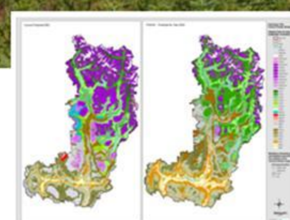
Adapting Forest Management in the Kamloops TSA to Address Climate Change

The Kamloops Future Forest Strategy

FINAL REPORT

By the KFFS TSA Team



June 8, 2009

“Even if you’re on the right track, you’ll get run over if you just sit there.”

Will Rogers

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- **Ken Zielke and Bryce Bancroft of Symmetree Consulting Group** - managed the project, led the consulting team, wrote a number of sections, assembled and edited the report.
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The approach and content of this project was led and influenced though every step by the KFFS TSA team of licensees and agency participants. This team made this project relevant to operations. This team included:

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TABLE OF CONTENTS[1]

APPENDICES

[1] Due to the level of detail surrounding the sensitivities and vulnerabilities found in the TSA the report has been structured to have general information presented in the main body of the report with the detailed direction and analysis presented in Appendices. Some reports would have this information provided as chapters or sections. The use of appendices was done to allow those interested in more detail to download only those Appendices they are interested in, saving time for downloading, and printing.

1 REPORT STRUCTURE.

The Kamloops Future Forest Strategy (KFFS) has information and discussion that may be of interest for a number of audiences, from policy makers to practitioners. Thus a brief description of the report structure is provided:

The KFFS is made up of three major parts:

1. **The Report:** This document provides the detailed recommendations, along with an overview of components of the strategy that lead to these recommendations. It is intended for those who are either interested in the general outcomes and the key recommendations from the strategy, or a general understanding of a process to conduct a vulnerability assessment at a localized level using expert opinion. For the Kamloops Timber Supply Area (TSA), it provides: the background and intent of the project; an overview of the process to build the strategy; a summary of ecological and management sensitivities; management options; and an adaptive capacity / vulnerability discussion.

2. **The Appendices:** There are six appendices that provide the details of the proposed strategy. Much of what is found here can be considered to be the "essence of the strategy," containing specific sensitivities and suggested adaptive actions that will be of interest to those who are involved in implementation, or those wish to develop a similar strategy for their management unit. These are meant to specifically provide:

   Appendix 1 –a description of the process used in this project, including suggested efficiencies for those interested in pursuing a similar approach elsewhere.

   Appendix 2 – general climate change trends and assumptions for the entire TSA based on TSA climate change modelling.

   Appendix 3 – a summary of specific sensitivities and adaptive management direction / actions by groupings of similar biogeoclimatic subzones. This appendix provides detail that is meant to inform operational strategic planning and implementation. Along with Appendix 4, these two appendices are the main components of the strategy.

   Appendix 4 – a summary of specific sensitivities and adaptive management direction for the entire TSA, by value (e.g., biodiversity, First Nations Cultural plants, timber…). It works in conjunction with Appendix 3 to provide a detailed picture of issues and options within the TSA by value.

   Appendix 5 – a vision of the Kamloops TSA up to 2080 with and without the implementation of the suggestions identified in recommendations (and found in more detail in the previous two appendices). This appendix is useful for those who wish to envision the future landscapes and the condition of the range of management values using the plausible futures, to understand the potential benefits and limitations of the proposed adaptive strategy.

Appendix 6 – provides a detailed discussion of adaptive capacity issues and subsequent vulnerabilities for climate change. It is useful for managers and policy specialists who are interested in a detailed discussion of the implementation barriers associated with the TSA vulnerabilities. It too would be useful for those contemplating using a similar approach elsewhere.

3. **Compendium of Supporting Documents.** A number of documents and presentations were created as background and as part of the building process for the KFFS, they are provided as separate files that may be of interest to both policy makers, those interested in pursuing their own strategy or for general interest. They are as follows:

   A Summary of Current Management Regimes Relevant to the Future Forest Strategy for the Kamloops TSA (March 31, 2008) - This document provides detail on the various objectives outlined for the area within the various plans for the area. This document provided guidance on what to assess within the climate lens.

   Climate Modeling and Future Ecosystem Climate Mapping (Version 2.0 September 26, 2008), and *Maps of Subzone Climate Envelopes (Version 2.0 September 26, 2008)*. These documents provide a detailed description of how the climate scenarios were used to help envision the future and allow vulnerabilities to emerge.

   Ecological Narratives – Simple bold narratives were created to summarize plausible future forest conditions and ecological sensitivities based on the climate change scenarios and the subsequent ecological sensitivity discussion workshops. These were done for 12 major subzones in the area. Each provides a slightly different view of the future and helped guide management vulnerabilities.

2 INTRODUCTION

2.1 Background: The BC Context

The British Columbia forest sector has experienced and continues to experience many challenges, including:

- Global climate change with expected significant impacts on species and ecosystem distribution and the range and impact of many forest pests and diseases;
- The largest recorded mountain pine beetle outbreak in North America;
- A provincial timber harvesting land base that is constantly under pressure and scrutiny from various competing interests and agencies;
- International market forces and economic drivers, impacts; and
- Increasing public concern regarding sustainable forest management.

A future forest strategy endeavours to articulate the vision of the desired forest condition, providing greater resilience to ecological, economic and social issues or drivers such as climate change, transition from harvesting old growth to second growth stands, and mountain pine beetle. Articulating a vision for our future forests and applying a "lens" to that vision of any forestry related challenges as they arise will provide the information that informs existing strategies, the need for new strategies and analysis, and potential gaps to be addressed.

The current management approach evolved over time in BC to have a solid foundation of high-level land use plans, comprehensive legislative and policy regimes that regulate forest practices, and a myriad of operational and tactical forestry plans and strategies, most of which are predicated on the current forest condition. Ultimately a future forest strategy can:

- Provide further assurance to the public, stakeholders, and government that their current and future forest needs are understood, balanced and addressed;
- Guide forest land base investments, and influence silviculture treatments, research activities, Forest Investment Account (FIA) activities and priorities;
- Inform future development of Sustainable Forest Management Plans (SFMP), Forest Stewardship Plans (FSP), Timber Supply Review (TSR) and forest management strategic documents;
- Inform the need for updates to land-use plans and / or legal land-use objectives and to identify possible legislative issues;
- Identify the need for potential changes to forest management policies relative to achieving the objectives outlined for the future forest strategy; and
- Promote First Nations information sharing at a strategic level.

2.2 Intent of the Kamloops Future Forest Strategy

The KFFS was initiated as a pilot project by the Ministry of Forests and Range in 2007-08 to create a vision of forest management for resilient conditions and a strategy to achieve those conditions within a Timber Supply Area[2] (TSA). The project was initiated to inform existing strategies, and explore the need for new strategies and scenarios. An additional objective was to identify any potential "gaps" that need to be addressed.

The intent of the Kamloops Future Forest Strategy is therefore principally to provide general management direction for future planning processes that:

- considers the changing context provided by climate change,
- integrates overlapping objectives and,
- seeks well-informed solutions to fit with stand and landscape structures and functions over time.

To effectively integrate management for multiple objectives over time it is important to have a vision of the mix of stand types and structures for various landscapes to reasonably fit with those objectives and the ecosystems present. Global climate change presents an uncertain, moving target for forest managers as they try to understand ecosystem attributes and function over the next rotation. This influence cannot be ignored.

