



*A Component of
British Columbia's
Land Use Strategy*

Kalum Land & Resource Management Plan (LRMP)

Socio-Economic & Environmental Assessment: Final Report

prepared by

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in association with the

**Kalum LRMP Inter-agency Planning Team and the
Ministry of Sustainable Resource Management**



January 2002



TO: Kalum LRMP Table & Inter-agency Planning Team
FROM: Gord Enemark, Senior Analyst - Ministry of Sustainable Resource Management
RE: Socio-Economic/Environmental Assessment of Final Land and Resource Management Plan
DATE: January, 2002

Attached is the assessment of the key socio-economic and environmental implications of the *Kalum Land and Resource Management Plan* (April, 2001).

The assessment was done by independent contractors Gary Holman (Consulting Economist) and Eliot Terry (R.P. Bio., Keystone Wildlife Research), with input from the LRMP Inter-agency Planning Team and myself. The objective of the report is to provide an impartial assessment of the implications and trade-offs that may result from the implementation of the Kalum LRMP. It is noted that the methodology attempts to be consistent with the provincial government's *Social and Economic Impact Assessment for Land & Resource Management Planning in B.C.: Interim Guidelines*, 1993.

The assessment incorporates Geographic Information System (GIS) data and the implications of several issues that have been resolved by government and the LRMP Table based on the results of previous socio-economic and environmental assessments and input from the public. This somewhat more detailed assessment was completed after the government decision on the Kalum LRMP was made in the spring of 2001. However, the key conclusions do not differ from those of the preliminary assessment done prior to the completion of Table deliberations.

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**Summary of Socio-Economic Implications – Kalum LRMP
Base Case vs Recommended Land Use Plan**

Account	Base Case	Land Use Plan
ECONOMIC DEVELOPMENT		
<u>Forestry</u>	<ul style="list-style-type: none"> • Total current Allowable Annual Cut (AAC) of the Kalum Plan Area is ~1.46 million m³/yr. • 12.5% of Plan Area Gross Land Base (GLB) in Timber Harvesting Land Base (THLB). • In 1996, there were 2,400 forestry jobs in the Plan Area, accounting directly & indirectly for 25% of total jobs & income. • Current AAC can be held for 1 decade but will likely decline over time due to “fall-down” & the FPC, (~340,000 m³/yr by year 51). • Sawmill closure & about 280 direct forest jobs at risk due to fall-down & FPC. Industry consolidation, technological change & trend to certification will reinforce employment impacts. • Underharvest of AAC in recent years, of over 20% of Plan Area timber volume, due primarily to market conditions (e.g., for hemlock-balsam). • Forestry employment in short term depends primarily on market factors & viability of Skeena Cellulose, regarding which considerable uncertainty. 	<ul style="list-style-type: none"> • Plan could reduce AAC in Plan Area by about 7% in decade 1, but significant, existing underharvest means that LRMP will not result in loss of existing jobs. • Harvest reduction resulting from LRMP could forego up to 80 future forestry jobs & 25-40 spin-off jobs, or 0.6% - 0.7% of total 1996 employment. • Future impacts likely would take form of foregone income rather than job impacts (i.e., fewer days of logging & milling employment). • Grizzly strategies largest source of impact, exacerbating adjacency constraints created by historical harvesting patterns. • Plan marginally increases risk of permanent sawmill closure in longer term, but risk already considerable in Base Case.
<u>Tourism & Recreation</u>	<ul style="list-style-type: none"> • In 1996, about 1,600 tourism jobs in Plan Area (incl. business travel), generating 13% of total jobs. Census data indicates strong growth. • Salt / freshwater sport fishing is the most important nature-based activity. • 38% of Plan Area offers high quality primitive & semi-primitive tourism / recreation opportunities, which will become increasingly scarce over time. • Most scenic, existing tourism use, Class I & II angling & primitive / semi-primitive areas in Plan Area are in the Base Case equivalent of General Management & Settlement Zones & will be compromised over time by continued timber harvesting & road building. • Timber-related road networks will improve access for some kinds of recreation. Commercial tourism/business travel likely to continue gradual growth for foreseeable future. 	<ul style="list-style-type: none"> • Creation of 21 new PAs to 21% of GLB (an increase from 15% in Base Case) & increase in SRMZs & no logging areas to 23% of GLB (up from 10%) will better protect key fish, wildlife & recreation values & increase growth potential in nature-based tourism. • PAs & SRMZs increases protection to 44% of existing tourism use areas, 49% of scenic areas, 49% of Class I & II angling areas. • Plan impact will be to increase future job growth over time in tourism, already the fastest growing sector in Plan Area. • Plan will still result in erosion of some key tourism values (e.g., over 80% of & primitive & semi-primitive areas still in GRMZs). • Trends in front-country tourism / business travel likely to be similar to the Base Case.
<u>Commercial Fisheries</u>	<ul style="list-style-type: none"> • Skeena River system is second largest salmon producer in B.C. In 1996, fishing / processing provided 110 jobs, ~1% of Plan Area total. • Commercial fishing employment has declined significantly since 1996 due to salmon stock declines & vessel buyback. • Forest Practices Code, Fish Protection Act & stricter harvest management should improve stocks, but still risks from continued timber harvesting & mixed stock fishery. 	<ul style="list-style-type: none"> • Better protection of key salmon watersheds (e.g., Upper Copper, Lakelse) & other management strategies will improve protection for salmon habitat. • Commercial benefits of better salmon habitat protection provided by LRMP will depend on effectiveness of federal fisheries management.

Account	Base Case	Land Use Plan
<u>Agriculture & Aquaculture</u>	<ul style="list-style-type: none"> • In 1996, agriculture contributed 2% of Plan Area employment (210 jobs). Most activity in Skeena River valley. Number of farms & jobs increasing. • Modest future growth, constrained by soils, small local market, & distance from larger markets. • No existing aquaculture operations, but potential for future growth. 	<ul style="list-style-type: none"> • Land use and resource management direction in the Plan for agriculture & aquaculture is not significantly different from existing provincial policies. Similar trends & activity levels anticipated in these sectors as in Base Case.
<u>Mining & Energy</u>	<ul style="list-style-type: none"> • Alcan smelter accounts for 14% of Plan Area jobs, but not linked to Plan Area resources. • No operating mines, but about 100 (0.7% of) total Plan Area jobs in quarrying & exploration. MEM considers Plan Area to be under-explored. • None of the 10 developed prospects, 20 past producers, 17 prospects or placer tenures are precluded by PAs. 5% of showings, 1.8% of extreme metallic potential, 0.5% of high industrial potential, & 1.4% of mineral claims are precluded by existing PAs. • Likelihood / timing of mineral development is uncertain. Sand & gravel will be developed as necessary to meet continued demand. • No oil/gas activity in Plan Area, & potential for development is low for several decades. BC Hydro has no plans for new power sources. • Some long term potential for small geothermal, but more likely as tourism-related development. • Land claims & low metal prices are key impediments to investment. 	<ul style="list-style-type: none"> • No existing quarries, developed prospects, prospects, mineral claims, placer tenures or metallic potential are precluded by new PAs. • Slightly more past producers (5%), showings (1%) & high industrial potential (1%) are precluded by new PAs. • Increased % of Plan Area in new SRMZs. Cost of mineral exploration & development could marginally increase, but Plan affirms road access to all lands outside PAs. Access through Brim & Exchamsiks PAs allowed if no alternative. Access to several claims in Foch/Giltoeyes PA also assured by the Plan. • PAs preclude slightly higher % of moderate oil & gas potential, but impacts not likely for several decades due to better prospects elsewhere in BC. Access to Skeena River gas & power line corridor for emergencies / upgrading assured by the Plan. • PAs also preclude slightly higher % of high geothermal, but tourism-related development may be allowed in some PAs. • Economic significance of mining & energy impacts depends on probability & timing of mine development, but very difficult to quantify because of “hidden” nature of resource.
<u>Trapping / Botanicals</u>	<ul style="list-style-type: none"> • Trapping & botanicals provide seasonal income & also important to First Nations culture. • Populations of key furbearing species (e.g., marten) at risk from continued timber harvesting & number of trappers likely to decline over time. • Market demand likely to continue growing for mushrooms & other botanicals. Pine mushroom habitat at risk due to continued clear cutting & inadequate regulation / management. 	<ul style="list-style-type: none"> • Plan better protects older forest & provides more support for key furbearers & some botanicals (e.g., Pine mushrooms). • Continuing decline in furbearers & number of trappers likely, but less than Base Case. • Better protection of older forest & identification of high value growing sites will better support Pine mushroom resource potential, but benefits subject to better regulation / management.

Account	Base Case	Land Use Plan
COMMUNITY	<ul style="list-style-type: none"> Water quality & quantity expected to be maintained over most of the Plan Area due to existing Community Watershed areas & existing regulations. However, there are specific areas where water quality/quantity remain a concern due to high demands & use (e.g., Kleanza, Lakelse). Most of Plan Area residents live in the Terrace – Kitimat corridor. Main economic drivers are forestry, Alcan smelter & tourism. Alcan smelter & Eurocan pulp mill in Kitimat not strongly linked, if at all, to Plan Area resources. Terrace is highly dependent on forestry & government jobs. Reduced timber harvests, industry consolidations & related forestry employment reductions expected after decade 1. Impacts could occur sooner depending on viability of SCI. Slow economic & population growth expected. Growth opportunities appear to be mainly in tourism & aquaculture sectors. Treaty settlements & Delgamuukw precedent likely to result in greater First Nations control over resource development & related benefits 	<ul style="list-style-type: none"> Impacts of Plan are primarily on potential future jobs, not existing jobs. SCI's mill / woodland workers in Terrace area most affected by future harvest constraints in the Plan Area. Harvest impacts on West Fraser (Terrace & Kitimat) relatively minor. Potential foregone future forestry jobs represent about 0.7% of total jobs in Terrace. Minor forestry impacts on Kitimat in short term because potential harvest impacts only about 1% of total Eurocan pulp mill requirement. Foch-Giltoyees PA & increased VQOs in Gardener Channel particularly important to growing marine tourism sector in Kitimat area. VQOs in Upper Copper / Miligit & PAs / SRMZs on Lakelse River important to Terrace. Industrial / settlement lands important to Terrace & Kitimat recognized by Plan, excluded from FLR.
FIRST NATIONS	<ul style="list-style-type: none"> Most of Plan Area in traditional territory of Tsimshian (Kitselas & Kitsumkalum Bands) & Haisla (Kitimaat Band). Nisga'a Treaty area excluded from Plan Area. First Nations comprise 7% of Plan Area resident population. In 1996, 30% of Plan Area on-reserve labour force worked in fishing & forestry. This has since declined due to problems in these sectors. Key concerns are sustainability of fish/wildlife, unemployment rates approaching 90% in some cases, lack of training/capacity, lack of control over, & benefits from land & resources. Future treaty settlements will likely include financial compensation, encourage joint ventures & increase economic stability in the Plan Area. 	<ul style="list-style-type: none"> Forestry, tourism & fisheries are most important sources of jobs affected by land use. Traditional hunting, fishing, trapping & food / medicinal plants important economically & culturally. Plan could place at risk future forestry-related job / income opportunities. Plan generally more supportive of "nature-based" tourism, sustenance activities & archaeological resources. Better protection of the Kowesas & Upper Kitsumkalum particularly important to First Nations in these areas. In general, Plan more consistent with the First Nations' economic development vision.
GOVERNMENT REVENUE	<ul style="list-style-type: none"> Plan Area timber harvest generates about \$27 - \$39 million/yr in provincial stumpage & corporate income tax revenues. Harvest level and related revenues can be maintained for the first decade. 	<ul style="list-style-type: none"> LRMP will not reduce existing stumpage & corporate income tax revenues due to current underharvest, but future revenues of \$1.3 - \$2.2 million/yr could be foregone.
ECONOMIC EFFICIENCY	<ul style="list-style-type: none"> Total net resource value of Plan Area timber harvest roughly estimated at \$3.9 million/yr depending on assumptions re net value (i.e., after costs) of harvested timber & viability of currently underharvested timber. 	<ul style="list-style-type: none"> No existing timber resource rents lost as result of LRMP, but future foregone rents of up to \$273,000/yr with a net present value of \$4.5 million, depending on net value assumptions. Annual loss in net timber value equivalent to about \$0.18/yr/household. Each household would have to be willing to pay this amount to regard the environmental & other benefits of the LRMP as a net social gain.

Summary of Environmental Implications – Kalum LRMP
Base Case vs Recommended Land Use Plan

Account	Base Case	Land Use Plan
<p>ECOSYSTEM REPRESENTATION & PAS</p>	<ul style="list-style-type: none"> • 18% of Plan Area in fully protected & partially PAs (i.e., Gitnadoiks Recreation Area). Provincially, only one of five ecosections (Kitimat) is reasonably well represented (18.5%). The Nass Basin (mostly Nisga'a Lands) & Nass Ranges are somewhat underrepresented with 4-6% in existing PAs. • Of the 15 biogeoclimatic subzone/variants that occur in the Plan Area, most have some degree of representation (4-26%). However, the CWHws1, which only occurs within the Kalum LRMP (Kitimat & Nass Ranges ecosections), is significantly underrepresented in PAs (<1%, partly due to an extensive logging history). 	<ul style="list-style-type: none"> • 21% of Plan Area in PAs. Foch/Giltoyees (59,765 ha – new PA) & Gitnadoiks Recreation Area (57,760 ha - upgraded to Provincial Park status), provide additional representation of the Kitimat Ecosection & three biogeoclimatic subzone/variants (CWHvm, MHmm1, ATp). • 19 Goal 2 PAs, which represents an additional 6,497 ha (0.31% of the LRMP area) in new parks. These relatively small areas vary in size from 3 to 890 ha & provide enhanced protection for regionally & provincially significant natural, cultural heritage & recreational features, particularly in the Douglas Channel (e.g., lagoons, estuaries, hotspots). • Similar to the Base Case, the Nass Ranges & in particular, the CWHws1 remains underrepresented (<1%).
<p>BIODIVERSITY</p>		
<p><u>Old Growth Riparian Habitat Red & Blue-Listed Species</u></p>	<ul style="list-style-type: none"> • Natural levels of biodiversity expected to decline over the long term as the amount of mature & old coniferous forest decreases & human disturbance increases. Overall, species dependent on early seral forests expected to benefit whereas species dependent on large contiguous areas of mature & older forests (e.g., grizzly) are expected to decline. • If continued, existing management practices/policies/regulations (e.g., implementation of Forest Practices Code (FPC), Landscape Unit Planning Guide (LUPG), Identified Wildlife Management Strategy (IWMS), Environmental Assessment Act), however, partly reduce the risks. <p>Risk: High</p>	<ul style="list-style-type: none"> • In general, new PAs (especially the large Gitnadoiks/Foch/Giltoyees PA), SRMZs & Seral Stage Transition Strategy reduces the risk to landscape-level biodiversity compared to current policy direction (i.e., LUPG). Implementation of full seral targets as outlined in the Biodiversity Guidebook (1995) will provide more opportunities to maintain native & wide ranging species & ecological processes. • Reduced risks to riparian habitats by identifying no logging zones (e.g., Upper Kitsumkalum, Ascaphus Creek) in riparian areas as well as applying alternate silvicultural systems in specific areas (e.g., Lakelse River Corridor Special Management Zone • Enhanced protection for some red & blue-listed species including tailed-frog (blue-listed) in the Ascaphus Creek Special Resource Management Zone (SRM) where logging is not permitted. • Other positive measures proposed to reduce risks to rare ecosystems include a no net loss policy for estuary ecosystems including the establishment of the Kitimat River as a Sensitive Area under the FPC. <p>Overall Risk: Moderate</p>

