincial policy will likely limit the scale and nature of investments and activities within new protected areas. LRMP management strategies would also limit development, but pre-existing tenures for commercial backcountry recreation, guide-outfitting and other non-resource extraction tenures will be permitted to continue subject to park master plans to be developed for each new PA. Tourism investments may be stimulated outside the new parks, particularly where they are bordered by Special Management Zones (SMZs) that better ensure resource developments do not compromise environmental values.

The Scenario would place 97% of the area around remote lakes and 83% of high value recreation sites in SMZs or new protected areas, compared to 53% and 72%, respectively, in the Base Case. Development of roads for timber harvesting (except for forest health purposes) around remote lakes would be restricted. The Scenario would also slightly increase the proportion of backcountry potential and tourism use areas in SMZs and new protected areas. Stricter controls on access in the Scenario will reduce pressures on wilderness lake fisheries and big game species upon which guide-outfitters and some fishing guide / lodge operations depend to attract their clients.

The Scenario would relax Visual Quality Objectives (VQOs)⁷ and reduce the proportion of visually sensitive land in partial or full retention zones. About 62% of high visually sensitive areas and 66% of visually sensitive areas in scenic areas in the Lakes Forest District are protected by SMZs and PAs in the Scenario, versus 84% and 88%, respectively, in the Base Case.⁸ The VQO standards proposed in the Scenario are more consistent with the natural disturbance cycle of forests within the District and with VQOs

⁶ As noted in the *Draft Lakes LRMP Socio-Economic Base Case*, op. cit., recreation activity by residents of the District, while obviously beneficial, is considered to represent a diversion of spending within the region rather than new income to the region.

⁷ The proportion of visually sensitive areas that can be disturbed, and minimum green-up requirements within the disturbed area, have both been relaxed in Scenario O. However, the area analysis is somewhat misleading since partial retention VQOs have been included in the IRM Zone in the Scenario, rather than the Special Management Zone (as in the Base Case), thus understating constraints on timber harvesting in Scenario O.

⁸ Inclusion of partial retention VQOs in IRM in the Scenario understates the proportion of tourism and recreation areas in which timber harvesting is somewhat constrained.

elsewhere in north-central B.C. Therefore, the socio-economic implications of relaxing VQOs (e.g., for tourism growth) are expected to be relatively minor.

In general, there is a higher level of protection of recreation and tourism values in the Scenario than in the Base Case, but slightly lower protection for scenic values. In the longer term, primitive recreation opportunities will be available only in Tweedsmuir Park and in new PAs proposed in the Scenario, and semi-primitive opportunities will be significantly diminished.⁹ This is because roaded development is likely to eventually occur throughout the 91% of the TSA (net of water, a full 63% of the pre-LRMP gross land base of the TSA is considered by MoF to be “long term timber harvesting land base”) that is not protected.

While it is expected that the new protected areas and increased special management for key recreation values in the District will generate additional employment and investment in wilderness tourism, compared to the Base Case, such impacts are will take place gradually, over time. However, data are not available to quantify these impacts.

5. Mining and Energy

Base Case

There are currently no operating mines in the Forest District, although there is active exploration in several areas. About 41% of the area in which there is current metallic exploration activity, 47% of high metallic potential, 39% of industrial potential and 39% of high energy potential, is included in Special Management / VQO zones where development may have to be sensitive to visual quality concerns and other environmental values. The Lakes District's most promising developed prospect, Lindquist / Deerhorn, is located in the 17,000 ha. Tweedsmuir Recreation Area, in which mining activity is currently allowed, but logging is not. This area also includes about 12 other mineral occurrences, about 18% of the total in the District, including the Midnight copper occurrence. Provincial resource agencies are currently considering management options for the Recreation Area, all of which involve varying degrees of constraints on resource development in order to protect the caribou in the area. The other developed prospect is the Mac moly-copper deposit at the northern tip of the District, with estimated reserves of roughly 100 million tonnes.

Other occurrences in the District which have had significant exploration programs include the Rhub-Barb property (Ootsa Lake), Uduk Lake gold / silver property (south of Ootsa Reach) and Yellow Moose and Moon properties (Knewstubb Lake). There is also a promising perlite deposit on Francois Lake and one on Uncha Lake. Due to uncertainty with respect to markets, the viability of these "hidden" resources, and the viability of alternative deposits, it is not clear when, or even whether, any of these properties would

⁹ See Prince Rupert Forest Region and Lakes Forest District, *Lakes Timber Supply Area Plan 1987-1991*, March 1987, p. 8. This document states that hectarage in the “primitive” category would disappear and that only 132,000 hectares in the “semi-primitive” category would remain after 20 years.

be developed in the Base Case. Also, it is likely that development of some of these occurrences (e.g. near lakes with high recreation values or in caribou winter habitat) would be subject to management constraints to minimize visual or resource impacts.¹⁰

There is currently no active energy exploration in the Lakes District, although potential oil, gas and geothermal resources do exist. None of this potential would be precluded from development in the Base Case, although the likelihood and timing of such development is very speculative at this time.