Gaining a perspective on climate change and potential impacts on an integrated management strategy is not simple. It requires best estimates of changing future ecological conditions, with a reasonable consideration of the uncertainty tied to those estimates. Climate change therefore became the lens through which the Kamloops Future Forests Strategy would examine the future forest condition.

What emerges in this strategy is not intended as an accurate prediction of the future. This project intentionally avoided comprehensive modeling and analysis, except to initially explore changing climate variables across the TSA. Climate change was examined to explore how much change we may realistically expect. At the same time, numerous qualitative estimates are made regarding sensitivities, adaptive capacity and vulnerabilities. These estimates may be improved in future planning through more quantitative analyses. Accordingly, the direction provided in the KFFS would benefit from further discussion and analysis to refine the options and better integrate them across the various objectives.

The KFFS Team views the strategy as a critical tool for long term management within the TSA. However, it must be emphasized that the KFFS was from the onset not intended to be a plan. It was intended as a strategy that provides direction for development of assumptions, targets, indicators and tactics in planning processes such as: Timber Supply Reviews (TSR), Sustainable Forest Management (SFM) planning for certification, Forest Stewardship Plans (FSPs) and other operational plans.

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[2] TSA – within BC a timber supply area is managed strategically as one unit with a number of tenures for harvesting and management within it. Allowable cut is re-determined every five years for the area and split accordingly between licensees.

Clearly, the KFFS takes the first small glimpse into a previously unexplored future for the Kamloops TSA, and it provides the first small steps to address some significant impacts from climate change. These steps should be considered just the start of an on-going journey for management over the long term.

2.3 Objectives of the Kamloops Future Forest Strategy

With the primary goal of rationalizing expectations and direction for future management in the context of expected impacts of climate change and other influences the following objectives for the KFFS were designed:

a. Identify current expectations and management direction for the future forest condition, and to highlight potential overlap.

b. Understand the range of plausible impacts from climate change, based on well-informed local climate modeling.

c. Identify sensitivities and vulnerabilities associated with forest management expectations and direction based on the impacts of climate change and other influences.

d. Develop management options to adapt the future forest to minimize the impacts of climate change and other influences.

e. Articulate an adaptive vision of the future forest that will promote resilience and adaptability to meet ecological, economic and/or social expectations over time in the context of climate change.

f. Identify data / research gaps and uncertainties and clarify assumptions.

g. Develop the KFFS as useful pilot example for other TSAs wishing to design a similar strategy.

2.4 Project Area

Description of KFFS Area:

The Kamloops Future Forest Strategy was designed for the Kamloops TSA, which has the following characteristics:

- A total area of approximately 2,666,375 hectares, when TFLs 18 (74,620 hectares) and 35 (36,564 hectares) are included (Fig 1.1).
- The project area follows the boundaries of the Kamloops Forest District and a portion of the Headwaters Forest District in the southern interior of British Columbia.
- The area extends from the Logan Lake area south of Kamloops north to Wells Gray Park, and is bounded by the Columbia Mountains to the east and the Cariboo/Chilcotin area to the west.
- Leading species distributions as a proportion of the Timber Harvesting Landbase are as follows: Douglas-fir (33%), lodgepole pine (30%), spruce (18%), true fir (9%), broadleaf species, western redcedar and hemlock (10%).
- The current annual allowable cut (AAC) for the Kamloops TSA is approximately 4.3M m^3 per year which is an increase from the base AAC of 2.7M m^3. This AAC is apportioned between replaceable Forest Licenses (36%), Non Replaceable Licenses (mountain pine beetle and cedar-hemlock with 37%), BCTS (20%), and various other small tenures for the remaining seven percent.
- The topography of the Kamloops TSA is one of sharp contrasts, from dry, hot grasslands in the south, to very wet and rugged mountain landscapes in the north. As a TSA, Kamloops is among the most diverse ecologically in the province, containing nine of the eleven interior biogeoclimatic (BEC) zones. The TSA is dominated by the four most important BEC zones for forest management in the southern interior – the Interior Douglas-fir (IDF), Interior Cedar-Hemlock (ICH), Montane Spruce (MS), and Engelmann Spruce-Subalpine Fir (ESSF). These zones break down into over thirty subzones across the TSA (Fig 1.2).
- As in other parts of the BC interior, the mountain pine beetle (MPB) is having a significant impact on the TSA. Beetle susceptibility models indicate that the majority of the pine stands in the TSA will be attacked by MPB within the next eight years. The diversity of ecosystems and forest types also provide conditions suitable for most of the other major insect and pathogenic disturbance agents found in the BC interior.

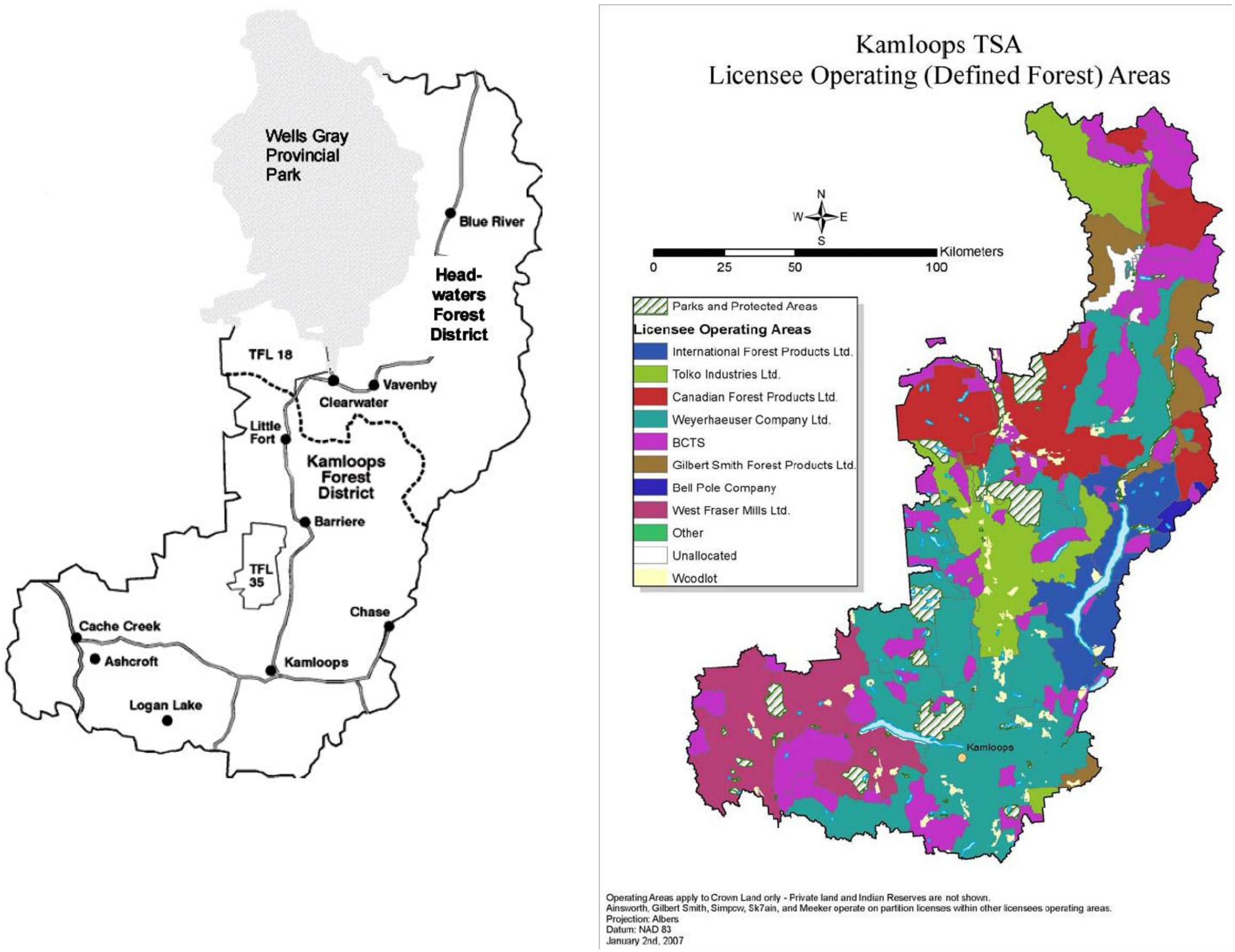

Fig 1.1. The project Area – in general (left), and showing the operating areas for the replaceable licensees (2007).

