Quesnel Forest District
Enhanced Retention Strategy

For
Large Scale Salvage of
Mountain Pine Beetle Impacted Stands

Release 1.0

Quesnel Forest District
Enhanced Retention Strategy Committee

Release Date: February 2006

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Introduction

History of Infestation and Management Response

The Mountain Pine Beetle (MPB) infestation in central British Columbia is exceeding historical levels, and is expected to impact 80% of the mature pine forests in the province. The Quesnel Forest District is in the epicentre of this infestation, and is on the leading edge of identifying and implementing response strategies to mitigate or mediate the economic and environmental impact resulting from the death of millions of cubic metres of mature Lodgepole pine.

The Chief Forester increased the Annual Allowable Cut (AAC) for the Quesnel Timber Supply Area (TSA 26) by 948,000 m^3 in 2001 to assist the MPB control efforts. At that time the Chief Forester asked staff to continue to monitor the infestation so that, if and when required, the determination may be revisited at an earlier date than stipulated by statute.

The Quesnel Forest District requested another review of the AAC for TSA 26 based on exponential increases in the area impacted by MPB. A second AAC increase of 2,032,000 m^3 was determined in the fall of 2004 to provide sufficient AAC to salvage timber killed by the current and projected MPB epidemic. This increased AAC volume is primarily aimed at MPB mortality in the moderately and severely impacted pine-leading stands.

In determining an AAC, the Chief Forester is required to consider factors in Section 8 of the *Forest Act*. One factor is *(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production.* The Chief Forester specifically turned his mind to forest stewardship principles that might be different from standard approaches when faced with catastrophic events with the potential for large salvage programs.

A discussion paper titled *Forest Stewardship in the Context of Large-Scale Salvage Operations (M. Eng et al)* was released on June 10, 2004 that contained a number of recommendations for possible future forest practices that might be different than current practices in light of the potential for significant harvest level increases. In the base case analysis for the Timber Supply Review (TSR), the most significant variance from current practice was to increase the amount of stand level retention in MPB infested pine-leading stands to account for the stewardship recommendation to increase the size of reserves concurrent with increasing opening size. The overall stand level retention was assumed to be 20% for moderately and severely infested pine-leading stands where the large openings are expected; this assumption incorporated the increased retention objective into the aspatial TSR.

The identification of Old Growth Management Areas was not completed at the time of the 2001 AAC determination. Landscape level retention was modelled in the TSR by imposing seral stage constraints; this strategy was repeated in the expedited TSR in 2004.

The increased AAC was targeted at moderately and severely MPB infested stands, where the dead timber was assumed to be available for harvest for fifteen years. Approximately 17.3 million m3 of infested timber was not recovered after allowing for the additional stewardship reductions. Of this amount 13 million m^3 occurred in low-impacted stands or was held for enhanced conservation objectives; the remaining 4.3 million m^3 were in moderately to severely infested stands which were not projected to be harvested due to forest cover constraints (all constraints except adjacency were applied in the TSR). The strategic placement of this non-recoverable timber can support the objective of increased stand level retention in MPB infested pine-leading stands.

In his 2004 AAC Rationale for Quesnel TSA, the Chief Forester states: *...I accept that the epidemic represents a catastrophic event and regardless of whether it is caused by natural or human-influenced events, it is evident that forest managers must consider new forest management strategies and responses to the ongoing epidemic... These strategies are essential for the implementation of any large salvage program.*

In the Reason for Decision section, it further states: *While...they are not mandatory, I feel it is appropriate to consider their implications in the decision in order to ensure that adequate opportunity is given to government decision makers to consider how to respond to this new information...I strongly encourage the appropriate policy analysis and resolution of how to consider this information from an operational perspective through the new Forest and Range Practices Act.*

Intent of the Guidance

This document is intended to support the goal of increasing stand level retention by providing guidance to assist field practitioners in selecting and distributing conservation legacy areas (CLA) during the implementation of the large-scale salvage of MPB impacted pine leading stands within the Quesnel Forest District. The best management practice (BMP) recommendations presented are considered to be the best non-legal direction to realize the objectives and expectations expressed in the Expedited Timber Supply Review for the Quesnel Timber Supply Area, while remaining consistent with the objectives and expectations of the Cariboo Chilcotin Land Use Plan (CCLUP).