Land Use Scenario

No existing mines would be precluded by Scenario O. The Scenario does not resolve the potential caribou and mining conflicts in the Tweedsmuir Recreation Area, which are to be addressed by an alternative process, and therefore the Scenario cannot be said to have any impacts on mineral values in the Recreation Area. The new PAs in the Scenario would preclude about 0.8% of areas with current metallic exploration activity, about 14% of high metallic potential, 5% of high industrial mineral potential, and 9% of oil/gas potential.¹¹ Another 38% of current metallic mineral activity, and 31%-36% of industrial, metallic and energy potential would be included in Special Management Zones, a decrease from the Base Case.

Perhaps the most significant implication of the Scenario for the mining sector is that the Mac moly-copper property falls within a new special management area for goat habitat in the north end of the District. This property, if developed, could potentially support about 150 direct jobs annually, according to the Ministry of Employment and Investment's Energy and Minerals Division. There are concerns that the management strategies for this area, including possible access restrictions, could impose additional costs or even preclude development of this deposit. However, the viability of this deposit is very uncertain at this time. Based on historical experience in B.C., the likelihood that developed metallic prospects such as the Mac and Lindquist / Deerhorn become operating mines is about 1 in 25.¹²

Overall, while new PAs in Scenario O preclude some mineral and energy potential, it is likely that activity in these sectors will be primarily driven by market and factors (e.g., taxes and other costs) not related to the LRMP

¹⁰ It is assumed that Special Management / VQO zones in the Base Case, many of which are primarily aimed at mitigating the impacts of timber harvesting on environmental areas and visually sensitive areas, also apply to mineral and energy development.

¹¹ MEI's definition of high metallic and industrial potential includes the top 5 of 10 mineral classes or levels. This definition of high potential, which essentially covers one-half of the entire planning area, is somewhat more broadly defined than for other resources.

¹² For example, according to the Ministry of Employment and Investment's Energy and Minerals Division, while there are nearly 12,000 mineral occurrences in B.C., there are 411 developed metallic prospects (i.e. properties with defined mineral reserves), and 17 of these are operating metal mines. Developed prospects are more likely to be the focus of exploration activity that could potentially result in commercial development, resulting in the approximate 1 in 25 probability estimate of becoming a mine at some time in the future.

6. Agriculture

Base Case

The new riparian areas established under the FPC (on both streams and lakes) could preclude or prevent access for cattle grazing. There could also be some additional costs associated with fencing riparian areas, and new watering structures. There could also be relocation and development costs of new range areas. The Grazing Enhancement Fund, other Ministry of Agriculture assistance programs, and FRBC are possible sources of assistance for at least partially mitigating these costs.

About 13% of the ALR, 27% of existing range tenures and 37% of range potential are in Special Management Zones in the Base Case, which could place some management constraints on potential range use. About 56% of the ALR is in the Settlement Zone in the Base Case.

Overall, the availability of arable land presently under-utilized for agriculture in the District, provide opportunities for growth.¹³ Given historical trends and market factors, it is likely that slow growth in this sector will continue.

Land Use Scenario

The Scenario would place none of the ALR, only 5% of existing range tenures and about 8% of range potential in new protected areas. Existing grazing tenures will be allowed to continue in new PAs, although management conditions may be amended to ensure grazing is compatible with the management goals for the new PAs. Although 8% of range potential would be precluded by new PAs, the overall proportion of range potential in management zones supportive to agriculture is decreased only slightly.

The Scenario slightly increases the proportion of ALR in Special Management Zones (from 13% to 17%). However, a much higher proportion of the ALR is also placed in a new Agriculture / Settlement Zone (about 80% compared to 56% in the Base Case), where agriculture will have higher management priority. The Scenario slightly reduces the proportion of range tenures and range potential in Special Management Zones and places about 14% of these values in the Agriculture / Settlement Zone.

Overall, the changes in management emphasis in the Scenario has offsetting effects on the agricultural land base within the District, and therefore are unlikely to have significant incremental impacts on existing or potential activity compared to the Base Case. Given the availability of under-utilized agricultural land in the District, and the creation of an Agriculture / Settlement Zone, the Scenario maintains significant opportunities for long term growth in this sector. However, market factors will continue to be the primary determinant of growth in this sector.

¹³ *Draft Lakes LRMP Socio-Economic and Environmental Base Case*, op. cit.

7. Commercial Salmon Fisheries, Trapping, Botanical Forest Products

Base Case

The Forest Practices Code and existing special management areas in the Base Case will provide some additional protection for commercial salmon species and botanical forest products. However, much of the Lakes Forest District would eventually be available for timber harvesting, agriculture or settlement in the Base Case. About 20% of salmon spawning habitat is within settlement areas, to which the FPC does not apply, and 40% is within IRM zones. The risks to salmon habitat would likely increase over time as timber harvesting and road access throughout the timber harvesting land base proceeds.

As mature and old growth forests are converted to younger forests, income from trapping of old growth dependent fur bearers (e.g. marten) will likely decline. The potential for some botanical forest products, such as commercially harvested mushrooms, would also likely decline outside of Tweedsmuir Park with successive logging passes in IRM Zones. More formal management of botanical forest products is being considered by MoF, which could better protect some of this potential.

Land Use Scenario

New protected areas in the Scenario will be of some benefit to salmon spawning habitat, trapping and botanical forest products, although there are some offsetting effects. For example, although 12% of salmon spawning habitat in the Forest District would be protected in Scenario O, this could be offset by the reduction in Special Management Zones and the placing of an additional 14% in the new Agriculture / Settlement Zone. The Scenario slightly increases protection of old growth (e.g. 3% of old growth in new parks), which provides support for a number of "nature-based" economic activities.