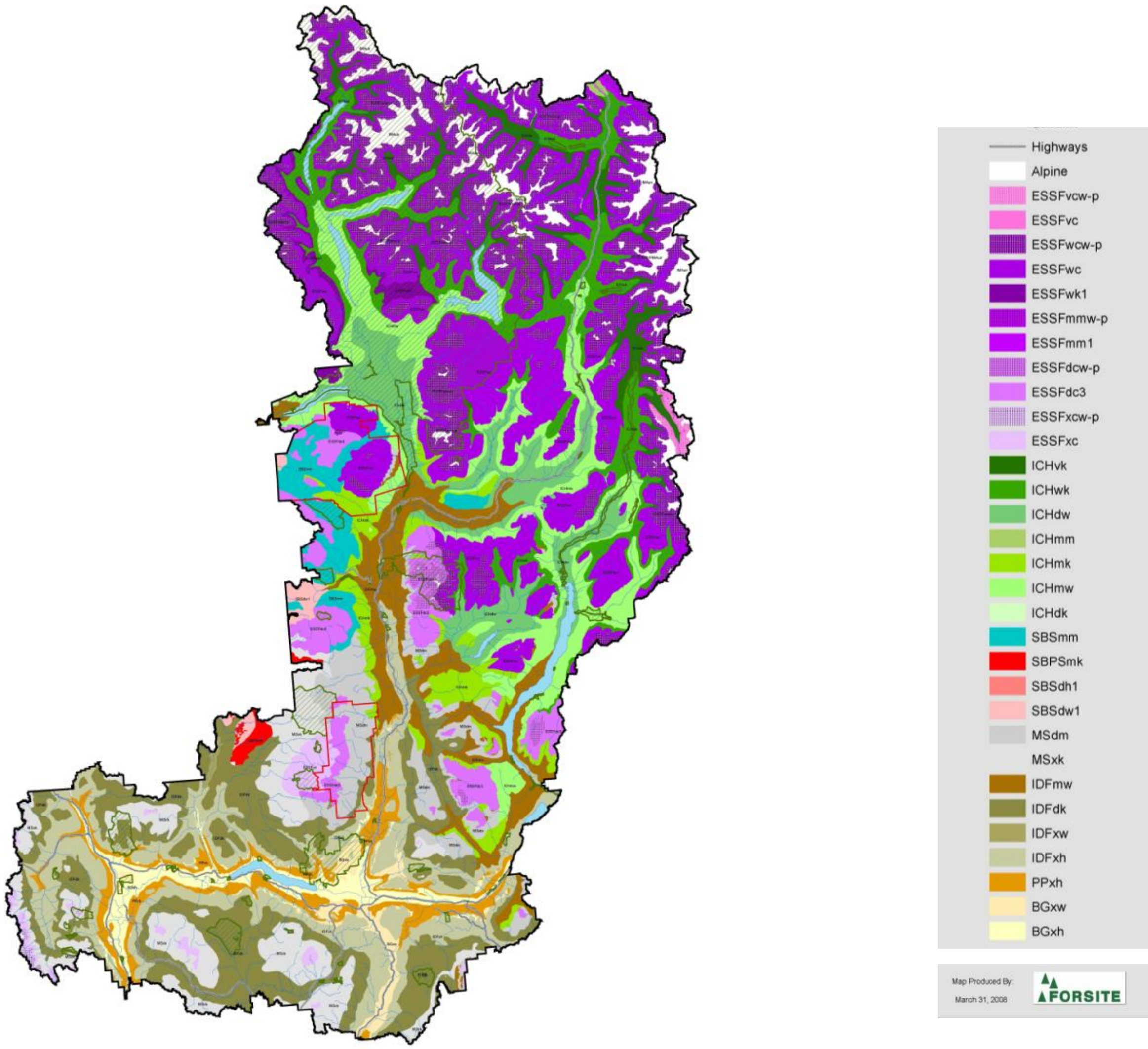

Fig1.2. The diversity of Biogeoclimatic subzones across the Kamloops TSA.

2.5 How the Future Forest Strategy fits within a Strategic Planning Framework.

A Future Forest Strategy (FFS) uses the lens of climate change to inform the strategic management planning cycle by changing the context for planning over the landbase (Fig 1.3). Climate change will alter ecosystem components, relationships and processes, sometimes profoundly, depending on the ecosystem. The future forest strategy (FFS) begins the exploration of those impacts, identifying vulnerabilities and potential management options.