Account	Base Case	Land Use Plan
WILDLIFE		
<p><u>Grizzly Bear</u> <u>(Blue-listed</u> <u>Identified</u> <u>Wildlife)</u></p>	<ul style="list-style-type: none"> • 18.7 % of High suitability grizzly bear habitat in PAs; 7% in SMZs. Majority, however, occurs in General Management (72%). • Although some stand-level management is expected (e.g., WHAs, buffering of avalanche chutes), lack of management direction (e.g., seral stage distributions/ road access) from a Higher Level Plan increases risks to grizzly bears over the long term. <p>Risk: High</p>	<ul style="list-style-type: none"> • 21.7% (an additional 3% or 55,572 ha) of moderate to very high capability grizzly bear habitat allocated to PAs, 3% to No Logging (3%) & another 20% to other Special Management Zones. 54% remains in General Management. • Reduced risks to grizzly bear habitat by setting seral stage targets in 2 key grizzly bear identified watersheds (Copper, McKay-Davies) & managing high value foraging areas (wetter site series) in 11 others. Management direction is proposed to maintain critical patch habitats (e.g., skunk cabbage swamps, avalanche chutes) across the Plan Area which will ensure access to important seasonal food sources. To reduce bear/human conflicts & mortality risks associated with increased road access, coordinated access management plans are proposed in key watersheds. • In addition, three Grizzly Bear Management Areas (GBMAs) are identified & designated as Special Resource Management Zones including a large benchmark [Khutzeymateen (386,184 ha)], & two population linkage areas that will serve as dispersal & movement corridors & may reduce the probability of population fragmentation (genetic isolation) over the long term. • Overall, reduced risks to grizzly bears over portions of the Plan Area compared to the Base Case. However, because not all GBIWs will be managed to meet grizzly bear seral constraints, risks will vary across the Plan Area. Overall risks are estimated as moderate. <p>Risk: Moderate</p>
<p><u>Moose</u></p>	<ul style="list-style-type: none"> • About 27,602 ha (37%) of moose winter range occurs on the timber harvesting landbase & is at risk from forest harvesting & silvicultural activities. • A relatively large amount (82%) of moose winter range occurs in the General Resource Management Zone (RMZ). Although the overall intensity of forest management activities in the General RMZ may provide suitable moose winter range in the short term, mature & old forest cover may become limiting over the long term. <p>Risk: Moderate</p>	<ul style="list-style-type: none"> • 30% of moose winter range allocated to RMZs considered to pose relatively low risks (i.e., No Logging, other SMZs.). Sixty-one percent of moose winter range remains in General Management. • Three key floodplain winter ranges (Beaver, Nass & Skeena) designated as Known Ungulate Winter Range under section 69 of the Forest Practices Code (FPC) of BC. In addition, both landscape & stand-level management strategies are outlined that will provide adequate food & shelter over time. Risks to the Beaver moose winter range (e.g., reduced thermal cover, increased road access) are further reduced because of the no logging provision proposed in the Upper Kitsumkalum Special Management Zone. • Overall, significantly reduced risks to moose winter range over the long term. <p>Risk: Low</p>

Account	Base Case	Land Use Plan
Mountain Goat	<ul style="list-style-type: none"> 21% of high capability mountain goat habitat occurs in fully or partially PAs (Kitlope Heritage Conservancy & Gitandoix Recreation Area respectively). Outside of these PAs, however, the remaining goat habitat is vulnerable to resource development activities over time. Although the <i>Identified Wildlife Management Strategy</i> (IWMS) may provide some habitat protection measures including the potential establishment of <i>Wildlife Habitat Areas</i> (WHAs) & <i>General Wildlife Measures</i> (e.g., access, silviculture), there is uncertainty regarding when & where these measures may be established. <p>Risk: Moderate-High</p>	<ul style="list-style-type: none"> 23.3% of mountain goat winter range in PAs (i.e., an additional 2% or 18,673 ha) & an additional 3% (28,084 ha) allocated to <i>No Logging</i> SMZs. Overall, enhanced protection for mountain goats due to PA & SMZ designations as well as management strategies that will reduce the risks associated with human disturbance & the loss of mature & old forests used as thermal cover (e.g., proposed 400-m no harvesting zone adjacent to known escape terrain) Improved mountain goat winter range mapping (1:20,000) will help identify critical escape terrain to be considered as potential WHAs &/or Old Growth Management Areas (OGMAs). <p>Risk: Moderate</p>
Fisheries	<ul style="list-style-type: none"> The potential to negatively impact fish & fish habitat will increase as resource development pressures increase over time. Although existing regulations provide some degree of habitat protection (e.g., FPC, Fish Protection Act), inadequate riparian habitat protection for small fish bearing streams as well as non-fish bearing streams that flow directly into fish bearing streams (i.e. S5, S6) remain a concern. Overall, increased riparian protection, watershed level assessments & the potential risks of aquaculture for wild salmonids have been identified as key issues that need to be addressed to reduce the risks to fisheries habitat. <p>Risk: Moderate-High</p>	<ul style="list-style-type: none"> Reduced risks to fish & fish habitats due to increased certainty that fish habitats will be addressed through further inventory & mapping of salmon, herring & oolichan spawning grounds. Increased emphasis on implementing comprehensive <i>Coastal Watershed Assessment Procedures</i> (CWAPs) for all major river/creek systems. Enhanced protection for specific areas including the designation of the Upper Cooper River as a Special Management Zone & the Lakelse Rive Corridor, which provides habitat for large numbers of both anadromous & non-anadromous fish. <p>Risk: Moderate</p>
WATER QUALITY/ QUANTITY	<ul style="list-style-type: none"> Water quality & quantity expected to be maintained over most of the Plan Area due to existing Community Watershed areas & existing regulations. However, there are specific areas where water quality/quantity remain a concern due to high demands & use (e.g., Kleanza, Lakelse). <p>Risk: Low-Moderate</p>	<ul style="list-style-type: none"> Enhanced protection for water quality/quantity due to the designation of five new Community Watersheds: <ol style="list-style-type: none"> 1) Rosswood (Clear Creek) 2) Usk (Skovens Brook), 3) Kleanza (Singlehurst Creek) 4) Gossen (Gossen Creek), & 5) Hatchery Creek. Kalum LRMP also proposes to maintain natural flow regimes to the extent possible by ensuring a clear-cut equivalency of less than 20% of the watershed area in sub-basins larger than 250 ha. <p>Risk: Low</p>

PART I:

**SOCIO-ECONOMIC ASSESSMENT
OF THE KALUM LRMP**

prepared by
Gary Holman, Consulting Economist
in cooperation with the
Kalum Inter-agency Planning Team

January, 2002

Executive Summary

The new Protected Areas (PAs) and “no logging” areas, Visual Quality Objective (VQO) zones and other specific management zones / strategies to protect Grizzly and Goat populations, will better support the resource values upon which eco-tourism, one of the fastest growing sectors in B.C. and in the Plan Area, depends. The Plan will also better protect other nature-based sources of livelihood such as fishing, trapping and botanical forest products (e.g. wild mushrooms). The economic impacts of the Plan on such livelihoods will occur over time, for example, in the form of faster growth and higher growth potential in wilderness tourism.

These land use designations and strategies could reduce future employment potential in mineral and energy (i.e., natural gas) exploration and development, but any impacts are unlikely for several decades. The hidden nature of mineral resources, and the many factors affecting viability, makes the likelihood and timing of mineral development difficult to predict.

The Ministry of Forests’ timber supply analysis indicates that the current Plan Area AAC can be maintained for a decade in the Base Case. The timber supply impacts resulting from the LRMP could result in a 7% decline the current AAC in the Plan Area, likely within the first decade. It is unlikely that these timber supply impacts, which are greatly exceeded by the current “underharvest” in the Plan Area, will result in loss of existing jobs in the region or in B.C. However, they could affect future job growth in the forestry and related sectors once markets for forest products improve.

Timber supply impacts will primarily affect forestry job growth potential in the Terrace area. Kitimat’s main industries, the Alcan smelter and the Eurocan pulp and paper mill are not linked very strongly (Eurocan) or at all (Alcan) to incremental changes in land use and resource management in the Plan Area. The Plan will better protect the growth potential for tourism in the Kitimat and Terrace areas as a result of better protection of readily accessible recreation areas (e.g. the Foch/Giltoyes PA, improved VQOs in Douglas Channel and in Upper Copper River).

The Plan could reduce some future forestry-related opportunities for aboriginals, but will be more supportive of First Nations’ nature-based economic development opportunities (e.g. land and coastal-based eco-tourism, fisheries for salmon and other marine aquatic species, botanical forest products), as well as other traditional and sustenance activities such as hunting and trapping. The Plan provides for involvement of First Nations in resource management planning (e.g. the Haisla in the Kowesas watershed). Therefore, the Plan will likely result in an economic and resource development vision that is more consistent with that of First Nations groups in the area.

The Plan is likely to result in a more diversified, sustainable economy than in the Base Case. Over time, the “zoning” of the land base and the involvement of First Nations in resource management should result in greater investor certainty, although it may take several years before the influence of the LRMP on lower level planning becomes clear.

The LRMP will not reduce existing stumpage and corporate income tax revenues due to the current underharvest, but future revenues of \$1.3 - \$2.2 million/yr could be foregone. No existing timber resource rents (i.e., in excess of a normal rate of return) will be lost as result of LRMP, but future rents of up to \$273,000 per year or \$4.5 million (NPV) could be foregone, depending on the recovery of forest product markets and net value assumptions. The annual loss in net timber value is equivalent to about \$0.18/yr/household. In other words, each household in B.C. would have to be willing to pay at least this amount to regard the environmental and other benefits of the LRMP as a net social gain.

Table of Contents

Executive Summary	i
List of Tables	iii
1. Introduction and Description of Base Case	1
2. Proposed Land Use Recommendations.....	2
3. Forestry	3
3.1. Base Case (i.e., without LRMP)	3
3.2. Implications of Proposed Land Use Plan.....	5
4. Tourism and Recreation.....	7
4.1. Base Case (i.e., without LRMP)	7
4.2. Implications of Proposed Land Use Plan.....	8
5. Mining and Energy	9
5.1. Base Case (i.e., without LRMP)	9
5.2. Implications of Proposed Land Use Plan.....	10
6. Agriculture and Aquaculture.....	12
6.1. Base Case (i.e., without LRMP)	12
6.2. Implications of Proposed Land Use Plan.....	12
7. Trapping and Botanical Forest Products	13
7.1. Base Case (i.e., without LRMP)	13
7.2. Implications of Proposed Land Use Plan.....	13
8. Commercial Fisheries	14
8.1. Base Case (i.e., without LRMP)	14
8.2. Implications of Proposed Land Use Plan.....	14
9. Community / First Nations Concerns	14
9.1. Base Case (i.e., without LRMP)	14
9.2. Implications of Proposed Land Use Plan.....	15
10. Government Resource Revenues and Economic Efficiency Implications	17
10.1. Base Case (i.e., without LRMP)	17
10.2. Implications of Proposed Land Use Plan.....	18
APPENDIX 1: Potential Economic Impacts of the Kalum LRMP Resulting from Foregone Timber Harvest	19

List of Tables

Table 1: Kalum Plan Area Gross Land Base (GLB) by Resource Management Zone Base Case vs. Land and Resource Management Plan (% of GLB).....	3
Table 2: Kalum LRMP Projected Timber Harvest Impacts (% of Current AAC).....	5

1. Introduction and Description of Base Case

This report evaluates the socio-economic and environmental implications of Crown land use recommendations by the Land and Resource Management Planning (LRMP) Table for the Plan Area (roughly consistent with the Kalum Forest District). This is a “strategic” plan providing broad direction to lower level planning. The proposed land use objectives and strategies are contained in the document entitled *Kalum Land and Resource Management Plan* (April, 2001). This evaluation focuses on key differences between the LRMP Recommendations and the “Base Case,” (the land use regime and associated trends likely to occur without an LRMP). A brief outline of some key implications of unresolved issues in the Plan is also presented.

The assessment is based on an evaluation of timber supply impacts by the Ministry of Forests and assumptions about the intent of LRMP strategies for forestry and other sectors in various zones. The economic impacts of the Land Use Plan are difficult to quantify because activity in affected sectors is dependent on many factors other than land use, such as international commodity markets and prices, technological change, population / demographic trends, and government policies. Only a limited proportion of the overall Plan Area economy is directly affected by land use changes. The most significant implications of the Land Use Plan, and the easiest to quantify, arise from potential impacts on timber supply in the Plan Area. Impacts on other sectors such as tourism and mining generally involve future potential, rather than existing activity, and are more difficult to quantify. The primary socio-economic indicator used in the assessment is employment, although other indicators are used if data is readily available.

The assessment compares the proposed Land Use Plan with the “Base Case” land use regime, i.e. the Crown land use regime in the absence of an LRMP. The Base Case includes the implications of the *Timber Supply Review* (TSR 2) management regime (excluding Nisga’a lands), the *Forest Practices Code* (FPC), and other current management initiatives of government (e.g., the *Mining Rights Amendment Act*, *Mineral Exploration Code*, etc.). As in TSR 2, the Base Case requires only the minimum biodiversity requirements of the FPC’s *Landscape Unit Planning Guide* (i.e. Old Growth Management Areas and Wildlife Tree Patches). Protected Areas (PAs) as recommended by the Regional Protected Areas Team (RPAT) and the LRMP Table are not attributed to the Base Case, since no PA target was set by government for this LRMP.

In order to have a “benchmark” against which to compare the recommended Plan, the study team requested the Inter-Agency Planning Team (IPT) to divide the 2.166 million hectare Plan Area into Base Case Management Zones (MZs). As a result, the Base Case MZs include: existing Protected Areas (PAs); a number of Special Management Zones (including Preservation / Retention / Partial Retention Visual Quality Objective or “VQO” zones, the Thunderbird Local Resource Use Plan or “LRUP” zone, and Community Watersheds); a General Management zone; and a Settlement/Private Land zone. These zones are then compared to the zones and management strategies developed for the recommended Plan (see Table 1).

2. Proposed Land Use Recommendations

Three categories of consensus management direction have been recommended for the LRMP area: Protected Areas, Special Resource Management Zones (SRMZs) and General Resource Management Zones (GRMZs). Settlement Zones comprise about four percent of Plan Area.¹

The GRMZ direction represents minimum, baseline management for resource activities on all Crown land (including SRMZs) outside Protected Areas, including the phasing in of elements of the FPC *Biodiversity Guidebook* (e.g., seral stage distribution targets), and additional management support for Grizzly and Goat. SRMZs apply to specific areas to provide more specific management support for distinct biophysical characteristics and resource issues. Key protected areas and SRMZs recommended in the Land Use Plan are as follows:

Protected Areas

An additional 21 new protected areas, comprising about 127,000 hectares (about 5.7% of the Plan Area) are recommended, including the 59,760 ha Foch/Giltoyes coastal area. This also includes the 57,760 ha Gitnadoiks Recreation Area, which in the Base Case allowed mineral development but not logging, but in the Plan is confirmed as a protected area that precludes all resource development.

Special Resource Management Zones (No Logging) – Upper Kitsumkalum, Ascaphus Creek, and goat winter range areas are all designated as no harvesting SRMZs.

Other Special Resource Management Zones

- **Visual Quality Objectives** - “Marine Backcountry Areas” (i.e., Jesse Lake, and upper Sue Channel/Loretta Island) along Douglas Channel designated as “Retention” rather than current “Partial Retention”. Also, there are additional VQO restrictions in the Upper Copper River, including the Miligit Valley.
- **Community Watersheds:** 6 existing community watershed zones are affirmed and the designation of an additional 5 community watersheds recommended.
- **Thunderbird Special Management Zone:** The existing plan for the Thunderbird has been integrated into the LRMP as an SRMZ with two subzones (i.e. Lakelse subzone #1 (no logging) and Lakelse subzone #2 (mostly selection logging).
- **High Priority Grizzly Bear Identified Watersheds (GBIW):** seral stage constraints and silviculture prescriptions in 11 identified watersheds to provide more forage for grizzly bears.