8. Community and Worker Adjustments, Mitigation / Transition Issues

The longer term forestry employment impacts estimated in this assessment are characterized as "jobs at risk" because of the uncertainties inherent in forecasting over a 45 year period and beyond and because estimates are based on the somewhat unrealistic assumption that firms and workers make no adjustments to minimize or avoid impacts. For example, firms could find alternative sawlog supplies, at least in the short term (e.g. Ootsa Lake salvage timber), or lower their labour costs through periodic shutdowns or attrition rather than lay-offs. For example, adjustments to harvest impacts through periodic downtime of harvesting / processing operations would mean that impacts would take the form of incremental income reductions rather than job losses.

This is not to trivialize the difficult adjustments for individual workers who are displaced and cannot find alternative employment, or for their families. There are a number of measures that could be implemented to mitigate the employment, income and government revenue impacts of land use changes in the shorter term. Probably the most

important is to phase in timber harvest reductions. This allows time for transition measures, and the beneficial effects of the Scenario on tourism growth and the investment climate, to take effect.

Other initiatives or trends that would ease transition include greater use of underutilized timber supplies (e.g. salvage timber, previously inoperable, low productivity or deciduous stands), incremental silvicultural activities funded by FRBC, and more labour intensive harvesting and encouragement of value-added processing. A formal economic transition strategy involving the various elements described above could be developed as a component of the LRMP.¹⁴ Such a strategy could "match" workers displaced as a result of timber supply shortages or industry rationalization, with employment opportunities in new value-added facilities or other new projects.

9. First Nations Concerns

The implications for First Nations will basically mirror overall impacts of the Plan itself. Most of First Nations' employment is in forestry, including the Burns Lake Native Development Corporation which has interests in logging, sawmilling and value-added processing. As indicated above, the forestry impacts of Scenario O, prorated among various license holders, including First Nation licensees, are relatively minor, and can be deferred for a number of decades.

First Nations have had historical concerns regarding the impacts of resource development on other sources of livelihood and subsistence such as trapping, hunting, plant gathering, archaeological sites, fisheries, and wilderness tourism. The land use changes proposed in Scenario are generally more supportive of these values, although there are still some resource values for which there are offsetting effects (e.g. botanical forest products) or which may still be eroded over time (e.g. trapping). The significance of these resources to First Nations' culture are not adequately reflected by simple economic indicators or measures.

Local First Nations have had concerns that new protected areas may preclude some traditional uses, but recommended management strategies to consult with First Nations on this issue and work with them as to the planning and management of parks would appear to mitigate this concern.¹⁵

10. Environmental Resource Analysis

10.1 Introduction

The purpose of this resource analysis is to provide LRMP participants with an assessment of the environmental consequences associated with both the Base Case and Scenario O.

¹⁴ See, for example, the economic strategy contained in the Robson Valley LRMP document.

¹⁵ Lakes LRMP, Draft Document, June 5 1997, p. 74.

The analysis presented here focuses on the various components of biodiversity (e.g., ecosystem representation, connectivity, sensitive species) and summarizes the expected changes to wildlife habitat that would result in the absence of a land use plan (i.e., Base Case) as well as by the implementation of the proposed Plan. The Base Case includes the *Timber Supply Review* (TSR 1995), the *Rationale for AAC Determination* (1996) as well as all FPC regulations including the implications of implementing recommendations outlined in FPC guidebooks (e.g., *Riparian Management Areas*). The focus of the assessment is to address incremental impacts of implementing Scenario O, sometimes also referred to as the “proposed plan.”

10.2 Methods (Indicators, Assumptions)

Two primary sources of information were used to determine the potential environmental impacts of the Base Case and the Scenario including:

(1) *GIS area analysis for each indicator.*

To compare the Base Case with the proposed Plan each environmental value requires a measurable criteria to be used as an **indicator** to assist LRMP participants determine if objectives for valued environmental components are likely to be achieved. Indicators for this assessment reflect environmental values identified in the Lakes LRMP Resource Accounts. A Geographic Information System (GIS) was used to generate area summaries that represent the amount of each mapped environmental indicator (e.g., high capability habitats) within each of the 5 Resource Management Zone categories. The primary indicator used for all environmental values was the percentage of each resource account (indicator) in each of the resource management categories.

(2) *Management Objectives and Strategies.*

Management Objectives and Strategies were provided by the draft Lakes District LRMP plan (June 5, 1997). Interpretation of the *General Resource Management Direction* (e.g., environmental objectives), the overall management intent for each of the resource management zones (e.g., conservation emphasis in Special Resource Management) as well as specific management strategies (e.g., maintain and enhance native browse species for moose and deer) were used to determine the potential implications for wildlife habitat.

