Report #10:

Project Consultations and Outreach

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1.0 INTRODUCTION

Recent reports by the International Panel on Climate Change (IPCC) confirm that global climate change is underway, and likely to accelerate over the coming decades unless humans make drastic cuts to global greenhouse gas emissions (IPCC 2007). In British Columbia, analysis of the last hundred years of climate data confirms that parallel climatic changes are also occurring in this province (Spittlehouse 2008), and in the Columbia Basin (Murdock et al. 2007). Visible evidence of changes in climate is also becoming increasingly apparent to local people – witnessed through a wide range of changes in a broad variety of different indicators.

Results from downscaled global climate models illustrate the range of potential climate changes for BC over the next century, depending on what assumptions are made about future greenhouse gas emissions. Potential changes for southern British Columbia include increases in annual temperatures and precipitation, decreases in summer precipitation, decreases in snowpack at low elevations, increases in annual and interannual climate variability and increases in the frequency and magnitude of extreme weather events.

The British Columbia government has recognized that the uncertainties associated with climate change demand a forest management approach that differs from the traditional (MoFR 2008). With the establishment of the Future Forest Ecosystems Initiative (FFEI) in 2006, the province began a move toward looking for ways to adapt the forest and range management framework with respect to potential future climates. The province established the Future Forest Ecosystem Scientific Council[1] (FFESC) in 2008 to deliver research grants to support the objectives of the FFEI. This report summarizes some of the findings of one project[2] that was among those funded by the FFESC under their 2009 call for proposals.

The main goals of the *West Kootenay Climate Change Assessment* project are to increase knowledge about climate change and ecological resilience and enhance the capacity of forest and land managers to adapt to the challenges of climate change. To achieve these goals, a survey, a workshop series and public outreach presentations were developed to actively engage stakeholders. The survey assessed current knowledge and attitudes and provided guidance to the development of subsequent workshops. The workshops were organized to present climate change-related research findings as well as to allow the opportunity for stakeholders to participate in identifying potentially viable adaptation options and barriers to such options. Public presentations provided an opportunity to share results from this project to a wider audience.

This report describes the project methodology developed for the survey, workshops, and public outreach component. In particular, it describes how the client group of science experts and forestry practitioners was selected, climate change-related information was conveyed to this client group and, in turn, their subsequent input

[1] Further information on FFESC: http://www.for.gov.bc.ca/hts/future_forests/council/index.htm

[2] Resilience and Climate Change: Adaptation Potential for Ecological Systems and Forest Management in the West Kootenays. For further information on the project: http://kootenayresilience.org

was considered and integrated into the overall project. Rather than a series of lectures dispensing information, the project was implemented as a regional collaborative learning process.

1.1 The Study Area Social System

West Kootenay forest and land managers were selected as the key components of the social system for this project. The client group included forest licensees (tree farm licence (TFL), community forest, woodlot, forest licence), private forest managers, government employees (federal, provincial, municipal), Environmental Non-governmental Organizations, educators (university and college) and biologists. Due to the portion of the area they manage, forest licensees and provincial government employees are probably the most significant players.

The study area is made up of the Kootenay Lake and Arrow Timber Supply Areas (TSAs). The TSAs are diverse in terms of numbers and types of forest license holders, including two TFLs, 12 volume-based forest licenses, extensive area of BC Timber Sales management, 29 woodlots and five community forests. This study area includes one pulp mill and seven moderate-sized timber processing facilities. Wood is also trucked out of the study area to two large processing facilities located to the east and west of the region.

Diversity in the basic economic sectors and forest vulnerability indices describing community dependency on the forest sector were calculated for each forest district in BC (Horne 2009). The forest industry accounted for 8% and 19% of total employment for Kootenay Lake and Arrow Boundary Districts, respectively, for the period between 1991 and 2006. Relative to other areas in the province, the economic diversity of communities in the Kootenay Lake and Arrow Boundary districts were rated moderate to high, and high, respectively. During this time span, both areas were considered to have a relatively low vulnerability to changes in the forest sector as compared to other districts in BC.

Although dependence on the forest industry is relatively low, West Kootenay communities depend on many other goods and services supplied by local ecosystems. This ranges from long-term subsistence use by First Nations, streamflow for community water supplies and non-timber forest products to a tourism industry based on wildlife and fisheries abundance and aesthetic qualities of the forests. All ecological services supplied by forests are potentially affected by the effects of climate change.

1.2 Principles

In developing the strategies to engage stakeholders in the process, four principles were followed:

1. Local context - information was downscaled and adapted to make it directly applicable to the study area.
2. Local participation – all members of the practitioner client group were engaged in local land or forest management in some capacity.
3. Practical information - information presented was relevant to the participants in that at least some of it could readily be applied into plans and operations.
4. Inspiring change – information and format were developed to provide a foundation from which participants were able to continue advancing knowledge and developing practices to reduce vulnerability of West Kootenay ecosystems with respect to climate change.

1.3 Approach

The broad approach to consultation with our client group was primarily through a series of workshops and secondarily through surveys. Figure 1.1 provides an overview of how the workshops and surveys were intertwined with the other project components.

The Resilience Alliance workbooks (www.resiliencealliance.org) guided initial development of the workshops for both science experts and practitioners. The workbooks provide a format for encouraging experts and practitioners to "think outside their respective boxes", in an attempt to consider as many relevant factors as possible in the analysis. This approach promotes inclusion of social as well as ecological components of the system.

A participant survey was conducted followed by a series of workshops to engage forest and land managers in the topic of climate change. As mentioned previously, the survey was used to assess the current state of knowledge and attitudes toward climate change and to guide workshop content. A total of five workshops were held; two were attended by science experts and three were targeted toward practitioners. Each of the science workshops were held in advance of each of the first two practitioner workshops. The science experts were asked to review the proposed content for the upcoming practitioner workshops, and to provide suggestions on the proposed approach to conveying key messages to the forest and land managers, and illicit the managers' input. The practitioner workshops were designed to combine general information with small workgroup sessions; in the latter new information was applied in practical scenarios, to inspire conversation and learning. Although the fifth and final workshop was initially intended for the practitioner group only, some science experts also attended.

In total, approximately 180 stakeholders were selected to participate in the survey, and about sixteen technical experts were invited to be part of the science expert group. The goal was to have approximately 30 attendees at each of the practitioner workshops. The intention was to engage with a broad range of science experts and practitioners in order to ensure a corresponding range of ideas was included in the various analyses.

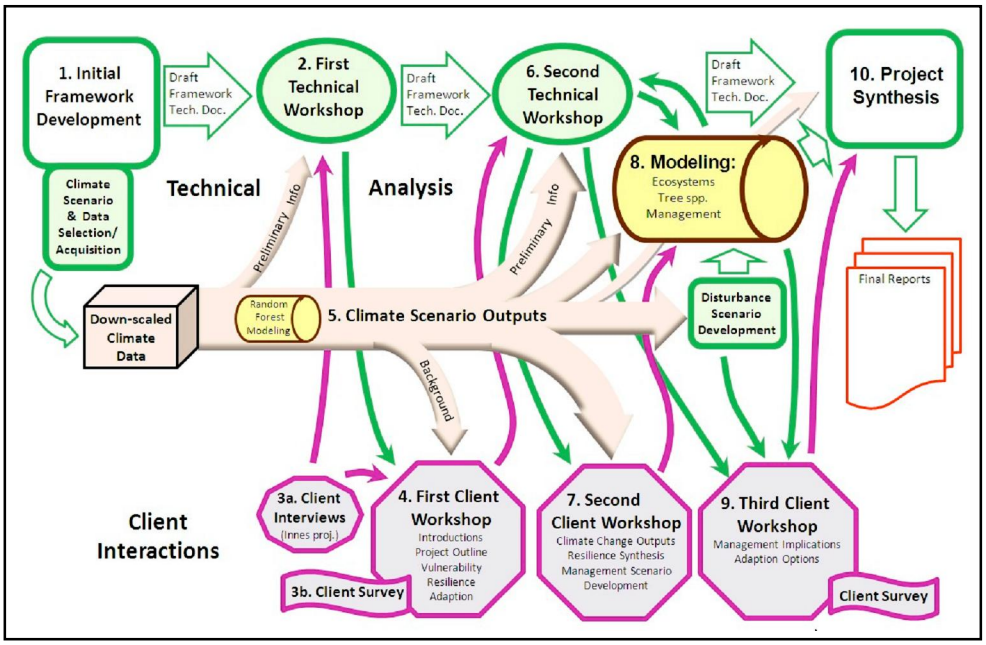

Figure 1.1. Schematic diagram of the project demonstrating how interactions with the science experts (green ovals) and practitioners (purple diamonds and banners) meshed with other project components.

2.0 RESULTS

2.1 Survey #1

Prior to the first workshop in fall 2010, a survey was conducted to assess knowledge and attitudes about climate change and resilience theory of persons associated with land and/or forest management in the West Kootenays. An internet link to the online survey was emailed to 180 potential participants living and/or working in the West Kootenays as well as former regional residents with work experience within the study area. Workshop invitees were included in the survey invitation. Of the 100 survey recipients who responded, 47 worked in forestry-related fields, 21 were municipal government officials, and 32 were classified as 'other'. The four topic areas within the survey were: (1) climate and the West Kootenays, (2) resilience, (3) adapting to climate change in the future, and (4) background (personal) information (Appendix 1).