¹ The Plan also designates certain areas in which Grizzly bear hunting is restricted or prohibited. However, since such areas do not affect land use per se, they have not been included in the GIS analysis.

Table 1: Kalum Plan Area Gross Land Base (GLB) by Resource Management Zone Base Case vs. Land and Resource Management Plan (% of GLB)^a.

	Settlement ^b	PAs	SRMZs No Logging ^c	Other SRMZs ^d	General Zones ^e
Base Case	4%	15%	3%	7%	70%
LRMP	4%	21%	3%	20%	52%

- (a) Total GLB is almost 2.2 million hectares. The timber harvesting land base (THLB) is about 270,000 hectares, about 12.5% of the GLB.
- (b) Settlement includes private land, Crown land within settlement areas and water.
- (c) No Logging SRMZs includes the Gitnadoiks Recreation Area in the base case and Goat Winter Range, Ascaphus Creek and Lakelse Lake (Subzone 1) in the LRMP.
- (d) Base Case Other SRMZs include: Established Visual Quality Objectives (VQOs), Thunderbird LRUP and Community Watersheds. LRMP SRMZs include all base case SRMZs plus: Miligit Creek SRMZ, higher priority Grizzly Bear Identified Watersheds (GBIW), Lakelse Selection Harvest Area (Subzone 2).
- (e) General in LRMP includes: lower priority GBIW and Alpine Recreation.²

3. Forestry

3.1. Base Case

The Kalum LRMP Plan Area is comprised of the Kalum TSA and TFLs 1 (Skeena Cellulose) and 41 (West Fraser), excluding Nisga’a Treaty lands. Direct forestry employment in the Plan Area was about 2,400 in 1996, accounting directly and indirectly for an estimated 25% of total employment.³ Only a proportion of these jobs is supported by the local timber harvest in the Plan Area, with the remainder based on imported fibre. The Eurocan pulp mill in Kitimat, two large sawmills in Terrace, and 6 smaller specialty and value-added processors located in the Plan Area are dependent to varying degrees on timber harvests in the area. Timber from the Skeena Cellulose TFL and its TSA forest license also supply fibre to its pulp mill in Prince Rupert.

The Base Case scenario includes the 1999 *Timber Supply Review* (TSR 2) management regime (on which the Chief Forester’s most recent AAC determinations are based), which includes the *Forest Practices Code* (FPC) and other current management initiatives.⁴ The Geographic Information System (GIS) area statistics provided by government for

² This designation is intended to preserve opportunities for non-motorized recreation designation (e.g., Mt. William Brown to Mount Morris), and in some cases exclude commercial recreation activities such as heli-skiing and hiking (e.g., Mount Remo). However, these zones lie outside the timber harvesting land base, and do not apply to mineral exploration and development.

³ Basic employment arises from income that flows into the Plan Area from outside and is determined by “external” factors (e.g., forestry, tourism, public sector, etc.). Total Plan Area employment was estimated at roughly 17,000 in 1996. This includes employment in several Nisga’a communities in the Nass Treaty area.

⁴ The impacts of new Protected Areas recommended by the Regional Protected Areas Team (RPAT) are not attributed to the Base Case, since the Plan Area was not given a protected areas target by Government. However, portions of the RPAT areas may have been implemented even without the LRMP.

this assessment indicate the Timber Harvesting Land Base (THLB) at roughly 270,000 ha, or about 12.5% of the entire Plan Area's Gross Land Base (GLB) of about 2.165 million ha, including both TFLs. According to MoF, total AAC for the Plan Area, excluding the Nisga'a Treaty lands, is currently about 1.458 million m³/yr. Previous to the Nisga'a agreement, the overall AAC was 1.584 million m³/yr. The AAC does not include harvests from private lands (which have averaged about 18,000 m³ over the 1996-99 period, but reached 75,000 m³ in 1995), or from First Nations reserves.

Timber supply analysis by MoF indicates that without an LRMP, the current, overall AAC of 1.458 million m³/yr for the Plan Area can be held for 10 years. In the Base Case, by year 11, the overall projected harvest begins to decline steadily until reaching a level of about 1.12 million m³/yr by year 51, a decline of about 23%. The declines in harvest levels are more significant in the two TFLs (about 30%, in aggregate by year 51) than in the TSA (about 7% by year 51).

Actual harvest levels will differ from the AAC, in the short term, due primarily to commodity prices. For example, actual harvest levels for the three management units in the Plan Area - TFL 1, TFL 41 and the Kalum Timber Supply Area (TSA) - have fallen short of the total AAC by an average of 428,000 m³ over the 1997 – 1999 period and by almost 300,000 m³ in 1999. In the long term, trends in technology, operability and timber utilization can also affect the AAC. There is also some indication that timber growth rates, and therefore medium to longer term sustainable harvest levels, may be higher than currently assumed.⁵

Employment in the forestry sector can be influenced by factors other than AAC levels. For example, the requirements of the FPC and Visual Quality Objectives (VQOs) could result in more labour intensive, selection harvesting methods. Commercial thinning and other intensive silviculture investments, funded in the past by Forest Renewal B.C., could also support additional employment. Growth in the value-added / specialty wood sector will likely continue. The future viability and the possible rationalization of Skeena Cellulose Inc. (SCI) operations is a significant factor determining future forestry employment in the Plan Area.

As noted above, the Nisga'a Treaty resulted in a 4% reduction in the Plan Area forest land base and about 126,000 m³/yr. in Plan Area AAC. In addition, the Treaty provides for the possibility of an additional forest license for the Nisga'a. These timber supply sources may still be available to processing facilities within the Plan Area and the region for at least a decade, since one of the terms of the settlement is that the Nisga'a may not establish a primary milling operation for that period. However, it is possible that reduced harvesting activity and/or preferential hiring on Nisga'a lands and in the forest license area could reduce the availability of harvesting jobs on these lands to Plan Area residents.

⁵ For a discussion of some of these factors, see *The Truth is Out There*, L. Pedersen address to Northern Forest Products Association, April 1997.

3.2. Implications of Proposed Land Use Plan

As shown in Table 2, the preliminary timber supply analysis undertaken by MoF indicates that the proposed Land Use Plan would result in a harvest reduction ranging from about 4.3% to 9.3% of the current AAC. For purposes of quantifying the potential economic impacts of the LRMP, a mid-point estimate – 7.1% of current AAC, or about 103,000 m³ - provided by MoF is used.⁶ The breakdown of these impacts by management unit and by source of impact is presented in Table 1 below. As the Table shows, Grizzly bear critical patch habitat and forage strategies in the proposed LRMP comprise the largest source of impacts, followed by Goat winter range, VQOs and no logging areas / protected areas.

Table 2: Kalum LRMP Projected Timber Harvest Impacts (% of Current AAC).

	TSA	TFL 1	TFL 41	Total LRMP	Midpoint Harvest Impact
Grizzly Bear Critical Patch Habitat	3-5	3-5	2-4	2.6 – 4.6	3.6
Grizzly Bear Forage	1-2	1-2	1-2	1-2	1.5
Goat Winter Range	1-2	1-2	0-1	1.3 – 1.6	1.5
Other (new visuals and no logging areas)	0-1	0-1	0-1	0-1	.5
Totals	5-10	5-10	3-8	4.3 –9.3	7.1

Although the timing of harvest impacts has not yet been analyzed in detail, MoF analysts indicate that they would likely be implemented within the next decade (i.e. possibly at the next Timber Supply Review). It is not likely that the timber harvest reductions arising from the LRMP, even if they cannot be deferred, will result in the loss of existing jobs in the Kalum Plan Area. As noted above, actual harvest levels in TFL 1 and 41 and in the Kalum TSA have fallen short of the total AAC for these three management units by an average of 428,000 m³/yr over the 1997 – 1999 period, due to market conditions. Since current employment levels are based on these recent actual harvest levels, the AAC would have to be reduced by much more than the estimated LRMP impact of 100,000 m³/yr before any impacts on current employment would occur.

The underharvest does represent an opportunity for future increases in forestry-related activity, but for incremental changes in harvest levels, it is more likely that this would result in changes in income than jobs. For example, for incremental harvest increases, it is more likely that employees and contractors would work more days, resulting in an income increase rather than a change in the number of workers. At worst, the LRMP would result in the foregoing of about 80 future, direct and an additional 25 - 40 indirect and induced jobs at risk within the Plan Area, representing up to 0.6% - 0.7% of total

⁶ The Chief Forester is responsible for AAC decisions based on a number of biophysical, environmental and social factors. Therefore, the possible magnitude and timing of AAC changes indicated by the results of the timber supply analysis should not be assumed to represent actual decisions by the Chief Forester.

1996 employment within the Plan Area. As shown in Table 2, most of the impacts of the LRMP would be on the TSA and TFL 1.

Provincial impacts (including the nearby Prince Rupert area, where the Skeena Cellulose pulp mill is located) could potentially place at risk an additional 85-100 future, direct harvesting and processing jobs, and 75-140 indirect and induced jobs.⁷ Regardless, foregone employment and income opportunities are less significant to workers and communities than the loss of existing jobs and income.

The likelihood of future, foregone forestry employment and income will depend on the recovery of demand for forest products, particularly for species such as hemlock-balsam which are currently difficult to market. The availability of alternative timber supplies for processing facilities should also be taken into account, for example, from other areas in B.C. (North Coast and Cassiar TSAs) or Alaska⁸ where harvests are also underutilized. The beetle kill problem in north central B.C. will also result in much higher harvest levels, at least in the short term, which could free up wood supplies (directly or indirectly) to processing facilities in the Plan Area.

Steep terrain and poor wood quality already make the Plan Area a high cost supplier. Cost increases attributable to the *Forest Practices Code* and stumpage changes in the 1990s have exacerbated this situation,¹⁰ although more recently, stumpage rates and FPC costs have been reduced somewhat. The LRMP places a higher proportion of the Timber Harvesting Land Base (THLB) in zones with additional management constraints (e.g., Goat winter range and Grizzly critical patch and forage areas, VQOs and community watersheds) compared to the Base Case, which could further exacerbate the high cost situation in the Plan Area. These impacts are not as significant as the direct impacts of harvest reductions, but could result in employment impacts, particularly during periods of low product prices.

Offsetting these potential cost impacts to a certain extent could be the recommendations in the Plan for identifying opportunities for incremental silviculture on medium to high growing sites that are readily accessible, and with an emphasis on higher value species. The Plan should also provide greater certainty for investments in the forestry sector as a result of the recommendation to include the provincial forest in the Plan Area within the provincial Forest Land Reserve.¹¹

⁷ Note these impacts are based on person-year coefficients derived from the socio-economic analysis for the Kalum TSA, and not coast-wide coefficients that include processing activities that are not supported by Plan Area harvests. Indirect and induced effects are estimated with multipliers based on models developed by Ministry of Finance and Corporate Relations. See Appendix 1 for summary of impact assumptions.

⁸ For example, SCI has recently been importing significant volumes of fibre from Alaska. (see *Northwest B.C. needs special economic zone, report says*, G. Hamilton, Vancouver Sun, November 17, 2000)

⁹ For example, SCI has recently been importing significant volumes of fibre from Alaska. (see *Northwest B.C. needs special economic zone, report says*, G. Hamilton, Vancouver Sun, November 17, 2000)

¹⁰ See *Financial State of the Forest Industry and Delivered Wood Cost Drivers*, KPMG for MoF, April 1997.

¹¹ *Kalum LRMP*, op. cit., p. 84. The FLR designation would not include provincial forest within settlement areas or industrial sites, which are particularly important to the communities of Kitimat and Terrace.

4. Tourism and Recreation

4.1. Base Case

Total direct tourism employment in the Plan Area is estimated at approximately 1600, accounting directly and indirectly for about 13% of total employment. Due to lower average wages and more seasonal employment, tourism accounts for about 5% of the Plan Area's total income. Most tourism employment is in "front country" tourism (e.g., motels and restaurants) in the larger communities and access routes such as Highway 16, and also includes business travelers. However, based on 1995-96 data for northwest B.C., about 20% of visitors to the region had a trip purpose involving an outdoor / wilderness activity.¹² Salt and fresh water fishing is the single most important component of nature-based tourism in the Plan Area. Terrace, on Highway 16, is the main access point to the Plan Area's rivers, hot springs and parks. Kitimat is the main access point to saltwater fishing and boating in the Douglas Channel and Barrie Reach.

While a smaller a proportion of overall tourism activity, outdoor recreation activities such as angling, boating, hiking, ski-touring, snowmobiling are growing more strongly than the "front-country" component. The following attractions in or accessed from the Plan Area offer excellent potential for further growth in "nature-based" tourism:

- Fully or partially Protected Areas such as the Nisga's Lava Bed Memorial Park, the Kitlope Protected Area and the Gitnadoiks Recreation Area.
- Abundant salt and freshwater angling opportunities, particularly for salmon and steelhead returning to the Skeena and Nass Rivers (two of the largest salmon producers in the province), and other streams such as the Copper, Lakelse, Kitimat, Zymoetz and Kalum Rivers.
- Large areas of wilderness (38% of the Plan Area, outside of existing Parks and Recreation Areas, provide primitive and semi-primitive recreation opportunities¹³), much of it with pristine viewscapes.

A significant amount of nature-based or "back country" tourism is strongly linked to Crown land use and management, and requires the availability of wilderness experiences and scenery as well as resource values such wildlife, fish, and old growth forests. The existing protected / recreation areas and resource management direction in the Base Case provide some protection for some key wilderness recreation and tourism values. However, more intensive roaded resource development can occur in General Management and Settlement Zones and road and motorized recreation access policies are not as supportive of nature-based tourism. Most of the Plan Area (70%) and many of the key values supporting nature-based tourism, including existing tourism use areas (84%), scenic areas (62%), Class I and II angling waters (81% overall), and primitive and semi-

¹² *British Columbia Visitor Study – The Report on Visitors to BC – Provincial Overview*, Tourism British Columbia, 1998. The survey also indicates that about 20% of visitors had a business-related trip purpose.

¹³ MoF's Recreation Opportunities Inventory defines "primitive opportunities" as those in areas greater than 5,000 hectares and more than 8 kilometres from a 4-wheel drive road, and "semi-primitive" opportunities as areas greater than 1,000 ha and more than 1 km from a 4-wheel drive road.

primitive recreation opportunities (99% and 89%, respectively) are located in areas basically equivalent to General Management Zones (GRMZs) in the Base Case. Over time, the types of recreation experiences offered by such areas will grow increasingly scarce in B.C. and the rest of the world.

Significant proportions of tourism values (e.g. existing tourism use areas and primitive and semi-primitive recreation areas) are located outside of the Timber Harvesting Land Base (THLB), which comprises less than 13% of the Gross Land Base (GLB). However, continued resource development and related road access in GRMZs (including gradual mineral exploration and development which is not limited to the THLB) would likely result in some erosion of scenic viewscapes, wilderness attributes and fish and wildlife populations over time. The impacts of timber harvesting could also increase if the THLB expands over time (i.e., as operability improves), as it has historically. Since the tenures under which commercial nature-based tourism operate do not preclude resource development, investor uncertainty in this sector will likely increase in the Base Case.

The magnitude and timing of land use and resource management impacts on the tourism industry are extremely difficult to quantify, in part because of potentially offsetting impacts. For example, while continued resource and related road development can have negative impacts on wilderness tourism values such as pristine scenery and fish and wildlife populations, it can also increase certain types of tourism activity by providing road access. Another complicating factor is that front-country tourism in the Plan Area is also somewhat dependent on the economic activity generated by resource development.