Specific **assumptions** were required in order to make qualitative predictions regarding the significance of potential impacts. Species specific assumptions and risks were outlined in the Lakes LRMP Base Case document (Dec 1996) and are not repeated here, however, the key assumptions are outlined below, along with a diagram depicting the general assessment framework. In general, assumptions are formulated using informed professional judgment to estimate the potential impacts to wildlife values by assessing the compatibility of various resource development activities (forestry, mining) with the maintenance of wildlife habitat and populations. Overall, a combination of indicator area summaries, management strategies and assumptions were used to estimate the potential impact to environmental values. Key assumptions are:

- *SMZ, GMZ, and ITM/ASZ resource development designations roughly correspond to High, Intermediate and Low Biodiversity Emphasis options respectively.*
- *Lower Intensity development areas (i.e., SMZs) provide more options and opportunities for maintaining native species and ecological processes. Therefore, risk to biodiversity increases with increasing intensity levels of resource development.*
- *Open roaded access considered a significant risk factor to grizzly bears and all ungulate species.*
- *ITM and ASZ areas are assumed to have the greatest amount of open roads and therefore, considered a high risk to fish and wildlife populations. Similarly, these RMZs are assumed to pose the greatest risks to connectivity (i.e., increased fragmentation). In contrast, PAs and SMZs (e.g., ‘Strong Links’) provide the least amount of open roaded access and the least risk to habitat connectivity.*
- *SMZs (or High Biodiversity Emphasis) and PAs considered compatible and preferred options for maintaining habitat for vulnerable species such as woodland caribou, mountain goat, grizzly bear and marten.*
- *Management Objectives and Strategies outlined for each RMZ by the Lakes District LRMP assumed implementable and enforced.*
- *Management strategies (e.g., access) can partly mitigate the potential negative impacts of resource development activities (i.e., reduced risk).*

Figure 1: Assessment Framework Used to Estimate Potential Environmental Impacts and their Significance

A relative risk assessment approach was used to assess the significance of land use allocation to environmental values. In general, increasing risks were assumed to correlate with increasing levels of land use intensity to reflect altered future landscape conditions. A brief rationale supporting each relative risk level is described below.

Table 4: Relative Risk levels used to Estimate Potential Impacts of each Land Use Zone Designation on Biodiversity and Environmental Values

Resource Management Zone	Risk Level	Rationale
Protected Area (PA)	Low-Very Low	Resource development precluded; Future conditions anticipated to change the least. i.e., natural levels of biodiversity potentially maintained. Usually unroaded and undisturbed; wilderness values maintained.
Special Resource Mgt. (SMZ)	Low-Moderate	<i>High Biodiversity Emphasis</i> ; maintains 75% natural mature/old forest cover; minimize open road network and fragmentation.
General Resource Mgt. (GMZ)	Moderate-High	<i>Intermediate Biodiversity Emphasis</i> ; reduced mature and old forest cover (50% natural), increasing road network. Although the intent of this zone is to balance economic and environmental values - species that require larger tracts of mature and old forest, less human disturbance become increasingly vulnerable.
Intensive Timber Mgt. (ITM)	High	<i>Low Biodiversity Emphasis</i> ; significantly reduced mature and old forest cover (25% natural); open road network maximized; increased fragmentation, reduced habitat connectivity.
Agriculture (A)	High-Very High	Alteration of plant and animal species composition; ecosystem structure and function Typically, permanent loss of mature forest cover and other plant species due to land conversion; habitat fragmentation. Although agriculture areas can enhance habitat for some species, overall, these areas result in lower biodiversity due to fragmentation as well as loss and displacement of native plant and animal species.
Settlement (S)	High-Very High	Land use activities considered unsuitable to maintain most native species and ecological processes; increased wildlife-human conflicts (e.g., bears).

Note: The table shown above should be considered only as a rough guide to relative risk levels. Current management practices (e.g., FPC), management strategies outlined by the Lakes District LRMP, and lower level planning processes can partly mitigate potential negative impacts to environmental values and therefore, reduce (to some degree) the relative risk level.

10.3 Overview of Areal Analysis Results (Gross Land Base)

The areal breakdown of the Lakes TSA by Resource Management Zone category for both the Base Case and Scenario O were presented in Table 1. The key changes in land use allocation are summarized below and include:

- A significant increase in the amount of Protected Area (9.23% of TSA land base, net of water) compared to virtually zero in the Base Case, which results from shifting land from Special Management to Protected Areas (Entiako, Sutherland Valley, Uncha). As a proportion of the Lakes District (including Tweedsmuir Park), the total amount of existing and proposed Protected Area rises from about 29% in the Base Case to 36% in the Plan (net of water).
- An increase in the amount of land (4.4% of TSA gross land base, net of water) to be managed primarily for Agricultural purposes compared to the Base Case. This occurs as a result of shifting land use priorities from SMZs/GMZs to the ASZ.

- A slight reduction in total amount of gross land base (47%) allocated to GMZ (27%) and ITM (20%) compared to Base Case (52%). Similarly, a slight reduction in the amount of *timber harvesting land base* (THLB) to be managed as GMZ/ITM from 63% in the Base Case to 57 % in Scenario O.

10.4 Protected Areas - Ecosystem Representation

Three new PAs are proposed in the Scenario which total about 92 000 ha. of the TSA (9.23% net of water bodies; 8.23% of TSA inclusive of water bodies). The Uncha Lake proposed PA increases representation (approx.19,587 ha) of the Bulkley Basin ecosection which was lacking TSA representation in the Base Case. This PA, together with the Sutherland River Valley proposed PA, would provide increased representation of the SBSdk to 30,911 ha or 5.8% of the subzone that occurs within the TSA (Fig. 2). The SBPSmc would be 100% represented due to the Entiako Lake proposed PA. The ESSFmc, ESSFmv and SBSmc2 would also receive modest increases in PAs.