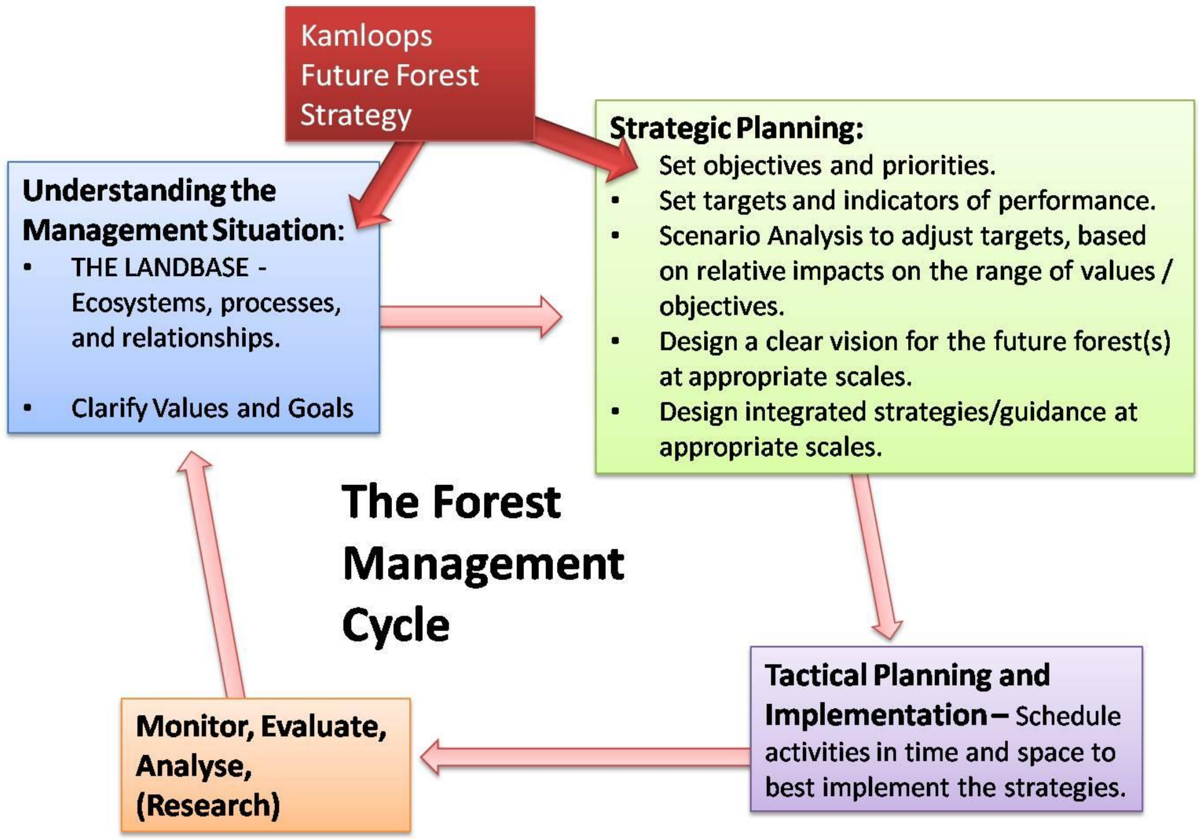

Fig 1.3. The relationship of the Future Forest Strategy (to address climate change) and the forest management planning cycle.

The FFS is not a plan. Strategic planning is a complex cycle of analysis, exploration, monitoring and continual improvement. The FFS is an important step in this process to ensure it is conducted with a reasonable consideration of climate change. The following section is designed to provide an overview of the FFS process, as explored in Kamloops with suggestions for efficiencies along the way. For more detail on the framework of a FFS process – SEE: Appendix 1 - The Roadmap to Success: The *Framework for a Future Forest Strategy*.

AN OVERVIEW OF THE FUTURE FOREST STRATEGY APPROACH USED IN THE KAMLOOPS TSA

FOR MORE INFORMATION – SEE: APPENDIX 1

A. Assemble the TSA Team / Steering Committee and the Strategy Development Team

- A steering committee of the TSA major licensees, First Nations licensees, the Ministry of Forests and Range, BCTS, and others to champion the project.

B. Summarize current management direction for the unit, based on the pertinent plans

- See *A Summary of Current Management Regimes Relevant to the Future Forest Strategy for the Kamloops TSA (March 31, 2008)* compendium of support documents for the summary of plans for the TSA.

C. Explore plausible future climate change scenarios locally.

- See *Climate Modeling and Future Ecosystem Climate Mapping (Version 2.0 September 26, 2008)*, and *Maps of Subzone Climate Envelopes (Version 2.0 September 26, 2008)* in the Compendium of Supporting Documents for direction on use, and an example of the final product.

D. Analyse and Understand the Ecological Sensitivities in your Management Unit

- Use ecological sensitivity workshops with experienced local practitioners, regional specialists, and academics - to explore the potential ecological sensitivities of subzones or subzone groups to plausible climate changes.
- Create ecological narratives - from the input of the participants, to provide a plausible future by BEC unit. See *Ecological Narratives* in the compendium of supporting documents for examples.

E. Analyse the Management Sensitivities in your Management Unit

a. Use management sensitivity workshops - with local, regional and provincial specialists and experienced local practitioners.

F. Design Management Direction and Options for Adaptation

- Use input from management sensitivity workshops. Explore issues, as much as possible, by analysing additional data, conferring with additional specialists, and reviewing studies and reports.

G. Assess Adaptive Capacity and Vulnerabilities for Management

- Use the summaries of implementation barriers and knowledge gaps to pinpoint the major adaptive capacity concerns.
- Use adaptive capacity to rank potential and projected vulnerabilities – thereby providing a complete picture of vulnerabilities across the TSA in the context of adaptive capacity issues.

H. Design Recommendations

- To move forward with the strategy.

I. Communication to Engage Participation and Ensure Support

- The KFFS used a range of communication approaches throughout the development of the strategy to engage participation and support. Considering the number of range of expertise required, this was a critical part of the strategy.

3 RESULTING ECOLOGICAL SENSITIVITIES

The KFFS explored detailed predictions for climate from global circulation models to predict changes and impacts on twelve important biogeoclimatic (BEC) subzones in the Kamloops TSA. While the climate modeling in the Kamloops TSA reflect some variations across BEC subzones, there are general climate trends across the TSA that are important to use as context when considering general TSA sensitivities and management direction (Appendix 2).

3.1 ClimateBC modeling in the Kamloops TSA

The ClimateBC model was used to assign climate data to each point on a 100 m grid covering the TSA, recognizing that coarser grids may not account well for steep elevational gradients and finer grids became too onerous to work with. The climate data at each point was then overlaid on the 52 biogeoclimatic (BEC) subzones (or portions thereof) that occur in the Kamloops TSA. This allowed the production of a spreadsheet showing climate variables rolled up to each BEC subzone.

Because the future climate is fraught with many uncertainties, no one climate change scenario should be considered 'most likely' and the range of possible outcomes should be explored (Meidinger, 2007, Spittlehouse 2006). Best and worst case greenhouse gas emission scenarios were needed to characterize the range of potential climate changes outcomes – ideally coming from different global climate models. Based primarily on the advice of Andreas Hamann (developer of the scenarios in ClimateBC), the HadCM3-A1FI scenario (from the Hadley Centre for Climate Prediction and Research) was selected as the worst case scenario and the PCM-B1 scenario (National Center for Atmospheric Research, Department of Energy Panel) was selected as the best case scenario. These future greenhouse gas emissions scenarios assume minimal reductions (HadCM3-A1FI) or significant reductions (PCM-B1) in future carbon emissions (Hamann and Wang, 2006). It should be noted that these scenarios have also been used for projecting impacts on forests elsewhere in the Western United States (Hayhoe et al 2004).

Climate variables were analyzed to identify shifts as ecological BEC subzone-climate envelopes, appearing as shifting BEC subzones across the TSA to provide context for subsequent ecological and management sensitivity discussions. To determine potential shifts in BEC subzone, the historical climate data were linked to the one hectare grid and analyzed to derive predictive variables/circumstances that would allow automated mapping of the current BEC subzones, as an initial calibration. This process was initiated through the use of 'data-mining' software and then further refined by our team ecologist. The process was designed to cluster points with similar attributes (i.e. climate variables) into specific BEC subzones. Once the process was established, it was then run using the climatic attributes predicted at the various time intervals (2050, and 2080) for the best case or least change (PCM B-1) and worse case or most change (HadCM3-A1FI) GCM scenarios. In this way, best case and worse case climate change scenarios were expressed spatially with equivalent BEC subzone-climate changes for the various time periods.

A second iteration of subzone mapping was completed because our emerging subzone climates did not always appear to be good matches for the existing suite of subzones in the Kamloops TSA, or even the Southern Interior. Our second iteration used a range of symbols to denote climates that were moister or drier than that indicated by the subzone label. As well, we relied more on the summer heat:moisture index (SHM) than in the first approximation to interpret changes over time. The SHM index is similar to a drought code for the growing season and therefore is very important to describe conditions for plants during that time. The approach to modeling and BEC subzone-climate mapping is described in detail in the report *ClimateBC Modeling and Future Ecosystem Climate Mapping Version 2.0* (September 26, 2008), which is found in the *Compendium of Supporting Documents*.