The survey results were used to guide the workshop design. Key findings that were incorporated into workshops were:

- Half of respondents had observed ecological changes in the West Kootenays that they felt are attributable to climate change while nearly a third of them were unsure.
- Insects/disease and fire account for 56% and 38% of these observed changes. Water-related changes (30%) and changes in species (24%) were also commonly observed. Over a third of respondents reported other observed changes that included drought-caused tree mortality, warmer winters, glacial recession and high intensity storms.
- Nearly a third of respondents mentioned they had seen social or economic effects of climate change; however, no examples were given.
- Climate change was viewed as an important issue facing the world.
- Climate change was also viewed as an important issue affecting respondents' work and personal lives.
- Eighty-five percent of respondents felt that climate change and its impacts are relevant to land and forest management decisions. Areas of highest concern were condition of ecosystems, water quality and quantity and wildlife populations. Areas of moderate concern were community stability, general economic implications, flooding or storm impacts, human health, and the future of the forest industry.
- Respondents rated their current knowledge on climate change as moderate to high.
- Fifty-five percent and 47% of the forestry and government respondents respectively had included climate change impacts into management decisions at some point. When asked why they wouldn't factor in climate change, responses included a high degree of uncertainty and lack of knowledge, lack of local information, no clear direction on mitigation strategies, and no evidence of economic benefits yet.
- Regarding next 20 years, greatest concern was expressed about the effects of climate change on insect and disease outbreaks, wildfire risk and frequency of drought occurrence. There was some concern about effects of climate change on frequency of extreme weather events, water quantity and quality, and spread of invasive plants.
- Regarding the next 20 to 50 years, greatest concern was expressed about the effects of climate change on changes to tree species suitability, wildfire risk, and insects and disease outbreaks. There was moderate concern about climate change effects on water quality and quantity, and frequency of drought occurrence, and some concern about loss of wildlife habitat/species and spread of invasive plants.
- Respondents found it more difficult to predict changes beyond 50 years, but were most concerned about effects of climate change to tree species suitability.

- As individuals, respondents felt as though they had some capacity to adapt to climate change in their jobs. Their adaptive capacity was limited primarily by economics, knowledge, and government regulations and policy. Politics and corporate policy and practice were also factors limiting adaptive capacity.
- Respondents felt there is little capacity within the provincial forest management system to adapt to climate change. Adaptive capacity at the provincial level was limited primarily by government regulations and policy. Politics, economics, corporate policy and inertia were also important. Knowledge was least limiting to adaptive capacity.
- Respondents felt they have some to moderate knowledge about how to apply the concept of resilience to communities and ecosystems, respectively. Almost all respondents felt as though resilience was a useful concept to apply to forest management decisions.

2.2 UBC Climate Change Research Survey

In collaboration with our project, a separate FFESC-funded study undertook to engage with a broader group of South Selkirk residents (their area included the southern part of our study area). As part of their work, 520 South Selkirk residents completed a survey that assessed opinions and beliefs about forest management and planning and climate change (Harshaw 2012). This survey stratified respondents into three groups: Aboriginal, non-Aboriginal, and forest managers and planners. The 60 participants that formed the forest managers and planners group in that study were also part of the client group selected for the survey conducted as part of the *West Kootenay Climate Change Assessment*. Relevant results are presented in sections below.

2.3 Workshops

A number of powerpoint presentations were given during workshops. These presentations are available at: http://www.kootenayresilience.org.

The following sections provide, for each workshop, first a narrative of the specific workshop methods and general outcomes followed by a table which details workshop objectives, attendance, format, products, and, when applicable, participants' feedback on the workshop. The latter made it possible to adjust intended components of the subsequent workshops in an adaptive way.

In the original planning for the project, we intended to base our structure of engagement on the methods outlined in the Resilience Alliance workbooks (www.resiliencealliance.org). During the development of the specific workshops tasks however, our internal team found that the workbook structure mired the process, and seemingly made it difficult to move forward. Part of the issue was perhaps the very broad nature of engagement that the RA requests – this made it hard to focus on key areas of relevance with our relatively limited-in-scope set of clients. Ultimately, we decided not to use the workbook structure, and went instead to using a Vulnerability Assessment framework. We did however, base some of our engagement on elements of the Resilience Alliance approach.

2.3.1 Workshop #1: Science Expert Group

The purpose of this workshop was to get feedback from the science expert group on the overall project approach. Ideas were tested with this group prior to sharing them with the practitioner group. Presentations in Workshop #1 included overview of the project, an introduction to the vulnerability/resilience approach used for the project (Holt and Pearce 2012), and a presentation of preliminary results of climate change modeling specific to the West Kootenays (Utzig 2011).

Unique to Workshop #1 was the discussion within the science expert group as to the appropriateness of applying the concept of vulnerability assessment at the selected geographic scale. Also, input was requested as to the

clarity of climate change information and whether or not it made sense. The final task for this group was a brainstorming session to develop a preliminary list of ecological and social drivers and processes that would be built upon at the subsequent practitioners' workshop.

For each of the drivers identified, the relevant subregion (North, Mid, or South) and scale (tree, stand, landscape, region, or province) was identified (Appendix 2). The next step was to assess the potential impacts of projected climate change on key driving processes, and potential implications of those impacts on the structure and composition of ecosystems and forest management systems for each of the subregions.

The intention of this work was to attempt to reveal the main drivers of social or ecological change and how this change has occurred (episodic or gradual) in the past, to help reveal longer-term dynamics of the system. From this baseline, an assessment of first the resilience of the system today followed by how resilience may be impacted by climate change in the future is possible. As part of this exercise, a list of historic trends and main governance bodies was generated to begin to identify underlying controlling variables (often those that change slowly) that caused changes in the natural system, the people and the interventions that people made.

Results from the UBC and this project's survey, and the brainstorming exercise described above, consistently identified wildfire and insects/disease dynamics as important processes shaping current forests, as well as future forests affected by climate change. This thinking was consistent across all participant groups: science experts, practitioners, Aboriginals, and non-Aboriginals. The results from this work were then used to select key drivers for subsequent analyses, with wildfire and insects/diseases being the most important.

Prior to workshop #1, a draft technical paper was circulated to participants to provide some structure for moving forward on a complex topic. The following key questions, intended to engage participants and facilitate discussion during the workshop, were posed in this paper:

- Have any thresholds been crossed yet?
- What characteristics of these systems make them more or less vulnerable to climate change and crossing thresholds?
- Consider what possible future states of the ecosystem may look like and how far away these are from current states.

Table 1. Workshop #1 for Science Experts, November 2010

Workshop objectives: • To review and provide feedback on information to be presented at subsequent practitioners workshop; and • To develop a preliminary list of ecological and social drivers influencing West Kootenay ecosystems.
Attended by: • Twelve science experts with expertise in forest health, wildfire, ecology and geomorphology. Participants included academia (Selkirk College and Simon Fraser University), provincial and federal government researchers, and local research consultants.
Workshop format: Presentations- • Project overview (goals and approach); • Resilience versus vulnerability assessments (Holt and Pearce 2012);

- Ecological and social systems in the West Kootenay; and
- Climate change projections relevant to study area (Utzig 2011).

Group discussions-

- How to integrate vulnerability and resilience assessments to effectively evaluate ecological and socio-economic systems, and to ultimately influence forest and land management; and
- Brainstorm regarding a preliminary list of ecological and social drivers for the study area.

Workshop Outputs:

- A list of over 70 ecological and social drivers influencing West Kootenay ecosystems (Appendix 2);
- A list of relevant governance bodies affecting management of West Kootenay ecosystems, prioritized based on their effectiveness at initiating change and influencing policy and legislation;
- Improved understanding within the group of vulnerability versus resilience assessment approaches as applied to this project;
- Input on how to approach the forthcoming practitioners workshop; and
- Project team received support from the group that resilience and vulnerability concepts are being appropriately applied to the topic of climate change.

2.3.2 Workshop #2: Practitioners Group

Presentation content for Workshop #2 was similar to Workshop #1, but more concise to allow more time for small group work. The exception was the climate change presentation due to its importance. After the morning presentations, the large group was split into four smaller groups, each with a different subregion as a focus area for discussion. Participants were placed in groups for the subregion that best matched their work experience. There was one group for each of the north and mid regions and two groups for the south region as this one was where most participants worked.

In the first break-out session, the list of ecosystem drivers developed in Workshop #1 was reviewed and participants were then asked to identify the relative importance of the drivers for their subregion. As individuals, participants were asked to select 10 drivers each and then, within the break-out group, the lists were compared and the top three drivers were selected. The latter were then presented to the entire workshop group. As mentioned above, the results from this exercise were used to guide subsequent analyses.

In the second break-out session the subregional groups created impact charts that described, for their respective subregions, how ecosystems might respond to predicted climate change by the 2050s, how these changes might affect forest management activities and what forest management responses might be taken to offset these impacts. This was the beginning of a discussion that would be repeated in subsequent workshops. Two charts were developed by each group, one for changes to summer climate and one for changes to winter climate (see examples in Figures 2.1 and 2.2). Participants also identified knowledge gaps that might affect success of applying different practices. Although the primary intent of this exercise was to encourage participants to think about how climate change may impact their work in forestry, results were also incorporated into future exercises exploring potential actions to moderate climate change impacts.

Back in the larger workshop group, each participant was asked if in their work they had encountered any changes in the forest that they felt could be attributed to changing climate. Each person had at least one observation to add to the list. Examples included more intense fires, more forest health issues, higher stream flows in winter and the home ranges of badgers extending north.