Overall, within the TSA part of the plan area, the Scenario would achieve some degree of representation in all 4 ecosections and all subzone variants except alpine tundra (AT) which makes up less than 1% (2,907 ha) of the TSA (Table 5). Because Tweedsmuir Park does not represent the full range of ecosystem types in the Lakes District, the increased representation of subzone/variants recommended by the Scenario provides a more representative sample of the ecosystems that occur within the overall plan area.

Figure 2: Areal Breakdown of the Lakes TSA by Subzone/Variant and % Representation in proposed Protected Areas

Table 5: Summary of Existing (Tweedsmuir) and Proposed Protected Area Ecosystem Representation (TSA)

	Total Area of Subzone in TSA	% of TSA Subzone in Proposed LRMP Protected Areas	Total Area of Subzone in Tweedsmuir Park (TP)	Total % of Subzone in Protected Areas for Planning Area
Subzone	Total ha. (TSA)	(TSA % only)	Total ha (TP)	(TSA % + TP %)
AT	2 907	0	84 411	96.5%
ESSFmv	7 681	18.7%	-	18.7%
ESSFmc	74 214	1.1%	160 432	68.6%

SBPSmc	53 125	100%	186	100%
SBSmc2	329 050	1.9%	142 801	31.4%
SBSdk	532 989	5.8%	12 288	7.9%

Note: three other subzones that do not occur in the TSA but have representation in Tweedsmuir Provincial Park include: ESSFmk; MHmm2; CWHws2

10.5 Old Growth (>140 years old SBS/SPBS; >250 years old ESSF)

Many plant and animal species depend on late-successional ecosystems to successfully survive and reproduce. Approximately 248, 915 ha of old growth exists within the Lakes TSA. Of that, about 206,166 ha (83%) occurs within the timber harvesting land base (THLB) and is considered initially at risk from timber harvesting activities. The remaining 17% exists in areas not available for harvest (i.e., exclusions) due to harvesting constraints that include (among others), *net-downs* such as inoperable forest types, and environmentally sensitive areas (ESA's). Although these areas can provide suitable wildlife habitats, it should be emphasized that this percent is a cumulative total of many small areas, and therefore should not be interpreted as providing default protection of one large area. Because many ecological processes and species habitat requirements are area-dependent, these areas may only function as marginal habitats.

The proposed Plan allocates almost 40% (99,280 ha) of the old growth forests to SMZ areas. About one-third is allocated to GMZ (sometimes referred to as "IRM") and another 20% (50,471 ha) to ITM (sometimes referred to as "Enhanced Timber") zones, as indicated in Figure 3.

In addition, compared to the Base Case, the Scenario allocates a similar amount of old growth to SMZ (40%) (Fig. 4). Scenario O also slightly decreases the amount of old growth allocated to GMZ and ITM zones from 58% in the Base Case to 52% in the Plan. Although this appears to suggest a positive shift in land use, the 6% reduction is equally split between the ASZ and PAs, which partly negates the potential benefits of reducing the amount of old growth forests in GMZ/ITM zones.

Figure 3: Total Area of Old Forests in each RMZ Category and Amounts Occurring in Areas Excluded from the Timber Harvesting Land Base in Scenario "O"

Figure 4: Proportion of Old Forests (>140 years) in each RMZ Category

In addition to the proposed land allocation, the *Timber Supply Review* (1995) also provides an indication of the supply of old forests over time. Because the timber supply impacts appear to be similar between the Base Case and the Scenario, the trend for species dependent on older forests outside of PAs are similar to the Base Case. That is, as mature and old forests are harvested, the proportion of early seral stands increases significantly over the next 50-100 years, which suggests species dependent on early seral stages will benefit most while those species dependent on mature and old forests (e.g., marten) remain at risk and will likely occur at lower population levels. The proposed plan, however, does provide management strategies (#3.1,3.2, Lakes District LRMP) and direction to lower level planning processes to develop a district wide network of *Old Growth Management Areas* (OGMAs) which indicates a positive step towards maintaining old growth ecosystems and may partly mitigate the loss of mature and old forests over time. Insect, disease and fire also poses significant risks to old growth forests. The draft Lakes LRMP document outline forest protection strategies (e.g., *Interim Forest Health Management Strategy*) that indicates a positive step towards managing fire, insect infestations and windthrow that should provide increased certainty that management actions taken to reduce these risk factors integrate all forest values.

10.6 Habitat Linkages (“Strong Links”)

Management Strategies outlined by the draft Lakes District LRMP reduce the risks to riparian communities by providing explicit direction to lower level planning processes to maintain ecosystem connectivity through the application of *Forest Ecosystem Networks* (FENs). ‘Strong Links’ identified by MELP will function as interim (FEN’s) until landscape unit plans are in place, which suggests the risks to species and ecological processes dependent on riparian habitats are reduced in the short term and possibly the long term compared to the Base Case.

Further strategies (e.g., #3.2) to promote alternative silvicultural systems in FENs provide additional certainty that ecological objectives will be adequately addressed and more natural forest conditions maintained.

Although the allocation of much of the area in “strong links” to SMZ (65%) and Protected Area (15%; Fig. 5) designations is generally positive and provides a key component of maintaining riparian connectivity, upland connectivity remains vulnerable due to the distribution of ITM zones.