This guidance is not intended to constrain a professional forester in identifying suitable CLA's at the stand level. It provides a set of suitable recommended options with supporting spatial and attribute information to consider when addressing this component of forest management. The flexibility and options presented are intended to support the government initiative to increase professional reliance and accountability.

The persistence of the enhanced retention is currently under discussion at the provincial level, but these areas are expected to last into the mid-term of the timber supply forecast. The guidance provided in this document assumes a 30-year retention period.

This strategy presents the following information:

1. A combination of landscape level (distribution) and stand level (attribute) recommendations.

2. Supporting Landscape Unit maps which identify high value retention areas suitable for CLA's, as well as polygons where stand level attributes require closer scrutiny by field practitioners to determine the potential for contributing to CLA objectives.

3. Recommended BMP's which provide guidance on the selection of additional CLA's. CLA's contribute toward the targeted retention level for each cut block and for the overall landscape unit.

General Best Management Practices

Best Management Practice Context

Forest management proceeding under Forest Development Plans is expected to reflect these BMP's as well as the full scope of Forest Practices Code (FPC) requirements, including management expectations relative to the FPC riparian defaults. It is also anticipated that these BMP's will be reflected in Forest Stewardship Plans as forest management transitions to the requirements and expectations of the *Forest and Range Practices Act*. The amount of riparian protection may require reconsideration if assumptions change as a result of MPB impacts to hydrological function.

The CCLUP specifically identifies the Baezaeko, Cariboo, Bowron, Quesnel and Cottonwood River watersheds with respect to managing for salmon stocks through riparian area protection and controls on rate of harvest. The CCLUP also specifically anticipates management of grizzly bear, moose, furbearers, species at risk and other sensitive habitats within the areas identified as riparian buffers in the Itcha/Ilgachuz, Lower Blackwater, Quesnel Highlands, Quesnel Lake, Upper Blackwater, Kluskus, Baezaeko, Nazko, Quesnel, Cottonwood, and Batnuni subzones.

The success of this strategy to mitigate potentially negative, unplanned, cumulative effects on biodiversity associated with large-scale salvage requires a collective commitment by resource management practitioners to increase retention levels on a landscape or watershed basis. This is of particular significance in watersheds, noted in the CCLUP or other approved government documentation, with identified concerns related to water quality and/or quantity, riparian management or fisheries values. Further information is contained in the *Summary of CCLUP Legal Requirements and Selected Non-Legal Direction* and relevant Sustainable Resource Management Plan (SRMP) reports.

General Principles for Enhanced Retention in Areas Impacted by Mountain Pine Beetle Salvage Activities

1. CLA's must be placed within pine-leading areas. The size and location of CLA's should consider operational feasibility for future harvest or rehabilitation opportunities. Fifty percent (50%) of CLA requirement should be located interior to the block area boundary.

2. Primary focus for establishing CLA's is on riparian retention, particularly where this supports overlap with other values such as preserving wildlife corridors, continuing patterns of retention connectivity or protecting known archaeological sites and areas of high archaeological potential.

3. Look for opportunities within cutblock boundaries to overlap retention with other relevant constraints such as archaeological potential, high risk terrain stability areas, Environmentally Sensitive (ES) areas, Conservation Data Centre (CDC) red-listed and blue-listed species locations and CCLUP objectives when establishing CLA's.

4. The size and location of CLA's should consider operational feasibility for future harvest or rehabilitation opportunities.

5. The default retention target is approximately 20% of the pine leading area of each Landscape Unit; 12 % in CLA's and the balance in WTP's. It is not the objective to apply the same retention level everywhere, but to vary the retention concurrent with stand level opportunities. As a general principle, the retention level should increase with increasing block size with a minimum of 15%, ranging up to 25% for larger blocks (1000+ hectares).

Old Growth Management Areas

* CLA's are not eligible for overlap with permanent OGMA's. CLA's may overlap pine-leading transition OGMA's.

Riparian Features

* Consider treating the entire Riparian Management Zone (RMZ) of all riparian features as a Riparian Reserve Zone (RRZ) and seek opportunities to increase the size where it is suitable to enhance the protection of fisheries habitat or watershed values.

