



CLIMATE ACTION PLAN

THOMPSON / OKANAGAN REGION

2016-2020

Climate change is real and its effects impact our business. This document outlines opportunities to adapt to and mitigate the effects of climate change within the Thompson/Okanagan Region.

Cover Photo: Okanagan Lake courtesy of: <http://promotiontours.ca/tours/kootenay-okanagan-tour/>

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EXECUTIVE SUMMARY

In 2010, British Columbia's over-arching [Climate Change Adaptation Strategy](#) called upon government to:

1. Build a strong foundation of knowledge and tools to help public and private decision-makers across B.C. prepare for a changing climate;
2. Make adaptation a part of B.C. Government's business, ensuring that climate change impacts are considered in planning and decision-making across government; and,
3. Assess risks and implement priority adaptation actions in key climate sensitive sectors.

The BC Ministry of Forests, Lands and Resource Operations (FLNRO) [Climate Change Strategy](#) (2015-2020) identifies the following three goals for responding to the impacts of climate change:

1. Manage climate change as a core part of FLNRO's business.
2. Increase the use of climate relevant science, data and knowledge to better understand the environmental, social and economic implications of climate change on core business.
3. Climate change adaptation and mitigation is integrated into program areas, operations, resource management decisions and actions.

The implementation of the FLNRO Climate Change Strategy involves the development of climate action plans (CAPs) for all FLNRO regions and branches. This Climate Action Plan for FLNRO's Thompson / Okanagan Region assesses climate changes impacts specific to the region, and identifies goals, objectives and actions for responding to climate change over the 2016-2020 time period.

The Plan identifies climate change actions based on the following themes:

- **Climate Change Adaptation**
 - Water Resources
 - Fish & Aquatic Ecosystems
 - Wildlife
 - Forest Ecosystems
 - Grassland Ecosystems
 - Natural Disaster Management, Public Safety and Infrastructure
- **Climate Change Mitigation**
- **Outreach & Education**
 - First Nations
 - Staff Education, Action & Resources

The goal, objectives, and actions for the adaptation and mitigation themes are summarized in the following diagrams (Figures 1 to 7). The main body of the Plan contains a full description for each action including a description of the following:

- **What is to be done:** A brief description of what the action involves.
- **Rationale:** A description of why this action is recommended for responding to climate change.
- **Implementation & Resourcing:** Which implementation & resourcing bin the action falls under:
 - **Current actions:** CAP actions that the T/O Region will implement in the current fiscal year and can be resourced with *existing resources*.
 - **Future actions:** CAP actions that the T/O Region will implement over the next 2 to 5 years and can be resourced with *existing resources*.
 - **CAP actions that cannot be supported with current resources.** T/O Region would implement these actions if *additional resources* were available.
 - **CAP Actions that require initiative from other work units or other ministries.** Actions that cannot be implemented by the T/O Region on its own because they require coordination with other FLNRO work units, or with other ministries or external agencies for successful implementation.
- **Responsibility:** Which work unit(s) are responsible for implementing the action.
- **Linkages:** Any policies, plans, guidelines, research, or other initiatives that the action is linked to.

The Plan was approved by Rick Manwaring, ADM for Regional Operations Division – South Area on March 16, 2016.