Figure 5: Proportion of “Strong Links” in each RMZ Category

Whether habitat fragmentation will impact the spatial distribution of populations depends upon how species perceive or respond to landscape connectivity. Landscape connectivity is a function not only of the spatial contiguity (i.e., connectedness) of habitat, but also the habitat affinities of the species and their ability to move across the landscape and effectively utilize spatially distributed resources. Because the required amount of connected mature forest is unknown for most species, considerable uncertainty and risk remain to species dependent (wholly or partly) on areas that occur within the GMZ/ITM zones and species that travel between the strong link riparian areas and upland forests. Lower level planning processes (i.e., landscape unit) may partly mitigate these risks by addressing upland forest connectivity and maintaining forest interior conditions.

10.7 Wildlife

Woodland Caribou

Although the Entiako caribou winter range would have been specially managed in the Base Case (which would have likely included a no harvest zone to protect core area around Entiako Lake), the proposed Plan designates all (100%) of the critical winter range as a PA (Fig. 6), providing significantly reduced risks associated with resource development (e.g., access). This designation, together with management strategies outlined by the draft Lakes LRMP, provides increased certainty that the winter range will be maintained over the long term.

Scenario O also reduces the risks to the Tweedsmuir-Entiako caribou herd by allocating all (100%) of the caribou migration subzones (i.e, very high, high, moderate value) to SMZ's (Fig. 7). This represents an additional 26% of the migration habitat that will be managed as a SMZ (mostly moderate value) compared to the Base Case (74%). In addition, the *Cheslaslie Caribou Migration Corridor Management Strategy* developed by the Lakes District LRMP Resource Council addresses a number of key issues including fragmentation, seral stage distribution, access, fire protection, forest health and windthrow which together provides enhanced protection and increased certainty that the Cheslaslie caribou migration corridor will receive the necessary consideration during operational planning. For these reasons, the Scenario O poses relatively low risks to caribou compared to the Base Case.

Although the Scenario minimizes risks to the Tweedsmuir Entiako caribou herd by providing full protection for their winter range as well as managing the migration corridor as a SMZ, considerable uncertainty remains regarding high value caribou calving habitat in the Tweedsmuir Recreation Area, which overlaps with lands that may experience future mineral exploration/development activities.

Figure 6: Proportion of Caribou Winter Range in each RMZ Category

Figure 7: Proportion of Caribou Migration Corridor in each RMZ Category

Grizzly Bear

The Scenario significantly reduces the risks to grizzly bears compared to the Base Case. This is largely due to increased protection given to one (Sutherland Valley) of the two seasonally important grizzly bear feeding areas in the Lakes District. Approximately 81% of the high value grizzly bear habitat will be protected (Fig. 8). (A Protected Area designation is considered to minimize the risks to grizzly bears by significantly reducing the probability of bear-human conflicts that are typically associated with increased resource development, especially increased road access.) However, because grizzly bears must travel to and from the Sutherland River each year also suggests adjacent areas should also be considered for special management (depending on movement patterns). Although the Plan does not currently provide a “buffer” or special management designation surrounding the proposed park, *Management Objectives and Strategies* outlined by the Lakes LRMP addresses these concerns by recommending the development of a grizzly bear management and park master plan.

Figure 8: Proportion of High Value Grizzly Bear Habitat in each RMZ Category

Similarly, Klaytahnkut Creek remains vulnerable to surrounding development and thus a management plan also needs to be developed for this grizzly bear feeding area, to maximize the potential benefits of the SMZ designation proposed in the Scenario. Current management plans developed by Babine Forest Products Ltd. for the Tildesley drainage may partially mitigate the potential negative effects of surrounding forestry development.

Overall, the Scenario provides enhanced protection for grizzly bears compared to the Base Case largely due to the proposed PA in the Sutherland Valley and explicit management direction to establish grizzly bear management plans. These land use strategies suggests risks to grizzly bears will be reduced from relatively high levels in the Base Case to low-moderate levels in Scenario O.

Ungulate Winter Range

Deer Winter Range

Moose and Deer winter ranges have been identified as one of four subzones in the Special Resource Management Zone category in the draft Lakes LRMP document. Similar to the Base Case, the GIS area analysis indicates over half (51%) of the deer winter range remains in the ASZ (Fig. 9). On Crown land, the Plan allocates the majority to SMZs and a small amount (5.85%) to PAs, and reduces the amount in GMZs vs. the Base Case.

Figure 9: Proportion of Deer Winter Range in each RMZ Category

However, about 8.6% of the deer winter range now overlaps with the proposed AS zone. Although the slight increase in the amount of deer winter range to be managed as Special Resource Management and Protected Area suggests deer winter range will be better protected compared to the Base Case, the increased area of deer winter range in the Agriculture zone partly offset potential benefits. Considering the whole TSA, the proposed Plan poses relatively low risks for deer; however, where agriculture and deer winter range overlap, these areas are now at higher risk because of potentially declining amounts of mature forest cover. Management Strategies developed by the Lakes LRMP may partly mitigate potential impacts in these areas. Deer winter range on private land remains vulnerable over the long term.