* Consider treating S6 streams as S4 streams where they are directly tributary to fish bearing streams and manage the RMZ as a RRZ (100% retention).
* Consider doubling the Riparian Management Area (RMA) width for higher value riparian features (those requiring a RRZ) and maintaining 100%

retention in the RMA. The integrity of these features may be critical to minimizing hydrological impacts within a watershed, and for maintaining fish habitat and water quality.

* Consider retention levels approaching 100% for the RMZ of S5 and S6 streams that are direct tributaries to fish bearing streams and sensitive lakeshore spawning habitats.

* Where high windthrow hazard exists, consider doubling the width of the RMA's, or widening the width of the RMA to connect to a natural windbreak, if possible. Consider100% retention within the entire RMA unless alternative windthrow management measures are proposed.

* Consider full retention rather than partial harvest in RMA's to reduce the windthrow hazard in RRZ's.

Non-Pine Species

Within the pine-leading landscape, there are often stands that contain significant components of other species, either in the main canopy or as understory or intermediate layers. These stands have high value for biodiversity and should be carefully assessed as CLA's, particularly when they are found within proposed block boundaries. The Landscape Unit maps contained in the appendix identify those pine-leading stands with significant volumes of other species in the inventory label. What are currently not identified are stands with an understory or sapling/pole layer that does not contribute to the inventory label. The following BMP's provide guidance for managing these stand types:

* MDWR and Cariboo Modified Harvest Areas do not require implementation of the enhanced conservation strategy because existing management strategies restrict harvest or limit opening size. These areas are treated similar to permanent OGMA's where they abut pine-leading stands subject to enhanced retention.

* The intent is to focus enhanced retention in the pine-leading landscape which is subject to the increased salvage harvesting. Pine-leading polygons with volumes of non-pine species are of particular value for retention. CLA placement should capture pockets of un-mapped non-pine species at the stand level where this achieves the broader range of objectives.

* WTP placement in non-pine leading stands is acceptable

* Pine-leading polygons with significant volumes of non-pine species are some of the highest value areas for retention. Consider selecting stands with significant understory or sapling/pole layers for retention. These stands are expected to contribute to the mid-term harvest and forest cover needs.

* Consider retaining buffers of dead pine around areas of retained non-pine species.

* Consider reserving deciduous species in riparian and harvested areas. Deciduous stands are particularly noted in the CCLUP as contributors to biodiversity, and are one of the key structural characteristics remaining in natural bark beetle disturbance patterns. Retention of deciduous during salvage of pine-leading stands is an important contribution to the enhanced retention strategy.

Wildlife Tree Patches

WTP's will continue to be established and managed in accordance with the requirements and recommendations of the CCLUP, specifically the recommendations outlined in Update Note #12 of the Regional Biodiversity Conservation Strategy.

* WTP's will represent up to 8% of the required retention areas for large openings, and can be placed within or directly adjacent to block boundaries.

* WTP's can be placed in non-pine areas, WHA's and Ungulate Winter Range areas, within or adjacent to the block, if these areas meet the location and composition requirements for WTP's

* The maximum inter-patch distance between WTP's, CLA's or the mature timber edge must not exceed 500 metres. WTP's and CLA's used to meet it must be at least 0.25 hectares in size. It is recommended that WTP's and CLA's be at least 2 hectares in size to maximize value to wildlife and to allow for future rehabilitation or harvest opportunities.

* Look for opportunities to add to and reinforce existing small WTP's when abutting existing blocks to improve stability and/or add interior habitat.

Timber Supply

The CCLUP established timber targets that provided for assurance to access for development of the forested land base. The timber targets were further distinguished between three levels of timber availability; conventional, modified and no harvest areas.

The CLA's, in conjunction with riparian areas, OGMA's, and other constraints, will create short term no-harvest percentages that are larger than the no-harvest targets in CCLUP. This increased retention is considered best practice when:

* little is known about the effects of the beetle- killed stands on ecological values
* caution is exercised to compensate for the increased rate of harvesting

- enough timber is available for salvage to support the increased cut
- the retained pine leading areas contain significant volumes of other species that will be valuable in the midterm.
- it is assumed that CLA's containing other species will maintain or grow enough timber for harvesting to occur after the salvage period.
- Scientific literature supports that larger retention areas are required with increased harvest area sizes, to mimic natural disturbance patterns.

