West Kootenay Climate Vulnerability and Resilience Project

Report # 8:

Achieving Climate Change Adaptation in West Kootenay Forest Management – Barriers and Opportunities

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1.0 INTRODUCTION

Recent reports by the International Panel on Climate Change (IPCC) have confirmed that global climate change is underway, and likely to accelerate over the coming decades unless humans make drastic cuts to global greenhouse gas (GHG) emissions (IPCC 2007). Analysis of climate data collected over the last century has confirmed that parallel climatic changes are occurring in BC (Spittlehouse 2008), and in the Columbia Basin (Murdock and Werner 2011, Utzig 2012a). Depending on assumptions about future GHG emissions, results from downscaled global climate models (GCMs) illustrate a range of potential climate changes for BC over the next century. These include increases in annual temperatures and precipitation, decreases in summer precipitation in southern BC, changes in snowpack, increases in annual 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 adapting the forest and range management framework to address management issues arising from potential changes in climate. 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.

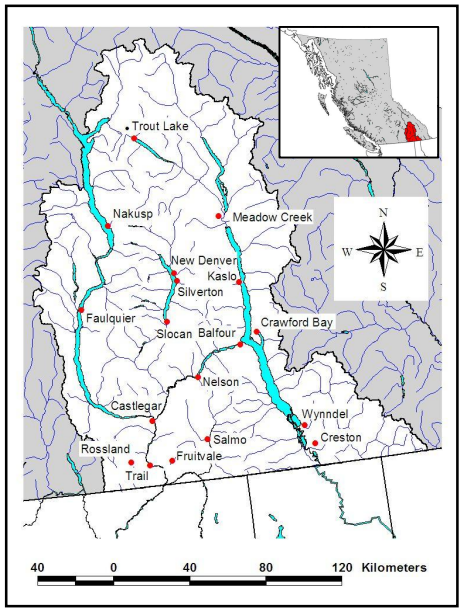

Figure 1. Study area.

This project recognizes the links in the West Kootenay forest management system through the impacts of decisions on forest ecosystems and through the provision of goods and services. Thus adaptation ideally must work towards a smooth transition for the ecosystems by adapting decision processes and social systems to respond to the predicted changes in goods and services provided by these ecosystems. It is vital to ensure the internal socio-ecological system links are mutually beneficial, or at least not degraded.

This project was primarily focused on ecological impacts of climate change, however as resources permitted it explored the human dimensions of adaptation – the legal, institutional, policy, professional practice and personal aspects of the forest management system in the West Kootenays. The concepts of socio-ecological drivers from the resilience literature, adaptive capacity from climate change adaptation vulnerability assessments and environmental psychology were explored as background for this aspect of the project. The fields of organizational behavior and corporate change were also identified as potentially offering insights, but it was not possible to include these in this project.

This paper describes the socio-economic system in the West Kootenays, describes broad concepts of adaptation, and summarizes findings from a literature scan for the Canadian and BC forest management systems. This is followed by a summary of the input from the West Kootenay practitioners regarding strengths and opportunities within the local forest system as well as the barriers and gaps from their perspective, and resulting

[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

recommendations. This preliminary research points to the need for a more significant focus on the human dimensions of adaptation to support timely, well thought out adaptations in the West Kootenay forest management system, and in BC generally.

2.0 WEST KOOTENAY FOREST MANAGEMENT SOCIO-ECONOMIC SYSTEM

Within BC the West Kootenays are unique both ecologically and in terms of the socio-economic system that has developed over time. The large river systems and diverse ecosystems in the area have supported distinct periods of economic and social development over the past century. Forests have played a prominent role, first as the backdrop for mining booms, then for timber processing, and now for a mixed economy of forestry and land-based tourism.

The social system selected for analysis in this project includes people actively engaged in forest and land management including forest licensees, private land managers, government employees, water managers, environmental non-governmental organizations, educators, forest professionals, fisheries and wildlife biologists and commercial recreation operators.

This section provides an overview of the social setting for the West Kootenay forest management system. It briefly describes the current socio-economic system including the human population and communities, organizations involved in forest management, development and the economy, and community values.

2.1 People

The West Kootenays are lightly populated with 56,500 people (BC Stats, 2012) living in nine incorporated communities ranging from 200 to 9,300 population. Nelson and Castlegar are the regional population centres where government offices and major suppliers are located. Citizens within the area value forests for the wide range of ecological goods and services they provide as well as the spectacular natural setting.

2.2 Organizations and roles

Many organizations have responsibilities and roles in the West Kootenay forest management system. Table 1 lists these organizations and briefly describes their influence on forest management in the area and the geographic scale of that influence. The large number and diversity of organizations with a role in forest management indicate the need for widespread education and awareness building, and joint planning to facilitate climate change adaptation.

2.2.1 Governments

The BC government has the central role in forest management as the level of government that is legally responsible for public lands. The BC ministry responsible for forest land management (currently Ministry of Forests, Lands and Natural Resource Operations) has historically been the most influential in the West Kootenays and BC. Typically considered the most powerful of the 'dirt ministries', this ministry has historically determined provincial level policies that control the rate and type of forest development and forest management practices. They also have had significant influence in relation to conservation strategies such as the location of protected areas and original implementation of 'soft' conservation tools such as old growth management areas. This ministry administers the *Forest and Range Practices Act* (FRPA)and associated regulations, policies, and other guidance that directs forest management in BC.

Table 1. Organizations involved in the socio-economic system in West Kootenay forest management

Organization	Influence	Scales
GOVERNMENTS		
Municipalities	Policy and implementation	Regional to stand
Regional Districts	Policy and implementation	Regional to stand
BC MFLNRO – local / regional offices	Implementation	Regional to stand
BC MFLNRO– Victoria	Policy	Regional to stand
BC MoE	Implementation of some elements of policy	Regional to stand
First Nations	Policy and implementation	Regional to stand
Federal – DFO	Implementation	Stand
Federal – Canadian forest service	Research	Provincial to stand
FOREST MANAGEMENT ORGANIZATIONS		
Large forest tenure holders	Policy to implementation	Policy / landscape / watershed / stand
Small forest tenure holders	Implementation?	Watershed / stand
Private land owners	Land purchase and management	Watershed
INTEREST GROUPS		
Professional associations	Policy and implementation	Provincial
Environmental groups – provincial	Policy	Provincial to stand
Environmental groups – local	Policy and implementation	Landscape/stand
User groups	Policy and implementation	Provincial to stand
INDIVIDUALS		
Natural resource professionals	Implementation	Landscape to stand
Community members	Implementation	Landscape to stand

In 2007 the provincial government initiated the Future Forests Initiative which is ”adapting British Columbia's forest and range management framework so that it continues to maintain and enhance the resilience and productivity of B.C.'s ecosystems as our climate changes”. This prompted the establishment of the Future Forests Ecosystem Science Council in 2008 to guide the allocation of a $5.5 million grant-in-aid to research that supports the objectives of the initiative. The government has also taken some specific policy and staffing actions including allocating a staff person to climate change activities, creating a Forest Stewardship Action Plan for Climate Change Adaptation, issuing a policy on assisted migration for larch, and the ongoing work on seed transfer zones.

The Ministry of Environment (MOE) is responsible for the management of several forest values including fish and wildlife, drinking water, and parks on provincial lands. MOE has had influence on forest management at the provincial scale, through certain aspects of policies (e.g. Forest Practices Code, ungulate winter range, mountain caribou recovery). Locally, MOE influence is through working relationships with the other ministries, though more recently the opportunity to engage in harvesting or planning issues has been significantly reduced.

For two decades beginning in the early 1990s, a series of provincial government agencies were established to lead regional land use planning across the province, resulting in the creation of the Kootenay-Boundary Land Use Plan (KBLUP) locally. Other provincial ministries are responsible for worker safety and other matters that affect forest management.