4.2. Implications of Proposed Land Use Plan

The Plan, with 21 new PAs (an additional 125,000 ha), full protection of the Gitnadoiks (58,000 ha), would be more supportive of nature-based tourism than the Base Case. The Plan would also result in a significant increase in the proportion of the Plan Area in Special Resource Management (including no logging areas) Zones (from 7% in the Base Case to about 20% in the Plan). These SRMZs are specifically supportive of fish and wildlife values, provide greater protection of visual quality and restrict motorized access in key recreation areas.

The Protected Area designation for the Foch / Giltoyes area and increased VQO protection for the Upper Sue Channel area are also important for the tourism sector. These marine backcountry areas offer a wide range of land and ocean-based recreation features and opportunities that are readily accessible from Kitimat. More stringent VQOs in the Class I angling waters on the upper Copper River and the Miligit Valley, and greater protection for the Lakelse watershed will also be economically significant because of the relative proximity of these recreation areas to commercial facilities in Terrace. In general, the LRMP places substantially more of the following resource values in PAs and supportive management zones, compared to the Base Case: existing tourism operator use areas (44% of the GLB versus 16% in the Base Case), scenic areas (49% versus 39%), primitive and semi-primitive recreation areas (16% and 19%, respectively, versus 1% and 12%), and Class I and Class II angling waters (88% and 35%, respectively, versus 45% and 6%).

Because of these land use changes, the Plan should preserve more of the existing and growth opportunities for nature-based tourism. However, with continued resource development and related road access, there will still be a significant portion of nature-based tourism potential that is foregone over the longer term. For example, about 54% of existing tourism operator use areas, 50% of scenic areas, and 65% of Class II angling waters, are still in General Management and Settlement Zones. The potential impacts of the LRMP on wilderness recreation opportunities are also significant – since over half of the Plan Area is still in General Management and Settlement Zones, there will still be substantial erosion of primitive and semi-primitive recreation opportunities under the Plan occurring over the longer term.

The Plan will restrict resource development potential, and therefore some related tourism (e.g. roaded and front country opportunities). However, it is likely that many front country operations in the Plan Area are still dependent to varying degrees on preservation of scenic and wilderness values. It is also possible that the growth of commercial tourism, recreation use and related employment in new PAs could be restricted, depending on the management plans for new parks. However, more intensive uses (e.g., lodges) can still be located outside the PA boundaries. Also, the value of tourism use within PAs is likely to be higher because of the preservation of roadless, wilderness experiences, particularly as such opportunities become rarer worldwide.¹⁴

In summary, over time, better preservation of wilderness values will likely improve the attractiveness of the Plan Area relative to the Base Case for nature-based tourism. For a number of reasons, as noted above, the economic impacts of land use changes on the tourism sector are difficult to quantify, but it is likely that these impacts would take the form of increased, overall tourism growth in the Plan Area compared to the Base Case.

5. Mining and Energy

5.1. Base Case

There are no operating mines in the Plan Area. However, current, resident employment in the area is estimated at approximately 100 in quarrying and exploration, accounting for about 0.7% of total employment. Employment at the Alcan aluminium smelter in Kitimat, which is not supplied by locally produced ore, is about 1,600. Together, the mining and smelting sector accounts for about 15% of total employment in the Plan Area.

Most of the high and very high metallic mineral potential (as assessed and ranked by the Ministry of Energy and Mines) lies in the eastern third of the Plan Area, with the industrial mineral potential in the western portion. Much of the Plan Area is considered by MEM to be under-explored. In the Base Case, existing Protected Areas in the Plan Area would preclude none, or only very minor proportions of developed prospects (0% of 10), prospects (0% of 17), past producers (0% of 20), mineral claims (1.4%), placer

¹⁴ For example, a survey of public preferences regarding conditions considered acceptable for recreation use indicated that most respondents preferred an unaltered setting but would accept sites where modifications were not evident. See *1994 Forest, Range and Recreation Resource Analysis*, MoF.

tenures (0%) and showings (4.8% of 186).¹⁵ Existing PAs preclude about 1.8% of extreme metallic (no high metallic) but no extreme industrial mineral potential (0.5% of high industrial).

The probability of a mine occurring in the Base Case is very uncertain and subject to a number of factors including world market prices. Production of sand and gravel, which is relatively abundant in the Plan Area, will likely be developed as necessary to meet continuing demand, although the cost of production may increase over time as deposits closer to population centres are depleted.

There is no proven oil/gas production or reserves, or related exploration activity in the Plan Area. There is no present indication of such activity occurring within several decades, although there have been recent proposals for gas export pipelines through the Plan Area (e.g. the Pac-Rim Gas project). The Ministry of Energy and Mines (MEM) indicates that there is about 10,000 ha of moderate¹⁶ oil and gas potential lands, or about 0.5% of the Plan Area.

B.C. Hydro has no plans in the foreseeable future to develop any hydro or geothermal electric projects. Future transmission / gas line upgrading to Prince Rupert is a possibility in the future. There are two significant areas of geothermal potential and a number of hot springs in the Lakelse and Gardener Canal areas, although any development is likely to be primarily tourism-related, not energy-related. Virtually none of high geothermal potential or known oil and gas potential is precluded from development by PAs in the Base Case.

5.2. Implications of Proposed Land Use Plan

With respect to minerals, it is assumed in this assessment that the probability of development is highest for developed prospects (i.e., occurrences with sufficient work to define or estimate reserves). Prospects, showings and extreme / high mineral potential areas are considered to be less probable.¹⁷ Similarly, the probability of development is considered to be higher if sufficient investment has been made to estimate oil and gas reserves. Due to uncertainty regarding the extent to which the viability of mineral and energy potential is affected by the LRMP, job or other economic impacts are not estimated (as is also the case for most other sectors such as tourism).

¹⁵ Mineral occurrences include producing mines, past producers, developed prospects (normally proven deposits with estimated tonnages and grades), prospects (occurrences for which there is some indication of dimension) and showings (not sufficiently defined to permit resource estimation). Note that although mineral development is allowed in the Gitnadoiks Recreation Area there are no identified metal, mineral, oil, gas or geothermal occurrences, claims, tenures or leases in the Gitnadoiks.

¹⁶ Defined as 251-500 m³/ha of oil potential and 40,000-100,000 m³/ha of gas potential (Dave Richardson, MEM, *pers. comm.*) MEM obtained the data from the *Bowser-Whitehorse Oil & Gas Assessment - Hydrocarbon Potential*, P. Hannigan *et. al.*, Geological Survey of Canada, 1995.

¹⁷ This “hierarchy of probabilities” is a very broad generalization, but is supported by the fact that mineral exploration tends to be concentrated near areas in which discoveries and development have already occurred. Therefore, the significance of known mineral occurrences may be that development is more probable within the vicinity, rather than at the occurrence itself. However, these generalizations are still subject to unexpected mineral finds.

Protected Areas in the Plan would not preclude any developed prospects, prospects, mineral claims, placer tenures, or extreme metallic potential, as in the Base Case. The new PAs in the Plan would preclude slightly more past producers (5%), showings (6%), and high industrial mineral potential (1%), than in the Base Case.

The Plan PAs preclude a slightly higher proportion of high geothermal potential and moderate oil and gas potential compared the Base Case. However, the likelihood of oil and gas development in the Plan Area is very low for the foreseeable future. Also, depending on the management plans, development of hot springs for small, wilderness lodges may still be allowed within some PAs. Note that the Plan recommends that access for purposes of mineral exploration and development should be provided through the Brim River and Exchamsiks PAs, where no practicable alternative access exists. The Plan will also exclude 3 mineral claims in the Foch/Giltoyes PA, and provide for access through the new park to these claims.

In general, the recommended Plan places a higher proportion of the land base in Special Resource Management Zones (SRMZs) and a lower proportion in General Management, compared to the Base Case, which could mean additional access and seasonal restrictions on subsurface exploration and development. However, the LRMP affirms existing provincial policy and legislation, which ensures that mineral and energy exploration and development (including roaded development) be permitted throughout the province outside of parks. Access and seasonal restrictions are not uncommon for mine development and operations under Base Case management (e.g. as can be required for development approved under the *B.C. Environmental Assessment* process), although such strategies are incremental to Base Case management if applied to mineral exploration.

Objectives and strategies in the Plan are primarily directed at timber access and extraction. However, adoption of the LRMP as a “Higher Level Plan” under the *Forest Practices Code* could also affect the conditions under which mineral exploration access is approved (e.g. through MoF’s *Special Use Permit* process). Depending on how management strategies such as access and seasonal restrictions are implemented in or near Goat and Grizzly critical habitat, the Plan could increase the costs of exploration and development and investor uncertainty, at least in the short term. This uncertainty should decline as experience in implementing LRMP strategies is gained. It should also be noted that air access for early stages of exploration is already common practice in the industry because of cost advantages. The following strategies could result in incremental costs or require clarification prior to exploration projects being carried out:

- Roads, where possible, are to run parallel to goat winter travel routes and are to avoid close proximity to Mountain Goat Winter Ranges. However, B.C. the Ministry of Water, Land and Air Protection has indicated that “avoid” means “avoid where feasible”, not “prohibited”.
- Avoid, where possible, road building, resource extraction and human access during winter months near Goat Winter Ranges. Such restrictions are not uncommon in the Base Case for exploration, but could result in additional costs if applied to mining.

- In areas of high visual sensitivity, conduct resource development in a manner that minimizes visual disturbance over time.

B.C. Hydro's review of more detailed mapping indicated that new PAs would not likely affect potential upgrades to transmission lines in the Plan Area. The Plan assures access to the key transmission line / gas pipeline corridor down the Skeena River to Prince Rupert (e.g., for emergency or upgrading purposes).

The extent to which the Plan reduces the likelihood and / or delay the timing of mineral and energy development, and therefore the economic significance of these impacts, is very uncertain. In general, the Plan precludes marginally more mineral and energy development potential compared to the Base Case, due mainly to the slightly higher amount of Protected Areas and to possible access restrictions for critical habitat. However, the economic significance of these impacts must be discounted to take into account the probability and timing of any future development. Also, the management intent of the Plan states clearly that opportunities for geological and energy resource exploration and development will be made available on all lands outside of Protected Areas.

6. Agriculture and Aquaculture

6.1. Base Case (i.e., without LRMP)

There is limited agricultural capability in the Kalum Plan Area due to its generally steep, glaciated and rocky terrain. The Agricultural Land Reserve, which includes most of the higher capability agricultural lands, comprises a very small proportion of the Plan Area. There are some productive lands in localized areas (e.g. in the Skeena River valley), including the Terrace area, that support small, mixed farms (e.g., fruit and vegetables, poultry and livestock), with vendors selling at community farmers markets. Agricultural activity generates direct employment of about 210 direct jobs, accounting directly and indirectly for about 2% of total employment in the Plan Area (based on 1996 Census data). Agricultural Employment appears to have been growing in recent years, and it contributes to the economic and social diversity of the Plan Area.

There is currently no aquaculture activity in the Plan Area but potential exists for future development. Almost 7% of the marine portion of the Plan Area is rated as Medium (i.e. acceptable) capability for finfish culture. The Kalum Plan Area also has potential for the culture of marine plants, currently being piloted in the south coast area. The Province is currently undertaking reviews of its policies regarding various forms of aquaculture in B.C., the outcome of which will have a significant bearing on activity in this sector, which could also contribute to the economic diversity of the Plan Area.

6.2. Implications of Proposed Land Use Plan

The LRMP makes a number of recommendations to support and encourage environmentally sustainable agriculture and aquaculture in the Plan Area. However, there are no major changes in land use and resource management direction in the Plan

that will significantly affect existing provincial policies or activity levels in these sectors, compared to the Base Case.

7. Trapping and Botanical Forest Products

7.1. Base Case (i.e., without LRMP)

Although there are a large number of licensed and non-licensed trappers in the Plan Area (e.g. about 260 in 1994), trapping is mainly a part-time occupation used to supplement incomes. A number of botanical forest products including wild mushrooms, floral and greenery products and medicinal plants are harvested in the Plan Area. Mushroom harvesting, particularly Pine mushrooms, is by far the most important commercial botanical forest product. The Plan Area is one of the most productive mushroom harvesting areas in the province. The use of botanicals is currently unregulated, but the regulatory and management needs of this resource are being researched by MoF.

Trapping is a key part of the cultural identity of First Nations, and an important income source. Botanical forest products are also important to First Nations in the Plan Area for a variety of medicinal, food, and cultural purposes. Yellow and red cedar are also important for carvings, totem poles and canoes.

The number of trappers appears to be slowly declining. It is likely that this decline will continue, reinforced by population declines of key furbearing species such as marten, as a result of the disruption of their habitat in older forests. Utilization of botanicals, particularly mushrooms, appears to be growing although data on current and potential harvest levels is limited. There are concerns that timber harvesting in key areas and the lack of a regulatory framework may threaten the sustainability botanical forest resources and activities over the longer term. However, some botanicals such as berries are compatible with and even encouraged by younger forests and associated road access.

7.2. Implications of Proposed Land Use Plan

Better protection of older forest characteristics and some management strategies (e.g., the location of slash piles in cut blocks) in the Plan should help to reduce the impacts of resource development on important trapped species such as marten. However, populations of these species will likely continue to decline, as will the number of trappers.

New PAs and SRMZs will generally better retain older forest characteristics that will benefit botanicals such as mushrooms. The Plan also proposes strategies to better integrate the management of botanicals, particularly mushrooms, with other resource uses such as timber harvesting. For example, the Plan recommends the establishment of an LRMP monitoring committee to identify high value mushroom sites and recommend supportive timber harvesting levels and patterns. A percentage of these sites are to be managed with an emphasis on Pine mushroom production. However, the benefits of such strategies will be constrained with continued timber harvesting throughout the Plan Area, and if a management framework for the commercial mushroom industry (e.g., the licensing of buyers), is not established.

8. Commercial Fisheries

8.1. Base Case (i.e., without LRMP)

The Skeena River and its tributaries are part of the second largest salmon producer in B.C. In 1996, fishing and processing provided over 100 direct jobs in the Plan Area, accounting directly and indirectly for about 1% of total employment. Commercial fishing employment has declined significantly since 1996 due to salmon stock declines and vessel buybacks by the federal government.

The *Forest Practices Code* applied to Crown lands, and the *Fish Protection Act* on private lands, as well as stricter management controls on commercial harvesting should improve stocks over time in the Base Case. However, continued timber harvesting (particularly around smaller streams with smaller setback requirements) and the mixed stock fishery (i.e., the harvesting of smaller, weaker stocks as they mingle with larger, more productive stocks), still pose a risk to salmon populations and commercial harvesting and processing activity.

8.2. Implications of Proposed Land Use Plan

The increase in PAs and SRMZs recommended by the LRMP should reduce risks to fish habitat in the Plan Area. Specific areas that receive enhanced protection include the designation of the Upper Copper River as a Special Management Zone and the Lakelse River Corridor, which provides habitat for large numbers of salmon.

The Plan also recommends a number of strategies to ensure that fish habitats are addressed during lower level planning processes including: further inventory and mapping of salmon, herring and oolichan spawning grounds, and comprehensive evaluations as per *Coastal Watershed Assessment Procedures (CWAPs)* for all major river/creek systems.

However, since a considerable proportion of the Plan Area remains in General Resource Management and Settlement Zones, there will continue to be resource and industrial development-related risks to salmon habitat. The commercial benefits of incrementally improved salmon habitat protection provided by the Plan will also depend on the effectiveness of the commercial and sport fisheries management regime, much of which is a federal responsibility.