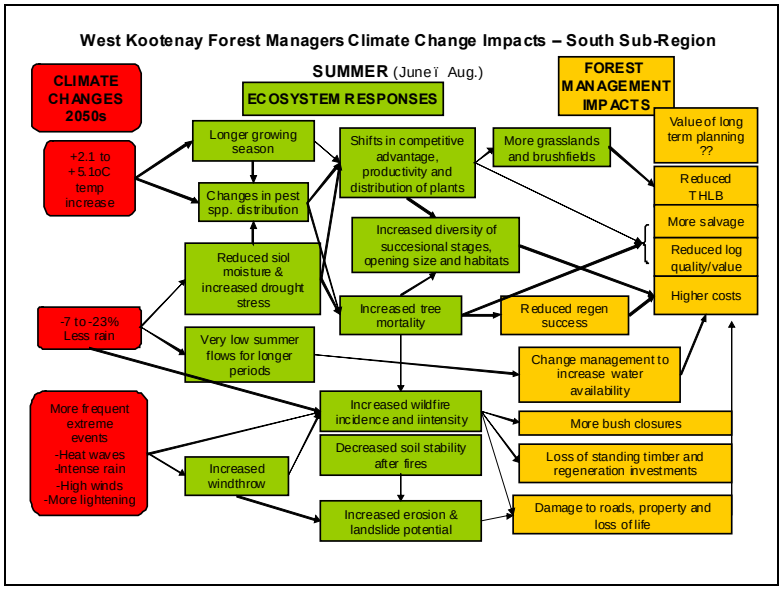

Figure 2.1. Impact chart for the South subregion – summer.

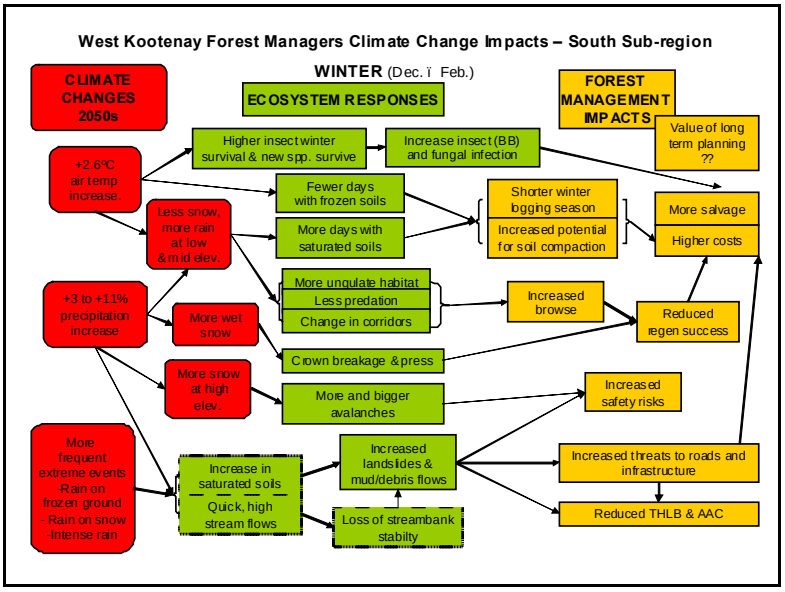

Figure 2.2. Impact chart for the South subregion – winter.

Table 2. Workshop #2 for Practitioners, December 2010

Workshop objectives:

- Engage participants in the West Kootenay Climate Change Assessment project;
- Provide information about historical and possible future climate changes that are relevant to forest management decisions in the West Kootenays;
- Seek input and share information about important ecological and social factors that affect local forests (drivers), observations of possible climate change impacts, and how climate change may affect local forests and forest management decisions; and
- Introduce the concept of adaptation strategies for forest management.

Attended by:

- Twenty-eight participants including forest licensees (TFL, forest license, BCTS, woodlot and community forest), regional district planners, forest health experts, hydrologists, and pedologists.

Workshop format:

Presentations-

- Project overview, vulnerability and resilience comparison (see Holt and Pearce 2012), ecological and socio-economic overview of the study area; and
- A detailed climate change presentation highlighting projected changes in temperature and precipitation for the 2050s, with special attention given to seasonal changes (see Utzig 2011).

Break-out groups-

- The participants were separated into four groups, based on the subregion that was most familiar to them (North, Mid and two for South), to evaluate the list of ecological and social drivers developed in workshop #1. The objective was to add any missing drivers and to rank the drivers with regard to importance in shaping West Kootenay ecosystems.
- Each of the small groups was provided with information about projected climate change for their geographic area for the 2050s. Information on changes to temperature, precipitation and frequency of extreme weather events was provided for the summer and winter seasons. Impact charting was used to assess ecological responses to the predicted climate changes and the forest management consequences of those ecological responses.
- The small groups then reconvened to expand their impact charts and brainstorm possible forest management responses that could be implemented to increase resiliency of West Kootenay ecosystems. Information requirements for the implementation of the top three forest management actions were also identified.

Large group discussion-

- A list was developed of observed ecosystem changes believed to be attributable to climate change. Most participants were able to provide at least one, and in some cases several, possible climate related changes observed during their careers.

Workshop Outputs:

- An expanded list of ecological and social drivers influencing West Kootenay ecosystems;
- Identification of important drivers influencing ecosystems in the North, Mid and South subregions;
- A list of ecosystems changes observed in local ecosystems that may be attributable to climate change;
- A list of possible ecological responses to climate change, and the forest management implications of those responses;
- A preliminary list of possible forest management responses that can be implemented now to increase ecosystem resilience; and

• A list of priority information gaps
Participant feedback: • The wide range of backgrounds of the participants provided added value to small group discussions and the large amount of time allocated to discussion was appreciated. • Good format for exchange of information. • All respondents indicated they were going to return to remaining workshops. • The list of over 70 drivers was too long to be absorbed and evaluated in the relatively short time period allocated to this exercise.

2.3.3 Workshop #3: Science Group

As with Workshop #1, the purpose of this workshop was to get feedback on new information to be presented at the following practitioners workshop. New information included projected shifts in bioclimate envelope shifts (Utzig 2012), changes to fire regimes (Utzig et al. 2011) and potential effects on forest health (Pinnell 2012). Following the presentations, discussions were centered on key messages to present to the practitioners workshop (Table 3).

Table 3. Workshop #3 for Science Experts, May 2011

Workshop objectives: • To review and provide feedback on information to be presented at subsequent manager's workshop.
Attended by: • Eight technical experts representing forest health and ecology. Representation included academia, provincial and federal government researchers, and local research consultants.
Workshop format: Presentations- • Presentations developed for subsequent practitioner workshop (see topics below) were reviewed to assess clarity of content, accuracy as well as to get feedback on key messages to present.
Suggested key messages for next client workshop: • Uncertainty: The message is: we need to acknowledge the importance of proceeding cautiously. Practitioners may want guidebooks; however, the high degree of uncertainty limits this approach. Because too much uncertainty may be used to justify a "do nothing" approach, part of the discussion included scenarios with limited uncertainty by showing the trends that all/most models support. • Mitigation: The goal is to empower practitioners with knowledge about actions to reduce carbon emissions/release (e.g., manage to reduce fire hazard, incorporate leave trees, manage soil carbon, etc.). There are greater gains through adaptation when mitigation practices occur concurrently. Adaptation has risks associated with it while mitigation does not. • Effective forest management will require major rethinking not just minor tweaks to fully integrate climate change impacts. Focus on basic principles (e.g., increasing landscape diversity) versus details (e.g., which species to plant where?). • Focus conversation with practitioners on important landscape and stand elements to retain. • The need to de-emphasize mean values and focus on the ranges in variability around the mean.

- Encourage practitioners to shift from short term to long term thinking. It is important to emphasize trends predicted for the 2020s since many current practitioners will still be managing by then. Important questions to ask include: What will your current management on the ground look like in the 2020s? How resilient will those stands be with respect to the predicted changes? Do we manage for mid- or long-term?
- Rethink the application of the range of natural variation (RONV). Analyzing historical conditions are still important for understanding how ecosystems respond to disturbances and other drivers, but they are no longer a reliable predictor of future conditions.
- Monitoring is important to verify change. Ask: Where is drought mortality occurring? What is going on in Washington/Idaho that we should know about?

2.3.4 Workshop #4: Practitioner Group

Presentations included potential changes to fire regimes and forest health, projected shifts in bioclimate envelopes for tree species and broad ecosystems, and an introduction to management decision-making in times of uncertainty. The addition of the discussion on uncertainty was a result of participant feedback from Workshop #3, where practitioners expressed concern about the uncertainty surrounding climate change impacts.

Throughout this workshop, much time was spent in small break-out groups where new information was applied to various management scenarios. The focus was less on finding solutions, than on learning how to think about and incorporate the large volume of new information. Participants were split into three groups representing different forest management focuses: fire management, harvest to free-growing, and post free-growing to mature.

One activity was an autecology review where participants listed, for each tree species, susceptibilities to drought, frost, shade, etc. The goal was to self-evaluate whether knowledge was up-to-date or required review with respect to species selection in a changing climate.

In a second activity, each group was given local maps and orthophotos showing forest cover, land features (water bodies, roads, existing cutblocks, etc.), and biogeoclimatic information as well as any available stand and stock tables. A worksheet (Appendix 3) guided participants into thinking about how growing conditions may change over time, and what may be the greatest climate change-related challenges in that particular area. Participants were then encouraged to consider how the forest may develop if no changes were made to current practices, and to consider what new management options should be considered to promote resiliency. As with the impact charts, the primary intent of this exercise was to have practitioners apply new information learned during the presentations. In addition, results were incorporated into later work exploring possible adaptation options available to practitioners.

Table 4. Workshop #4, Practitioners Group, May 2011

Workshop objectives:

- Provide participants with current research findings about impacts of projected climate change on West Kootenay forests;
- Explore how this information can be incorporated into land and forest management decisions; and
- Seek input into the final workshop.

Attended by:

- Eighteen participants including forest licensees (TFL, forest license, BCTS, woodlot and community forest), regional district planner, hydrologists, biologists and wildfire experts.