Incorporated municipalities have influence over provincial forests within their boundaries, but these areas are not extensive. Regional districts and municipalities participate in forest management through involvement in public participation processes, and through agency referrals. Domestic watersheds cover a significant portion of the study area (see Figure 2), and prompt substantial input from local governments and other water users about forest management. Following high impacts from wildfires in 2003, local governments in BC have become focused on community wildfire protection. The West Kootenays have aggressively engaged in this program, though actual area of land affected has been relatively small, and the current funding formula limits their future involvement. Most communities in the study area have been informed about climate change adaptation through events, publications and community planning through the Columbia Basin Trust's Communities Adapting to Climate Change Initiative[3].

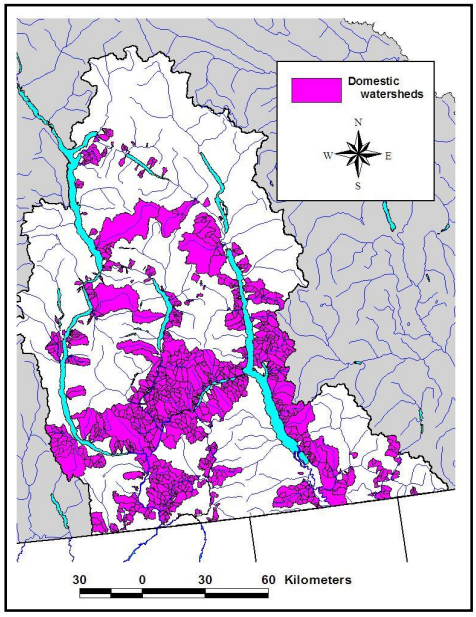

Figure 2. Domestic watersheds.

First Nations have increasing influence provincially on land rights, and land management issues. Within the West Kootenays, First Nations have land management influence at different levels, typically in fairly localized areas.

The federal government's role in land management in the West Kootenays is limited to impacts on water systems that affect fisheries. After a recent period of active involvement, this agency has recently reduced their role with loss of the local federal fisheries office.

2.2.2 Forest management organizations

A wide variety of organizations are responsible for forest management in the West Kootenays (see Figure 3). Tenure holders form an important part of this social system due to the large proportion of Crown land they manage. The Kootenay Lake and Arrow Timber Supply Areas (TSAs) are likely the most diverse in BC in terms of numbers and types of forest license holders, including two Tree Farm Licenses (TFLs), twelve volume-based Forest Licenses, extensive area of BC Timber Sales (BCTS) management, twenty-nine woodlots and five Community Forests.

The study area also includes large tracts of private land that are Managed Forests with requirements defined by provincial legislation. Recently one of these tracts was established as a conservation area.

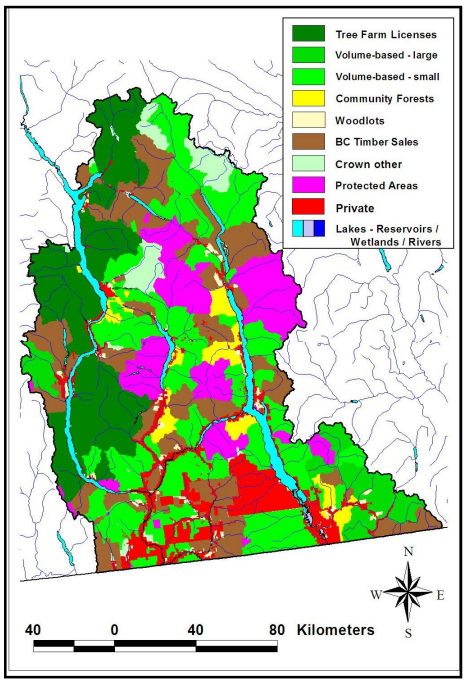

Figure 3. Forest tenures.

2.2.3 Interest groups

Historically, the West Kootenay has had very active environmental groups and groups representing users such as recreationists, commercial tourism businesses and watershed groups. Local 'grassroots' groups inputting into land use planning processes have

[3] See http://www.cbt.org/Initiatives/Climate_Change/?Adapting_to_Climate_Change and http://adaptationresourcekit.squarespace.com/

historically had influence on parks, management strategies for old growth, cutblock planning and harvest planning in key areas (e.g. domestic watersheds, caribou zones, high use recreation areas). It is unclear to what extent these groups remain active within the current forest management paradigm under the FRPA, and engagement appears to have been reduced in the last decade. Provincial level interest groups have also had significant influence in this region, particularly in relation to development of mountain caribou recovery plans.

2.3 Development and economy

The primary drivers of development and economy in the area are the basic human needs of local residents, and global and regional demands for products that can be extracted from the regional landscapes (e.g. minerals, hydro-electric power and timber), and more recently, outdoor based tourism. The range and intensity of development in the area is often determined at a provincial level through policies and land use decisions, but is often driven by market conditions at the national or even international scale.

In addition to the obvious forest products of timber and fibre, the forest ecosystems of the area are also important to other economic sectors in the region, including all-season commercial tourism, wildcrafting, hunting and backcountry guiding, and through their impact on the hydrologic cycle, water flows for electrical generation and agricultural irrigation. The forest ecosystems also provide numerous ecological services, including domestic and irrigation water supplies, erosion control, flood mitigation, recreation opportunities, as well as aesthetic and spiritual values.

The area includes one pulp mill and seven moderate-sized timber processing facilities. One of these mills has been idled for more than a year, and the others have experienced financial struggles, though they have continued to operate, illustrating their capacity to adapt. Wood is also trucked out of the area to two large processing facilities located to the east and west.

Compared to other areas in BC, the West Kootenays had a moderate to high economic diversity for the period between 2006 and 2011 (Horne, 2009) with a resulting low vulnerability to changes in the forest sector (relative to other parts of the province). This signals resilience to withstand changes in the forest sector.

3.0 METHODS

The initial project objective of exploring the relevance of resilience theory and climate change vulnerability assessments lead to a focus on 'adaptive capacity', which is a component of both approaches, as the focus for assessing strengths and barriers to adaptation. There was also a curiosity about the possible benefits in evaluating the application of psychology theory in this context. The team had hoped to explore the relevance of organizational change and business 'continuous improvement' practices to climate change adaptation in the West Kootenay forest management system, but resources did not permit this additional work. Gray et al. (2011 and 2012) provide views on the role of organizational change theories to climate change adaptation in Canadian natural resource management, indicating value in pursuing these practices further.

As a starting point for further adaptation work, this project provides an initial overview of the literature about resilience, climate change vulnerability, psychology and adaptive capacity of forest management systems. Fortunately a number of recent documents compile much of this literature, making it easily accessible to this project and others (Isaac and Wlliamson, 2012; Swim et. al., 2011; Johnston et. al., 2011; Perez, 2012).

In addition, the project probed strengths and opportunities as well as challenges and barriers for adaptation three times during the process: in a web-based survey at the beginning of the project, as an exploration of the drivers of forest management in the area during the first workshop with practitioners and in a survey of adaptive capacity in the final workshop with practitioners. These assessments were designed based on the literature to meet the needs

of the project participants. The results from these assessments were compiled and form the basis for the findings about the West Kootenay forest management system. General feedback during the workshops also informed this report, as well as a recent public opinion survey distributed in the project area (Harshaw 2012).

This report provides only a preliminary exploration of adaptation strengths and barriers for climate change adaptation in the West Kootenay forest management system. However, this initial work highlights the relevance of some broadly recognized strengths and barriers.

4.0 CONCEPTS

This section briefly describes how strengths and barriers to climate change adaptation within the social components of socio-ecological systems are evaluated through 'adaptive capacity' in resilience and climate change vulnerability assessments, and through 'drivers' in resilience assessments. It also introduces recent perspectives about the psychological barriers to climate change adaptation and mitigation. In all three cases the conceptual theories are relatively new and require further development.