It is expected that future analysis will determine whether the CLA's will require rehabilitation following the salvage period to avoid unacceptable reductions in the future timber supply.

Timber Supply Monitoring

Many projects are working on developing an understanding of the impacts of the pine beetle epidemic on forest values. The assumptions in the expedited Timber Supply Analysis with respect to retention levels, harvest levels and shelf life will be reviewed as more data and knowledge becomes available. The review should consider if sufficient timber volume is available to support AAC commitments, shelf life assumptions, and ecological, economic and social expectations.

Review Schedule

An interim annual review schedule for this strategy has been suggested. This will trigger the first review of the implementation of this strategy in October 2006. Prior to that review, discussions will continue on how to design the future portions of this strategy.

Supporting Maps

Each landscape unit has a map product developed to visually represent the highest value features and areas suitable for retention present in each landscape unit, and to facilitate the identification of higher value CLA's.

The maps show the following potential high value features:

- Riparian Management Areas (for lakes, streams and wetlands). The entire Riparian Management Area is shown; there is no differentiation between RMA and RRZ as it would not be recognizable at the scale of mapping. The differentiation between the reserve and management zones is available for any desired analysis.
- Old Growth Management Areas (both permanent and transition). Although transition OGMA's in pine-leading are available for harvest, they may still be a higher priority for retention than conventional harvest areas.
- Wildlife Habitat Areas - pelican and caribou for Quesnel (although there is no harvest restriction for the Pelican areas, the 1km buffer for seasonal mechanized

activity restriction makes this area of higher value for retention than conventional harvest areas).

- Conservation Data Centre red and blue-listed species and rare ecosystem locations (both non-sensitive and sensitive layers are in this layer of information).
- Critical fish habitat no-harvest area from Quesnel SRP maps.
- Moose high value wetlands.
- Ungulate Winter Range areas.
- Pine polygons with 40% or more other species.
- Pine polygons with 30-40% other species present.
- Snow course sampling sites.
- Goal 2 Protected Areas.
- Retention Visual Quality Objective areas.

The establishment of CLA's relies on a stand level assessment by a qualified professional to review and determine if these features are present and whether they are the best locations for the CLA's considering the BMP's presented in this document, local knowledge and site conditions or constraints. The potential CLA coverage can be found on the Quesnel MoF&R FTP site at:

http://www.for.gov.bc.ca/ftp/DQU/external/!publish/Conservation_Uplift/

References

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Province of British Columbia. December 1995. Ministry of Forests and BC Environment. *Forest Practices Code of British Columbia Act* – Biodiversity Guidebook. Canadian Cataloguing in Publication Data. 99pp.

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Appendices

A. Landscape Unit Specific Best Management Practices

Landscape unit specific BMP's clarify, enhance or add to the General Best Management Practices previously presented. The landscape specific practices take precedence where there is any conflict with the general BMP's.

The spatial information is intended to be a visual rendering of the values already discussed in the main body of the document as best management practices. Accuracy is questionable for the GIS generated boundaries for these features; the presentation is a first approximation of the high value areas. The exception is for spatially identified CLA's, or areas endorsed or established outside of this process.

Each map has provides a summary showing area and percent of the identified high value features relative to the pine-leading component of the landscape unit.

A broad hierarchy was applied to facilitate visual representation and the area/percentage summaries. For example, permanent OGMA areas are considered the maximum level of protection and mask any RRZ, RMZ, or other identified value features.

The hierarchy is:

1. Permanent Old Growth Management Areas.
2. Riparian Reserve Zones, Conservation Data Centre identified sites and Class 'A' Lakeshore Management Zones.
3. Riparian Management Zones and other Lakeshore Management Zones.
4. Wildlife habitat Areas, Critical Fish Habitat, Moose Wetlands and pine leading stands with 30% - 40% and >40% other species by volume.

Baker Landscape Unit

The Baker Landscape Unit is considered to be a riparian-sensitive watershed. Anecdotal information appears to support public concerns that hydrological changes are occurring resulting in peak flow aberrations.