Workshop format:

Presentations-

- Climate change review;
- Sources of uncertainty encountered with climate models;
- Introduction to strategies for making decisions while working with uncertainty;
- Projected bioclimate envelope shifts (Utzig 2012);
- Projected range shifts of selected tree species based on bioclimate modeling(Utzig 2012); and
- Mechanisms of change within West Kootenay ecosystems: Insects, disease, tree decline and fire (Pinnell 2012 and Utzig et al. 2011).

Break-out groups-

- Autecology review: First individually, then in small groups, tolerances to frost, heat, water deficit, water surplus and shade were rated for each of the main West Kootenay tree species at various developmental stages (0-20 years, 21 to 50 years, > 50 years) with the goal of assessing current knowledge of autecology important to forest planning with respect to changing climate.
- Four small groups were formed each with a different scale of focus: stand level (silviculture prescription), stand level (intermediate stand management), landscape (old growth management) and landscape (fuel management). As a preliminary exercise, impact charts for the south subregion created in Workshop #2 were reviewed by each group to determine if any changes or additions came to mind due to new information learned during Workshop #4.
- Maps and forest data were used to guide conversation to answer questions related to how thinking processes may have to change in order to account for predicted ecosystem changes due to climate change. Questions focused discussion on the range of possible ecosystem changes with high versus low projected climate change, possible adaptations to forest management in response to changing conditions, and evaluating how robust various practices may be depending on the magnitude of climate change.
- As a final exercise, participants moved from a hypothetical scenario in the previous exercise to looking at their own work environments to see if they could identify geographic areas of concern that are likely at greatest risk to impacts from climate change.

Workshop Outputs:

- Potential forest management options in response to climate change

Participant feedback:

- All but one participant felt they needed to be making changes with respect to how they are practicing land or forest management.

2.3.5 Workshop #5: Client Group

In this final workshop, the focus was to experiment with, and encourage thinking about how to apply decision-making processes in complex situations. The uncertainty associated with climate change predictions and affected ecosystem processes can be overwhelming when trying to assess how to incorporate climate change thinking into plans and operations. The structured decision-making process demonstrated in this workshop was intended to increase confidence in applying climate change thinking into plans and operations. The goal of this session was less aimed at finding complete solutions to various scenarios, but rather to experiment with one decision-making process, to guide thinking and increase confidence in decision-making.

Prior to the workshop, a worksheet was distributed to participants to encourage thinking about how the changing climate may affect ecosystems and forest management activities in the West Kootenays (Appendix 4). Nearly six months had passed since the previous workshop and this assignment was intended to refresh participants' thinking about climate change. Participants were asked to provide their opinion on current observations versus future expectations with regard to potential impacts of specific changes in climate variables (e.g., increased frequency of extreme wind events). They were also asked to relate these changes management activities (e.g., shifts in tree species suitability, water management, harvest operations).

At the workshop, a brief review of information presented in previous workshops (climate change, changes in fire regimes, tree species suitability shifts, etc.) was followed by a presentation describing four different decision-making methods: business scan, risk assessment, vulnerability assessment and structured decision-making. This was followed by an example application of structured decision-making to old-growth management, using an approach adapted from Ohlsen et al. (2005). The approach to structured-decision-making was then used as the basis for small group sessions that applied the tool to a three management decision scenarios: mature forest management, regeneration decisions and access management. Each group completed a series of worksheets that guided them through the process outlined below. A completed series of worksheets is provided in Appendix 5).

Structured Decision-making Application Sessions

Step 1 - Define problem and management objectives: Because of time limitations, management objectives that were directly applicable to the three management scenarios were pre-selected from Forest Stewardship Plans contributed by participating licensees. Worksheet #1 guided participants to work toward identifying climate factors that may affect achieving these objectives.

Step 2 – Assess system vulnerabilities: Worksheet #2 required participants to think about adaptation options that may be possible for impacts associated with climate change. Potential climate impacts from worksheet #1 were carried over to worksheet #2 and adaptations to reduce these impacts were generated. For example, if drought was assessed as a possible climate impact, reducing stocking levels or planting drought resistant species may be possible adaptation options. Gaps in adaptation capacity and barriers to implementing the adaptation options were also identified.

Step 3 – Develop risk management strategies: In step 3, adaptation options developed in worksheet #2 were carried over to worksheet #3A and rated across various criteria (e.g., cost effectiveness, technical feasibility, ease of implementation, etc.) to screen out any options that were unacceptable. Remaining adaptation actions were then grouped into action categories, and used to construct a table for rating different strategies (see example worksheet #3B in Appendix 5). Different strategies were then compared against similar categories by circling actions appropriate to the various selected strategies.

Step 4 – Evaluate and decide: Each of the strategies developed in step 3 were then carried over to consequence tables in worksheet #4 and compared against management objectives and performance measures identified in step 1. At this stage, the highest rated strategy became the 'decision'.

Step 5 – Implement and monitor: In worksheet #5, an action plan was developed for the selected strategy and each of the associated actions were evaluated using criteria that include priority, responsibility, required resources and timeframe. Ways to resolve barriers and gaps identified in step 4 were also described.

After the allotted time, the large group reconvened to discuss the experience of working through the structured decision-making tool as presented. Although there was overall agreement that there was value in going through the worksheets and learning about structured decision-making, there was also general agreement that more time was required due to the number of steps and large range of ideas that must be synthesized at each step. Also, it would have been helpful to have more of the information pre-filled in so the process could be moved through quicker.

The final discussion was about how to move forward now that the workshop series was completed. There was general agreement that it was important to continue working on how to incorporate climate change thinking into resource planning and operations. Practitioners felt that significant information had been generated in the current project, and focus was needed now for applying the information to their day to day decision-making. There was agreement that it was important to continue meeting in a conversational setting where situations could be explored together in search for innovative problem solving.

Table 5. Workshop #5, Client Group, November 2011

Workshop objectives:

- To become familiar with some of the approaches for factoring climate change into forest management decisions;
- To introduce a decision-making process and practical strategies that can be applied in forest planning and management to account for uncertainties associated with climate change;
- To identify barriers and opportunities to adapting forest management in the West Kootenays to climate change; and
- To explore formats for continued learning about climate change and practical adaptation actions over time.

Attended by:

- 28 participants including forest licensees (TFL, forest license, BCTS, woodlot and community forest), regional district planners, forest health experts, biologists and hydrologists.

Workshop format:

Pre-workshop assignment-

- A week prior to the workshop, attendees were sent a worksheet to fill out and asked to bring it to the workshop for discussion. The purpose of the worksheet was to get participants thinking about how the changing climate may affect ecosystems and forest management activities in the West Kootenays.

Presentations-

- Review of climate change, ecosystem/species climate envelop shifts, forest health; and
- Four methods for decision-making: business scan, risk management, vulnerability assessment and structured decision-making (Holt and Pearce 2012).

Break-out groups-

- Using case studies, participants in small groups worked through strategy tables, decision worksheet, and barriers/opportunities worksheet; and
- Discussion about how to improve the demonstrated decision-making process.

Large group discussion on knowledge gained and next steps-

- Participants described 'Ah Ha!' moments experienced during project;
- Participants discussed how to move forward with incorporating climate change into their day to day work.

Workshop Outputs:

- A worksheet series for structured decision-making, and feedback from practitioners based on three practical application trials
- Practitioner feedback on the project as a whole.

Participant feedback:

- Only present one (recommended) method on decision-making.
- Simplify worksheets or allow more time to complete worksheets.
- In the large group, work together through the worksheets for a selected scenario. Blank or partially filled in worksheets are projected at the front of the room and filled in using ideas generated by the group.

2.4 Public Outreach

A website has been launched to provide periodic updates on the project for client groups and the general public (www.kootenayresilience.org). We have also used the website for distributing presentations used in the workshops to a wider audience, and for making our reports available to a wider audience. We will be updating the website with the final reports once they are complete, and are attempting to secure funding to continue the website into the future.

To date, over a dozen presentations on information developed in this project have been delivered to various groups and organizations outside our primary client group, mostly in the Kootenays, but also extending to Vancouver, Edmonton and Seattle (Appendix 6). Audiences included the general public, resource professionals, scientists, and conservation activists. Some of the presentations were made at science conferences on climate change topics, others were in response to invitations from local organizations with an interest in the topic. Once the final reports are disseminated, we expect more requests for presentations.

The high interest in local climate change and its potential impacts is supported by survey results reported by Harshaw (2012) where 67% of respondents (primarily located in the West Kootenays) expressed they had some concern about climate change impacts. Most respondents felt their lives were already affected by climate change. Observations included summer drought, warmer winters, mountain pine beetle, melting glaciers and changes to bird migration patterns. Looking into the future, respondents are most concerned about severe insect outbreaks. Other concerns include more frequent extreme weather events, changes in plant and animal distributions and habitats, drought and a reduced timber harvesting landbase. They also believe that forest managers should be doing something in response to climate change.

Harshaw (2012) also concludes that scientists and experts may be the most trusted and therefore effective group to extend climate change information to the general public through presentations and meetings. Other trusted information sources include friends and the internet. Least-trusted sources for information on climate change were politicians and the media, especially national media.

2.5 Collaboration

During the time period of this project, we specifically collaborated with two other FFESC projects the 'Innes' project and the "Morgan" project.

Innes Project: a team from UBC had a related project based in the South Selkirks part of the West Kootenays (extending to the East Kootenays, and being based more in the south and east than our project). Irrespective, we assessed in advance a) areas to avoid overlap and b) areas to collaborate on technical aspects of the work.