4.1 Resilience theory

The Resilience Alliance is "a multi-disciplinary group that explores the dynamics of complex systems" and have developed theories of resilience in socio-ecological systems, undertaken case studies applying this approach and compiled a series of workbooks that outline an approach to assessing resilience. Their approach has a number of defining characteristics, including the need to assess the social-ecological system as a unit (rather than separating out the different elements and recombining them later). The hypothesis about systems focuses on loops of change through time when systems become more or less open to changing their fundamental structure, the importance of cross-scale interactions, and the importance of different drivers acting at different scales. In this context, "resilience" as applied to integrated systems of people and the natural environment, has three defining characteristics:

- the amount of change the system can undergo and still retain the same controls on function and structure,
- the degree to which the system is capable of self-organization, and
- the ability to build and increase the capacity for learning and adaptation.

The adaptive capacity of a social- ecological system is a key concept of this approach and is described as follows:

> *In social systems, the existence of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving and balance power among interest groups play an important role in adaptive capacity in this concept (Scheffer et al. 2000, Berkes et al. 2002). Systems with high adaptive capacity are able to re-configure themselves without significant declines in crucial functions in relation to … social relations and economic prosperity. A consequence of a loss of resilience, and therefore of adaptive capacity, is loss of opportunity, constrained options during periods of re-organization and renewal, an inability of the system to do different things. And the effect of this is for the social-ecological system to emerge from such a period along an undesirable trajectory*[4].

Folke et al. (2002) identify and expand on four critical factors of social-ecological systems that seem to be required for dealing with natural resource dynamics during periods of change and reorganization:

[4] http://www.resalliance.org/index.php/adaptive_capacity

- learning to live with change and uncertainty;
- nurturing diversity for resilience;
- combining different types of knowledge for learning; and
- creating opportunity for self-organization towards social-ecological sustainability.

Resilience assessments (Resilience Alliance, 2010) focus on the governance aspects of systems, emphasizing the importance of decision-making roles, compliance/enforcement, stakeholder power relations, and social networks. Advocates for this concept see the social aspects of change - how people respond to periods of change, how society reorganizes following change - as the most neglected and the least understood aspect in conventional resource management and science (Gunderson and Holling 2002).

One aspect of the resilience concept is a broad overview of system change through time, which can reveal patterns of past disturbances and responses as well as the impacts of cumulative or gradually changing variables. Understanding what is behind these changes—the change drivers—can provide insight into how historical system dynamics have shaped the current focal system and what effects they might have in the future. Change drivers were explored in this project to signal factors that might influence climate change adaptation. Initially the project team planned to model this project following the Resilience Alliance workbooks, then decided to shift emphasis to a vulnerability framework (see Reports #1 and #2, Holt et al. 2012), while still retaining some of the key concepts from resilience theory.

4.2 Climate change vulnerability assessments[5]

In climate change adaptation vulnerability assessments, adaptive capacity is defined as: the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC 2007). A system with high adaptive capacity (e.g. access to information, strong network, substantial financial resources, etc.) is seen as having the ability to identify adaptation requirements and implement adaptation actions to reduce vulnerability to climate change, and to non-climate stressors, and to take action on opportunities. This definition is very similar to the resilience concept, however the adaptive capacity factors are more extensive. In the vulnerability approach, projected impacts and adaptive capacity are compared to assess vulnerability (see Report #2 for more details, Holt et al. 2012).

Isaac and Williamson (2012) have completed an extensive literature review of the adaptive capacity concept, and developed guidelines for adaptive capacity assessments of forest management systems. They observe that there currently is no cohesive theory of adaptive capacity – instead there are a variety of views about what it is and how it should be addressed. As well, while some of the identified aspects of adaptive capacity can be measured and counted (e.g. education levels, number of staff), many aspects are qualities or characteristics that can't be easily measured (e.g. ability to manage risk). This makes it difficult to assess adaptive capacity in forest management systems. These authors recommend an assessment structure that includes examining:

1. What is it? — Description of the system's current adaptive capacity

The six dimensions of adaptive capacity that have been identified in the literature are:

- determinants or assets, e.g. knowledge, technology, culture, economic and financial resources, infrastructure, natural capital, social capital, political capital, and institutional capital,
- indicators and mapping,

[5] Note that in this project the vulnerability of the ecosystem component of the socio-ecological system was assessed. This section discusses assessing the adaptive capacity of the social component of this system.

- properties and qualities of determinants, e.g. are assets flexible?
- mobilization processes, e.g. can assets be accessed if needed as climate changes?
- case histories and proxy measures – e.g. how did the system cope with a recent change or event?
- distribution of adaptive capacity, e.g. does everyone in the system have similar capacities?

2. Is it OK? – Analyze or interpret whether the system has the adaptive capacity it may need as the climate changes

   It is difficult to predict the requirements for adaptive capacity in the future, as the climate changes. However, understanding what is needed today to cope with and recover from the impact of current climate, and other stressors, can help to think about how requirements may change in the future. From this analysis, gaps between optimal adaptive capacity or the capacity needed to adapt and the actual ability to adapt can be identified. Such a gap is termed an adaptive capacity *deficit* (Williamson and Johnston, 2010). If there is a deficit, the analysis should identify its cause and show how the deficit limits the ability to adapt.

3. What to do? - identify options to strengthen adaptive capacity based on identified gaps/deficits

   Options can include providing additional resources or by reorganizing the use of existing resources (e.g. funding for research or creating collaborative planning across government and business). "Mainstreaming adaptation" — integrating climate change into policy development and day-to-day decisions, is identified as one of the most powerful ways to improve the adaptive capacity of an organization or agency as climate changes.

Within climate change vulnerability assessments, adaptive capacity is evaluated before adaptation options are identified and for the entire system, not the specific aspects of the system that will need to adapt to implement options. This results in broad statements of capacity (e.g. limited awareness, knowledge, etc.) that are not necessarily linked to the actual adaptation options. In their Engineering Protocol for Climate Change Infrastructure Vulnerability Assessment, the Canadian Council of Professional Engineers (2009) has placed the assessment of capacity after brainstorming options, prompting a more focused assessment of adaptive capacity based on specific actions.

The relevance of "adaptive capacity" in the day to day operations of a Canadian SFM system is increasing in part because the management environments are becoming more complex, uncertainty is increasing, and the pace of changes affecting forest management seems to be rising. The combined effect is increasing recognition of the need for being adaptive and increasing recognition of the need for understanding and possibly developing the system's inherent capacity to adapt (Isaac and Williamson, 2012).

4.3 Psychology

Although adaptation to climate change is fundamentally driven by human psychology and behaviour, these aspects of adaptation have only very recently begun to be explored. A recent Task Force Report of the American Psychological Association (Swim 2011) and a dedicated volume of their journal[6] clearly articulates the psychological challenges posed by climate change, provides a model for psychological processes that influence adaptation to and coping with climate change (Reser and Swim 2011), and identifies barriers to adaptation (Gifford 2011). This information can be helpful, if not essential to understanding the adaptive capacity of individuals and organizations, and to identifying and designing effective adaptations.

[6] http://psycnet.apa.org/journals/amp/66/4/

The model identifies the importance of individual and social psychological adaptation processes (e.g. cognitive risk assessments, coping appraisals, motivations) that powerfully mediate public risk perceptions and understandings, effective coping responses, and overt behavior adjustment. The authors observe that these and other psychological perspectives on climate change adaptation have been neglected in the arena of climate change science.

Gifford identifies a host of psychological barriers that limit climate change adaptation potential – 'Dragons of Inaction' -which he categorizes into the seven categories (See Appendix 1 for more details): 1) limited cognition about the problem, 2) ideological worldviews that tend to preclude pro-environmental attitudes, 3) behavior comparisons with key others; 4) sunk costs and habits; 5) discredence towards experts and authorities; 6) perceived risks of change; and 7) positive but inadequate behavior. He concludes that while structural barriers to adaptation (e.g. legislation, policy, funding, etc.) must be overcome, this is 'unlikely to be sufficient' to prompt widespread adaptation. Psychology is clearly an aspect of adaptation that requires more attention.