3.2 Determination of Ecological Sensitivities

Ecological sensitivities were discussed and assessed qualitatively for twelve key subzones[3] in "expert workshops". Input and advice was provided by local ecologists, other resource specialists, practitioners and academics. The KFFS team synthesized this information into "ecological narratives" to generate plausible stories of how ecological conditions within these BEC subzones may change over time with a warming climate, and the ecological sensitivities that could emerge.

The sensitivities of these twelve subzones were distilled into five "subzone groups" based on their similarities (Table 2.1). Over 60% of the Timber Harvesting Land Base (THLB) within the TSA is projected to be threatened with a moderate-to-high or a high ecological sensitivity (Table 2.1). This means that a high or moderate-to-high degree of ecological alteration is expected within these subzone groups. The most susceptible subzones fall within the two dry subzone groups and the moist transitional subzones in the ICH and IDF. Only 21% of the THLB in the Kamloops TSA is expected to have a low ecological sensitivity.

It should be noted that these ecological sensitivities, like the climate modeling on which they are based, are not presented as a precise prediction of what the future will be like. These projections must be viewed as plausible[4] scenarios designed to help us understand the potential amount and types of changes that could occur and inform us on possible management options to address change as it emerges.

For more information on ecological sensitivities:

- For the five ecological groups – see *Appendix 3*.
- For the 12 individual subzones - see *Ecological Narratives* in the *Compendium of Supporting Documentation*.

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[3] **Key Subzones** – generally more than 100,000 ha in size with significant management values. The twelve subzones were also chosen to cover the natural range of ecological conditions in the TSA.

[4] **Plausible** - describes the scenarios used to forecast impacts from climate change because no one can predict the future with certainty. The rate of climate change and its actual influence on ecosystems is highly uncertain. Yet, some believe that considering current trends and potential positive feedback mechanisms, the worse-case (most change) scenarios used in this project may be conservative.

Table 2.1 Overview of ecological sensitivities in the Kamloops TSA, based on expected impacts from climate change, ecological conditions and perceived ecological adaptive capacity. The sensitivitity ranking is based on the degree of ecological alteration that is attributed to climate change (beyond what is considered to be normal) by the scenarios tested (e.g. changing plant communities, disturbance regimes and other processes). The rationale includes key points from the ecological narratives, that tend to emphasize the worst-case most change climate scenario to explore how much change may occur.

SUBZONE GROUP	BEC subzones	% of THLB in TSA	Ecological Sensitivity	Summarized Rationale for Vulnerability
Dry Subzones with Pli	MSxk, IDFdk, (SBPS)	28	**HIGH**	• Too hot and dry after 2050 for Pli. • Estimate 37% of THLB in young Pli that will not be ecologically suitable past 2050. • Increased fire risk.
Dry with Douglas-fir & Ponderosa Pine	IDFxh, PPxh	10	**HIGH**	• Continuing mortality in Fd will thin out and open up stands. • Increased grassland patches. • Increased fire risk.
Interior Cedar-Hemlock Transition to Dry Douglas-fir	ICHmw, ICHdw, IDFmw, (ICHmk)	26	**MOD-HIGH**	• Fd drops out of mixedwoods due to drought / Armillaria / D-fir beetle combo. • Lose considerable Cw, Sx, Ep past 2050 • Increased fire risk.
Dry- Moist Plateau/ High Elevations	MSdm, SBSmm, ESSFdc, (ESSFxc)	15	**MOD**	• Increased growth in most species (except Bl) up to 2050. • Beyond 2050 – Bl drops out, Pli at high risk, Sx questionable on some sites lower down. May see a few large fires.
Cool/Cold & Wet	ESSFwc, ICHwk, (ICHvk)	21	**LOW**	• Increased mortality in old growth • Increased growth in young stands • Weevil increasing problem for young Sx.

4 RESULTING MANAGEMENT SENSITIVITIES

Using the understanding of ecological sensitivities and the types of changes that may occur across the TSA, management actions can be adjusted over time to avoid being "painted into a corner" with only a few difficult options available. To achieve this goal with the KFFS, management values and potential climate change concerns were investigated using a range of specialists and practitioners from the TSA and the region, similar to the approach used to explore ecological sensitivities. Potential management sensitivities were estimated for the important aspects of each management value in each subzone group, and then summarized for the TSA (Table 3.1). The rationale for each sensitivity ranking in each subzone group was explored and is provided in more detail (Appendix 3).

Table 3.1 Overview of management sensitivities in the Kamloops TSA, based on expected impacts on management from the ecological sensitivities in Table 2.1. The sensitivity ranking indicates the degree of impact on various aspects of key management values.

SUBZONE GROUP	BEC subzones	% of THLB in TSA	Management Sensitivity	Summarized Rationale for Sensitivity
Dry Subzones with Pli	MSxk, IDFdk, (SBPS)	28	MOD-HIGH	• High impacts on productivity and growing stock for timber. • High impacts on biodiversity and a range of habitats and fish. • Significant issues for water, interface, and First Nations culturally important plants.
Dry with Fd & Py	IDFxh, PPxh	10	HIGH	• High impacts on THLB, productivity and growing stock for timber. • High impacts on biodiversity and a range of habitats and fish. • High impacts for water, interface, and First Nations culturally important plants. • Significant issues for visual quality
ICH-IDF Transition	ICHmw, ICHdw, IDFmw, (ICHmk)	26	MOD-HIGH	• High impacts on productivity and growing stock for timber. • Significant issues on biodiversity and a range of habitats and fish. • Significant issues for water, and interface. • Significant issues for visual quality
Dry- Moist Plateau/ High Elev	MSdm, SBSmm, ESSFdc, (ESSFxc)	15	MOD	• Moderate impact on growing stock for timber. • Significant issues for some habitats and fish • Moderate impacts for water and First Nations culturally important plants.
Cool/Cold & Wet	ESSFwc, ICHwk, (ICHvk)	21	MINOR-MOD	• Minor timber supply concerns long term – may be some short term benefits. • Minor concerns for habitat, except for Caribou where there are many outstanding questions. • Signficant issues possible for water quality.

The rankings used in the table were determined as follows:

> High sensitivity– There is a high likelihood of a substantial negative impact on the management concern.
>
> Moderate sensitivity – There is a high likelihood of a limited negative impact on the management concern.
>
> Minor Sensitivity – There is a likelihood of a small or minimal impact.

The most important management sensitivities in the Kamloops TSA emerge due to increased stand mortality as conditions become hotter and drier through the summer, especially beyond 2050. This mortality will be due to drought stress, insects, pathogens, and a higher incidence of larger and more severe wildfires. It should be noted that for timber management these extreme conditions will reduce productivity on many sites, especially in dry subzones. It will also have large impacts on growing stock, with substantial losses occurring in pulses of mortality that coincide with warmer, drier climatic cycles. These impacts will similarly have a major influence on biodiversity and habitat, with a significant decline in structural and habitat complexity, a large increase in early seral communities, the appearance of novel plant communities and an increase in invasive species.

In dry subzones with lodgepole pine, the dominant issue is the continuing domination of lodgepole pine in developing young stands in spite of high levels of beetle-mortality in older stands. Combined with a climate that will become less favourable for the pine stands over time, beyond 2050 these stressed mid-aged lodgepole pine stands are projected to be highly susceptible to mortality due to a range of factors. Timber values in these stands may be marginal and subsequent regeneration challenging if these stands are clearcut at that time.