Client Group: We communicated throughout the project with H. Harshaw from the Innes project (by email, phone, and in in person meetings), as stated in our original collaboration plan. We organized approaches to ensuring that our various workshops and client interactions did not overlap or confuse participants – which was unlikely given their largely different spheres. We also collaborated in sharing lists of the participants in our workshop in order to provide an overlap for their survey work in order to extract additional value from this effort. Once the projects were underway, there was little actual overlap so in reality few efforts were needed to keep the projects separate. The Innes team were invited to the West Kootenay client workshops.

Modeling: We had not originally budgeted for significant amounts of modeling within our project budget, with the intention of collaborating with the Innes project and getting additional input from their proposed modeling work. With regard to TELSA modeling, we met with W. Klenner and his staff on a number of occasions to share our local information for input into their timber and values modeling work that overlapped with part of our study area. However, due to budget cuts for that group, their work did not produce results in sufficient timeline for inclusion in our workshops. In addition, we investigated the use of TACA (through UBC) and considered using that model as a basis for our work. However, we eventually went the route of collaborating extensively with scientists at University of Alberta instead (climate and bioclimate and tree species shifts), and engaged in our own modeling and investigation of potential drivers of change. In retrospect, this approach from 'first principles' of ecosystems, rather than moving straight to values was more appropriate for the overall approach we took.

Morgan Project: as part of our collaboration with the Morgan project two of our team attended two workshops organized jointly and worked through approaches to this type of work. Subjects for discussion included concepts of resilience and vulnerability and approaches to engaging with the client group. We have further engaged with Daust et al. in writing a joint summary of the lessons learned during these projects. (on-going).

3.0 DISCUSSION

3.1 Participant Feedback on Workshops

In addition to feedback forms, a group discussion concluded the final workshop by exploring positive aspects of the sessions and potential improvements to the workshops. The overall response to the workshops was very encouraging. The local relevance of the information was crucial in terms of catching and holding the attention of the practitioner group. Also important was that practitioners were left with information they could immediately begin to apply or could build upon in the future. The following summarizes key points:

3.1.1 Information Quality

- Local focus (versus provincial or larger scale) made the information relevant to participants and was very important for capturing and maintaining interest throughout the workshop series. Because of the local context, many participants felt they now had enough information to begin to incorporate climate change considerations into forest management plans and operations. Many of the practitioners were sufficiently motivated by the workshop content to attend all three workshops.
- The scope of information was useful to all groups of participants (i.e., managers, educators, scientists, government – municipal, provincial, federal), and can be applied in the various fields.
- Having the reports and presentations available online for future reference was appreciated. Having a website that targets local climate change related information is useful.
- The information generated by the project has more local credibility because it was created through cooperation between the project team, science experts, and practitioners (most of whom were local).

3.1.2 Workshop Format

- The mixed backgrounds of participants made the workshops very informative. It was useful for science-based people to hear the licensee perspective/viewpoints and vice versa.
- Diversity of participants gave credibility to the process and will help participants achieve success when applying new this information.

- Having short presentations interspersed with group discussions where new information was applied in exercises was useful.

3.1.3 Improvements

Overall feedback on the workshop series was very positive. The one area where improvement was recommended was with regard to the decision-making session as many participants were overwhelmed by the amount of information presented. Suggestions were to reduce presentation information down from four to one recommended decision-making tool which would provide more time for working with and learning how to apply the concept. There was general agreement that it would have been useful to work through an example together in the large group. The worksheets would be projected at the front of the room and as a group the participants would fill in the worksheets to create a common understanding.

3.2 Key messages

At the end of the final workshop participants were also asked to describe some of the important messages they received. The most common responses were:

- They could see the urgency to act after seeing the climate change modeling results;
- There is comfort knowing that a local group is engaged in this work looking for local solutions;
- The opportunity to gather and share ideas with other people who are thinking about climate change impacts was valuable;
- The worksheets developed for the workshops are a good resource;
- Being introduced to the concept of structured decision-making was useful as it provides a framework to begin organizing thought processes on such a complex topic; and
- Participants felt the workshops inspired change and there was commitment to move ahead on this topic.

3.3 Moving into the Future

3.3.1 Conversation Forums

There was strong interest expressed within the group to continue with discussions initiated within the workshops. Participants seemed satisfied that enough local information had been generated and shared and that focused discussion on particular issues was a logical next step. In particular, there was interest in exploring strategies and options associated with particular management concerns and possible impacts of selected actions. It was expressed that licensees have a lot of anecdotal knowledge that would be good to share, and that this knowledge in combination with science-based information could lead to innovative problem solving. It was expressed by the group that it is important to move away from theory and instead to move toward practices that can be applied immediately.

This is supported by survey results (Harshaw 2012) where 87% of the manager/planner group stated they felt they should be doing something in response to climate change. Nearly 62% felt that it was important to start acting now rather than continuing to learn more about local climate change by further monitoring.

These Conversation Forums would be attended by a diverse group of forest/land practitioners and science experts. Sessions would be structured such that diverse groups of people work on a single problem together. These forums would require a champion to coordinate topics, attendance, and scheduling. Survey results suggest that government has an important role to play in leading forest management to reduce climate change (Harshaw 2012).

Some of the topic areas that participants expressed interest in for future conversations included:

- Stocking standards – how to adapt them to shifting climatic envelopes
- Silvicultural systems - how to identify risks associated with each
- Reserve networks – how can they be used to reduce vulnerability?
- Is ecosystem restoration a tool that can help to create resilient stands?
- Potential impacts of climate change to wildlife habitat (especially keystone species) - what are the thresholds?
- Autecology of trees (regenerating to mature) and the effect of provenance on autecology - what are the thresholds?
- A detailed look at local ecosystem impacts of climate change projections
- Risk assessment methodologies including probabilities of success
- More information about high-elevation snow and water
- Geotechnical considerations
- Impacts on community watersheds and local government management of those watersheds
- More information on fire disturbance scenarios
- How to remove barriers to change (e.g., how to adapt legislation)
- Potential impacts of climate change on Timber Supply Review

3.3.2 Continued public outreach

Survey results and demand indicate that continued public outreach is a valuable way to extend results from this project. Scientists and experts are the most trusted group to deliver information in presentations or meetings. The general public view climate change as something that is already occurring and they are interested in knowing what it could mean to them. They are also interested in knowing what types of actions are and can be taken locally to address climate change impacts.

Possible presentation topics include showing predicted climate change impacts on:

- Fire regimes and insect/disease outbreaks
- Frequency and types of extreme weather events (e.g., wind storms, high intensity precipitation events)
- Plant and animal range shifts and habitat availability
- Drought occurrence
- Timber supply

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APPENDIX 1: CLIMATE CHANGE SURVEY

CLIMATE AND THE WEST KOOTENAYS:

1. Have you noticed any ecological changes in the West Kootenays that you attribute to climate change? (Yes, No, Unsure)

2. If you answered 'Yes' or 'Not sure / maybe' to above question (# 1), what types of changes?

- ☐ Fire
- ☐ Wind/ windthrow
- ☐ Landslides
- ☐ Insects/ disease
- ☐ Flooding
- ☐ Other water-related issues
- ☐ Species change
- ☐ Other

3. Have you noticed any social or economic changes that relate to land management that you attribute to climate change? (Yes, No, Unsure)

4. Among all the issues facing the world, how do you rate climate change as an issue? (7 choices ranging from 'Not important at all' to 'Very important')

5. Are you concerned about climate change? (7 choices ranging from 'Not concerned at att' to 'Very concerned')

6. Do you consider climate change or its impacts relevant to land or forest management decisions? (Yes, No or Unsure)

7. If you answered 'Yes' or 'Not sure / maybe' to above question (#6), what aspects of change or impact are you concerned about? (check all that apply).

- ☐ Wildlife populations
- ☐ The state or condition of ecosystems
- ☐ Water quantity or quality
- ☐ Flooding or storm impacts
- ☐ Forest industry's future
- ☐ General economic implications
- ☐ Human health
- ☐ Community stability
- ☐ Other

8. How would you rate your level of knowledge of climate change? (7 choices ranging from 'Very knowledgeable' to 'Not very knowledgeable at all')

9. If you are involved in land management or forest management, have you personally included climate change or its impacts into current management decisions? (Yes, No or N/A)

10. Over the following time periods, which, if any, climate change associated effects do you think will have the largest impact on FORESTS or FORESTRY in the West Kootenay?

Next 20 years?
20 to 50 years?
50 to 100 years?

11. Over the following time periods, which, if any, climate change associated effects do you think will have the largest impact on COMMUNITIES in the West Kootenay?

Next 20 years?
20 to 50 years?
50 to 100 years?

RESILIENCE:

1. How would you rate your understanding of the concept of 'resilience' as applied to forest dependent communities and ecosystems? (7 choices ranging from 'No understanding' to 'Significant understanding')

2. What would be your short definition of resilience?

3. Do you consider resilience to be a useful concept in relation to forest MANAGEMENT decisions today? (Yes, No, Maybe, Don't know)

4. Do you consider resilience to be a useful concept in relation to forest COMMUNITY decisions today? (Yes, No, Maybe, Don't know)

5. If you are familiar with the concept of resilience and ecosystems, what aspects of forest ecosystems do you think would contribute to resilience, and may be important to manage in the future?