5.0 FINDINGS FOR CANADIAN FOREST MANAGEMENT SYSTEMS

5.1 National assessments

Since 2008 three assessments of the adaptive capacity of the Canadian forest sector to climate change have been completed (Lempriere et. al., 2008, Williamson et. al., 2009 and Johnston et. al., 2010). These have been conceived through the lens of climate change vulnerability and have utilized assets or determinants as the measures of adaptive capacity. The most recent and extensive by Johnston et. al. (2010) is based on insights from extensive discussion and interviews with Canadian forest managers and other practitioners, and a literature review. Their key findings, structured on the IPCC determinants of climate change adaptive capacity, were:

- **Awareness of the issue and perception of urgency** - Awareness of climate change as an important issue for forest management is increasing in Canada, although site specific impacts and adaptation options are not yet well understood.
- **Range of technological options available to decision makers** - Availability of technological options for adaptation is variable; cost is often a limiting factor.
- **Limited economic resources** - Investment in innovation in the Canadian forest sector is generally low, limiting the ability to develop innovative solutions to climate change impacts. In addition, resources are often lacking to support vulnerability assessments and adaptation planning.
- **Institutional barriers** (e.g. design and structure, flexibility, ability to efficiently allocate resources to adaptation, degree of autonomy in making adaptation choices) - Institutional barriers are an important limitation to implementing adaptation options. Analyses of current policy could help identify features likely to hinder adaptation. Canadian forest management has a number of institutions that increase adaptive capacity, e.g. FPAC, the model forest network, forest certification programs, the national forest strategy, professional associations, and others.
- **Mixed human and social capital of adaptors** (e.g. skills, education, experience, networks) - While adaptive capacity of the forestry profession is generally high, a lack of scientific capacity is an important constraint to planning for climate change. In some locations the lack of human capacity was seen as a constraint.
- **Gaps in knowledge and access to information** - Research capacity related to forest management is high in Canada but to date has not addressed climate change in a comprehensive manner. There is a lack of scientific capacity relative to understanding and dealing with climate change in the Canadian forest sector, and also a lack of information at spatial and temporal scales relevant to forest management

planning and decision-making. New modeling tools will assist in better understanding the impacts of climate change and the role of potential management interventions in adaptation activities.

- **Ability to manage risk is a challenge** - Forest companies, like any other, engage in risk management as a part of normal business practice. However, some aspects of forest management, such as long term commitments made during reforestation about what tree species to favour, make risk management in a changing climate more difficult.

Lemmen et. al. (2008) examined current adaptive capacity and identified challenges for resource dependent communities, finding these communities have constraints on their ability to adapt including limited economic resources, less diversified economies, they are isolated from services, and they have less access to education. They also found strengths in these communities, including strong social networks, attachment to community, high levels of local and traditional knowledge and high rates of volunteerism.

Williamson et. al (2009) stress the need to enhance the general capacity of forest managers and forest management to adapt, not only with respect to climate change, but also to position the forest sector to address the array of global, political and economic changes that it faces. They identify the following specific adaptive capacity needs:

- increased awareness and access to information;
- reliable prediction models and methods for forest management decision-making in the context of uncertainty; and
- reducing or removing institutional and policy barriers that are based on historical, relatively constant climate.

Regardless, they suggest that there is currently enough information and adequate capacity to undertake adaptation in many areas.

5.2 BC assessments

5.2.1 Kamloops TSA Future Forests Strategy

The Kamloops Future Forest Strategy emphasized 'management' adaptive capacity in a vulnerability assessment for a 2.7 million hectare forest area in central BC (Kamloops Future Forest Strategy Team, 2009). Management adaptive capacity was defined as including:

> *… current legislation, policies, administrative structures, and other factors that shape the way forest management functions in the area, including its influence on the management actions that managers will be willing and/or able to implement.*

Following the identification of possible management actions to reduce the sensitivity of ecosystem groups, management adaptive capacity was considered by evaluating barriers to implementation. The five broad themes or general barriers that emerged were:

- the lack of a comprehensive strategic planning process;
- more costly reforestation;
- more costly or break-even harvesting;
- the need for on-going stand management beyond free growing through the rotation; and
- a requirement for government to take on increased management risk.

5.2.2 BC Forest management adaptive capacity inquiry

Perez (2012) explored barriers to adapting BC reforestation practices in light of a changing climate through literature reviews and two surveys, each completed by 50-60 BC forest practitioners. He notes that the adaptive capacity of the forest management framework in BC has only recently begun to be explored. The following findings are relevant to the West Kootenay system:

- **High awareness and urgency** – Both licensees and government employees who prepare and approve reforestation plans in BC feel that climate change is occurring and that humans have a responsibility to ensure forests are resilient to cope with those impacts. A large majority from both groups also think that managers need to account for climate change in their planning over the next planning cycle.
- **Lack of assessments** – There is a critical need for adaptation-policy assessments that can bridge the gap between research on impacts, vulnerability, and adaptive actions and the operationalization of actions in the BC forestry sector.
- **Adequacy of available climate projections** – There are 'mixed' feelings about whether the currently available projections of climate change are sufficiently reliable to support the implementation of reforestation strategies that are different to those currently recommended in government documents. The survey didn't explore whether respondents were familiar with the regionally based projections available for BC.
- **Free growing criteria are an opportunity** – All respondent groups overwhelmingly agreed that meeting free growing obligations is the main consideration for licensees developing stocking standards, including species suitability. Adjusting these criteria thus presents an opportunity for climate change adaptation. The existing criteria for the approval of stocking standards is supposed to represent a balance of several important factors including forest health, ecological suitability, consistency with projections of the timber supply, and the provision of a supply of economically valuable timber. However, FRPA objectives limit decisions to those that do not affect the timber supply. Understandably, both licensees and government employees that approve reforestation plans felt that the approval of stocking standards is primarily based on the ability to sustain merchantable timber volumes over time. Other research has concluded that these criteria seem to promote the use of fast growing conifer species in many places and are actually reducing stand diversity, which is the opposite of what climate change demands. As well, participants of this study were unsure whether current government guidelines for stocking standards are adequately promoting ecosystem resilience. As the author states:

    > *Broadening these criteria to ensure stands are not only reforested promptly but also facilitate reforestation strategies toward a number of objectives will help ensure stands grow into resilient, healthy and vigorous forests over the long term. These criteria should be science-based and may for example include structural and compositional diversity.*

- **Need new tests for species suitability – T**he ecological suitability test within the free growing criteria is based on a menu of *currently* preferred and acceptable species for biogeoclimatic (BEC) units in BC. However, suitable habitats for tree species are shifting with changing climate (see Report #5, Utzig 2012b), with a low level of confidence about future conditions in some ecosystems. This makes it essential to update what is considered ecologically suitable in light of a changing climate and the importance of species diversity to counter the uncertainty about future conditions on some sites. The new science-based policy for the assisted migration of western larch demonstrates an approach to meet this need.
- **Barriers to novel stocking standard approval** – Stocking standards are set in Forest Stewardship Plans (FSP) for forest management units (e.g. Tree Farm Licenses, forest licenses, BC Timber Sales operating areas, etc.) in BC. Under the professional reliance framework in the BC *Forest and Range Practices Act* (FRPA), the registered forest professional who signs each FSP is responsible for the content, including stocking standards, and these plans are to be approved by government designated decision-makers, who are often registered forest professionals, if they meet the requirements of the Act. Signing professionals must provide a written rationale when standards other than the existing government guidance (e.g. the

preferred and acceptable species menu) are included in a plan. There is a difference of opinion about whether the government is willing to authorize new stocking standards even with a suitable rationale - most volume-based licensees disagreed with this statement and all government personnel agreed with it. According to those licensees that participated in this study, understanding of local conditions is not adequately accounted for in the approval process.

The project team is aware that the perception amongst licensees is that 'professional rationales' will not be supported by government, and that this dampens attempts to innovate with new stocking standards, including suitable species. The team is also mindful that the Association of BC Forest Professionals, the institution that regulates the practice of forestry in BC, has not provided professionals with any training or guidance about how to incorporate climate change in these types of professional responsibilities.