Transitional subzones (Interior Cedar-Hemlock to Interior Douglas-fir) are similarly challenged for management in the anticipated warmer, seasonally drier conditions. As trees become drought-stressed over summer, mortality will accelerated, mostly in conjunction with disease and insects. The nature of these diverse ecosystems could change dramatically with fewer tree species resulting in open broadleaf stands with considerable mortality. Broadleaves will not be immune to mortality and the current trend of birch die-back is expected to worsen. The trend of mortality in conifers, Douglas-fir in particular, may challenge the potential for an economic harvest in these stand types, impacting timber management, and making a conversion to more resilient stand types a slow process.

Similarly, other values that depend on forest cover, such as habitat and visual quality will be degraded in a number of areas, as drought stress and losses to disturbances increase. First Nations culturally important plants will be displaced locally in some subzones. Water quantity will be a major concern, especially in watersheds with a preponderance of drier subzones. In the cool wet subzones, the projected increase in precipitation delivered during extreme weather events may cause problems with water quality, and could possibly threaten infrastructure. Salmonid populations are expected to decline, potentially disappearing in some locales, as adverse water temperatures spread through the warmer portions of the TSA.

While mortality will likely be cyclic, it will at times significantly increase fine fuel loading in some stand types for short periods. Also, more open stands may develop dense understories that will further increase ladder-fuels in these stand types. If these conditions coincide with expected more frequent hot / dry summer extremes, larger and more severe fires will increase as well. Where these conditions occur in the rural urban interface, important habitats, or areas with visual sensitivities, sustained and significant impacts could result.

For a more detailed discussion of sensitivities in each subzone group refer to Appendix 3.

5 MANAGEMENT DIRECTION SUGGESTED ACROSS THE TSA

A Perspective on the Management Direction in this Report

As has been described in the introduction to this report, the future is uncertain. The KFFS used plausible futures to identify sensitivities and management direction, which is presented by ecological grouping in Appendix 3, and by value (TSA-wide) in Appendix 4. The KFFS direction is designed as a first step to incrementally adapt planning and practices in the TSA. The intent is to prudently manage risk and avoid the major issues anticipated, while recognizing that climate change may have more or perhaps less impact than general predictions suggest. Accordingly, the direction provided is a first step in continuous improvement and adaptation.

This direction allows for both a deterministic and indeterministic future. Some guidance is meant to provide resilience based on the concept that the changes will be within the scenarios assessed - a somewhat deterministic approach. With this approach we are assuming we know what the future will provide, albeit only within a range of plausible futures. Additional guidance and recommendations allow for experimentation and learning over a varied future - allowing for an indeterministic future. With these approaches we may cross thresholds we have not yet identified and we may have disturbance from sources we are not presently aware of. Continuous learning based on good communication and a combination of both deterministic and indeterministic management approaches will promote success. Modification of approaches and continuous learning as new information becomes available will be a cornerstone of adapting to climate change.

Adaptation to climate change can take a number of forms. To be effective the Kamloops Forest Strategy suggests using a range of approaches to maintain or help create healthy resilient forests. In some cases there are no clear options to address the sensitivities that climate change will bring. What are presented are available today and should be considered as a starting point. As new information becomes available they should be reviewed and reconsidered.

An Overview of Management Direction/Actions Suggested in this Report

The most prominent management direction / actions for specific practices on the ground across the TSA include:

Reforestation

- Promote species diversity and limit climate induced mortality by increasing the amount of Douglas-fir, ponderosa pine, western larch, and white pine, and reducing the reliance on lodgepole pine (in a range of subzones) and occasionally subalpine fir (in several subzones). As well, in a number of subzones broadleaf species should be promoted in some areas, and not discouraged in others.
- Promote more flexible stocking standards that allow for a range of stocking densities (specific direction depends on subzone group).

– Evaluate licensee obligations regarding the existing free-growing policy.

Harvesting and stand tending

– Direct harvesting at specific stand types anticipated to be at-risk for high amounts of mortality over time. By harvesting these stands before this mortality occurs, economic values can be realized, and more resilent new stands established.

– Encourage broadleaf species in a prudent manner (see subzone groups), as broadleaf species are expected to be vulnerable in large portions of the TSA, their ecological and habitat values are high, and they hold potential benefits for mitigating fire risks, and forest health issues.

– Target stand-tending treatments in some subzones to help establish more resilient species or to mitigate fuel concerns for wildfire.

– Target specific subzone groups for actions to address one or two specific management concerns, such as fuel reduction or root disease treatments.

Planning

– Most remaining direction ties into a range of specific planning elements. A few examples of broad themes are:

  - In urban interface areas, enhanced fuel management or fire protection should be a central feature of forest planning.
  - Existing forest health management and strategies need to be reexamined and discussed based on the sensitivities highlighted in the KFFS.
  - Wildlife tree retention requires an explicit strategy that functionally links it to other landscape level reserves such as OGMA and ungulate winter ranges to meet stated objectives for biodiversity in different ecological and landscape settings.

– The need for a comprehensive strategic and tactical planning process is clearly apparent for a number of reasons:

  - Few of the suggested planning direction items (including the three examples above) will be effectively implemented if they are not integrated with other values over appropriate, possibly several, spatial scales.
  - Specific management actions such as *targeted, proactive harvesting in susceptible stands* can only be successfully implemented if they are tied to a comprehensive operational strategic process, which integrates such direction with other values and associated targets and indicators.
  - Managing to adapt the forest to mitigate climate change sensitivities for all values is complex and multi-layered. It will not be accomplished successfully by addressing each issue for each value separately.
  - A long term planning view, across the life of the forest, is required for proper implementation of this direction over time. Currently, many of the suggestion management actions are outside of the current short term planning horizons.

Detailed Direction for Future Management Direction/Actions

For a more detailed discussion of the full range of suggested management actions and the rationale for each, refer to:

- Appendix 3 – for a discussion of management actions by subzone-group.
- Appendix 4 – for a discussion of management actions / direction by management value (biodiversity, timber, etc.).

Detailed Descriptions of Future Forest Conditions Resulting from Management Direction/Actions

For a more detailed description of future forest conditions resulting from management actions, refer to Appendix 5. This appendix will describe:

- A "vision" of the developing landscape in each subzone group at 2050 and 2080 as a result of the KFFS.
- Potential opportunities for the range of forest values if the KFFS is followed, and if the KFFS is not followed. This comparision provides a subjective estimate of the benefits of the KFFS over time.
- A conceptual overview of potential timber supply impacts if the KFFS is followed.

6 MANAGEMENT ADAPTIVE CAPACITY AND VULNERABILITIES

A central focus for the KFFS is to provide direction and management actions and/or options to help address potential impacts from climate change. In designing this direction, implementation barriers and knowledge/ data gaps were also tracked. With the climate modeling data and the ecological sensitivities identified, the essential components are present for an initial vulnerability analysis to climate change in the TSA (Fig 6.1). Such an analysis helps to characterize priorities and challenges for implementation.