6. Do you think the resilience of your community is dependent on the resilience of local forests? (Yes, No, Maybe, Don't know)

ADAPTING TO CLIMATE CHANGE IN THE FUTURE:

1. How would you rate the capacity of the provincial forest management system to adapt to climate change? (7 choices ranging from 'Very little capacity' to 'Significant capacity')

2. What may limit adaptive capacity? (check as many as apply)
Government policy/regulations, Corporate policy or practice, Knowledge, Economics, Inertia, Politics, Other

3. From a forest/ land management perspective are there decisions that could be taken today at the provincial level that would assist West Kootenay forest managers or communities adapt to climate change? (Yes, No, Not sure)

4. If you are responsible for managing a specific tenure or some aspect of forest ecosystems, how would you rate your capacity to adapt to climate change? (7 choices ranging from 'Very little capacity' to 'Significant capacity')

5. What do you feel may limit your capacity to adapt your management? (check as many as apply)
Government policy/regulations, Corporate policy or practice, Knowledge, Economics, Inertia, Politics, Other

6. If you are responsible for managing a specific tenure of some aspect of forest ecosystems, are there any decisions that YOU (or YOUR ORGANIZATION) could take today that could assist in adapting to the effects of climate change on your tenure? (Yes, No, Not sure)

7. Is there information on climate change, resilience, and ecosystems that may assist you in making or advocating for sound management decisions? (Yes, No, Not sure?

8. Other comments.

PERSONAL INFORMATION:

1. Home location (nearest community):
2. Office location (if different from above):
3. Highest education level attained.

- ☐ No high school certificate or diploma
- ☐ High School certificate
- ☐ College, or other non-university certificate or diploma
- ☐ University certificate or degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Earned doctorate

4. How long have you lived in the West Kootenays?

- ☐ Fewer than two years
- ☐ 2 to 5 years
- ☐ 5 to 10 years
- ☐ 10 to 20 years
- ☐ Longer than 20 years
- ☐ Not applicable

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5. If directly employed in forestry or land management, please indicate what type of employment (check as many as apply)

- ☐ Silviculture
- ☐ Prescription development
- ☐ Forest health
- ☐ Engineering/ roads
- ☐ Planning/ administration
- ☐ Research
- ☐ Hydrology/ water management
- ☐ Terrestrial biologist
- ☐ Aquatic biologist/ fisheries
- ☐ Protected area management/ conservation
- ☐ Other

6. If employed in local government, please indicate your role.

- ☐ Management
- ☐ Engineering/Public works
- ☐ Planning
- ☐ Other

7. In what other ways do you engage with forest management issues (as employment or other)? (check as many as apply)

- ☐ Rural water user/ watershed group
- ☐ Environmental non-government organization
- ☐ Municipal or regional government
- ☐ Educational activities
- ☐ Outdoor recreational association (e.g. rod and gun club, snowmobile association)
- ☐ Other

8. Describe the location that you manage or are primarily engaged with (e.g. region, specific tenure, watershed, TSA, etc.).

9. Years in forestry/land use management
- ☐ Fewer than two
- ☐ 2 to 5
- ☐ 5 to 10
- ☐ 10 to 20
- ☐ Longer than 20
- ☐ Not applicable

10. Where do you currently get information regarding climate change? (check as many as apply)
- ☐ Peers (professional)
- ☐ Friends (social and non-professional)
- ☐ Conferences and seminars
- ☐ Webinars/ e-lectures
- ☐ Internet
- ☐ Magazines and newspapers
- ☐ Local/regional governnment reports/briefings
- ☐ Provincial government reports/briefings
- ☐ Federal government reports/briefings
- ☐ Scientific publications and technical articles
- ☐ Non-academic & non-technical publications
- ☐ Environmental organizations
- ☐ Consultants
- ☐ Professional associations
- ☐ Face-to-face extension activities
- ☐ Nowhere - I do not follow information on climate change
- ☐ Other

Other (please specify)

11. Which of the above would you rate as most influential for you?

12. Do you know of any work that describes climate change, or its impacts, specifically in the West Kootenay?

13. If you are interested in engaging with this project in future, please indicate how you would like to be engaged below. (check any that apply)
- ☐ Receiving emailed updates on the project
- ☐ Attending management / resilience workshops
- ☐ Learning about climate change potential futures for the Kootenays
- ☐ Receiving notification about reports produced
- ☐ Other

14. If we could contact you for follow-up, please provide your name, daytime phone number and e-mail.

APPENDIX 2: ECOLOGICAL AND SOCIAL DRIVERS

				Scale					
#	**Type**	**Driver**	**Subregion**	**Tree**	**Stand**	**Watershed / landscape**	**Region**	**Province**	**Larger**
Environmental Drivers									
6	Biodiversity / Disturbance process	Bark beetles	All	1	2	3			
7	Biodiversity / Disturbance process	Defoliators	S →N	3	1	2			
9	Biodiversity / Disturbance process	Disease (above ground)	Var	1	2	3			
8	Biodiversity / Disturbance process	Disease (below ground)	Var	1	2				
27	Biodiversity related	Soils – biota	All	2	1				
15	Biodiversity related	Vegetation Succession	S →N		1	2			
13	Biodiversity related	Wildlife (e.g. keystone species)	Var	1	2				
14	Biodiversity related	Wildlife (foundation species)	Var	1	2				
18	Climate	Climate – extremes	??	1	2				
19	Climate	Climate – interactions	S →N	1	2	3	4		
20	Climate	Climate – lightening	All?	1		2			
22	Climate	Climate – major weather systems (jet stream etc.)	All			2	1		3
16	Climate	Climate – precip.	S →N	1	2	3	4		
17	Climate	Climate – temp.	S →N	1	2	3	4		
21	Climate	Climate – wind	All	1	2				
11	Climate	Drought (frequency/ intensity/ duration)	S →N	1	2	3			
4a	Disturbance process	Fire (stand replacing)	N	3	2(1)	1(2)			
4b	Disturbance process	Fire (stand replacing)	M	3	2(1)	1(2)			
4c	Disturbance process	Fire (stand replacing)	S	3	2	1			
5	Disturbance process	Windthrow	All	1	2				
24	Invasive Biodiversity	Alien Invasives (veget.)	S →N		1				
25	Invasive Biodiversity	Invasives – insects/disease	S →N	1	2	3			
26	Invasive Biodiversity	Wildlife invasives	All		1				

				Scale					
#	**Type**	**Driver**	**Subregion**	**Tree**	**Stand**	**Watershed / landscape**	**Region**	**Province**	**Larger**
Environmental Drivers (cont'd)									
1	Physical	Macro topography	All			1	2		3
2	Physical	Meso/micro topog	All	2	1				
23	Physical	Nitrogen cycle	All	1	3	2			
10	Physical/ Climate	Snow (depth/duration)	S →N		1	2	3		
3	Physical	Soils – AWSC*	S →N	3	1	2			
12	Physical	Soils – mineralogy	All	1	2	3			
Social Drivers									
35	Forest Policy	Large Crown Grants	S →N		2	1			
44	Forest Policy	Fire suppression	S →N		2	1	3		
55	Global Issues	Markets	All					2	1
47	Forest Practices	Wildlife transplants	S →N		2	1			
57	Forest Practices	Lack of forward-looking, planning	All		1	2		3	
61	Forest Policy	Transparency in planning & management	All		2	1	3		
65	Worker Safety Policy	Danger trees	All	2	1	3		4	
32	Forest policy	Old Growth liquidation	S →N		2	1	3		
34	Forest policy	Intermediate Utilization	S →N		1	2	3		
36	Forest policy	Harvest patch size	All		2	1			
38	Forest policy	Forest tenure development	All			3	2	1	
39	Economic devel policy	Forest tenure ownership	All			3	2	1	
49	Forest policy	Reforestation	All	2	1				
50	Forest policy	Salvage harvesting	All		2	1			
51	Forest policy	Riparian management	All		1	2			
53	Corporate policy	Forest certification	S →N		2	1	3		
54	Forest practice	Stand density control	All		1	2			
56	Forest policy	Free to grow	All		2	3		1	
59	Forest policy	Visual quality management	All		1	2			
66	Forest policy	Carbon mgmt.	S →N		1	2			
69	Forest policy	Timber Supply Management – AAC	All				2	1	
31	Forest Practices	Plantation forestry	All		1	2			
37	Forest Practices	Harvesting retention	All	2	1	3			
58	Forest practices	Harvesting technologies	All		2	1	3	4	
28	Human population	First Nations	S →N	2	1				

				Scale					
#	**Type**	**Driver**	**Subregion**	**Tree**	**Stand**	**Watershed / landscape**	**Region**	**Province**	**Larger**
Social Drivers (cont'd)									
29	Human population	European settlement	S →N		2	1	3	4	5
30	Human population	Urbanization (into interface)	S →N		2	1			
40	Human population	Roads / utility corridors	All		2	1	3		
41	Human population	Backcountry use	All		2	1			
45	Human population	Subsistance uses	All	1	2				
46	Human population	Hunting / fishing	All			1	2		
52	Human population	Individual personalities	All		4	1	2	3	
62	Human population	Forestry organizaitons (e.g. COFI, ABCPF)	All				2	1	
63	Human population	Environmental NGOs	All		4	1	3	2	
64	Human population	Research/ extension	All		4	1	3	2	
68	Human population	Water Users	All		2	1	3	4	
70	Human population	Historic railroad + mining	All			1	2		
71	Human population	Building Dams	All			1	2		
72	Human population	Agriculture Expansion	S / M			1	2		
74	Human population	Intensive recreation	All		2	1			
60	Global Issues	Externalities	All				3	2	1
33	Non-forest industrial	Trail Smelter	S	2	1	3			
42	Forest policy	Fire suppression	S →N		2	1	3		
75	Forest policy	Grazing tenures	S/ M						

Notes: Subunit – S → N indicates that the driver interactions vary from south to north; Var – variable, response will vary depending on specific aspects of the driver in question

- AWSC = Available water storage capacity

APPENDIX 3: APPLICATION TO FOREST MANAGEMENT

Purpose: Explore how the new climate change impact information might affect day-to-day forest management decisions.