- **Perception of risks involved in changing reforestation practices** – Both licensees and the government felt that they would each carry most of the risks associated with implementing novel stocking standards or new species provenances and genotypes. Submitting a novel standard and rationale creates risks to licensees of delays in plan implementation, or even rejection of plans. Once a FSP is approved, the government becomes accountable if the plan is implemented as stipulated - by approving a plan, the government assumes responsibility and risks associated with it. These risks included factors such as ecological fall out, plantation failure, not meeting free-growing criteria, and reductions in merchantable timber volumes. This author recommends the process be improved so that risks are more evenly distributed between the licensee developing and implementing FSPs and government personnel and the institution that approve them.
- **Costs –** The additional time and money to both licensees and the government to design and implement adaptations and to respond to failures pose very important impediments. The most important barriers to licensees are the costs associated with having to replant if free growing requirements are not met, when all respondent groups overwhelmingly agreed that meeting free growing obligations is the main consideration for licensees developing stocking standards, including selection of suitable species. The survey did not explore views about the potential for reforestation failures without adaptations or the relative costs of these failures compared to adaptations.
- **Appraisal tenure obligation adjustment disincentive -** These are cost allowances provided to licensees for meeting their tenure obligations, such as replanting harvested stands. As they are broadly defined they do not capture site-specific challenges or additional costs, and there is no process for revisions to account for changes in practices such as climate change adaptation. This provides very little incentive for a tenure holder to spend money on anything other than on what is necessary to meet tenure obligations. A majority of respondents from both government and licensee (area and volume-based) agreed that the way these cost assumptions are currently set up promotes choices that are based solely on cost. According to licensees, changing the way tenure obligation adjustments are calculated has the greatest potential for encouraging innovative climate-wise reforestation. The author notes that these changes would have to account for the terms of the existing softwood lumber agreement between the United States and Canada.
- **No measurable landscape level management objectives** – Land and Resource Management Plans (LRMPs), Sustainable Forest Management Plans for certification, and other regional plans (e.g. Sustainable Resource Management Plans) have been developed for most areas of the province – before climate change was recognized as a factor that needs to be accounted for in land-based decisions. These plans often do not include landscape level targets, and achievement of LRMP objectives is not currently monitored. Without higher level targets, it is difficult to assess the impacts of FSPs, making rationales for novel stocking standards, suitable species or free growing criteria difficult to craft.
- **Potential tenure-based incentives** – In the survey, area-based licensees put greater weight on the probability that incorporating climate change risk into timber supply analyses will encourage climate change considerations by licensees. Most volume-based licensee respondents felt that government taking on more of the risk associated with novel management strategies would encourage climate change

adaptation on the part of licensees. This reflects the difference in these tenures, where timber supply impacts of management activities are realized directly by area-based licensees (e.g. Tree Farm Licenses, community forests, woodlots, etc.), but not by volume-based licensees. The project team notes that perhaps a more critical issue is the current spotty acknowledgement of the risks associated with current management practices in the face of climate change, and the slow pace of adaptation.

- **Lack of data available about the condition of forest stands post free growing** - There was a general neutrality and lack of agreement among licensees and government employees about whether or not current reforestation practices adequately promote ecosystem resilience, an indication of a lack of data available about the condition of forest stands post free growing. Both government and licensee respondents overwhelmingly felt that current post-free growing monitoring efforts are inadequate. The project team noted a much lower knowledge and understanding of these forests amongst the West Kootenay practitioners, and recognition of the lack of data about these forests and monitoring of their condition. Implementing novel management strategies to enhance forest resilience and reduce climate vulnerability will require regular data collection from sample plots across the province, as the background climate will change differentially in places and management will vary locally. According to study participants, paying for and implementing monitoring after reaching 'free to grow' should be the responsibility of the provincial government.

5.2.3 Adaptive capacity of BC community forest organizations

Furness (2012) describes the adaptive capacity to climate change of the 38 community forest organizations (CFOs) in BC based largely on interviews with representatives of these tenure holders. The author identifies the following factors as important in the potential role of CFOs as governance mechanisms for promoting local adaptation to climate change in BC:

- **Mixed awareness, concern, and urgency** - Two thirds of the CFOs were concerned about climate change. The author suggests that barriers for the remaining CFOs may be a lack of access to recent scientific education or poor understanding of the complexities and probabilities of climate change. She also identifies the perspective in the populist view that climate change is often regarded as something that you're 'for' or 'against', rather than a risk that requires pragmatic risk reduction adaptations, like any other risk, as a barrier.
- **Knowledge gaps** – Although the self-reported level of access to human capital is high (79-97% reporting access to skills, knowledge/information and experience), only 66% had access to training and education. Representatives from organizations with greater adaptive capacity had often attended workshops and seminars on climate change provided by government bodies, universities or other research initiatives as well as working alongside external organizations to improve their adaptive capacity. Of greatest concern is that knowledge about climate change adaptation is not high - only 40% of CFOs had an understanding of the likely impacts of climate change on their forest, 37% understood risk reduction and 63% reported not knowing what to do to adapt to climate change.
- **Limited money, time and equipment** - Access to external funding and the ability to generate a revenue surplus to reinvest into the organization were more common in organizations which were adapting to climate change, signaling that availability of financial capital could be barrier for adaptation. Less than half of the CFOs surveyed (18 of 38) usually had enough surplus to invest in their organization, and 23 of the 38 could find external sources of capital such as grants or loans if they needed to. A lack of GIS and monitoring equipment were also identified barriers.
- **Valuing the long-term, but not future plans** – The level of concern for climate change was interpreted by the author to mean that at least two thirds of the CFOs aim to manage their forest for the long term, a value that is seen to be a strength in climate adaptation. In contrast, 53% made staff time available to develop future plans which the author observes is low, given the industry they are working in, where planted trees can often expect to be harvested at least 50 years later.

- **Small geographic focus** – The relatively small geographic size of CFOs means that their decisions have comparatively little impact on the landscape, so whether or not they begin to try to adapt to climate change is perceive to have little real implication for forests as a whole, which creates a barrier. As well, the tendency to focus on local rather than regional concerns can create tension that could hamper climate change adaptation.
- **Democracy, governance and involvement expertise** - The expertise that CFOs have built up to manage community consultation and maximize trust indicate an unusual level of expertise which could certainly be a strength in local adaptation.

5.2.4 South Selkirks project survey

The results from the quantitative public opinion survey on attitudes towards climate change in the South Selkirks (Harshaw, 2012), in the southern portion of the project area, shed some light on potential strengths and barriers to climate change adaptation in the West Kootenays. The survey was administered between July and September 2011. A total of 520 people responded to the survey, representing a range of ages, educational backgrounds, occupations, and household income levels. Results were analyzed for three groups: 401 non-Aboriginal participants, 59 Aboriginal participants, and 60 community and landscape planners and managers (practitioners identified through this project). Generally, respondents were longstanding residents of their communities.

The survey responses show several adaptive capacity strengths: high levels of awareness and concern about climate change, a sense of urgency to start acting now with what we know, and an acceptance of changes in forest management practices to adapt to climate change.

Dissemination of information (and knowledge) about climate change to local citizens is a potential challenge. Several traditional sources of information: politicians, government, religious/spiritual and local leaders, as well as local media (and to a lesser extent, the national media), are not seen to be as trustworthy in delivering climate change information as scientists, experts, the Internet, and friends.

6.0 PROJECT RESULTS FROM FOREST PRACTITIONERS

In forest management in the West Kootenays, barriers, incentives and opportunities for adaptation will likely be somewhat different for each forest manager making decisions in their unique combination of ecosystems, tenure, organization and individual characteristics.

6.1 Survey

A web-based survey was distributed in October 2010 to 180 individuals in October including forest practitioners and managers, local government representatives including elected officials and employees and others. There were 100 responses to the survey. Responses to questions that relate to adaptive capacity are summarized in Table 2.