9. Community / First Nations Concerns

9.1. Base Case (i.e., without LRMP)

As noted above, forestry, the Alcan aluminum smelter and tourism are the most important sources of private sector employment in the Plan Area, by far. Forestry is the dominant industry, accounting directly and indirectly for 25% of basic employment in the Plan Area, followed by the smelter (14%) and tourism (13%). However, recent historical data

¹⁸ The percentage estimates earlier in the report are direct jobs only, i.e., they exclude indirect employment.

indicates that tourism is the fastest growing sector of the Plan Area economy. Because of lower average wages, tourism comprises a smaller proportion of Plan Area income, about 5%. Also, roughly 20% of tourism is generated by business-related travel.

Most of the employment in forestry and tourism is roughly evenly divided between the two main communities in the Plan Area, Terrace and Kitimat. The aluminum smelter is the single largest source of employment in Kitimat, accounting for about 35% of total employment in the community. Since the raw material inputs for the smelter and most of the wood fibre requirements of the Eurocan pulp mill are sourced outside the Plan Area, the economy of Kitimat is much less strongly linked to changes in land and resource management in the Plan Area than is the economy of Terrace.

Most of the Plan Area is in the traditional territory of the Tsimshian (Kitselas and Kitsumkalum Bands) and Haisla (Kitimaat Band). Small portions of the Gitanyow and Gitksan traditional areas also overlap parts of the Plan Area. The estimated First Nations population comprises about 7% of total population in the Plan Area, excluding the Nisga'a Treaty settlement area. Forestry, tourism and commercial fisheries are the most important sources of employment for those local First Nations that are affected by land use changes. Traditional and sustenance activities (hunting, fishing, trapping, food and medicinal plants) are also an important part of their culture and livelihood. Protection of the resources upon which First Nations livelihoods and sustenance activities depend, protection of cultural and archaeological sites, and the desire for greater involvement in resource management, have been on-going issues of concern to First Nations.

First Nations in the Plan Area are implementing economic development plans and recent Court decisions will give them greater input into resource use decisions. These Court decisions and the eventual resolution of land claims in the Plan Area (both the Haisla and Tsimshian are involved in the treaty process in B.C.) will significantly further their economic development and resource management aspirations, regardless of the LRMP.

9.2. Implications of Proposed Land Use Plan

The forestry and tourism impacts of the Plan are the most significant in terms of socio-economic implications for communities in the Plan Area, because these are the two most important sectors in terms of existing jobs, and they are also relatively strongly linked to land and resource management. However, as indicated in section 3, the timber harvest impacts of the Plan are unlikely to result in the loss of existing jobs due to the substantial underharvest that currently exists. Tourism impacts are also likely to occur over time, but as noted previously, are difficult to identify and quantify.

Unpublished Ministry of Finance and Corporate Relations' (MFCR) economic dependency analysis results¹⁹ indicates that 40% of workers in logging/log hauling jobs reside in Terrace, 5% in Kitimat and the rest outside of municipal boundaries proper, but likely in locales close to Terrace and, to a lesser extent, Kitimat. As for solid wood manufacturing, about 50% of the jobs are within the Terrace municipality, 12% are in

¹⁹ Prepared for the LRMP by G. Horne, Manager - Economic Impact Analysis, Ministry of Finance and Corporate Relations, February 2000.

Kitimat, with the remainder held by workers employed in either Terrace or Kitimat, but who reside outside (but likely near to) those municipalities.

As noted above, most of the timber harvesting impacts of the Scenarios would be felt in Terrace and its adjacent rural areas. Based on the distribution of harvesting/log hauling and solid wood processing employment in the Plan Area, it is possible that about 45%-50% of the future, foregone forestry employment resulting from the Plan (roughly 150 - 200 direct, indirect and induced jobs) could be felt in Terrace, equal to about 2% - 3% of that community's total 1996 employment.

As concluded in section 3, the Plan provides greater support for the nature-based portion of the tourism sector in the Plan Area. For example, the protection of the Foch/Giltoyees area, better protection in the Plan of visual quality and key recreation sites in the Douglas Channel, and the involvement of the Haisla in the development of management plans for the Kowesas watershed could all positively contribute to the local economies of Kitimat and the Haisla's Kitimaat Village. However, these employment and income gains, which would occur over time, would not likely offset potential, longer term impacts associated with timber harvest reductions. Any impacts of the Plan on mineral exploration and development would also take the form of foregone opportunities rather than loss of existing jobs.

The Settlement Zone in the Plan gives greater priority to future settlement and industrial development rather than to forestry. The LRMP recommends that the provincial Forest Land Reserve (FLR) designation should not apply to Crown lands within Settlement Zones or General Management Zones that have been identified by Terrace, Kitimat and the Regional District of Kitimat-Stikine as important to accommodate population growth and economic development. At the same time, the LRMP recommends that development on such lands be subject to a coordinated and integrated review process to ensure impacts on environmental values are minimized.

All local governments have expressed concerns regarding the potential implications of the Plan for a number of industrial sites on Crown lands outside of the Settlement Zone in the Terrace-Kitimat corridor and in the Douglas Channel area. These lands are included in General Management Zones, but have been identified as sites for which local government have economic development interests that must be addressed in any future planning. These sites will also require planning to mitigate impacts of any proposed development on environmental values. Sites in the Douglas Channel which are covered by new VQOs would not be precluded but must also be developed in a way to minimize impacts on viewsapes. Industrial sites will not be placed in the FLR. The LRMP did not adopt two small Miskatla PAs (comprising in total about 237 ha) on either side of a waterfront industrial site in response to concerns that designation would impede eventual development on the site.

The Plan also provides more protection for First Nations traditional use areas and resources and cultural values in new PAs and SRMZs, that restrict resource development (particularly timber harvesting and related road access). One area of particular significance to the Haisla is the Kowesas watershed adjacent to the existing Kitlope

Protected Area. The Kowesas is important to the Haisla because of its cultural significance and also because it provides greater protection for a traditional oolichan fishery, one of the most important subsistence fisheries to First Nations. The Plan designates the Kowesas (41,300 ha) as a Special Management Zone in which a detailed landscape level plan for potential timber development will be developed through a consensus based process with the Haisla, West Fraser and government. A process has also been initiated with the Tsimshian to review the recommended Land Use Plan and how it might affect their interests.

The Plan includes strategies for data collection on oolichan and other marine aquatic species that are important to First Nations and recommends consideration of a sensitive area designation for the Kitimat estuary. The Plan also incorporates and reinforces supportive management strategies that are already part of the Base Case management regime for First Nations resource values, namely:

- More detailed inventories and assessments of archaeological resources, and management / mitigation as part of resource development planning.
- Consultation with First Nations, including traditional use studies, to ensure that aboriginal rights and / or title are not unjustifiably infringed upon by land and resource management activities

In general, the Plan is more supportive of First Nations' nature-based economic development opportunities (e.g. land and coastal-based eco-tourism, fisheries and marine aquatic species, botanical forest products), as well as traditional and sustenance activities such as fishing, hunting and trapping. The Plan also affirms provincial policy which accommodates traditional First Nations uses within PAs. Therefore, in very general terms, the land use changes and management strategies proposed in the Plan, appears to be more consistent with the economic development and resource management vision of First Nations groups in the Plan Area.

10. Government Resource Revenues and Economic Efficiency Implications

10.1. Base Case (i.e., without LRMP)

Provincial revenues from Plan Area resources are predominantly related to timber harvesting. Based on average target stumpage rates for the Coast and average forest industry corporate income tax (provincial share) for recent years.²⁰, the total provincial timber harvest-related revenue for the Plan Area is estimated at roughly \$27 million to \$39 million. As noted in section 3, the Ministry of Forests estimates that the current AAC and therefore, related revenues can be maintained for the first decade. Additional net

²⁰ Based on average target stumpage rate for the Coast of \$13.05 - \$21.65 per m³ (1990-2001) and average B.C. corporate income tax revenue from the forest industry of \$5.25/m³ over the 1994-99 period. Sources: Ministry of Forests, Timber Pricing Branch and *The Forest Industry in British Columbia*, Price Waterhouse Coopers. The lower end of the range nets out estimated Forest Renewal B.C. expenditures from government revenues. Estimates exclude personal income taxes of forest workers and other indirect taxes.

provincial revenues for other resource activities such as commercial and backcountry tourism, quarrying and trapping and fishing would be relatively minor in comparison.

Economic efficiency of resource use refers to the net social value of a resource after all private and public sector revenues and costs (including a normal return on invested capital) are taken into account. Net resource value can also include non-monetary values for activities such as recreation for which there are no market transactions. Due to data limitations, it is well beyond the scope of this assessment to estimate the net social value of all resources in the Plan Area. However, the overall, potential timber net resource value can be roughly estimated at \$3.9 million per year at current harvest levels, based on the assumption that the provincial government captures all of the net timber value in its stumpage billings.²¹ This probably overestimates the current net timber value since industry appears to be earning less than a normal rate of return on capital and because of the significant underharvest of Plan Area timber.

10.2. Implications of Proposed Land Use Plan

Since the current underharvest of Plan Area timber greatly exceeds the estimated timber supply impacts of the Plan, there would be no loss in existing government revenue or of net timber value resulting from the LRMP. However, there could be foregone opportunities in terms of net revenue and timber value. The estimated 103,000 m³/yr harvest impact of the Plan could result in potential, future government revenue losses of about \$1.3 - \$2.2 million per year, and in a potential loss of about \$4.5 million in net present value (NPV) of net timber value.²² This assumes that the foregone timber becomes economic to harvest in the near future.

The Plan will have impacts on future activity in other sectors such as tourism, mining and energy, fishing and trapping, but the data required to quantify impacts is not available. The impacts of the Plan on non-forestry sectors are subject to greater uncertainty (particularly mining and energy) and will take place over longer periods of time. The timber harvesting impacts of the Plan (the resource most strongly linked to land use changes and most easily quantified) could be viewed as the key “opportunity cost” of the environmental benefits resulting from the Plan. Based on the above assumptions used to develop estimates of the net value of the foregone timber harvests, each household in B.C. would have to be willing to pay about \$0.18 per year, or a cumulative, one-time lump sum of \$4.5 million, to achieve the environmental benefits of the Plan.

²¹ See *Social and Economic Impact Assessment for Land and Resource Management Planning in British Columbia: Interim Guidelines*, August, 1993 (under revision). The above estimate is based on the average billed rate for the Kalum Forest District of \$2.65/m³ for the years 1999-2001.

²² Based on assumptions in footnotes 20 and 21.

APPENDIX 1:
Potential Economic Impacts of the Kalum LRMP
Resulting from Foregone Timber Harvest

Foregone Future Harvest Opportunity (m3/yr)	103,000
Foregone Future Employment Opportunity	
Plan Area Employment (PYs/yr) ^a	
Direct	71-78
Indirect & Induced ^c	24-41
Total	95-119
Total Foregone Employment as % of Plan Area Jobs	0.6% - 0.7%
Provincial Employment (PYs/yr) ^b	
Direct	100
Indirect & Induced ^c	115
Total	215
Foregone Government Revenue^d	\$1.3-\$2.2 million/yr (\$0.90-\$1.49/yr/household)
Foregone Net Resource Value (NPV @ 6%)^e	\$4.5 million (NPV) (\$0.18/yr/household)

- (a) Plan Area direct Person-Years (PYs) of employment at risk based on coefficients in logging / silviculture of 0.31-0.38 PY/'000 m3/yr & in sawmilling of 0.38 PY/'000 m3/yr. (Source: *Socio-Economic Assessment for the Kalum TSA*, Ministry of Forests, March 1999.) Coefficients take into account employment in Plan Area supported by imported timber. Range of estimates based on with & without silviculture, which is not as strongly linked to incremental changes in timber harvest levels. It is assumed that pulp & paper employment in the Plan Area (i.e., Eurocan in Kitimat) is not linked to incremental harvest impacts which comprise only a negligible proportion of Eurocan's fibre requirement. Total Plan Area employment estimated at 16,950 in 1996. (Source: B.C. STATS).
- (b) Provincial impacts include direct employment of Plan Area residents, plus employment of non-resident logging & silviculture workers who live outside of the Plan Area within B.C.. Direct PYs at risk in B.C. based on coefficients in logging / silviculture of 0.34-0.43 PY/'000 m3 & in sawmilling / pulp & paper of 0.49-0.54 PY/'000 m3. Range of estimates based on with & without silviculture & pulp & paper. (Source: *Socio-Economic Assessment for the Kalum TSA*, op. cit.)
- (c) Indirect & induced impacts based on employment multipliers for the Plan Area of 1.36-1.53 for harvesting & 1.35-1.52 for processing. B.C. indirect & induced impacts based on employment multipliers of 1.8 – 2.14 for logging & 1.93-2.57 for sawmilling & pulp & paper (weighted average). Provincial multipliers adjusted for log hauling/ road building. Lower end of range assumes all displaced workers stay in the region & B.C. & receive income support - higher end assumes all displaced workers leave B.C.. (Sources: *A Provincial Impact Estimation Procedure for the British Columbia Forest Sector*, G. Horne, 1996, & *Socio-Economic Assessment for the Kalum TSA*, op. cit.).
- (d) Based on average target stumpage rates for the Coast of about \$13.05 (rates for month of April, average for 1990 - 1994, excluding Forest Renewal B.C. estimated expenditures) to \$21.65 / m3 (rates for April, average for 1999 - 2001, including FRBC) plus average corporate taxes of \$5.25 / '000 m3 for the years 1994-99 (*The Forest Industry in British Columbia*, Price Waterhouse Coopers). Per household estimate based on 1.5 million households in B.C..
- (e) Net present value of timber resource rents lost or foregone, based on average billed stumpage rates for the Kalum Forest District (incl. Nass area) of about \$2.65/m3 for 1999-2001, & a discount rate of 6%. The NPV of foregone timber value would be lower if market factors delayed harvesting of this timber. Annualized value per household (based on 1.5 million households) represents additional amount each household would have to be willing to pay annually to achieve the environmental benefits of the Plan.

PART II:

**ENVIRONMENTAL ASSESSMENT
OF THE KALUM LRMP**

prepared by

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in cooperation with the

Kalum Inter-agency Planning Team

January, 2002

Table of Contents

1. Introduction	1
2. Methods	1
2.1. Assumptions.....	1
2.2. Area Analysis.....	2
2.3. Risk Assessment.....	3
2.4. Data Limitations.....	6
3. Ecosystem Representation / Biodiversity	6
3.1. Base Case.....	6
3.2. Land Use Plan.....	7
4. Red and Blue-Listed Species and Plant Communities	9
4.1. Base Case.....	9
4.2. Land Use Plan.....	9
5. Seral Stage Distribution and Old Growth	9
5.1. Base Case.....	9
5.2. Land Use Plan.....	10
6. Riparian Habitat	10
6.1. Base Case.....	10
6.2. Land Use Plan.....	10
7. Grizzly Bear	11
7.1. Background.....	11
7.2. Base Case.....	12
7.3. Land Use Plan.....	12
8. Moose Winter Range	14
8.1. Background.....	14
8.2. Base Case.....	15
8.3. Land Use Plan.....	15
9. Mountain Goat Winter Range	16
9.1. Background.....	16
9.2. Base Case.....	17
9.3. Land Use Plan.....	17
10. Wildlife Habitats (General)	18
11. Fish and Fish Habitats	18
11.1. Base Case.....	18
11.2. Land Use Plan.....	18
12. Water Quality/Quantity	19
12.1. Base Case.....	19
12.2. Land Use Plan.....	19

List of Tables

Table 1: Key assumptions used to estimate potential land use impacts on environmental values. 1

Table 2: Relative risk levels used to estimate potential impacts of each land use intensity category on biodiversity and environmental values. Kalum LRMP..... 4

Table 3: Ecoregion and biogeoclimatic subzone/variant representation (in Protected Areas) for the Base Case and Kalum Land Use Plan..... 8

Table 4: Indicators and assumptions used to estimate potential impact of land use management zones on Grizzly Bear Habitat. Kalum LRMP..... 12

Table 5: The amount of grizzly bear habitat allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP..... 13

Table 6: Indicators and assumptions used to estimate potential impacts of land use management zones on moose winter range. Kalum LRMP..... 14

Table 7: The amount of moose winter range allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP..... 15

Table 8: Indicators and assumptions used to estimate potential impact of land use management zones on mountain goat habitat. Kalum LRMP. 16

Table 9: The amount of mountain goat winter range habitat allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP..... 17

1. Introduction

This section of the report provides a strategic environmental assessment of the Kalum Land Use Plan (April 2001). The assessment summarizes the environmental implications and relative risks of implementing the Kalum LRMP compared to the Base Case. The Base Case assumes a continuance of current management practices initiatives, and attempts to address qualitatively the trends for each environmental value in the absence of a land use plan.