It is recommended that field practitioners locate retention areas to protect and enhance riparian features, particularly those highlighted on the Baker Landscape Unit enhanced conservation map.

QFD Enhanced Conservation Strategy

Baker Landscape Unit

High value retention areas

File: W:\for\rsi\workare\DQU\Conservation_Uplift_Working\bak_over_rippy_1117.mxd

Kilometers
0 0.5 1 2 3 4 5 6 7 8

Projection : UTM Zone 10
Datum: NAD83
Created: 05.07.14

1:150,000

Landscape Unit: pantage

Landscape Unit: tibbles

Landscape Unit: baker

Landscape Unit: ramsey

Landscape Unit: narcosli

whittier

umiti

Milburn Lake

Bouchie Lake

093G015 093G016 093G005 093G006 093G007 093G008 093B095 093B096 093B097 093B085 093B086 093B087 093B088 093B075 093B076 093B077 093B065 093B066 093B067 093B055 093B056 093B057

Baker Pine leading land use	Area (ha)	Percent
trans OGMA	731.25	1.7%
pine leading	43367.21	98.3%
Total area	**44098.46**	

	Area
Pine Leading with Secondary Species 30-40%	5219.2ha
Pine Leading with Secondary Species 40%+	440.6ha

Legend

- city
- town
- other
- gravel 1lane; gravel 2lane
- paved 1lane; paved 2lane
- road unimprv
- trail
- Woodlot
- PL leading
- Non PL leading
- Perm. OGMA in PL lead
- Trans. OGMA in PL lead
- Perm. OGMA in non PL lead
- Trans OGMA in non PL lead
- 30-40% Secondary species comp.
- 40%+ Secondary species comp.
- depletion layer
- riparian reserve zone
- riparian management zone
- wetland
- wetland buffer
- Moose high value
- critical fish
- MDWR
- wildlife habitat areas
- wildlife habitat potential heron

Dragon Landscape Unit

The pine-leading stands in the Dragon Landscape Unit are not extensive, but form the headwaters of several streams that link directly to the Fraser and Quesnel Rivers. These streams often flow through private land where peak flow aberrations can negatively impact improvements to these lands.

Critical fish habitat has been identified by DFO and MoE along the Quesnel River.

It is recommended that field practitioners locate retention areas to protect and enhance riparian features.

QFD Enhanced Conservation Strategy

Dragon Landscape Unit

High value retention areas

File: W:\for\rsi\Workarea\DQU\Conservation_Uplift_Working\drag_over_1117.mxd

Kilometers
0 0.5 1 2 3 4

Projection : UTM Zone 10
Datum: NAD83
Created: 05.07.14

1:150,000

Quesnel

Kersley

Australian

Goal2 Area: Dragon Mountain

Landscape Unit: gerimi

Landscape Unit: victoria

Landscape Unit: dragon

Landscape Unit: narcosli

Landscape Unit: twan

Dragon Pine leading land use	Area (ha)	Percent
trans OGMA	349.16	1.86%
Pine Leading	18401.32	98.13%
Total Area	18750.48	

Dragon	Area
Pine Leading with Secondary Species 30-40%	4093.5ha
Pine Leading with Secondary Species 40%+	279.4ha

Legend

- city
- town
- other
- gravel 1lane; gravel 2lane
- paved 1lane; paved 2lane
- road unimprv
- trail
- Woodlot
- PL leading
- Non PL leading
- Perm. OGMA in PL lead
- Trans. OGMA in PL lead
- Perm. OGMA in non PL lead
- Trans OGMA in non PL lead
- 30-40% Secondary species comp.
- 40%+ Secondary species comp.
- depletion layer
- riparian reserve zone
- riparian management zone
- wetland
- wetland buffer
- Moose high value
- critical fish
- MDWR
- wildlife habitat areas
- wildlife habitat potential heron

Gerimi Landscape Unit

The pine-leading stands in the Gerimi Landscape Unit are not extensive, but form the headwaters of relatively short streams that link directly to the Quesnel River. These streams often flow through a relatively steep escarpment where peak flow aberrations can negatively impact stream channel stability and sediment load potential.

Critical fish habitat has been identified by DFO and MoE along the Quesnel River.