FIGURE 1: SUMMARY DIAGRAM – WATER RESOURCES

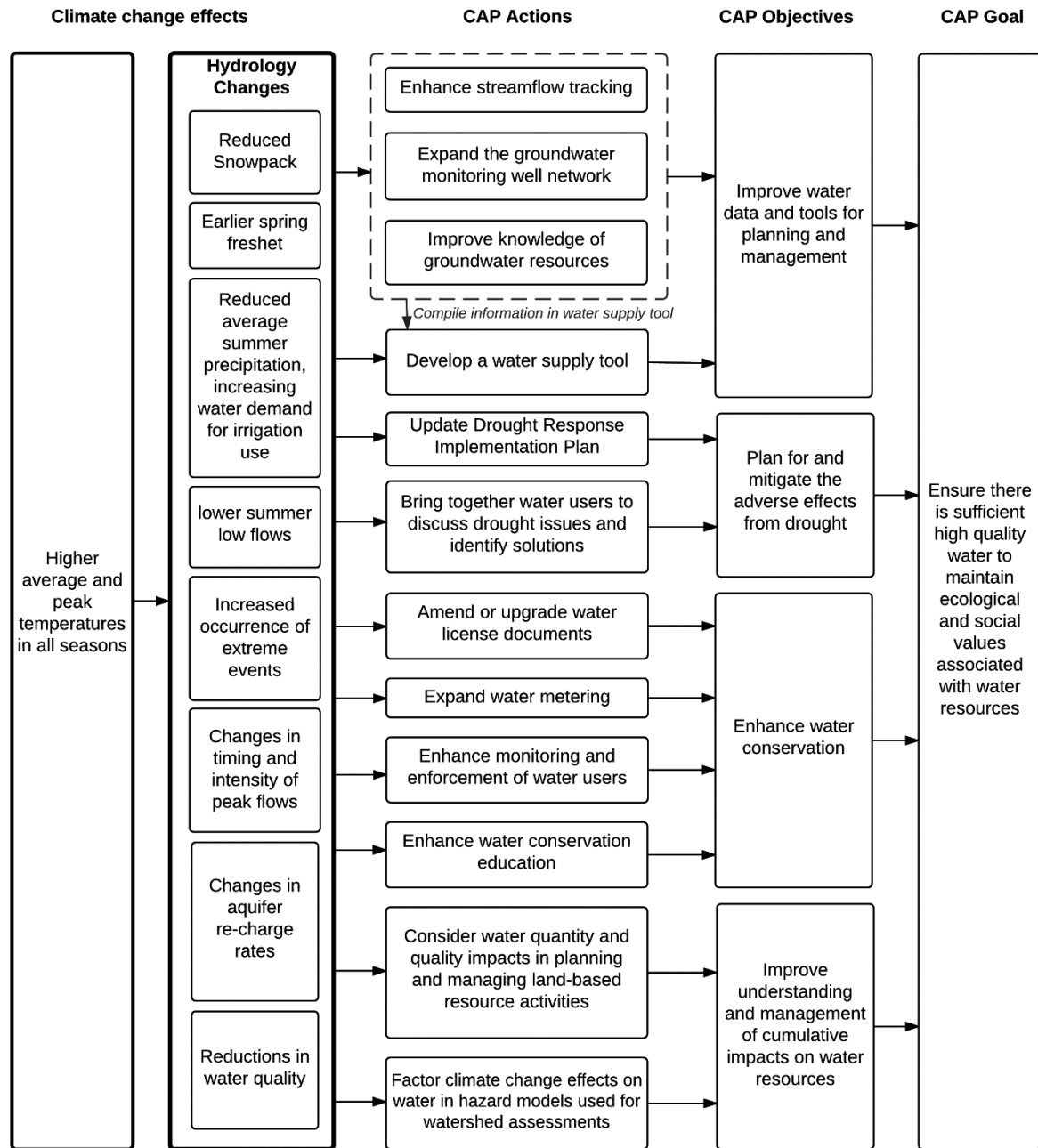


FIGURE 2: SUMMARY DIAGRAM – FISH & AQUATIC ECOSYSTEMS