2. Methods

2.1. Assumptions

In order to estimate potential impacts to environmental values and provide clarification regarding conclusions reached, a number of key *assumptions* were required (Table 1).

Table 1: Key assumptions used to estimate potential land use impacts on environmental values.

- *The more closely that managed forests resemble natural disturbance regimes²³ (i.e., maintain forest composition and stand structures), the greater the probability that populations of all native species will be maintained.*
- *Consistent with the Biodiversity Guidebook (1995) risks to biodiversity increases along a continuum with increasing intensity levels of resource development. That is, lower intensity development areas provide more options and opportunities for maintaining native species and ecological processes.*
- *Wildlife habitats that occur on the Timber Harvesting Land Base (THLB) are at higher risk than habitats that occur on excluded crown land areas (i.e., inoperable areas) due to loss of unique valley bottom habitats, significantly altered seral stage distributions, road access and increased human disturbance. Although forested areas that occur outside of the THLB contribute to biodiversity, they do not necessarily provide adequate or equivalent habitat quality compared to areas that occur within the THLB. Establishment of Old Growth Management Areas (OGMAs), Wildlife Habitat Areas (WHAs) and Wildlife Tree Retention (WTR) on the THLB, however, are assumed to partly reduce the risks for some species.*
- *More open roads result in increased risks to specific species. In particular, increased road development results in greater mortality risks for large mammals (e.g., grizzly bears and ungulates) and potential habitat loss and fragmentation for smaller species (e.g., amphibians, small mammals). Access management strategies (e.g., access control points etc.), however, are assumed to partly mitigate potential long-term adverse effects of increased road access from forest, mineral or other development.*

¹ “Natural” disturbance regime refers to disturbance events pre-European contact.

In addition, species-specific assumptions for grizzly bear, moose and mountain goat were also used to aid in the assessment. All assumptions were derived from the published literature (see references), local knowledge, discussions with the Inter-agency Planning Team (IPT) and professional judgement.

2.2. Area Analysis

To compare the Base Case with the Recommended Land Use Plan, each environmental value requires a measurable criteria to be used as an **indicator**²⁴ to determine if objectives for valued environmental components are likely to be achieved. Indicators for this assessment reflect environmental values identified by the Kalum LRMP. Key resource values/indicators used in this assessment include grizzly bear, mountain goat and moose. BC Environment (Skeena Region) provided wildlife habitat capability³ maps (1:250,000) for moose winter range, mountain goat⁴ and grizzly bear.

A Geographic Information System (GIS) was used to generate habitat area summaries which represented the amount of each mapped environmental indicator (e.g., high capability habitats) within each resource management zone category. The primary indicator used for all environmental values was the percentage of each resource value (indicator) that occurred in each of the resource management zones. Within each resource management zone, the land base was further broken down to show the amount of habitat that occurs on the timber harvesting land base (THLB).

To facilitate a comparison between the Base Case and the Recommended Land Use Plan, 6 broad resource management zones were identified to best reflect existing and proposed land use intensities including:

- (1) Existing Protected Areas
- (2) New PAs
- (3) No Logging (Special Management Zones)
 - SRM No Logging
 - Goat Winter Range

²⁴ It is important to differentiate between indicators necessary to conduct the area analysis (i.e., *mapped* or spatial representations of resource values - **assessment indicators**) and those that are *not mapped* but still are critical to maintain environmental quality (e.g., sedimentation rates, concentration of water contaminants (ppm) - **monitoring indicators**). Although this analysis primarily used assessment indicators, other monitoring indicators were also considered if they were explicitly part of current management objectives and strategies.

³ Capability is defined as the *potential* value of a habitat under optimum seral stage and management conditions whereas suitability refers to the *current* seral stage and condition of the habitat.

⁴ More detailed goat winter range mapping (1:20,000) was examined by the IPT to determine the timber supply implications of protecting this habitat. Mapping at this level of detail was not available for the Base Case or final GIS analysis. Broader mapping (1:250,000) available for the GIS analysis overestimates the amount of high capability mountain goat winter range, but still provides a reasonably accurate indication of the incremental effects of the Land Use Plan.

(4) Other Special Management Zones

- SRM Miligit Creek
- McKay Davis Grizzly Bear Identified Watershed (GBIW)
- Copper GBIW
- VQO (Preservation and Retention)
- VQO (Partial Retention)
- Lakelse Subzone 2 Cedar/Lakelse-Cecil GBIW
- Third Priority GBIWs (7 watersheds)
- Community Watersheds

(5) General Management

- General Management
- Remaining GBIWs
- Alpine Recreation

(6) Settlement

- Settlement
- Private Lands
- Saltwater

2.3. Risk Assessment

Using quantitative (GIS) area statistics and applying the above assumptions, a relative *risk assessment* approach was used to qualitatively assess the potential impacts of land use designations on each environmental value.

Risk is defined as the probability or likelihood of an adverse event occurring over the short or long term (Bergmann et al. 1993). For the purposes of this conservation risk assessment, an adverse event or outcome includes such things as a significant decrease in habitat quantity or quality, increased mortality, altered predator-prey relationships, population decline or reduced water quality/quantity.

Potential causal factors that may result in adverse outcomes include timber harvesting, mining, road development and increased human disturbance. In general, risks were assumed to be positively correlated with increasing land use intensity to reflect altered future landscape conditions. A brief rationale supporting each relative risk level is described below in Table 2.

Table 2: Relative risk levels used to estimate potential impacts of each land use intensity category on biodiversity and environmental values. Kalum LRMP.

Resource Management Zone	Risk Level	Rationale and Implications
Protected Area	Low-very Low	<ul style="list-style-type: none"> 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. However, risks can be higher due to surrounding resource development activities (i.e., inadequate buffers) or increased recreational use. Overall, fish and wildlife populations expected to remain stable.
No Logging SMZs <ul style="list-style-type: none"> SRM No Logging (e.g., Kitsumkalu, Ascaphus) Goat Winter Range 	Low	<ul style="list-style-type: none"> Forest harvesting precluded. Reduced risks anticipated due to lower intensity of resource development and human disturbance.
Other Special Management Zones <ul style="list-style-type: none"> Retention and partial Retention VQOs Community Watersheds Grizzly Bear Identified Watersheds 	Low-Moderate	<ul style="list-style-type: none"> Maximum of 5-15% disturbance (visibly altered) allowed in Retention/partial Retention VQO areas. Low disturbance level results in relatively long rotation intervals and maintains supply of mature and old forest. However, higher levels of disturbance may occur in certain site-specific circumstances. GBIW - Seral stage constraints maximum mid-seral (25-100 yrs old) 30% Open road network and fragmentation tends to be minimized. <i>Coordinated Access Management Plans</i> generally in place.
General Resource Management <i>(includes portions of land base that will be Enhanced Timber Development)</i>	Moderate-High	<ul style="list-style-type: none"> Typically, 3 pass harvesting; maximum of 33% under green-up (i.e., < 3m); reduced mature and old forest cover (25-50% natural; assuming managed to meet Low/Intermediate BEOs), increasing road network. Increased fragmentation, (loss of forest interior). Although the intent of this zone is often to balance economic and environmental values - species that require larger tracts of mature and old forest and less human disturbance, become increasingly vulnerable. Risks may be very high if enhanced timber production as well as mineral development occurs simultaneously (i.e. cumulative effects). Overall, early seral species are expected to increase while mature and old-dependent species

		are expected to occur at lower densities over time.
<i>Agriculture / Settlement</i>	High-Very High	<ul style="list-style-type: none"> • Alteration of plant and animal species composition (extirpation of some species expected); ecosystem structure and function • Typically, permanent loss of mature forest cover and other plant species due to land conversion and 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. • Overall, land use activities considered unsuitable to maintain most native species and ecological processes; increased wildlife-human conflicts

Note: This table should only be considered as a rough guide to relative risk levels. Current management practices (e.g., *Forest Practices Code, Mineral Exploration Code*), lower level planning processes and future management strategies outlined by the Kalum LRMP could partly mitigate potential negative impacts to environmental values and therefore, reduce (to some degree) the relative risk level. Similarly, a lack of explicit management strategies in an RMZ or current government policy (e.g., *Landscape Unit Planning Guide*) would increase relative risk levels.

To help clarify what the various risk levels mean in terms of implications for ecosystems and wildlife populations, a brief explanation is provided below for each risk level category. These risk levels were initially defined according to how well natural levels of biodiversity would be maintained, using seral stage distributions as an indicator (MELP 2000). Although seral stage distributions on a landscape unit basis were not available for this analysis, the deviation from natural levels were assumed to be correlated with resource development intensity as outlined in Table 2. It should also be recognized that these risk levels do not explicitly incorporate other risk factors such as increased road access. As mentioned above, management strategies (e.g., access) are used qualitatively to adjust risk ratings to account for other risk factors.

- ***Very low risk:*** most populations likely to remain stable, or possibly increase where habitat restoration is successful; likely to be multiple areas of each habitat type which will allow habitats to withstand changes due to all but the most catastrophic natural stand-replacing events (e.g. unusually extensive forest fires); where local extirpations occur, connectivity (continuity of habitats) will likely allow for re-establishment of replacement populations.
- ***Low risk:*** some populations likely to remain stable, or possibly increase where habitat restoration is successful; some populations dependent on habitats in short supply may decline; likely to be multiple areas of each habitat types which will allow habitats to withstand changes due to most natural stand-replacing events; where local extirpations occur, connectivity may allow for re-establishment of replacement populations.

- **Moderate risk:** likely to result in reductions in some local populations with others remaining stable; local extirpations are possible where populations are left vulnerable to predators or other increased stress; may be sufficient redundancy in habitats to withstand changes due to most natural stand-replacing events; where extensive areas of young forest are present, these will create imbalances in habitat over time (e.g. ‘boom and bust’ feeding areas for grizzly bears); re-establishment of locally extirpated populations may be limited by lack of connectivity.
- **High risk:** likely to result in significant declines in some populations with some local extirpations due to the lack of mature and old forests; the lack of redundancy in habitats will mean that any changes due to natural forest stand replacing events will likely result in further local extirpations; extensive areas of young forests will create imbalances in habitat over time; may contribute to semi-permanent and/or regional extirpations if risk level is long-lasting and/or covers a significant portion of a given population’s range.
- **Very high risk:** major reductions are likely in populations that are dependent on mature and/or old forest stands; many local extirpations; extensive areas of younger trees will create imbalances in habitat over time (e.g., ‘boom and bust’ feeding areas for grizzly bears); significant potential for contributing to permanent and/or regional extirpations or extinctions if risk level is long-lasting and/or the area at risk covers a significant portion of a given population’s range.

2.4. Data Limitations

Although the ability to accurately predict the consequences of land use changes on wildlife populations is improving, few ecological studies have been conducted at spatial and temporal scales appropriate for regional conservation assessments (i.e., millions of ha over long time periods). The lack of empirical data on the functional relationships between habitat supply, habitat structure and population density further limits the ability to predict the impacts of land use changes. Ideally, habitat supply models and/or spatially explicit population models (derived from empirical data) would be developed to permit forecasting of temporal and spatial habitat availability under alternative land use scenarios. Nonetheless, science-based qualitative predictions regarding the implications of land use practices can still be made given the relatively high level of knowledge of the habitat requirements and mortality risks associated with the wildlife species considered here (e.g., grizzly bear, mountain goat, moose).

3. Ecosystem Representation / Biodiversity

3.1. Base Case

The Kalum LRMP area is represented by five ecosections and 15 biogeoclimatic subzone variants. From a provincial perspective, of the five ecosections, only the Kitimat ecosection is reasonably well represented (18.5%) in the Base Case. The Nass Basin (mostly Nisga’a Lands) and Nass Ranges, however, are somewhat underrepresented with

4-6% in existing PAs (provincially⁵). Considering only the area within the Kalum LRMP boundary, the Nass Ranges remain underrepresented at 2% (Table 3). Of the 15 biogeoclimatic subzone/variants that occur in the Plan Area, most have some degree of representation (4-26%). However, the CWHws1, which only occurs within the Kalum LRMP (Kitimat and Nass Ranges ecosections), is significantly underrepresented in PAs (<1%), partly due to an extensive logging history).

3.2. Land Use Plan

The Kalum proposed Land Use Plan provides a modest increase in ecosystem representation. In particular, the Foch/Giltoeyes Watersheds (59,765 ha or 2.76% of the Plan Area) and Gitnadoiks Recreation Area (57,760 hectares or 2.67% of the Plan Area) have been recommended as Class A Provincial Parks. Both of these fully protected areas (mineral exploration and development was previously allowed under the Recreation Area designation) provide additional representation of the Kitimat Ranges Ecosection and three biogeoclimatic subzone/variants (CWHvm, MHmm1, ATp). Although this ecosection and these biogeoclimatic subzones were already reasonably well represented, a Protected Area designation provides greater certainty that wildlife and wilderness values will be maintained over the long term. Similar to the Base Case, the Nass Ranges and in particular, the CWHws1 remains underrepresented (<1%).

In addition, because the Foch/Giltoeyes PA is immediately adjacent to the Gitnadoiks PA, these designations form a relatively large, contiguous protected area (about 118,000 ha) which will reduce risks for wide ranging species (e.g., grizzly) and better maintain ecosystem processes (i.e, predator-prey relationships and hydrological functions).

Although the Kalum LRMP does not provide a significant increase in Goal 1 PAS objectives (i.e., ecosystem representation), the Recommended Land Use Plan does propose 19 Goal 2 Protected Areas, which represents an additional 6,497 hectares (0.31% of the Plan Area) in new parks. These relatively small areas vary in size from 3 to 890 ha and provide enhanced protection for regionally and provincially significant natural, cultural heritage and recreational features, particularly in the Douglas Channel (e.g., lagoons, estuaries, hot springs). Two of the Goal 2 proposed Protected Areas (Brim River Hot springs and Exchamsiks extension), however, include provisions for road access through the protected area (ELUA corridors) to support potential mineral exploration and development. Although the ELUA corridors have the potential to compromise recreational and wilderness values, when and to what extent road access would impact specific values remains uncertain at this time.

Overall, the Recommended Land Use Plan would result in 454,032 hectares or 21.4% of the Plan Area in existing and proposed Protected Areas compared to 18.2% Case (including the Gitnadoiks Recreation Area which is partially protected) in the Base.

⁵ Source: LUCO PAS database 2000.

Table 3: Ecosystem and biogeoclimatic subzone/variant representation (in Protected Areas) for the Base Case and Kalum Land Use Plan.