It is recommended that field practitioners locate retention areas to protect and enhance riparian features.

QFD Enhanced Conservation Strategy

Gerimi Landscape Unit

High value retention areas

File: W:\for\rs\Workarea\DQU\Conservation_Uplift_Working\ger_over_1117.mxd

Projection : UTM Zone 10
Datum: NAD83
Created: 05.07.14

Kilometers
0 0.5 1 2 3 4 5

1:150,000

Landscape Unit: umiti

Landscape Unit: lightning

Landscape Unit: swift

Landscape Unit: victoria

Landscape Unit: dragon

Landscape Unit: gerimi

Goal2 Area: Dragon Mountain

093B098 093B099 093B100 093A091 093B088 093B089 093B090 093A082 093A081 093B078 093B079 093B080 093A071 093A072 093B068 093B069 093B070 093A061 093A062

Gerimi Pine leading land use	Area (ha)	Percent
trans OGMA	20.89	0.17%
Pine Leading	11675.34	99.83%
Total area	**11696.23**	

Gerimi	Area
Pine Leading with Secondary Species 30-40%	2776.9ha
Pine Leading with Secondary Species 40%+	69ha

Legend

- city
- town
- other
- gravel 1lane; gravel 2lane
- paved 1lane; paved 2lane
- road unimprv
- trail
- Woodlot
- PL leading
- Non PL leading
- Perm. OGMA in PL lead
- Trans. OGMA in PL lead
- Perm. OGMA in non PL lead
- Trans OGMA in non PL lead
- 30-40% Secondary species comp.
- 40%+ Secondary species comp.
- depletion layer
- riparian reserve zone
- riparian management zone
- wetland
- wetland buffer
- Moose high value
- critical fish
- MDWR
- wildlife habitat areas
- wildlife habitat potential heron

B. Riparian Features Supplement

All riparian areas are potentially important biodiversity features in the pine-dominated landscape of the Quesnel TSA. Riparian areas are often the most likely to have tree species and moisture regimes that differ from the surrounding upland areas. Live and dead timber (standing or windthrown) in riparian areas continues to contribute to wildlife and fisheries habitat for many years after disturbance. As a result, timbered riparian areas are often typical structural characteristics of natural bark beetle disturbance patterns, and riparian areas in pine-dominated landscapes become important candidate areas for retention.

Harvesting riparian areas, especially in large blocks, is usually not consistent with maintaining structural characteristics of natural disturbances. Harvesting of an RMA within a large block must be consistent with statutory requirements to maintain structural characteristics of natural disturbances and stand-level fish and wildlife attributes within the RMA.

The primary objective of management zones adjacent to riparian reserve zones (RRZ) is to manage the windthrow risk of the RRZ, and retain opportunities for wildlife trees and wildlife habitat features. The primary objectives of riparian management zones adjacent to riparian features with no RRZ is to maintain stream channel processes, stream temperatures, wildlife trees, and habitat for furbearers and other wildlife.

Additional retention of timber in all RMAs and widening the width of all RMA's may help mitigate the negative watershed and hydrology impacts from the extensive mortality of pine stands within a watershed.

C. Reporting and Tracking

- WTP's and CLA's are submitted via the FTP site (F:\DQU\external\incoming\FDP_submissions) at FDP amendment application if the areas are known at that time.

- WTP's and CLA's are re-submitted through the FTP site at the time of CP application when the area for the WTP or CLA has been modified between the time the FDP amendment is submitted and the CP is submitted.

- WTP's and CLA's are submitted through the FTP site at the CP application when the areas are not known at the time the FDP amendment is done.

- Any amendments to the WTP location or size after the CP issuance should be submitted for update through the FTP site.

- Digital submission should be labelled correctly (WTP or CLA) and which tenure they are related to) and be submitted in the proper format:

    i. All data must be in ESRI Shapefile format
    ii. NAD 83 UTM Zone 10
    iii. Must include **Retention_type, Licensee, CP_NO and BC_NO** fields in submission.

- This information is tracked by the District for planning use, and is constantly updated and available for the licensees to view on the FTP site (F:\DQU\external\!publish\FDP) in an ARC format.