Moose Winter Range

The Scenario has mixed implications for moose winter range. It increases the amount of moose winter range in SMZs from 31% in the Base Case to 41%, including an additional 5.4% in PAs, which suggests enhanced protection for moose winter range values. However, it also designates 18.7 % of high capability moose winter range to the ASZ (Fig. 10). The relatively high percentage (19%) of moose winter range that overlaps with areas that emphasize agricultural development suggests portions of moose winter range is at increased risk in Scenario O. Exactly how much of this land does not currently provide suitable winter range because of past agricultural development is unclear. Nonetheless, future agricultural expansion in these areas may result in further loss of low elevation winter ranges. Because the availability of winter range is considered to be one

of the limiting factors affecting moose population viability, local moose populations that depend on these areas (e.g., Endako River) remain at high risk.

Figure 10: Proportion of Moose Winter Range in each RMZ Category

Overall, the distribution of moose winter range among the various RMZ categories suggests implementing the Scenario has both positive and possibly negative implications for moose populations. Management of ‘Strong Links’ that incorporate riparian areas used by moose will provide key habitats over most of the plan area, however, the incompatibility of agricultural activities with the maintenance of key moose winter ranges, suggests some winter habitat remains at risk.

The draft Lakes LRMP document recognizes these concerns and has outlined *Management Objectives and Strategies* (e.g., striving to exclude critical winter range from development) designed to mitigate habitat conflict issues. Although uncertainty remains regarding the extent of agricultural development and the effectiveness of mitigation measures, the intent of the ASZ to integrate wildlife habitat management suggests the potentially high risks to ungulate winter range is partly reduced.

Mountain Goat Winter Range

Scenario O enhances protection for mountain goats vs. the Base Case by shifting the areas of high value goat winter range from GMZs to more compatible land use designations, including 86% in SMZs and 13% in PAs (Tetzalto Mountain situated in the proposed Sutherland Valley PA) (Fig. 11). This shift in land allocation together with *Management Objectives and Strategies* (e.g., establishment of *Wildlife Habitat Areas* at headwater of Tildesley Creek) outlined by the draft Lakes LRMP document, indicates relatively low risks to mountain goats and provides increased certainty that mountain goat winter range will be appropriately addressed during landscape unit planning.

Figure 11: Proportion of Mountain Goat Winter Range in each RMZ Category

10.8 Fisheries

Salmon Spawning Habitat

FPC *Riparian Reserves Zones* and *Watershed Assessment* procedures (in the the Base Case) reduce the risks to fisheries values, including salmon spawning habitat. The Scenario retains a little over a third (37%) of spawning habitat in SMZs, which is slightly less than the Base Case. However, the Scenario also allocates an additional 12% to PAs (Fig. 12). Although this appears to suggest enhanced protection for salmon spawning habitat, a similar increase (14%) in the ASZ indicates diminished benefits and suggests no positive net area effect. Similar to the Base Case, approximately 20% of spawning habitat occurs in Settlement Areas and also remains at risk. However, *Management Strategies* outlined by the draft Lakes LRMP document (inventory, monitoring , designation of sensitive areas as wildlife habitat areas) may mitigate the potential adverse effects of resource development activities that pose risks to spawning habitat.

Figure 12: Proportion of Salmon Spawning Habitat in each RMZ Category

Significant Fish Streams

Although *Riparian Management and Lakeshore Management Areas* (FPC) are anticipated to provide enhanced protection for fish streams, the Scenario provides some incremental benefits compared to the Base Case by allocating the majority (61%) of significant fish-bearing streams to SMZs, including 9% in PAs (Fig. 13). This shift in land allocation suggests reduced impacts to riparian areas and fisheries values, particularly those associated with increased road development. The draft Lakes LRMP document also proposes the development of a strategic fisheries plan that will include the identification and establishment of sensitive fisheries areas. Overall, the proposed plan indicates enhanced protection for significant fish streams compared to the Base Case and pose relatively low risks to maintaining freshwater fish habitat on crown land. Fish habitat in ASZs, however, remains vulnerable.

Figure 13: Proportion of Areas Surrounding Significant Fish Streams in each RMZ Category

10.9 Biodiversity Implications of designating an Agriculture Zone.

Although the potential effects of agricultural development (e.g., livestock grazing) on biodiversity have not been formally researched to that extent that forestry-related impacts have, it can be confidently stated that the implications to biodiversity from agricultural activities are generally more severe. This is because land conversion and livestock grazing result in permanent and often irreversible effects on native plants, animals and ecosystem processes. Although agricultural areas can enhance habitat for some wildlife species, overall, agricultural areas are likely to suffer a greater loss of biodiversity than are areas subject to forestry activities.

It should be recognized that the impact of agriculture on biodiversity, however, will depend largely on the natural and land-use history of the farming area, the size of the farm, and the horticultural and husbandry methods being used (Seigel 1996). Major threats to biodiversity from agricultural development typically include livestock grazing, habitat fragmentation, (removal of mature forest cover, particularly aspen), degradation of riparian areas and reduced water quality.

The draft Lakes LRMP document explicitly recognizes these concerns, and contains management strategies (# 4.1-4.4) aimed at mitigating these potential impacts. Also, the intent of the Agriculture/Settlement zone is also to place a high value on integrating wildlife habitat concerns (e.g., ungulate winter range). *Range Practices Regulations* (FPC) will also assist in mitigating the potential adverse effects of range development.

Finally, much (about 43,000 ha.) of the proposed Agriculture/Settlement Zone (ASZ) occurs in the dry-cool Sub-Boreal Spruce (SBSdk) biogeoclimatic zone which has already undergone extensive land conversion. The SBSdk supports a large number of terrestrial vertebrate species (especially birds) as well as a number of rare plant communities (Radcliffe *et al.* 1994; draft Lakes LRMP Socioeconomic & Environmental Base Case 1996). Further development in this ecologically diverse subzone suggests increased risks to remaining areas that support sensitive plant and animal communities.