A. Practice including climate change impacts in FM decisions

Each group will be provided information about a watershed, mature forest, mid-aged forests and a potential cutblock in the watershed. Groups will begin by considering one of the following decisions:

1. Silviculture prescription
2. Management of mid-aged forests
3. Retaining old-growth habitats
4. Fuel management prescription

If a group finishes discussing the first decision, other decisions can be explored.

First define the land management objectives:

Questions to consider:

1) How do you think climate will affect growing conditions and on this site? For the mid-aged and old-growth sites, how do you think the forests will change over time (i.e. species and stand structure)? How do you think fuel management requirements will change?

- With current climate conditions?
- If the lower level of the projected climate change happens?
- If the higher level of the projected climate change happens?
- A stand replacing event occurs ?(fire, pests or wind…which are most likely?)

Management practices

- What are the current practices?
- What adaptation practices should be considered?
- What practices would be most robust if the lower level of projected climate change happens? Why?
- What practices would be most robust if the higher level of projected climate change happens? Why?
- What practices would be most robust given the uncertainty about the level of climate change that might occur? Why?

APPENDIX 4: STRUCTURED DECISION-MAKING EXAMPLE

Worksheet 1 – Problem Definition, Management Objectives and Current Practice

Management unit name: **TFL 23**
Forest management activities: **Managing for Old Growth**
Ecological unit (if needed): **Whole area**

1. Problem Definition – *Why is this decision process needed?*

Suggested: To identify forest management practices that are robust across the potential future climate scenarios and decide how to implement these practices, including reducing any barriers.

2. Management Objectives - *What outcomes should this decision achieve?*
Select three objectives from the management unit description and define how you would measure whether each objective had been achieved

Objectives (at a minimum include ecological & economic; in some cases also include social)	**Performance measures, targets, thresholds**	**Forest management activities that influence achieving this objective**	**Climate factors that may impact achieving this objective**
A. Maintain timber supply – all government objectives are limited by the phrase, "without unduly reducing the supply of timber from BC's forests"; Employment: provide employment and economic opportunities for dependent communities *[impiies maintaining reasonable timber supply]*	AAC projections Timber Harvesting Landbase	Harvesting Regeneration Silvicultural treatments	Drought ---> increased fire Shifting ecosystem climate envelopes and natural disturbance regimes ---> increased fire/ insects/ disease
B. Maintain Old Growth Habitat - Wildlife /Fisheries: Maintain a diversity of forest habitats capable of supporting wildlife species; KBLUP Obj. 1 and 2: Biodiversity Emphasis Options and required retention of Old and Mature by LU and NDT/BEC units; GAR Order u-4-014: Caribou ungulate winter range reserves to recover caribou *[all require maintaining specified levels/ areas of Old Forest*]	Species population numbers Habitat inventories GIS summaries of existing OG by BEC and LU Caribou inventories	Harvesting Policy Constraints that place limits on OG retention levels Historical harvesting/ fires Establishment of recruitment areas Policy Constraints on managing all caribou habitat	Seasonal temp / precip changes ---> Shifting tree spp. climate envelopes Drought ---> increased fire Shifting ecosystem climate envelopes and natural disturbance regimes ---> increased fire/ insects/ disease Extremes – high and low snow depths that affect arboreal lichen availability
C. Minimize short-term costs – *[assumed to be an objective of all corporations]*	Costs - dollars		Drought ---> increased fire Shifting ecosystem climate envelopes and natural disturbance regimes

3. Current practices – *Describe the current practices for this ecosystem and forest management activity*

Establishment of OG and caribou management areas
Limited salvage harvesting
Wildfire protection – priority for initial attack?

Worksheet 2 – Climate Impacts and Adaptations

Objective *Maintain Old Growth Habitat*

Climate conditions	**Climate impacts** List Impacts that are occurring now, and that can be expected with each of the climate scenarios	**Current & Brainstormed adaptations** List actions that are being taken now, and brainstorm what could be done in the future to cope with the identified impacts	**Adaptation gaps & barriers** List gaps in adaptation capacity and barriers to implementing the brainstormed adaptations
Current climate	Deficits of OG in low emphasis Biod areas	Establishment of more reserves	Timber supply constraints
	Deficits in OG at lower elevations in some units, due to fire and past harvesting	Establishment of recruitment areas	Timber supply constraints
	Current loss of existing OG areas due to fires in severe drought years	Increase redundancy; increase fire protection effort	Timber supply constraints; funding and human resource constraints
Climate scenario 1	*Moderate change in disturbance regime at low elevations (increased drought -> increased fire and insects/disease)*	Increase redundancy; increase fire protection effort; relocation to more fire-resistant sites	Timber supply constraints; costs; public resistance
	Increased tree mortality associated with extreme events	Assess existing OGMAs and select new ones where necessary and feasible	Costs; harvest planning disruption
Climate scenario 2	Severe change in disturbance regime at low elevations (increased drought -> increased fire and insects/disease)	Increase redundancy; increase fire protection effort – including fire guards, management treatments for resiliency	Timber supply constraints; costs; public resistance
	Increased temperatures and snowfall at higher elevations -> tree species and ecosystem climate envelope shifts	Re-assess representation and possible redeployment	Policies; public resistance; cost; harvest planning disruption

Worksheet 3 – Adaptation Strategies

Action Screening/Ranking Table: 3 = high 2 = medium 1 = low

Potential Adaptation Action (from Worksheet 1)	**Rating Criteria**									**TOTAL RATING**
	Relative Effectiveness	**Robustness across Scenarios**	**Agreement with 'No Regrets'**	**Compatibility with other objectives**	**Flexibility**	**Technical Feasibility**	**Ease of Implementation**	**Cost Competi-tiveness**	**Mainstream Potential**	
Assess OGMAs	**1**	**1**	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**19**
Increasing redundancy	**3**	**2**	**3**	**1**	**3**	**3**	**1**	**2**	**1**	**18**
Establish recruitment areas	**1**	**1**	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**17**
Wildfire buffers (fire guards)	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**14**
Resilience treatments	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**18**
Re-assess representation	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**1**	**2**	**19**

Worksheet 3 – Adaptation Strategies

Adaptation Strategy Tables Strategy = combination of actions

Selected actions for each strategy

Strategy 1 – Current Practice

Policy and Landscape Level				
Action Category	Retention/Redundancy	Representativeness Assessment	Re-evaluate Disturbance Regimes	
Possible Actions	BioD Guidebook	BEC units	Maintain present requirements	
	Increase all areas to "High Biod"	Anticipate ecosystem shifts, reassess representation & reassign	Adjust percentage requirements as NDTs change	
	Increase KLBUP requirements in Low Biod by half	Change representation to enduring features		
	Increase all areas to "High Biod"			

Stand Level				
Action Category	Risk review of current OGMAs	OGMA management	Buffer management	Relocate OGMAs
Possible Actions	Don't do	No harvest	None	Maintain locations
	Do 50% sample	Treat if pests/disease threaten adjacent forests	Reduce wildfire risk to OGMAs to low	Relocate based on assessments and/or to reduce fire/ pest risk
	Do all	Use fuel treatments in OGMAs to reduce wildfire risk	Reduce pest risk to OGMAs to moderate	Relocate to accommodate climate envelope shifts
				Relocate based on enduring feature representation

Strategy 2 – Short-term risk reduction

Policy and Landscape Level				
Action Category	Retention/Redundancy	Representativeness Assessment	Re-evaluate Disturbance Regimes	
Possible Actions	BioD Guidebook	BEC units	Maintain present requirements	
	Increase KLBUF requirements in Low Biod by half	Anticipate ecosystem shifts, reassess representation & reassign	Adjust percentage requirements as NDTs change	
	Increase all areas to "High Biod"	Change representation to enduring features		

Stand Level				
Action Category	Risk review of current OGMAs	OGMA management	Buffer management	Relocate OGMAs
Possible Actions	Don't do	No harvest	None	Maintain locations
	Do 50% sample	Treat if pests/disease threaten adjacent forests	Reduce wildfire risk to OGMAs to low	Relocate based on assessments and/or to reduce fire/ pest risk
	Do all	Use fuel treatments in OGMAs to reduce wildfire risk	Reduce pest risk to OGMAs to moderate	Relocate to accommodate climate envelope shifts
				Relocate based on enduring feature representation

Strategy 3 – Maximum resilience to long- term high climate change impacts

Policy and Landscape Level				
Action Category	Retention/Redundancy	Representativeness Assessment	Re-evaluate Disturbance Regimes	
Possible Actions	BioD Guidebook	BEC units	Maintain present requirements	
	Increase KLBUP requirements in Low Biod by half	Anticipate ecosystem shifts, reassess representation & reassign	Adjust percentage requirements as NDTs change	
	Increase all areas to "High Biod"	Change representation to enduring features		

Stand Level				
Action Category	Risk review of current OGMAs	OGMA management	Buffer management	Relocate OGMAs
Possible Actions	Don't do	No harvest	None	Maintain locations
	Do 50% sample	Treat if pests/disease threaten adjacent forests	Reduce wildfire risk to OGMAs to low	Relocate based on assessments and/or to reduce fire/ pest risk
	Do all	Use fuel treatments in OGMAs to reduce wildfire risk	Reduce pest risk to OGMAs to moderate	Relocate to accommodate climate envelope shifts
				Relocate based on enduring feature representation