Ecosystems	Total Area (ha) in LRMP	Base Case % Protected Areas	Land Use Plan % Protected Areas
Alaskan Panhandle Mountain	2,875	0%	0%
Bulkley Ranges	2,561	0%	0%
Kitimat Ranges	1,452,664	26%	30%
Nass Basin	16,781	24%	24%
Nass Ranges	696,492	2%	2%
Total	2,171,373	18%	21%
Biogeoclimatic Subzones	Total Area (ha) in LRMP	Base Case % in PAs	Land Use Plan (% Existing + New PAs)
Alpine Tundra parkland (ATp)	467,981	24%	26%
Coastal Western Hemlock, Very Wet Hypermaritime Central (CWHvh2)	21,220	0%	19%
Coastal Western Hemlock, Very Wet Maritime (CWHvm)	296,375	31%	38%
Coastal Western Hemlock, Very Wet Maritime, Submontane (CWHvm1)	15,930	0%	6%
Coastal Western Hemlock, Very Wet Maritime, Montane (CWHvm2)	13,965	0%	0%
Coastal Western Hemlock, Wet Maritime (CWHwm)	88	0%	0%
Coastal Western Hemlock, Wet Submaritime, Submontane (CWHws1)	212,976	0%	1%
Coastal Western Hemlock, Wet Submaritime, Montane (CWHws2)	280,768	17%	17%
Englemann Spruce - Subalpine Fir, Moist, Cool (ESSFmc)	3,612	0%	0%
Englemann Spruce – Subalpine Fir, Wet, Very Cold (ESSFwc)	260	0%	0%
Interior Cedar – Hemlock, Moist Cold, Nass (ICHmc)	3,736	0%	0%
Interior Cedar - Hemlock, Moist Cold, Hazelton (ICHmc2)	31,569	23%	23%
Mountain Hemlock, Moist Maritime, Windward (MHmm1)	347,901	28%	35%
Mountain Hemlock, Moist Maritime, Leeward (MHmm2)	423,186	8%	8%
Mountain Hemlock, Wet Hypermaritime, Windward (MHwh)	4,037	0%	0%
Total	2,123,603	18%	21%

Percentages represent the total amount of each ecosystem and subzone/variant in existing Protected and Recreation Areas within the LRMP boundaries (i.e., this is not a provincial summary).

4. Red and Blue-Listed Species and Plant Communities

4.1. Base Case

Currently, there are three red-listed, eight blue-listed, and one yellow-listed vertebrate species of management concern in the Kalum LRMP area. In addition, there are four red-listed and 20 blue-listed plant communities. Under Base Case management, some wildlife species and plant communities may be adequately addressed during regulatory review processes as well as through the *Identified Wildlife Management Strategy* (IWMS), for example, establishment of *Wildlife Habitat Areas*. However, wildlife species that require additional protection from a higher level plan (e.g., grizzly bear, fisher, bull trout) or species that have inadequate protection as provided in the IWMS (e.g., marbled murrelet) remain at moderate to high risk.

4.2. Land Use Plan

The Kalum Land Use Plan provides management direction for red and blue-listed wildlife species as well as rare plant communities. In particular, tailed-frog (blue-listed) riparian habitat will receive enhanced protection (no logging) in the Ascaphus Creek *Special Resource Management Zone* (SRM). Although some habitat protection for some species may occur as part of the IWMS, the direction given by the Kalum LRMP suggests greater certainty that red and blue-listed species will be adequately addressed during lower level planning processes. In addition, the Kermode bear (white colour phase of the Black Bear) as well as marmots have been identified for priority inventory and mapping of their habitats, which also suggests positive management direction necessary to ensure existence and viability of these provincially significant species.

Because specific biogeoclimatic subzones and ecosystems have been identified in the Plan as ‘biodiversity sensitivities’ risks to red and blue-listed plant communities may also be reduced in certain portions of the Plan Area. Other positive measures proposed to reduce risks to rare ecosystems include a no net loss policy for estuary ecosystems including the establishment of the Kitimat River as a *Sensitive Area* under the FPC.

5. Seral Stage Distribution and Old Growth

5.1. Base Case

Old forest retention in the Kalum LRMP is largely provided through provisions of the Landscape Unit Planning Guide (LUPG) as well as through forest age class constraints in place for the Thunderbird IRM (6,706 ha) where 12% of productive forests must be > 140 years (TSR II, 1999). Within the Kalum TSA portion of the Plan Area, the current age class distribution of forests indicate most of the forest that occurs on the timber harvesting land base are either less than 40 years old or older than 300 years. As these older forests are harvested under Base Case management, most forest stands that occur on the timber harvesting land base are projected to be < 100 years old in 50-100 years. This suggests plant and animal species dependent on mature and old habitats that occur on the timber harvesting land base are at increased risk over the short and long term. However, because a substantial portion of old forests also occurs in areas outside the timber

harvesting landbase, risks to mature and old growth dependent species may be somewhat reduced. This largely depends on each species seasonal habitat requirements and the spatial distribution of their critical life requisites (e.g., foraging areas, nesting sites) between operable and inoperable areas.

5.2. Land Use Plan

The Kalum Land Use Plan recognizes the shortcomings of current policy direction with respect to biodiversity (i.e., LUPG) and proposes incremental objectives and strategies to conserve biodiversity that will be phased in over time (seral stage transition strategy). Specifically, the Plan proposes to implement full seral targets as outlined in the *Biodiversity Guidebook* (1995). Although early, mature and old seral stage targets outlined in the BGB will be followed, there has been some allowance to exceed maximum early seral (10-15%) due to past logging history. The seral stage transition strategy is still an improvement over existing policy (i.e., Base Case/Landscape Unit Planning Guide) where only old seral targets are required to be met and suggests risks to biodiversity should decline over time. Similar to the Landscape Unit Planning Guide, old seral retention is to be applied at the variant level, however, possibilities exist to reduce impacts to specific rare ecosystems by adhering to identified biodiversity sensitivities (i.e., high value site series) during lower level planning processes. In addition to seral stage management direction, the Kalum LRMP also proposes the Cecil-Kitimat River old growth Sitka spruce grove be established as *Sensitive Area* under the *Forest Practices Code* and the old growth areas identified in the Thunderbird IRM Plan be established as old growth management areas (OGMAs).

6. Riparian Habitat

6.1. Base Case

The *Forest Practices Code* (FPC) as well as the *Mineral Exploration Code* (MX Code) requires *Riparian Reserve Zones* around most fish-bearing streams and water bodies. Depending on the stream classification (stream width), FPC reserve zones (i.e., no-harvest buffers) vary between 0-50m. Although S3, S2 and S1 streams require 20, 30 and 50m buffers respectively, no reserve zones are required for S4-S6 streams. Because some fish may be present in S4 streams, these headwater streams remain vulnerable to resource development practices. Overall, the FPC riparian reserve zones reduce the risks to S1, S2 and S3 stream classes and help maintain some riparian values (e.g., fish habitat, water quality). However, to maintain some terrestrial vertebrates (birds, amphibians), wider reserve zones may provide better protection than these relatively narrow strips. Approximately 4 625 ha were netted out of the timber harvesting land base to maintain riparian reserve zones in the Kalum TSA portion of the Plan Area.

6.2. Land Use Plan

The Kalum Land Use Plan reduces the risks to riparian habitats by identifying no logging zones (e.g., Upper Kitsumkalum, Ascaphus Creek) in key riparian areas as well as

applying alternate silvicultural systems in specific areas. In particular, the Lakelse River Corridor Special Management Zone includes a 200 m no harvesting zone immediately adjacent to the river (Subzone 1) and a modified harvest regime that extends a further 800 m (Subzone 2). The early seral stage constraints (maximum of 27% less than 40 years) outlined for the Subzone 2 combined with selection silviculture systems and/or opening size constraints suggests reduced risks to riparian values along the Lakelse River.

7. Grizzly Bear

7.1. Background

Grizzly bears are provincially *blue-listed*²⁵ primarily because they require large wilderness areas, have low reproductive rates and are vulnerable to human disturbances. To reduce bear-human conflicts, it is generally accepted that grizzly bears require large relatively undisturbed areas (350-2500 km² for an adult male). However, because large, undisturbed areas exceeding thousands of square kilometres are rare, the majority of grizzly bear range will require some form of special management to ensure grizzly bear survival.

Grizzly bears require a variety of seral stages to meet seasonal habitat requirements. Important habitats for coastal grizzly bears include estuaries, skunk cabbage swamps, salmon-bearing streams, mature floodplain forests, avalanche chutes, and non-forested fen/marsh complexes. In addition, habitats that provide abundant berry-producing shrubs (e.g. salmonberry, Devil's club, red elderberry) are used extensively as foraging areas throughout the summer months.

Most of the potential threats to grizzly bear populations are related to human settlement and road access and therefore, the amount of land remaining unroaded or where road densities are minimized provide the least risk to grizzly bears. In addition, intensive silviculture practices can reduce the amount of berry-producing shrubs and herbs by favouring early conifer establishment and high stocking densities.

Because grizzly bears are sensitive to specific land uses, sub-regional planning processes (LRMPs) can provide management support at the necessary spatial scale (i.e., thousands km²) to meet their needs for relatively large areas. A list of assumptions used to evaluate potential impacts of land use practices on grizzly bears are outlined in Table 4.

²⁵ BC Environment uses a 3 class system to rank vertebrate species according to their provincial degree of endangerment. *red-list* = endangered; *blue-list*-vulnerable/sensitive; *yellow-list* = not at risk, but may be regionally significant.

Table 4: Indicators and assumptions used to estimate potential impact of land use management zones on Grizzly Bear Habitat. Kalum LRMP.

Indicator	Assumptions
1) <i>Percent of High suitability grizzly bear habitat in each RMZ category</i>	<ul style="list-style-type: none"> • General/Enhanced Timber Management Zones considered to have moderate-high risks to grizzly bear populations due to increased road access, potential bear-human conflicts, poaching, altered seral stage distributions and loss of mature forests.
2) <i>Percent of High suitability habitat in the timber harvesting land base (THLB)</i>	<ul style="list-style-type: none"> • Low Intensity RMZs (e.g. Special Management/GBIWs) considered low-moderate risk. • Deactivation of roads assumed to partly mitigate impacts but less preferred than unroaded areas.
3) <i>The number of landscape units remaining undeveloped (i.e., proposed protected areas); their size and how they are spatially distributed</i>	<p>Undeveloped watersheds provide the least risk to grizzly bear survival. Larger protected areas (100-1000 km²) are better than smaller areas. Connected areas are better than disjointed areas. Protected Areas preferred land use designation (low risk). Special Management preferred for managing RMZs immediately adjacent to Protected Areas. (i.e., “buffer” areas)</p>

7.2. Base Case

The *Grizzly Bear Conservation Strategy* and *FPC Identified Wildlife Management Strategy*, recognize that sub-regional land use planning processes (LRMPs) can contribute significantly to grizzly bear conservation by explicitly stating grizzly bear management objectives over relatively large areas. As such, grizzly bears are considered a higher-level plan species that require explicit objectives and strategies from *Higher Level Plans* to adequately address their landscape-level requirements. Without this direction to guide landscape unit and operational planning, grizzly bears will remain vulnerable to resource development activities over the short and long term.

7.3. Land Use Plan

The Kalum Land Use Plan reduces the risks to grizzly bears over the long term by proposing a number of positive initiatives designed to maintain habitat at both stand and landscape levels as well as reduce mortality risks. This is largely achieved by setting seral targets in 2 key grizzly bear identified watersheds (Copper, McKay-Davies) and managing high value foraging areas (wetter site series) in 11 others. Management direction is proposed to maintain critical patch habitats (e.g., skunk cabbage swamps, avalanche chutes) across the Plan Area which will ensure access to important seasonal food sources. To reduce bear/human conflicts and mortality risks associated with increased road access, co-ordinated access management plans are proposed in key watersheds.

In addition to the General Management Direction for grizzly bears, three *Grizzly Bear Management Areas* (GBMAs) are identified and designated as *Special Resource Management Zones*. The first GBMA referred to as the Khutzeymateen Benchmark, is a relatively large area (386,184 ha) where hunting of grizzly bears is prohibited. This benchmark will provide an opportunity to study grizzly bear populations that are regulated by more natural processes and serve as a baseline (control) to compare to other populations that are hunted. The other two GBMAs are population linkage areas located at the Skeena River and Highway 16 corridor (near Little Oliver Creek) and the Lakelse-Kitimat settlement and Highway 37 south corridor where the highway crosses the Kitimat River. These linkage areas will serve as dispersal and movement corridors and may reduce the probability of population fragmentation (genetic isolation) over the long term.

These new land use initiatives are reflected in the allocation of grizzly bear habitat to RMZs that pose relatively lower risks compared to the Base Case. Most notably, the Land Use Plan increases the amount of grizzly bear habitat in *Protected Areas* from 18.7% to 21.7% (an additional 3% or 55,572 ha; see Table 5) and also shifts a significant amount of habitat from *General Management* to *No Logging* (3%) or other *Special Management Zones* (20%; see Table 5).

Table 5: The amount of grizzly bear habitat allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP

Resource Management Zone	Base Case		Land Use Plan	
	%GLB	%THLB	%GLB	%THLB
<i>Existing PAs</i>	18.7	0	18.7	0.0
<i>Proposed PAs</i>	NA	NA	3.0	1.0
<i>No Logging SMZs</i>	NA	NA	3.0	2.0
<i>Other SMZs</i>	7.2	12.7	20.0	41.0
<i>General Management</i>	71.5	82.9	54.0	53.0
<i>Settlement</i>	2.2	3.0	2.0	3.0
Total	100	100	100	100

Total grizzly bear habitat (Class 1,2,3): Gross land base (GLB) = 2,050,476 ha; Timber Harvesting Land Base (THLB) = 290,238 ha

% of grizzly bear habitat that occurs on THLB = $290,238 / 2,050,476 = 14.2\%$

Overall, the GIS area analysis combined with the proposed management strategies suggests reduced risk to grizzly bears over portions of the Plan Area compared to the Base Case. The creation of a large (118,000 ha), contiguous Gitnadoiks/Foch/Giltoyees PA will also better protect grizzly populations in these areas. However, because not all GBIWs will be managed to meet grizzly bear seral constraints, risks will vary across the Plan Area. Overall risks to grizzly resulting from the Land Use Plan are considered moderate.

8. Moose Winter Range

8.1. Background

Although not overly abundant, high capability moose winter habitat occurs in discrete locations throughout the Kalum Plan Area. Relatively large moose winter ranges occur along the Skeena River and tributaries, the upper Kitsumkalum (Beaver) and along the Nass River. Other smaller areas of moose winter range can be found near Lakelse Lake and along the Kitimat River.

To maintain moose habitat over the long term (a rotation), adequate quantities of forage and cover must be appropriately distributed over time and space. A desirable mix of forest seral stages to meet these requirements should include 30-40% mature forest and 30% early seral (shrubs and herbs available). In addition, road access must be minimized and managed effectively to reduce the potential for over-hunting (i.e., increase hunter success) and poaching. Specific assumptions used to estimate potential land use impacts on moose are outlined below (Table 6).

Table 6: Indicators and assumptions used to estimate potential impacts of land use management zones on moose winter range. Kalum LRMP.

Indicators	Assumptions
<p>(1) <i>Percent of High and Moderately High capability moose winter range in each RMZ category</i></p> <p>(2) <i>Percent of High and Moderately High capability moose winter range that occurs on the timber harvesting land base</i></p>	<ul style="list-style-type: none"> • Enhanced Timber Development areas (within General Management) assumed to have relatively high risks to moose. Mature forests required for summer & winter thermal cover as well as security cover considered limiting over the long term. Travel routes between riparian areas considered fragmented over time. Increased road network considered a high risk. • General RMZs considered compatible in short-medium term. However, long term supply of mature forest cover may be limiting especially in areas that receive higher snowfalls. Overall, General RMZs pose moderate risk levels to moose populations. • Special Management RMZs (access restrictions/ provide the least risk (low) to moose populations (i.e., preferred designation). Seral stage distributions adequate to maintain forage and cover (thermal/security) requirements. Road network minimized.