10.10 Conclusions

Overall, Scenario O provides many benefits for environmental values. This is largely due to the allocation of Special Management Zones where significant environmental values occur (e.g., riparian corridors, caribou migration corridor, ungulate winter range, remote lakes). The establishment of 3 new Protected Areas also provides significantly enhanced protection for two key large mammal species (i.e., woodland caribou, grizzly bears).

In addition, the explicit attempt to conserve riparian connectivity through the identification and management of 'strong links' indicates a key element of biodiversity (landscape connectivity) has been addressed at a sub-regional level and provides a framework for the establishment of Forest Ecosystem Networks (FENs) during landscape unit planning. This approach, in combination with FPC regulations, reduces the risks to species and ecological processes dependent on riparian communities. *Management Objectives and Strategies* recommended by the Lakes LRMP also contribute positively by providing management direction to lower level planning processes which can help reduce uncertainty and risks.

Although implementing Scenario O suggests some positive consequences and reduced risks to many environmental values, certain risks remain. For example, although the Scenario provides management direction to maintain riparian connectivity through management of 'strong links', the distribution of Intensive Timber Management Zones (i.e., Enhanced Timber Development Areas) suggests *interior forest conditions* maybe at risk in upland areas. This would have negative effects on species that require large contiguous patches of mature and old forests (e.g., marten, some forest songbirds). Although reducing the rate of timber harvest is by far the most effective means to reduce habitat fragmentation and maintain more area in mature forests, careful establishment of *Wildlife Habitat Areas* (WHAs), *Forest Ecosystem Networks* (FENs) and *Old Growth Management Areas* (OGMAs) during landscape unit planning should partially mitigate the potential adverse effects of resource development.

A further risk involves the proposed Agriculture/Settlement Zone. Although just how much agricultural development would have occurred in the absence of a land use plan (i.e., in the Base Case) remains unclear, the explicit establishment of this zone increases the risks to fish and wildlife habitat. The GIS area analysis indicates conflicts are most severe with moose and deer winter ranges as well as salmon spawning habitat. However, the intent of the Agriculture/Settlement zone to place high value on wildlife habitat together with management strategies designed to mitigate potential conflicts suggests potentially high risks are somewhat reduced.

10.11 References for Environmental Analysis

BC. Environment. 1995. A future for the Grizzly: British Columbia Grizzly Bear Conservation Strategy. pp. 15.

Belsky, A.J., and D.M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the Interior West. *Conservation Biology* 11(2):315-327.

Bunnell, F.L. and L.L. Kremsater. 1990. Sustaining wildlife in managed forests. *N.W. Environ. J.* 6:243-270.

Cichowski, D.B. 1989. Seasonal Movements, habitat use and winter feeding ecology of woodland caribou in west-central British Columbia. M.Sc., Univ. B.C. Vancouver, B.C.

Cichowski, D.B. & A. Banner 1993. Management Strategy and Options for the Tweedsmuir-Entiako Caribou Winter Range. Land Management Report, 83. MoF

D.N. Cole., and P.B. Landres. 1996. Threats to wilderness ecosystems: impacts and research needs. *Ecol.Appl.* 6:168-184.

Fleischner, T.L. 1994. Ecological costs of livestock grazing in North America. *Conservation Biology.* 8: 629-644

Forest Practices Code of BC 1995. Riparian Management Area Guidebook.

Forest Practices Code of BC 1996. Managing Identified Wildlife Guidebook (Draft)

Forest Practices Code of BC 1996. Lake Classification & Lakeshore Management Guidebook.

Franklin, J.F. 1993. Lessons from old growth. *J. Forestry* (Dec): 11-13

Lakes District Land and Resource Management Plan (Draft). June 5,1997.

Lakes TSA. AAC Determination Meeting. Unpub. Report. Jan. 24-25, 1996

McLellan, B.N. 1989. Dynamics of a grizzly bear population during a period of industrial extraction. III. Natality and rate of increase. *Can. J. Zool.* 67: 1865-1868.

Morrison, M.L., B.G. Marcot, and R.W. Mannan. 1992. *Wildlife-Habitat Relationships. Concepts and Applications.* The University of Wisconsin Press. pp. 343.

Pederson, L. 1996. Lakes TSA. Rationale for AAC Determination. MoF.

Radcliffe, G., Bancroft, B., Porter, G., and C. Cadrin. 1994. Biodiversity of the Prince Rupert Forest Region. Ministry of Forests, B.C. pp.115.

Report for the Lakes LRMP Working Group on the East-Ootsa-South Area.

Seigel, 1996. "Subdivisions versus Agriculture": from false assumptions come false alternatives. *Conservation Biology* 10: 1473-1474.

Timber Supply Review - Lakes Timber Supply Analysis. 1995. MoF.

Prince Rupert Region Protected Areas Strategy Report. 1996.

Thompson, I. 1994. Marten populations in uncut and logged boreal forests in Ontario. *J Wildl. Manage.* 58:272-280.

With, K. A., Gardner, R.H. and Turner, M.G. 1997. Landscape connectivity and population distributions in heterogeneous environments. *Oikos* 78: 151-1