The above steps are an interim process that is expected to change pending discussions with the data custodians of the Land and Resource data Warehouse (LRDW) on management and updating of stand level retention features. The final process is expected to link to electronic submissions into Forest Tenure Administration (FTA) and Reporting Silviculture Updates and Land Status Tracking System (RESULTS).

D. Monitoring and Review

Implementation of this strategy will be simple in design. Monitoring of the on the ground results and what it means to biological diversity and timber supply will be more difficult to assess. That being said it is clear that the pine forests which dominate the Fraser Plateau are in the midst of the largest landscape disturbance in recorded history.

It is clear that much of this infested timber will be harvested and the areas regenerated to young forests. Also, it is evident that we do not have the harvesting capacity to completely remove all dead timber prior to the end of its predicted economic life nor is it a good idea given the rapid rate of change. Therefore, we will be leaving some of this timber on the land-base. The dilemma is where to leave it. We have the opportunity to design retention over a large landbase in a short time frame which if managed correctly can be used to mitigate some short-term landscape and stand level biodiversity issues.

The following outlines the process which will be followed to measure the success and identify the pitfalls of this strategy. The retention objectives outline the intent of the strategy. The management practices discuss the tools which will help to deliver the objective. The assessment describes what will be reviewed to measure the achievement of the objective. We expect that information from both the management practices and the assessment will be fed back into the loop to refine the objective and streamline management practices through time. Also, we expect this direction to be linked with regional or provincial direction regarding adaptive management programs which will be put in place in the future.

Retention Objectives

Monitoring is best done by comparing actual results to defined baseline objectives. The following retention objectives are defined to allow for meaningful monitoring even though they are not legally binding.

1. Retain proportions of salvaged openings based on the Chief Forester's recommendations (*Guidance on Landscape- and Stand-level Structural Retention in Large-scale Mountain Pine Beetle Salvage Operations, December, 2005*). Retention should increase with increasing opening size, up to 25% for openings greater than 1000 hectares.

2. Locate retention patches within openings based on the following set of priorities:
    a. Locate patches of at least 0.25 hectares in size to meet 500 metre dash rule
    b. Larger patches have higher value; recommend at least 2 hectares in size where feasible.
    c. Locate patches within the block boundary
    d. Locate patches along riparian areas and other areas of special values

Assessment of Implementation and Effectiveness

Implementation of the Strategy

- Is the strategy being used in the development of harvest plans?
    - i.e. Do harvest plans identify the amount and location of retention recommended in this plan?
- Are the harvest plans being delivered on the ground as planned?

Effectiveness of the retention

- What are the long-term forest management implications of these retention areas?
- Are the leave areas sufficiently large that they will make viable treatment areas in the future?
- Is retention at the stand level being tracked in a way that is meaningful?
- Are representative stands being identified for retention?
- Are connections being maintained through the landscape?
- Are special features being protected through the retention?
- Is the retention creating a mosaic of cut-over areas with scattered leave areas?
- Is the retention accomplishing the ecological goals for which it is retained?
- Are landscape level connections being maintained?
- Is the retention creating a mosaic of cut-over areas with scattered leave areas?
- Are the monitoring activities feeding back into the planning to further develop and revise objectives and management practices?

D. Adaptive Management Framework

We expect that the basic objectives and monitoring framework described here will evolve over time. This should include some active adaptive management scenarios being built into the process so that some of the basic questions related to this large scale landscape level disturbance can be addressed. We acknowledge that in order for this process to get implemented in a timely manner many of the planning issues related to active adaptive management have not been addressed. That does not mean that they are excluded from possibility. In order for many of the effectiveness questions to be truly answered it implies that some active adaptation of the stand level guidance be implemented. This will allow managers to assess whether a particular action is accomplishing its desired effect in the landscape.

Generally, it is expected that the retention of conservation legacies will follow the practices recommended in this document and monitoring will be implemented accordingly. However, the MPB epidemic presents an ecosystem perturbation that is unprecedented. As such, it also provides an opportunity to apply a wider range of treatments in selected areas to determine answers to specific ecological questions. This is known as active adaptive management and the opportunity exists to link with existing research and effectiveness monitoring committees. Two examples of potential projects include the effects on hydrology of harvested and un-harvested MPB damaged stands and the effects on furbearers of riparian reserves of different size.