Table 2. Survey responses related to adaptive capacity

Survey question	Response
Awareness, concern and urgency	
Have you noticed ecosystem changes in the West Kootenays that you attribute to climate change?	50% Yes/30% Not sure or maybe - Insects, disease, fires, flooding, other water related and species shifts identified
Have you noticed any social or economic changes that relate to land management that you attribute to climate change?	46% No
Among all the issues facing the world, how do you rate climate change as an issue?	87% Important to very important/ 37% very important
Are you concerned about climate change relating to your work?	87% mildly to very concerned /27% very concerned
Do you consider climate change or its impacts relevant to land or forest management decisions?	85% Yes – relevant to state/condition of ecosystems, wildlife, water, community stability and general economy identified by >50% of responses
Over which time periods do you think climate change will have the largest impact on forests or forestry in the West Kootenay?	89% next 20 years/ 82% 20-50 years
Over which time periods do you think climate change will have the largest impact on communities in the West Kootenay?	80% next 20 and 20 to 50 years
Knowledge	
How would you rate your level of knowledge of climate change?	4.1 on 6 point scale by forestry practitioners, where 6 indicated "very knowledgeable"
Capacity to adapt	
Have you personally included climate change or its impacts into current management decisions?	44% yes/ 20% no, with reasons including too much uncertainty about impacts and what to do, and lack of direction
How would you rate the capacity of the provincial forest management system to adapt to climate change? What may limit adaptive capacity at the provincial level?	2.4 on 6 point scale by forest practitioners, where 6 indicated "significant capacity" with limits due to government policy/regulations, politics, economics, corporate policy or practice and inertia identified by 60% or more respondents; knowledge was identified as a limit by 51% of practitioners
How would you rate your capacity to adapt to climate change? What may limit your adaptive capacity?	3.3 on 6 point scale by forest practitioners, where 6 indicated "significant capacity" with limits due to economics (77%), government policy/regulations (65%) and knowledge (65%)
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?	65% yes – most frequent suggestions: research and information distribution; ecosystem based management with expanded protected areas and connectivity reserves and enhanced biodiversity and riparian management practices; changes in reforestation regulations and policies; wildfire management and interface fuel reduction; and increased flexibility
Are there any decisions that you (or your organization) could take today that could assist in adapting to the effects of clime change on your tenure?	74% yes – most frequent suggestions: reforestation with species that are likely to be suitable over the long-term, enhanced wildfire management, increase forest diversity to strengthen resilience and monitor forest health to facilitate prompt action

6.2 Social drivers

At the first Managers Workshop (12/1/2010), participants individually, and as subregional groups rated the a list of drivers identified by participants an earlier Technical Workshop (11/9/2010) with regard to their overall significance by subregion. Participants were asked to first individually identify the ten most significant and ten least significant from each of the lists of ecological and social drivers. Participants were also encouraged to add drivers that they felt were missing form the existing lists. Twenty-eight forest practitioners participated in this workshop. Table 3 summarizes the responses.

Table 3. Social drivers identified by workshop participants

Social Drivers	Top drivers for individuals	Top drivers for regional groups		
		North	Mid	South
Land and water management				
Building dams	4	x		x
European settlement/urbanization into interface	5			x
Roads / utility corridors	10	x		
Water users (including IPPs)	11			x
Public land ownership			x	
Historic railroad + mining		x		
Protected area establishment		x		
Pressure for expanding development		x		
Forest management policies/practices				
Timber supply management – AAC	1		x	
Fire suppression	2		x	x
Reforestation policies	6			
Lack of forward-looking planning and operations	7		x	
Old growth liquidation	8	x		
Forest tenure ownership	9			x
Riparian management		x		
Stumpage/ revenue pressures (links to markets)			x	
Business factors				
Global timber markets	3	x		x
Externalities (incl. Free trade agreement)				x
Individuals				
Individual personalities				x

6.3 Adaptive capacity self-assessment

During the final workshop participants identified the 10 'top of mind' opportunities and challenges for adapting to climate change in their operations. They were also asked to assess the possible strengths, gaps and barriers of their organization against a list of characteristics compiled by the team based on adaptive capacity and behavior psychology research. Ten participants completed this assessment. Participants found the concept of gaps and barriers difficult to assess, resulting in inconsistent classification, so these have been combined. A summary of the strengths/opportunities and challenges/gaps/barriers follows.

6.3.1 Strengths and opportunities

Four characteristics of the system were identified as strengths and opportunities by most of the participants:

- **Local forest conditions** – The range of elevation and aspects in the local landscape, the diversity of species and forest types, the large protected areas and predominantly public land ownership were most often identified as top of mind opportunities.
- **Organizations** – All representatives of the tenure holders described their organizations with characteristics that create top of mind opportunities – for community forests these include willingness to innovate, broad objectives beyond financial and long tem planning; for the forest licensees a desire to identify competitive advantages and to be at the forefront were noted.
- **Personnel** – Forest sector staff who are educated, experienced, capable and now informed are top of mind opportunities. Other favourable characteristics were a willingness to learn, being used to change and now daily experiencing climate change effects. Having informed, skilled and trained personnel available was also identified as a consistent strength in the detailed survey.
- **Scientific, local and traditional knowledge available** – The local information made available through this project was identified most often as a strength in the detailed survey and this project and the workshops, which were noted as 'creating dialogue', were also listed as top of mind opportunities. Some survey respondents added a caveat that the abundance of information was overwhelming at times.

Additional top of mind opportunities identified by some of the participants:

- **Public** support and pressure for addressing climate change impacts.
- **Forest management** approaches, including stewardship ethics and certification, as well as potential benefits from climate change such as increased forest productivity, value of forest products, agriculture grazing and opportunities for carbon management.
- **Local forest sector** capacity to specialize its sawmills to mill a range of products, and the absence of a single large employer.

In the detailed assessment, perception of climate change as a risk, and capacity of facilities to withstand floods, landslides or wildfires were most often identified as strengths.

6.3.2 Challenges or gaps/barriers

Participants identified a long list of challenges, gaps and barriers:

- **Limited funds** was most often identified as a top of mind challenge, by a wide margin above others, and as a barrier/gap in all responses in the detailed survey, with **operational constraints** related to the restricted financial conditions of the sector such as downsizing and time constraints for remaining personnel also listed.

- **Government regulations** was most often identified as a challenge and all regulation/policy choices, including incentives, were identified as gaps in the detailed survey.
- **Political factors** such as priorities and relative 'urban/rural' power were identified as challenges, and ability to influence appropriate political levels was a gap for all but one government agency representative.
- **Lack of education/training/information and clarity about how to adapt** was identified as a top of mind challenge and **low awareness/understanding of adaptation options** was a consistent gap in the detailed survey.
- **Research & innovation investment** was rated by all as a gap in the detailed survey, due to limited funds, being a small company and having declined in recent years.
- **'Individual mindsets'** including 'stuck ideas', 'suspicion of agendas' and (lack of) 'openness' were listed by some participants as a top of mind challenge. **Optimism bias about future conditions** by non-professional managers was most often identified as a barrier in the detailed assessment. This was not rated as a gap for professional managers.
- **Organization/corporate capital long-term planning** was most often identified as a gap in the detailed assessment.

6.3.3 Differences between types of licences

Although based on a very small sample size, the participant responses to the detailed survey provided some insights between community forest licensees and forest licensees, as follows:

- **Knowledge exchange, extension and technology transfer** was rated as a strength by community forests, and a gap by others.
- **Information management systems for monitoring** was rated as a strength by forest licensees, and a gap by others.
- **Ability to mobilize resources** through plans and protocols that are in place for swift action was rated as a strength by forest licenses and a gap by most others.

7.0 DISCUSSION, LEARNINGS AND RECOMMENDATIONS

A more thorough assessment is needed to fully understand the adaptation strengths and barriers for West Kootenay forest practitioners, their organizations and the forest management system. These strengths and barriers will be specific to the adaptation actions that will need to be implemented and the type of license, as well as the characteristics of the management unit, the forest management organizations responsible for planning and approvals, other land users, the public and the individuals involved. However, the information gathered in this project, coupled with the Canadian and BC assessments summarized above point to some obvious opportunities to facilitate adaptation.

Although local governments, non-timber tenure holders, interest groups and the general public are influential elements of the West Kootenay forest management system, it was not possible to explore the adaptation challenges to forest management from these elements of the system. Further work on climate change adaptation in this setting will need to expand to include these parts of the system.