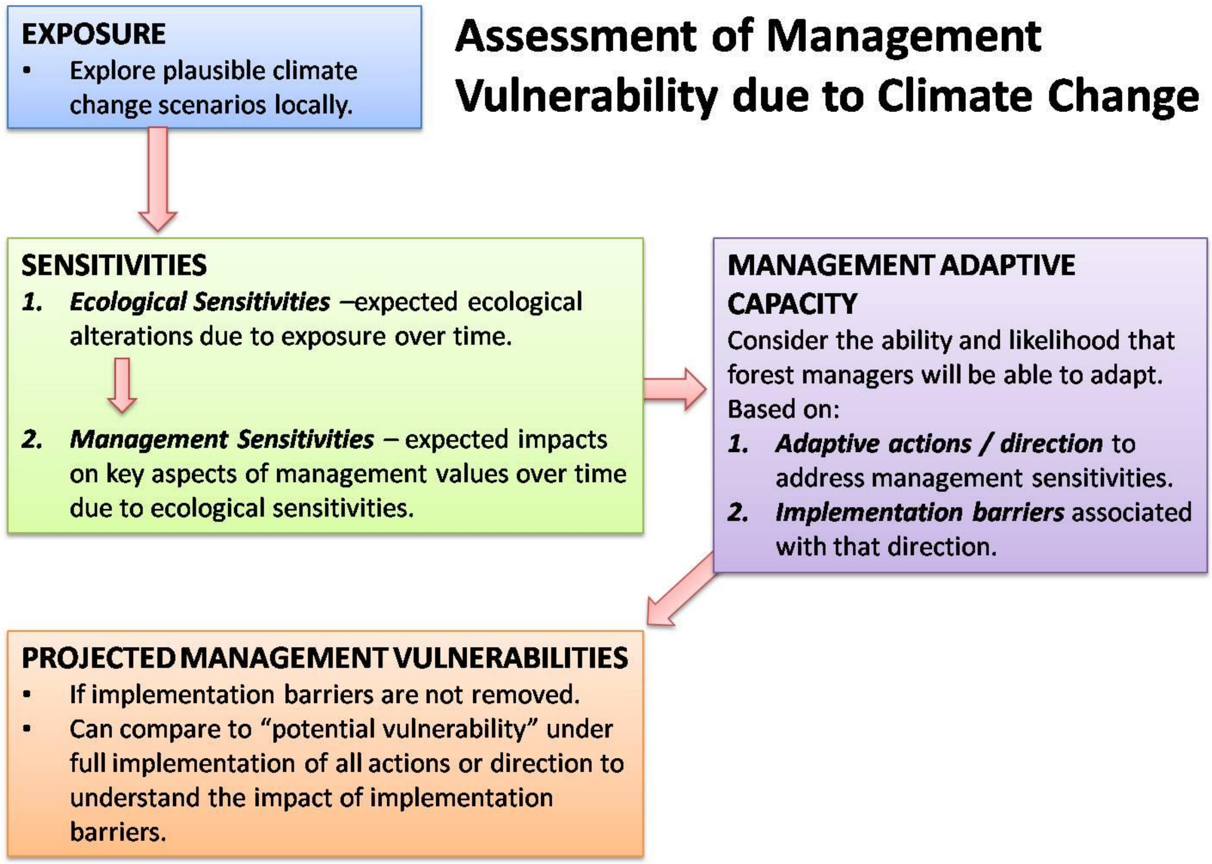

Fig 6.1. Diagrammatic flow chart of the assessment procedure for management vulnerability in the Kamloops Future Forest Strategy.

Management adaptive capacity is a measure of the ease or difficulty attached to implementation of the direction in the strategy. It is simply the likelihood that a manager will be willing and able to implement this strategy. Issues associated with adaptive capacity for management can significantly contribute to the vulnerability of a range of management concerns. Accordingly, adaptive capacity was examined and considered by exploring the influence of implementation barriers on the strategy and its potential to mitigate climate change impacts.

A range of existing implementation barriers emerged that will impede the success of this strategy. These barriers fell into five broad themes or general barriers:

(1) the lack of a comprehensive, integrated, operational strategic planning process;

(2) more costly reforestation;

(3) more costly or break-even harvesting;

(4) the need for on-going stand management beyond free growing through the rotation;

(5) a requirement for government to take on increased management risk.

These barriers were explicitly considered for their impact on the implementation of all management direction across all subzone groups. The result is a snapshot of management vulnerability if none of the implementation barriers are removed – *projected vulnerability* (right hand coloured column in Table 6.1). When these management vulnerabilities are summarized across all subzone groups and compared to the *potential vulnerabilty* if all direction is followed and all barriers are removed (middle column, Table 6.1), the influence of management adaptive capacity in the Kamloops TSA is striking. It is estimated that over 60% of the TSA would still have a vunerability ranking beyond moderate if the strategy is implemented without addressing the identified barriers.

Table 6.1. Comparison of potential management vulnerability (assuming all barriers for implementation were removed), and projected vulnerability (assuming no barriers are removed)

Vulnerability with FULL implementation (barriers removed)

Vulnerability with PARTIAL implementation (Due to barriers)

SUBZONE GROUP	Mgmt Sensitivity	Potential Vulnerability	Projected Vulnerability	% OF AREA
Dry with Pli	MODERATE TO HIGH+	MINOR TO MODERATE +	MODERATE TO HIGH -	28%
Dry with Doug-fir and Ponderosa pine	HIGH -	MINOR TO MODERATE +	MODERATE TO HIGH +	10%
Transitional Cedar-Hemlock to Douglas-fir	MODERATE TO HIGH -	MINOR TO MODERATE -	MODERATE TO HIGH --	26%
Transition to Plateau or High Elevations	MODERATE -	MINOR -	MODERATE -	15%
Cool and Wet	MINOR TO MODERATE -	MINOR -	MINOR +	21%

For more information on the assessment of adaptive capacity and vulnerability refer to Appendix 6.

7 RECOMMENDATIONS

The Kamloops Future Forest Strategy is multi-layered, with analysis, interpretations, suggestions and observations that may be useful for agencies and licensees at many levels. The focus for the project was two-fold – to provide operational managment direction for resource managers and practitioners in the Kamloops TSA, while providing suggestions for the Ministry of Forests and Range (MFR) when they initiate similar projects in other areas of the province. In the learning process associated with meeting these two broad goals, the KFFS team developed a suite of ideas for the MFR and the Kamloops TSA team to facilitate implementation. These ideas are presented below as general recommendations, and suggested next steps.

Forest management has evolved over time from focussing on sustained yield of timber to a more holistic approach that values a much broader range of goods and services. Because forest management is done on time frames of multiple human generations, a backdrop of change is part of the natural framework. A key consideration for management is to work with our knowledge of biological and other systems to provide desired outcomes or a desired future forest - one that will provide goods and services to future generations.

Climate change has added another dimension to the process. It has made us look more carefully to the future and to focus attention on what we are calling vulnerabilities. It is realized that we will not have all the solutions and the future will be uncertain and provide unexpected twists, with this in mind the following recommendations are provided.

1. **The province should develop a comprehensive, continuous, integrated, operational strategic planning process for provincial forest lands, including TSAs and other management units.**

   A common theme emerged from the management workshops within this project. Managers and practitioners from every agency and licensee company expressed frustration that the forest management cycle is too fragmented and dysfunctional within the TSA. Planning and implementation for different values and objectives is often done in silos with little connection between them.