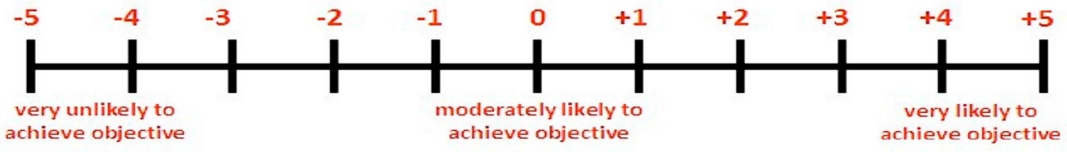
Strategy 4 – Attempted Optimization

Policy and Landscape Level				
Action Category	Retention/Redundancy	Representativeness Assessment	Re-evaluate Disturbance Regimes	
Possible Actions	BioD Guidebook	BEC units	Maintain present requirements	
	Increase KLBUP requirements in Low Biod by half	Anticipate ecosystem shifts, reassess representation & reassign	Adjust percentage requirements as NDTs change	
	Increase all areas to "High Biod"	Change representation to enduring features		

Stand Level				
Action Category	Risk review of current OGMAs	OGMA management	Buffer management	Relocate OGMAs
Possible Actions	Don't do	No harvest	None	Maintain locations
	Do 50% sample	Treat if pests/disease threaten adjacent forests	Reduce wildfire risk to OGMAs to low	Relocate based on assessments and/or to reduce fire/ pest risk
	Do all	Use fuel treatments in OGMAs to reduce wildfire risk	Reduce pest risk to OGMAs to moderate	Relocate to accommodate climate envelope shifts
				Relocate based on enduring feature representation

Worksheet 4 – Consequence Tables – Current Climate

Achievement ratings

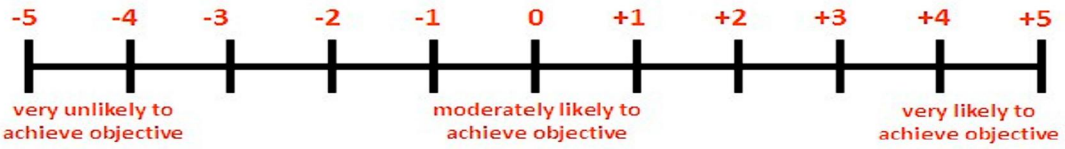


Objectives	Performance measures	Achievement Ratings			
		Strategy 1 (Current)	Strategy 2	Strategy 3	Strategy 4
A. Maintain timber supply – all government objectives are limited by the phrase, "without unduly reducing the supply of timber from BC's forests"; Employment: provide employment and economic opportunities for dependent communities *[implies maintaining reasonable timber supply]*	AAC projections Timber Harvesting Landbase	**+4**	**+3**	**+2**	
B. Maintain Old Growth Habitat - Wildlife /Fisheries: Maintain a diversity of forest habitats capable of supporting wildlife species; KBLUP Obj. 1 and 2: Biodiversity Emphasis Options and required retention of Old and Mature by LU and NDT/BEC units; GAR Order u-4-014: Caribou ungulate winter range reserves to recover caribou *[all require maintaining specified levels/ areas of Old Forest*]	Species population numbers Habitat inventories GIS summaries of existing OG by BEC and LU Caribou inventories	**+1**	**+3**	**+4**	
C. Minimize short-term costs – *[assumed to be an objective of all corporations]*	Costs - dollars	**+5**	**+4**	**+1**	
	STRATEGY TOTAL	**+10**	**+10**	**+7**	

Adaptation gaps/barriers:

Worksheet 4 – Consequence Tables – Climate Scenario 1

Achievement ratings

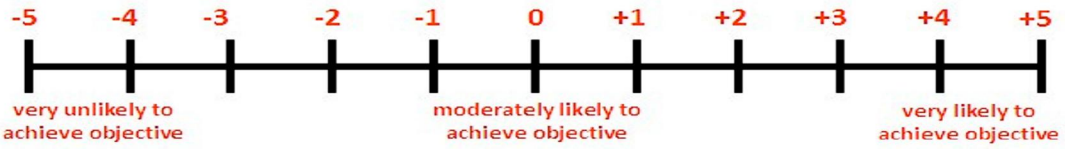


Objectives	Performance measures	Achievement Ratings			
		Strategy 1 (Current)	Strategy 2	Strategy 3	Strategy 4
A. Maintain timber supply – all government objectives are limited by the phrase, "without unduly reducing the supply of timber from BC's forests"; Employment: provide employment and economic opportunities for dependent communities *[implies maintaining reasonable timber supply]*	AAC projections Timber Harvesting Landbase	**+3**	**+2**	**+1**	
B. Maintain Old Growth Habitat - Wildlife /Fisheries: Maintain a diversity of forest habitats capable of supporting wildlife species; KBLUP Obj. 1 and 2: Biodiversity Emphasis Options and required retention of Old and Mature by LU and NDT/BEC units; GAR Order u-4-014: Caribou ungulate winter range reserves to recover caribou *[all require maintaining specified levels/ areas of Old Forest*]	Species population numbers Habitat inventories GIS summaries of existing OG by BEC and LU Caribou inventories	**-1**	**+1**	**+3**	
C. Minimize short-term costs – *[assumed to be an objective of all corporations]*	Costs - dollars	**+4**	**+3**	**+1**	
	STRATEGY TOTAL	***+6***	**+6**	**+5**	

Adaptation gaps/barriers:

Worksheet 4 – Consequence Tables – Climate Scenario 2

Achievement ratings



Objectives	Performance measures	Achievement Ratings			
		Strategy 1 (Current)	Strategy 2	Strategy 3	Strategy 4
A. Maintain timber supply – all government objectives are limited by the phrase, "without unduly reducing the supply of timber from BC's forests"; Employment: provide employment and economic opportunities for dependent communities *[implies maintaining reasonable timber supply]*	AAC projections Timber Harvesting Landbase	**+2**	**+2**	**+1**	
B. Maintain Old Growth Habitat - Wildlife /Fisheries: Maintain a diversity of forest habitats capable of supporting wildlife species; KBLUP Obj. 1 and 2: Biodiversity Emphasis Options and required retention of Old and Mature by LU and NDT/BEC units; GAR Order u-4-014: Caribou ungulate winter range reserves to recover caribou *[all require maintaining specified levels/ areas of Old Forest*]	Species population numbers Habitat inventories GIS summaries of existing OG by BEC and LU Caribou inventories	**-3**	**-1**	**+3**	
C. Minimize short-term costs – *[assumed to be an objective of all corporations]*	Costs - dollars	**+3**	**+3**	**0**	
	STRATEGY TOTAL	**+2**	**+4**	**+4**	

Adaptation gaps/barriers: Limits on timber impact; lack of information on alternative representation approach; lack of funding; lack of agency personnel;

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Worksheet 5 – Strategy Decision & Action Plan

DECISION:

Selected Strategy(ies)/Rationale: _____

Adaptation gaps: _____

Adaptation barriers: _____

ACTION PLAN:

4.1.1 Action	Adaptation Priority		Responsibility (Lead person and support)	How to overcome gaps/barriers	Resources ($, time, expertise)	Timeframe (when to start/no. years to finish)	Status (to be completed as action is implemented)
	Urgency	Potential Impact					
Assess present OGMAs for resiliency to fire/ insects/ etc.	Within 10 or 10+	H – loss of habitat	MoE/ MoF	Funding; methodology	??	Now – 5 years	
Increase redundancy	Within 10	H – loss of habitat	MoE/ MoF	Funding; relaxation of timber limitations	??	Now – 5 years	
Increase resiliency of OGMAs to fire	With in 10 or 10+	H – loss of habitat	MoF	Funding; inventory; relaxation of timber limitations; methodology	??	5 years	
Develop new version of BEC that has more focus on enduring features	10+	H – loss of habitat	MoE/ ENGOs	Funding for contract; convene conference of ecologists, conservation biologists and climate scientists	??	Now – 3 years	
Monitoring							

Urgency – When are impacts expected (now, within 10 years, 10 years+)

Potential impact – H = stops operations or high financial impact M = disrupts operations or moderate financial impact L= not H or M

APPENDIX 5: CLIMATE CHANGE OUTREACH

Date	Location	Organization	Main Audience	Topic
9/23/09	Osoyoos, BC	Conservation Northwest – Wildlinks Conference	Scientists and conservation activists from BC and WA	Climate change and habitat in the PNW/BC
9/15/10	Rossland, BC	CBT-CACC – Communities Adapting to Climate Change	Regional program participants	Our project approach and expected outcomes
10/26/10	Seattle, WA	Conservation Northwest – Wildlinks Conference	Scientists and conservation activists from BC and WA	Our project approach and expected outcomes
2/14/11	Vancouver, BC	UBC Forestry Climate Change Conference	Forestry professionals	Our project and early results
3/2/11	Edmonton, AB	CFS – Climate Change Vulnerability Practitioner's Workshop	Forestry professionals	Our project and approach
7/26/11	Nelson, BC	Kokanee Creek Provincial Park Nature Centre	General public (campers)	Climate change and local ecosystems
8/8/11	Skookumchuck, BC	Wildsight	Conservation activists and biologists	Climate change and conservation planning in the Kootenays
10/10/11	Johnson's Landing, BC	Johnson's Landing Community Association	General public	Climate change and local ecosystems
10/25/11	Vancouver, BC	Conservation Northwest – Wildlinks Conference	Scientists and conservation activists from BC and WA	Our project results in relation to conservation planning
2/8/12	Rossland, BC	Local Outdoor Club (w/ Craig DeLong)	General public – outdoor recreation	Climate change and local ecosystems
2/14/12	Cranbrook, BC	Wildsight	Conservation activists and biologists	Climate change and conservation planning in the Kootenays
3/12/12	Golden, BC	Wildsight	Conservation activists and biologists	Climate change and conservation planning in the Kootenays
5//1/12	Nelson, BC	Columbia Mountains Institute	Research scientists and resource professionals	Our project results
5/4/12	Nelson, BC	Assoc. of Professional Biology	R. P. Biologists	Our project results