8.2. Base Case

Approximately ~75,000 ha of moose winter range occurs in the Kalum Plan Area. Of that, about 40% (31,152 ha) occurs on the timber harvesting landbase and is at risk from forest harvesting and silvicultural activities. In the Base Case, a relatively large amount (82%) of moose winter range occurs in the *General Resource Management Zone (RMZ)* (Table 7). Although the overall intensity of forest management activities in the *General RMZ* may provide suitable moose winter range in the short term, mature and old forest cover may become limiting over the long term. Therefore, moose are anticipated to become increasingly vulnerable to forest and road development over time, which may result in lower population levels under Base Case management.

8.3. Land Use Plan

The Kalum LRMP significantly reduces the risks to moose winter range over the long term. This is largely accomplished by designating three key floodplain winter ranges (Beaver, Nass and Skeena) as *Known Ungulate Winter Range* under section 69 of the *Forest Practices Code (FPC)* of BC as well as providing both landscape and stand-level management strategies that will provide adequate food and shelter over time. Risks to the Beaver moose winter range (e.g., reduced thermal cover, increased road access) are further reduced because of the no logging provision proposed in the Upper Kitsumkalum Special Management Zone. Overall, establishing KUWRs (FPC) as well as implementing the objectives and strategies outlined by the Kalum LRMP will provide sufficient management direction to lower level planning processes and reduce the risks to moose populations over the long term.

The GIS area analysis also suggests reduced risks to moose winter range compared to the Base Case. The Land Use Plan allocates 8% of moose winter range to No Logging SMZs and increases the amount of moose winter range in other Special Management Zones from 7% to 18% (Table 7). This reallocation result in less habitat in General Management (61%) compared to the Base Case (82%) and suggests reduced risks to moose.

Table 7: The amount of moose winter range allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP.

Resource Management Zone	Base Case		Land Use Plan	
	%GLB	%THLB	%GLB	%THLB
<i>Existing PAs</i>	0.9	0	0.9	0
<i>Proposed PAs</i>	NA	NA	3.0	2.0
<i>No Logging SMZs</i>	NA	NA	8.0	2.0
<i>Other SMZs</i>	6.7	8.6	18.0	25.0
<i>General Management</i>	82.0	84.6	61.00	66.0
<i>Settlement</i>	8.7	4.9	9.0	5.0
Total	100	100	100	100

Total moose winter range on gross land base (GLB) = 75,778 ha; total moose winter range on THLB = 31152; THLB/GLB = 41%

9. Mountain Goat Winter Range

9.1. Background

The Kalum LRMP area supports high suitability mountain goat habitat. Mountain goats are typically associated primarily with alpine and subalpine habitats. However, some mineral licks can be associated with forested areas if there is suitable escape terrain nearby. Overall, risks associated with resource development activities are mainly due to increased road access into remote areas and potential human disturbance (e.g., helicopter activity) during critical seasonal periods (e.g., lambing, kidding, and spring use of mineral licks).

The potential impact helicopters and other human disturbances (aircraft, blasting) have on mountain ungulates varies with the timing (season), frequency and duration of disturbance. Although some ungulate species may show a greater degree of habituation and tolerance to human activity, mountain goats appear more susceptible to human disturbances than other species.

Although mountain goats may have minimal direct conflict with forest harvesting activities, maintaining forested corridors between alpine areas is important to avoid isolation of sub-populations. Therefore, minimizing fragmentation and maintaining landscape-level connectivity during land use planning is beneficial. Assumptions used to estimate impacts of land use activities on mountain goats are outlined below (Table 8).

Table 8: Indicators and assumptions used to estimate potential impact of land use management zones on mountain goat habitat. Kalum LRMP.

Indicator	Assumptions
<i>(1) Percent of mountain goat habitat in each RMZ</i>	<ul style="list-style-type: none"> • Increased road access poses high risks to goat populations over the long term. • Forested areas near adjacent escape terrain (bluffs, cliffs) considered limiting (thermal/security cover; kidding areas). • Protected Areas or Special Management preferred options to maintain goat population(s) due to reduced industrial disturbance/road networks. Connected areas are preferred to disjointed areas to maintain population linkages. • Mineral exploration/development and commercial recreation (e.g., heli-skiing) can increase risks to goat populations through disturbance and habitat displacement. Degree of impacts will vary with frequency and duration of activity. • Access management strategies (e.g., access control points) or seasonal closures during resource development activities considered to partly reduce risks.

9.2. Base Case

The Kalum LRMP supports provincially significant populations of mountain goats. Of the high capability mountain goat habitat identified in the Kalum LRMP about 21% currently exists in fully or partially protected areas (Kitlope Heritage Conservancy and Gitnadoiks Recreation Area respectively). Outside of these protected areas, the remaining goat habitat is vulnerable to resource development activities over time. However, the *Identified Wildlife Management Strategy* (IWMS) currently provides some habitat protection measures necessary to maintain mountain goat habitat including the potential establishment of *Wildlife Habitat Areas* (WHAs) and *General Wildlife Measures* (e.g., access, silviculture) designed to reduce disturbance near critical natal areas. However, at this time, it is uncertain how many, if any, WHAs would be established in the future.

9.3. Land Use Plan

The management strategies outlined by the Kalum Land Use Plan suggest lower risks to goats compared to the Base Case and are accomplished primarily by addressing disturbance near critical winter ranges. The recommended 400 metre no harvesting zone adjacent to known escape terrain will reduce the risks associated with loss of mature and old forests used as thermal cover. In addition, the Kalum LRMP provides direction to maintain travel corridors between winter range/escape terrain complexes, minimize human disturbance (e.g., road placement) as well as minimize resource extraction activities during winter months.

The GIS analysis also indicates somewhat less risk to mountain goats compared to the Base Case. The Land Use Plan increases the amount of mountain goat winter range in *Protected Areas* from 21.3% to 23.3% (i.e., an additional 2% or 18,673 ha) (Table 9) and allocates an additional 3% (28,084 ha) to *No Logging SMZs*, which suggests reduced risks to mountain goat winter range over certain portions of the Plan Area (i.e., fewer roads, less human disturbance).

Table 9: The amount of mountain goat winter range habitat allocated to each land use zone for the Base Case and Recommended Land Use Plan. Kalum LRMP.

Resource Management Zone	Base Case		Land Use Plan	
	%GLB	%THLB	%GLB	%THLB
<i>Existing PAs</i>	21.3	0	21.3	0.0
<i>Proposed PAs</i>	NA	NA	2.0	0.0
<i>No Logging SMZs</i>	NA	NA	3.0	7.0
<i>Other SMZs</i>	5.9	11.9	12.0	18.0
<i>General Management</i>	67.5	87.8	48.0	68.0
<i>Settlement</i>	0.3	0	0	0
Total	100	100	86	100

Note: Area statistics represent the original mountain goat winter range mapping (1:250,000) and not the revised 1:20,000 mapping. Total does not add to 100 – reason unclear at time of report. Total mountain goat winter range (Class 1 and 2) = 808,235 ha (GLB). Total mountain goat winter range that occurs on the THLB = 11, 859 ha.

10. Wildlife Habitats (General)

The Kalum LRMP proposes co-ordinated access management planning throughout the Plan Area including 9 priority watersheds. Because many wildlife species are sensitive to increased road access (e.g., grizzly bears, ungulates), this initiative is viewed as a positive measure that will help reduce the risks to wildlife populations compared to the Base Case.

The LRMP states that significant fish, wildlife and other resource values will be identified and protected through site specific strategies such as: identification of the best location for roads, limiting the use or frequency of use during certain periods and, if necessary, restricting access through road closures or deactivations. Access may be prohibited in specific areas where fish or wildlife values are critical to species maintenance.

11. Fish and Fish Habitats

11.1. Base Case

Although there are existing regulations in place to protect fish and fish habitat (e.g., FPC, Fish Protection Act), the primary concerns of maintaining freshwater fish habitat are related to inadequate riparian habitat protection, especially for small fish bearing streams and non-fish bearing streams that flow directly into fish bearing streams (i.e. S5, S6). Because the potential for resource development activities to negatively impact fish and fish habitat will likely increase as resource development pressures increase over time, fish habitats remain vulnerable. Overall, increased riparian protection as well as watershed level assessments have been identified as key issues that need to be addressed to reduce the risks to fisheries habitat. The commercial, mixed stock fishery (i.e., the harvesting of smaller, weaker stocks as they mingle with larger, more productive stocks), also poses risks to the resource.

11.2. Land Use Plan

The Kalum Land Use Plan provides similar management direction as the Base Case for fish and fish habitats. However, positive measures that increase certainty that fish habitats will be addressed during lower level planning processes include further inventory and mapping of salmon, herring and oolichan spawning grounds. The Kalum Land Use Plan also stresses the importance of conducting comprehensive evaluations as per *Coastal Watershed Assessment Procedures* (CWAPs) for all major river/creek systems. Specific areas that receive enhanced protection include the designation of the Upper Copper River as a Special Management Zone and the Lakelse River Corridor, which provides habitat for large numbers of both anadromous and non-anadromous fish including Pink, Coho, Steelhead, Sockeye, Chinook, Cutthroat Trout and Dolly Varden. Overall, the General Management Direction proposed by the Kalum LRMP combined with an increase in area designated as Special Management suggests reduced risks to fish habitat in the Plan Area.

12. Water Quality/Quantity

12.1. Base Case

There are currently six Community Watersheds in the Kalum Plan Area. It is expected that the guidelines and assessment procedures associated with the *Forest Practices Code* will result in reduced risks to water quality and quantity over most of the Plan Area. However, there are specific areas where water quality concerns remain an issue, particularly in settlement areas where water use demands are increasing. In general, the potential for domestic and general water use will likely increase as communities grow. Increased use of surface waters would also be expected to increase as recreation related activities become more popular.

12.2. Land Use Plan

In addition to the six existing Community Watersheds, five additional Community Watersheds are proposed including Rosswood (Clear Creek), Usk (Skovens Brook), Kleanza (Singlehurst Creek), Gossen (Gossen Creek), and Hatchery Creek. The harvesting constraints typically applied to Community Watersheds suggests reduced risks to water quality/quantity. In addition, to these Community Watersheds, the Kalum LRMP proposes to maintain natural flow regimes to the extent possible by ensuring a clear-cut equivalency of less than 20% of the watershed area in sub-basins larger than 250 hectares. This also suggests reduced risks to water quantity/quality.

APPENDIX 1

- Arcese, P. and A.R.E. Sinclair. 1997. The role of protected areas as ecological baselines. *J. Wildl. Manage.* 61:587-602.
- BC. Environment. 1995. A future for the Grizzly: British Columbia Grizzly Bear Conservation Strategy. pp. 15.
- Bergmann, M.A., S. Ferson, and H.R. Akcakaya. 1993. Risk assessment in conservation biology. Chapman Hall. University Press Cambridge. pp 309.
- Bleich, V.C., R.T. Bowyer, A.M. Pauli, M.C. Nicholson and R.W. Anthers. 1994. Mountain sheep (*Ovis Canadensis*) and helicopter surveys: ramifications for the conservation of large mammals, *Biological Conservation* 70: 1-7.
- Bunnell, F.L. 1995. Forest-dwelling vertebrate faunas and natural fire regimes in British Columbia: patterns and implications for conservation. *Conservation Biology*. Vol. 9 (3): 636-644.
- Bunnell, F.L. and L. L. Kremsater. 1990. Sustaining wildlife in managed forests. *Northwest Environ. Journal*. 6:243-270.
- Calow, P. and V.E Forbes. 1997. Science and subjectivity in the practice of ecological risk assessment. *Environmental Management* Vol.21, No.6: 805-808.
- Cole, D.N., and P.B. Landres. 1996. Threats to wilderness ecosystems: impacts and research needs. *Ecological Applications* 6:168-184.
- Cote, Steeve, D. 1996. Mountain goat responses to helicopter disturbance. *Wildlife Society Bulletin* 24: 681-685.
- Kareiva, P. and U. Wennergren. 1995. Connected landscape patterns to ecosystem and population processes. *Nature*. Vol.373 :299-302.
- Kinley, T. A. and N.J. Newhouse. 1997. Relationship of riparian reserve zone width to bird density and diversity in southeastern British Columbia. *Northwest Science* 71:75-87.
- Forest Practices Code (FPC) of British Columbia 1999. *Landscape Unit Planning Guide*.
- Forest Practices Code (FPC) of British Columbia 1999. *Managing Identified Wildlife: Procedure and Measures. Vol I*.
- Forest Practices Code (FPC) of British Columbia. 1995. *Riparian Management Area Guidebook*.
- Forest Practices Code (FPC) of British Columbia. 1996. *Lake Classification and Lakeshore Management Guidebook*
- Forest Practices Code (FPC) of British Columbia. 1995. *Biodiversity Guidebook*.
- Foster, B. R. and E. T. Rahe. 1983. Mountain goat responses to hydroelectric exploration in northwestern British Columbia. *Environmental Management* 7: 189-197.
- Franklin, J.F. 1993. Lessons from old growth. *J. Forestry* (Dec): 11-13.

- Frid, A. 1996. Responses by Dall's sheep to helicopter disturbance: preliminary data from the southwest Yukon. *Caprinaea News*: Nov, pp 3-6.
- Mace, R. D., J. S Waller, T.L. Manly, L.J. Lyon and H. Zuuring. 1996. Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. *Journal of Applied Ecology*. 33: 1395-1404.
- Mattson, D .J., Herrero, S, R.G. Wright, and C.M. Pease. 1996. Science and management of Rocky Mountain grizzly bears. *Conservation Biology*. Vol 10 (4): 1013-1025.
- McLellan, B.N. 1990. Relationships between human industrial activity and grizzly bears. *Int. Conf. Bear. Res. and Manage.* 8:57-64.
- McLellan, B.N. 1989. Dynamics of a grizzly bear population during a period of industrial extraction. III. Natality and rate of increase. *Canadian Journal of Zoology*. 67: 1865-1868.
- McLellan, B.N., and D. M. Shackleton. 1988. Grizzly bears and resource extraction industries: effects of roads on behaviour, habitat use and demography. *J. Applied Ecology* 25:451-460.
- McLellan, B.N., and D. M. Shackleton. 1989. Grizzly bears and resource extraction industries: habitat displacement in response to seismic exploration, timber harvesting and road maintenance. *J. Applied Ecology* 26:371-380.
- Morrison, M. L., B.G. Marcot, and R.W. Mannan. 1992. *Wildlife-Habitat Relationships. Concepts and Applications*. The University of Wisconsin Press. pp. 343.
- Naiman, R .J., H. Decamps and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3: 209-212.
- Noss, R.F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* 4: 355-364.
- O'Neill, R., C.T. Hunsaker, K. B. Jones, K.H. Riitters, J.D. Wickham, P.M. Schartz, I.A. Goodman, B. L. Kackson and W.S. Baillargeon. 1997. Monitoring environmental quality at the landscape scale: using landscape indicators to assess biotic diversity, watershed integrity and landscape stability. *Bioscience* 47: 513-519.
- Patch, J. 1988. Habitat supply analysis and forest management. *Trans. 52nd N.A. Wildl. & Nat. Res. Conf.* 53-59.
- Ruggerio. L.F., G.D. Hayward and J. R. Squires. 1994. Viability analysis in biological evaluations: concepts of population viability analysis, biological population and ecological scale. 1994. *Conservation Biology* 8: 364-372.
- Stevens, V. 1995. Wildlife diversity in British Columbia: distribution and habitat use of amphibians, reptiles, birds and mammals in biogeoclimatic zones. B.C. Ministry of Forests, Research Branch, Victoria, B.C. Working Paper No. 04. pp. 288.
- Weaver, J.L. Paquet, P.C. and L.F. Ruggerio. 1996. Resilience and conservation of large carnivores. *Conservation Biology*. Vol 10. (4) 964-976.
- With, K.A., R.H. Gardner and M.H. Turner. 1997. Landscape connectivity and population distribution in heterogeneous environments. *Oikos* 78: 151-169.