   Climate change is anticipated to cause considerable disturbance over a relatively short period to many of the ecosystems in the Kamloops TSA. This disturbance could have a variety of implications for a range of values at different scales. We will not be successful by continuing to plan for biodiversity, timber, ungulate winter range, the urban-forest interface, and other values in disconnected silos, often using simplistic approaches.

   Management decisions to address the impacts of climate change, require a coordinated and structured planning process to promote multidisciplinary communication to provide effective and timely approaches to address area-specific vulnerabilities. One option is to build on the current TSR process, refining the focus toward one that is foward-looking, with scenario-based decision making to set targets and indicators that licensees use to guide their management and subsequent monitoring. Such a process must be operationally focused, with senior operational staff managing the process. It must be led by government with clear goals and policies to provide support and incentives. And, it must be well supported by agency, consulting and academic specialists used as participants on planning teams.

What is envisioned is a on-going process of integrated operational management and learning, not just a plan. This process is strategic, and operational. It is not a stakeholder negotiation. In this type of planning process a vision for the future forest condition continually evolves, influenced by evolving management values, forest health, fire, climate change and other influences. Management targets and performance indicators are designed to fit with the future forest condition. Modeling and scenario analysis can be used to provide a clearer picture of the impacts of various targets on different resource values over time, helping to effectively balance those targets. Long-term monitoring programs are focused by this process, linked to operations through local performance indicators that evolve with research and operational trials, targeted to test the assumptions associated with them.

Strategic planning must be continuous to evolve with monitoring and improvement over time. Focussing management in this way within Forest Districts will increase effectiveness, management efficiency, promote timely research and learning, and clarify issues and options for stakeholders and the general public. Such an approach would also provide an effective conduit to reflect evolving provincial goals and priorities. This type of process, generally loosely referred to as "sustainable forest management planning" is currently becoming the foundation for forestry in other provinces such as Alberta, Saskatchewan, Manitoba and Ontario.

2. **Governments, all levels and branches in relevant agencies, licensees, forest professionals, and others need to be organized so that they are working in a coordinated and integrated fashion around a common vision, set of principles, and goals.**

This recommendation is linked to one above. The challenges involved in interagency planning with multiple licensees cannot be unestimated. All too often multi-disciplinary planning teams function more as a committee interested more in their agency's stated values, than as a team interested in designing a holistically robust design solution (Andison 2009[5]).

It is not only a strategic planning process that is required, but a cultural corporate shift within governments, agencies and companies to promote cooperation, good communication and operational management under a common vision with a clear connected set of goals and priorities. It is time to get all agencies, branches, departments, licensees and others in the same boat, rowing in the same direction. The

[5] Andison, D.W. 2009. The Hwy40 North Demonstration Project: Using Natural Patterns as the Foundation for Operational Planning -Part 2: What Did We Learn? Alberta Foothills Disturbance Ecology Demonstration Series, Report No. 2.

strategic planning process suggested in recommendation #1 could serve as a focal point for this to happen locally, supported by provincial and regional specialists, monitoring programs and research.

3. **Utilize the broad direction and recommended specific actions to help priorize management action.**

   Within Appendix 3 and 4 are a set of issues, identified as sensitivities with associated management direction. The sections are set up to provide an overview using tables with rankings followed by more detailed guidance. This guidance is meant to help managers priorize opportunities. It is noted in a number of options that to be effective, recommendation number 1 is desired or needed.

4. **Assess general direction and recommended actions for specific areas to guage the overall impact.**

   This project attempts to answer questions about how we should start managing for climate change on the ground, with a minimum of modeling and technical analysis. As such, it capitalizes on the knowledge of local specialists and practitioners to provide a picture of general trends and suggestions to move forward. It must be viewed for what it is, examined critically, and improved with more detailed analysis and discussion where required as implementation proceeds.

5. **Use the information provided as management sensitivites in Appendix 3 and 4 to help direct Forests For Tomorrow planting projects, species selection and other activities.**

   For example lodgepole pine and subalpine fir are projected to be outside of their ecological tolerance in a number of areas by 2050, thus impacting reforestation decisions being made today.

6. **Use the KFFS to help address other implementation barriers that will be common across the province.**

   The KFFS has identified numerous implementation barriers, many of which will be regional and/or provincial in scope (Appendix 3 and 4). An example is the lack of a fair cost accounting mechanism, or incentives for planting less common species, discouraging such management options. It is recommended that the province should address those barriers in a coordinated fashion to support the operational direction to promote diversity and forest resilience.

7. **Use this strategy to help direct and/or refine research priorities for climate change in the province.**

   The KFFS identify a number of information gaps (Appendix 3 and 4). These may be useful to help direct limited funding toward the key questions that will help forest management address climate change over time. As other strategies are designed and evolve over time, more questions will emerge.

8. **Use the KFFS as guidance to proceed with similar planning in other areas in the province.**

The *Roadmap for Successful Future Forest Strategies* (Appendix 1) should be considered to help move this process to other areas in the province. This document outlines the key steps in development of a future forest strategy, with insights and lessons based on the Kamloops experience.

9. **Consider using the Kamloops TSA as a case study to more thoroughly explore potential impacts and comprehensive strategic planning within a TSA.**

   The KFFS provides a good starting point to explore comprehensive strategic planning to implement the future forest strategy. The ideas and direction that emerges may be useful throughout BC.

7.1 Suggested Next Steps for the KFFS TSA team.

1. Review the KFFS document(s) – ensure structural barriers, gaps or suggestions for management actions are not missed.
2. Highlight direction in the strategy that can be initiated right away (Appendix 3 and 4).

   Licensees and the District should work together starting with management actions that have been confirmed as being easy to moderately easy to implement. There may also be some initial steps that can be taken within the District on more challenging direction, while the province addresses barriers, or research addresses gaps.
3. Identify the implementation barriers that may be addressed within the District and cooperatively explore ideas to solve them.
4. Confirm or identify the structural barriers that must be addressed by the Province and communicate with the appropriate agencies.
5. Confirm or identify priority research questions and discuss with local researchers at Thompson Rivers University and the Ministry of Forests and Range.
6. Design an Action Plan for implementation.

7.2 Suggested Next Steps for the Province.

1. Develop a long term action plan with the District/Licensees to confirm an approach to move forward with the strategy, with some short term goals to maintain momentum over the next year.
2. Review the KFFS document with the FFEI – to highlight issues and barriers that are provincial in scope and discuss ways to address them.
3. Consider how to approach development of future forest strategies elsewhere in the province.
4. Be realistic about what can be achieved by the TSA steering committee. Support them as they explore ways to move the strategy forward.
5. To address the provincial issues and barriers – determine:
   a. Which require new policies?
   b. Which require new legislation?

c. Which can be addressed over the short term? Long term?

d. What Ministries, branches and departments are involved? Consider inter-agency overlap and conflicting regulations and ways to resolve them.

6. Design a long term action plan to address the issues / barriers / opportunities.

7. Carefully determine who should be involved to help support work at the provincial level and within the TSA and engage them to be involved.

   a. Regional specialists and research groups (government, consulting, universities)

   b. The Future Forests Ecosystem Initiative

   c. The “Forests for Tomorrow” (FFT) program

   d. The provincial Forest Investment Account (FIA) and the Forest Science Program (FSP) funding account.

   e. Other agencies

   f. Other programs such as “the New Vision for BC Silviculture”.

8. Communicate over time with the Kamloops TSA team as they try to implement the strategy and the province tries to address barriers and other issues. Compare action plans together and track progress.

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