This section begins with a summary of the findings from this part of the project, followed by a brief discussion and recommendations about the most influential factors in the West Kootenay system. Many of these factors are also relevant at the provincial scale.

7.1 Summary of findings

The relevant factors identified in the BC assessments, and the strengths/opportunities and challenges/barriers to climate change adaptation in the West Kootenay forest management system identified during this project are summarized in Table 4.

Table 4. Summary of opportunities/strengths and challenges/barriers to climate change adaptation in the West Kootenay forest management system

bold = most frequently identified

Factor	Strengths/Opportunities	Challenges/Barriers
Local forest conditions	• Range of elevations and aspects • Diversity of species and forest types • Large protected areas • Predominant public land ownership	
Forest management system	• **Relevant scientific, local and traditional knowledge made available through this project** • Stewardship ethics • Certification • Past landscape scale and certification plans could be the foundation for a renewed comprehensive strategic planning effort • Potential benefits from climate change	• **Perception of low adaptive capacity in the provincial forest management system by forest practitioners** • **Limited funds and related operational constraints due to downsizing, and perceptions of increased costs** • **Inadequate research and innovation investment** • **Lack of vulnerability assessments** • **Inadequate knowledge exchange/extension and technology transfer** • **Inadequate information management systems for monitoring and poor information about forest conditions after free-growing** • **Lack of organization/corporate capital long-term planning** • **Limited ability to mobilize resources** • No ongoing stand management beyond free growing • Lack of forward looking planning and operations • Inertia
Government regulation, policy, practices (continues on next page)	• Provincial government has some staff involved in adaptation policy development and research and has developed an adaptation action plan • Local governments are aware of adaptation through the Columbia Basin Trust initiative	• **Out-dated provincial landscape management plans, thus climate change is not included in protected areas, connectivity, biodiversity and riparian management practices, and no measurable or monitored management objectives** • **Lack of a comprehensive strategic planning process linking landscape, forest stewardship and site plans**
Government regulation, policy,		• **Provincial forest management regulations and policy are inflexible, lack choice or incentives and don't account for climate**

Factor	Strengths/Opportunities	Challenges/Barriers
practices (continued)		• **adaptation, particularly those related to reforestation, free-growing criteria and appraisal allowances** • Climate change is not factored in timber supply reviews or allowable annual cut decisions • Concerns about adequacy of wildfire management and interface fuel reduction • Provincial staffing inadequate to address scope and scale of information extension, research, policy development and local solutions • Political factors such as priorities and urban/rural power
Forest management organizations	• CFs – willingness to innovate; broad objectives; long term planning; knowledge exchange/extension/tech transfer • FLs – desire to create competitive advantage and be at the forefront; information management systems for monitoring; ability to mobilize resources • Capacity for local sawmills to produce a range of specialty products • Absence of a single large employer • Capacity of facilities to withstand floods, landslides or wildfires	• **Limited financial resources due to five year economic downturn and related operational constraints** • Inability to influence appropriate political levels
Forest practitioners	• **Aware, concerned and recognize the urgency of climate change adaptation for forest management and communities, in part through daily experience of climate change** • **Perceive climate change as a risk** • **Educated, experienced, skilled, capable and now informed and 'creating dialogue' through this project** • **Perception of having some capacity to adapt** • Willing to learn; used to change • Adaptations included in current decisions by some • Recognition of adaptation decisions that could be taken today (e.g. reforestation with species that are likely to be suitable over the long-term, enhanced wildfire management, increase forest diversity to strengthen resilience and monitor forest health to facilitate prompt action)	• **Lack of education, training and information available resulting in inadequate knowledge about climate change and impacts** • **Lack of clarity about how to adapt including awareness/understanding of adaptation options** • **Economics, government policy/regulation and knowledge identified as limiting their ability to adapt** • Unfamiliar with decision approaches when the future is uncertain • Individual personalities and mindsets • Optimism bias about future conditions by non-professional managers
Public	• Support and pressure for adaptation	

7.2 West Kootenay system

The high level of awareness, concern, urgency and perception of risk amongst practitioners found in the both the project survey and the South Selkirk survey is a clear strength in support of forest management adaptation. The presence of several locally based license holders who are closely connected with the landbase and their neighbours via community forests and family-owned, relatively small businesses are also strengths. These strengths are countered by the following factors:

- **Time and money constraints** – The down-sizing of regional government operations and the financial stress in the forest sector makes it very difficult for practitioners to prioritize 'non-essential' tasks, which includes climate change adaptation for many practitioners. Innovative design of materials and activities is required to mainstream climate change adaptation in these conditions.
- **Moving beyond early adopters** – Given the plethora of psychological barriers to climate change adaptation, the identified barrier of individual personalities and mindsets, in addition to the real time and resource limitations of local forest practitioners and managers, there are many reasons why some practitioners (e.g. BC Timber Sales, conservation organizations and managers) did not participate in the project. Non-participants should be queried to better understand their barriers and find ways they can become involved. Particular attention should be paid to senior government and industry managers, as no senior managers participated in the project, practitioners rated optimism bias about future conditions as a barrier for senior managers, and yet these managers will strongly influence adaptation implementation.
- **Compilation and accessibility of currently available information –** The research, literature and local knowledge about climate change adaptation that is relevant to West Kootenay forest management is significant, and continues to grow. Participants described the available information as 'overwhelming' and difficult to use because it is not compiled in ways that facilitate day to day use in forest management decisions. This issue spans the province.

  This project shows that much can be accomplished by compiling what is available and making it readily available to practitioners via workshops and a website. The key elements of the project approach have been: 1) as much as possible compile information based on ecological units that are relevant to forest management decisions (e.g. North, Mid and South West Kootenays); 2) summarize in topic-specific, relatively short, concise, clearly written and graphic format documents; 3) organize a series of 1 day workshops with a combination of information presentation and discussion to 'grow' understanding of this complex issue; and 4) make presentations and documents easily available on a website. Different approaches will need to be developed to effectively engage managers using shorter more targeted materials and presentations.

  These efforts should be continued. Survey results from this project indicate conferences/seminars, scientific/technical articles and professional peers are the most influential information sources regarding climate change for those involved in forest management, and the most often used. While the internet is one of the most frequent sources of information, it is not the most influential for survey respondents. Presentations to interested groups, webinars and workshops with smaller groups are other alternatives to overcome the time and resource constraints of practitioners.
- **Focus now on 'what to do'** – Making decisions about climate change adaptation is a complex process that requires significant time and resources, and this project only took a very preliminary step along this path. The practitioners identified not knowing 'what to do' as one of the highest priority gaps at this stage. Continuing the information sharing, conversation forums and structured decision approaches with local practitioners is recommended to fill this gap. Exploring options for climate-wise silviculture prescriptions and monitoring/management of fires, pests and diseases are suggested first priorities. Processes should explore and understand the psychological reasons for preferences as well the technical reasoning. Creating adaptations that are jointly supported by government, industry and local interest groups will expedite their acceptance by the provincial government and the public, possibly overcoming the perceived inability to influence appropriate political levels.

- **Regional science-management adaptation partnership** – Climate change destabilizes much of the existing knowledge about ecosystems, challenges existing forest planning processes and creates questions about appropriate adaptation practices. As well, it is impossible to predict exactly how climate will change and ecosystems will respond into the future, and which adaptations will be most effective, thus we must 'learn as we go'.

  Collaborative initiatives involving science and practitioners exploring regional socio-ecological systems have been found to strengthen adaptive capacity (Petersen 2011). This type of collaboration does not exist in the current forest management system. The participants of this project have indicated a strong interest in creating this type of partnership, and have taken the first steps themselves. It should be a long-term goal of the next steps of this project to create this partnership. Similar partnerships are needed at regional scales across the province. These partnerships must be adequately funded to compile relevant information, host discussions amongst scientists and practitioners and conduct the needed research.

7.3 Provincial forest management

Since adaptation will inevitably involve trade-offs across the many forest values in the BC landscape, it is essential that the provincial government take a leadership role in climate change adaptation as the representatives of the public landowners of most of the forest lands in BC. The provincial government has recognized the importance of climate change to forest management through the Future Forests Initiative and the Future Forest Ecosystem Science Council research projects. The government has also taken some specific policy and staffing actions including allocating a staff person to climate change action, creating a Climate Change Adaptation Action Plan, issuing a policy on assisted migration for larch, and the ongoing work on seed transfer zones. These are strengths in the movement towards mainstreaming adaptation. However there is much more to do as outlined below.

An overarching factor in climate change adaptation in BC's forests will be the equitable sharing of risk between tenure holders and the government. This factor permeates all of the adaptive capacity challenges/gaps that are listed below. The government has developed experience in risk management in some areas of its operations (e.g. compliance and enforcement) and will need to add risk management more explicitly to its development and implementation of forest management legislation and policy.

A second overarching factor is the implications of different types of tenures on climate change adaptation in BC. It can be expected that the adaptive capacity and mode of adaptation implementation will vary by tenure based on: 1) geographic and organizational size (e.g. woodlots versus TFLs); 2) area or volume basis; and 3) community or corporate based. As illustrated by Perez's study and input from the practitioners in our project, area-based licensees tend to embrace responsibility for outcomes on the forest over the long term, while volume-based licensees focus on the policy-driven responsibility to achieve free-growing status. While this suggests area-based licenses are better suited to account for and adapt to the long-term perspective needed as the climate changes, if a large scale disturbance occurs within an area-based tenure, the reduced harvesting may obliterate the ability to generate revenue to fund forest management. With volume-based tenures, reduced harvesting could be distributed across operations, with impacts shared by all. This project has not fully elicited information from a sufficient sample of tenure types to draw firm conclusions; however, there is enough information to say that one size of adaptation policy will not fit all in the BC forest management system. This has been recognized by the BC government in the previous creation of specific policies for woodlots and community forests.

The most important challenges and gaps to adaptation in the provincial forest management system identified through this project are:

- **Wildfire management and community wildfire protection** – Recent high impact fire seasons have prompted changes in wildfire management practices and resources, and implementation of community wildfire protection. However, West Kootenay practitioners continue to identify these efforts as inadequate given projected climate impacts. This should be a priority topic for next steps in this project and provincially.

- **Climate-sensitive free-growing criteria and appraisal allowances** – Inflexible regulations, tension in the implementation of professional reliance, unfamiliarity with writing rationales, including climate change adaptation, the policy-driven short-term focus of licensees on removing free-growing liabilities, and reforestation appraisal allowances that can't account for innovations - are all barriers to creating climate-sensitive FSPs and site plans. As this is a first priority in creating more resilient forests across BC for the long term, immediate attention is needed to overcome these barriers. Participation will be needed at the provincial and regional levels in both government and industry, by researchers, practitioners and managers to expedite design and implementation of science-based solutions. In the West Kootenays, initially these processes should focus on the highly vulnerable valley-bottom landscapes where forests could be significantly altered in the near term.
- **Monitoring** – This project identified inadequate information management systems for monitoring and poor information about forest conditions, particularly after free-growing, as gaps in adaptive capacity. These gaps are worrisome given the projected increase in pest and disease impacts as the climate changes. Although previously established permanent sample plots offer a solution, these have not been maintained for some time and some have been logged. While solutions can be found at the regional level, provincial resources are needed to fully address this gap.
- **Timber supply reviews and allowable annual cut decisions** – Climate change should be factored in to timber supply reviews through, for example, adjustments to wildfire, insect and disease losses, reforestation success and growth projections. At a minimum, timber supply reviews should include sensitivity analyses of the potential impacts of climate change scenarios.
- **Climate-sensitive land management plans** – Current land management directions contained in the Kootenay-Boundary Land Use Plan and other legislated direction in the West Kootenays, and throughout the province, do not account for climate change, raising concerns about the adequacy of protected areas, connectivity, biodiversity and riparian management practices, and perhaps leaving some of these values at significant risk. The projected scale and magnitude of ecological changes over time heighten the need for up-to-date landscape scale planning to account for major ecological phenomena such wildfires and pest outbreaks. An assessment of the risks to landscape values from climate change is needed to identify potential challenges, followed by changes to plans where needed. Updated climate sensitive plans will provide a solid foundation for FSPs and site plans.

7.4 Professional associations

The results-based forest management model in BC, , implemented through professional reliance in the *Forest and Range Practices Act* places responsibility on registered forest professionals to achieve forest management objectives based on stewardship principles. This creates a responsibility for their professional association to provide members with guidance about how to consider and incorporate climate change in their professional decisions, especially for professionals who prepare strategic plans and site level prescriptions. Unlike the BC Professional Engineers (APEG 2010), the Association of BC Forest Professionals has not provided guidance, or ensured forest professionals have access to training opportunities regarding climate change adaptation.

In the absence of this guidance, early adopters of climate change adaptation can be thwarted by professional disagreements over their responsibilities. In the current period of sometimes tense relationships over the implementation of the professional reliance model, forest professionals working for licensees face barriers from government colleagues who are unwilling to approve their innovative approaches.

7.5 Other land users and the public

Practitioners identified public support and pressure for adaptation in local forest management as a strength. This was echoed in the South Selkirks survey. However, when the needed adaptations are fully understood, particularly

those that impact community values including domestic water supplies and wildfire management (e.g. priority harvesting of vulnerable forests in conservation areas, extended backcountry closures during high fire hazards) the public generally, and those directly affected by these adaptations may not be so supportive.

For this project there should be some consideration of involving non-timber tenure holders, user groups and members of the public in the next steps to inform them about the project findings, ensure their views are incorporated, and trust is built in the discussions and decisions about 'what to do'. Alternatively, once practitioners have a better understanding of adaptation options, public views will need to be incorporated. This will need to be done provincially as well.

7.6 Probing the social aspects of forest management adaptation in BC

To date, research on climate change adaptation in BC forest management has largely focused on the bio-physical impacts and vulnerabilities, with less emphasis on the social adaptive capacity. As adaptation is essentially a human activity, and must be supported across the many organizations and diverse interests in BC's forests to be swiftly implemented, fully understanding the social and psychological barriers to adaptation, and ways to overcome these barriers is crucial, and deserves more attention.

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9.0 APPENDIX 1: PHYSIOLOGIAL BARRIERS TO CLIMATE CHANGE MITIGATION AND ADAPTATION

Psychological Barriers to Climate Change Mitigation and Adaptation**		
General psychological barrier	**Specific manifestation**	**Examples**
Limited cognition	Ancient brain	Designed for fight or flight
	Ignorance	Is there a problem? What to do?
	Environmental numbness	Not aware or too much exposure
	Uncertainty	Perceived or real
	Judgmental discounting	Undervaluing distant or future risks
	Optimism bias	Discounting risks
	Perceived behavior control/self-efficacy	My actions won't have much impact
Ideologies	Worldviews	Capitalism
	Suprahuman powers	Religious deity or Mother Nature in control
	Technosalvation	Innovation will save us
	System justification	Defending and justifying the status quo
Comparisons with others	Social comparison	What's the 'proper' thing to do?
	Social norms & networks	What are my neighbours & fellow workers doing?
	Perceived inequity	Why should I if they won't?
Sunk costs	Financial investments	I've already paid to do it that way or this is going to hit my pocketbook
	Behavioural momentum	Habits
	Conflicting values, goals and aspirations	Wanting to reduce environmental impacts without higher costs
Discredence	Mistrust	I'm don't trust this source so I'm not going to do what they say
	Perceived program inadequacy	It's only voluntary – I don't have to do it
	Denial	I don't believe it
	Reactance	I won't take that
Perceived risks	Functional	Will it work?
	Physical	Are there dangers?
	Financial	Payback on innovations
	Social	Will I lose face with friends/colleagues?
	Psychological	Damage to self-esteem/confidence
	Temporal	Is this a waste of time?
Limited behaviour	Tokenism	Doing the easy things then stopping
	Rebound effect	Offseting adaptations by future decisions

**Based on Gifford, R., 2011.