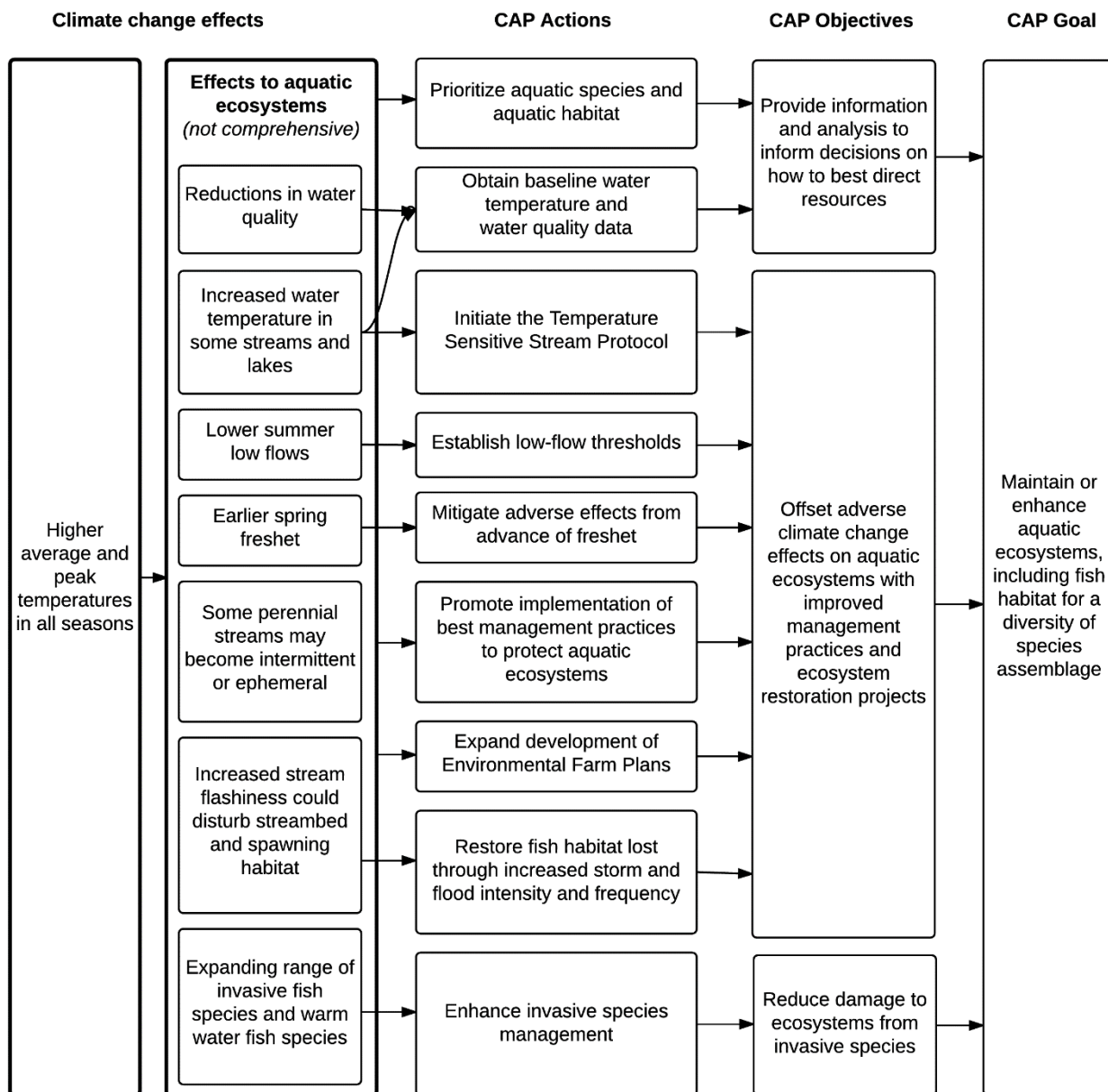


FIGURE 3: SUMMARY DIAGRAM – WILDLIFE

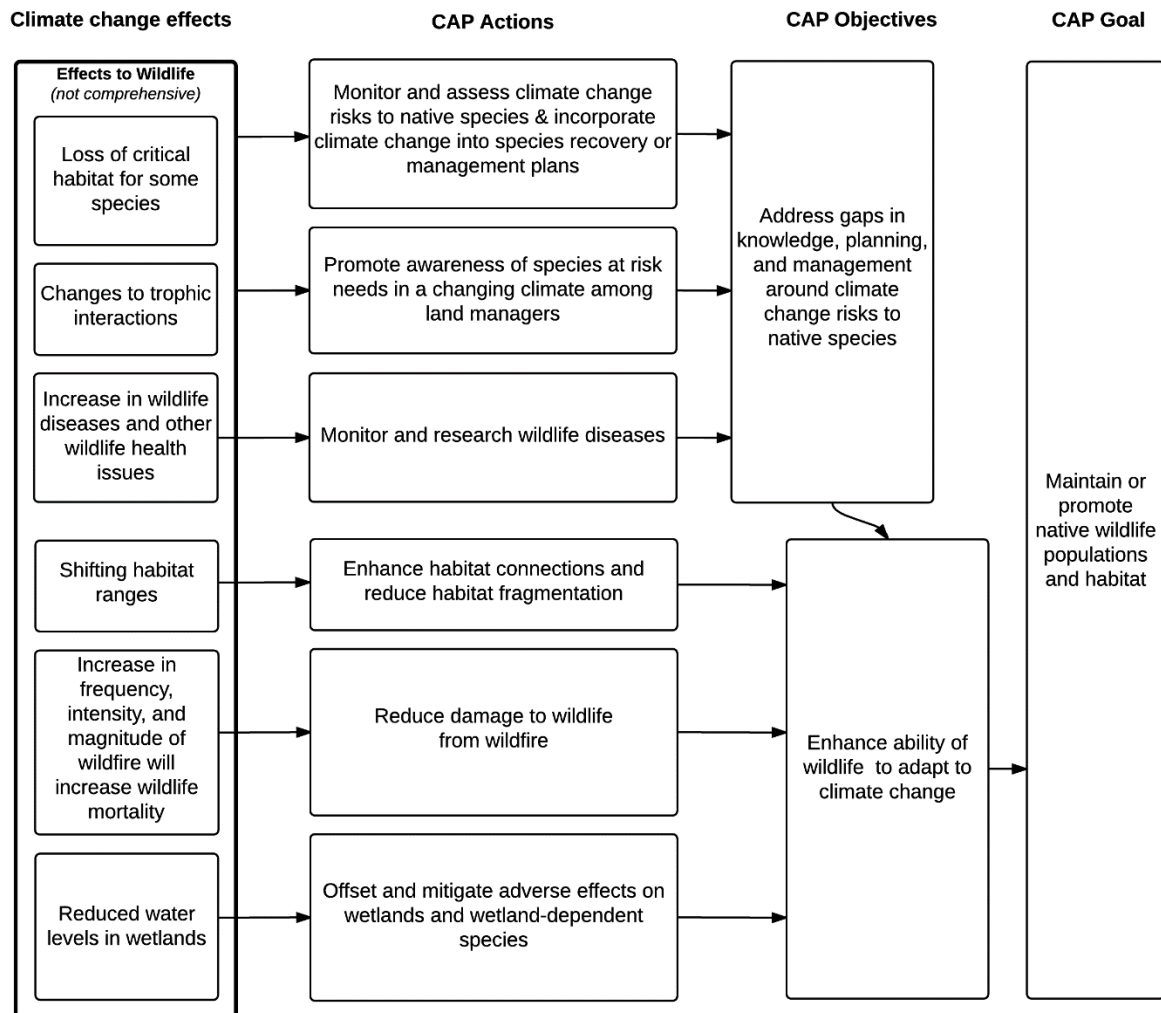


FIGURE 4: SUMMARY DIAGRAM – FOREST ECOSYSTEMS

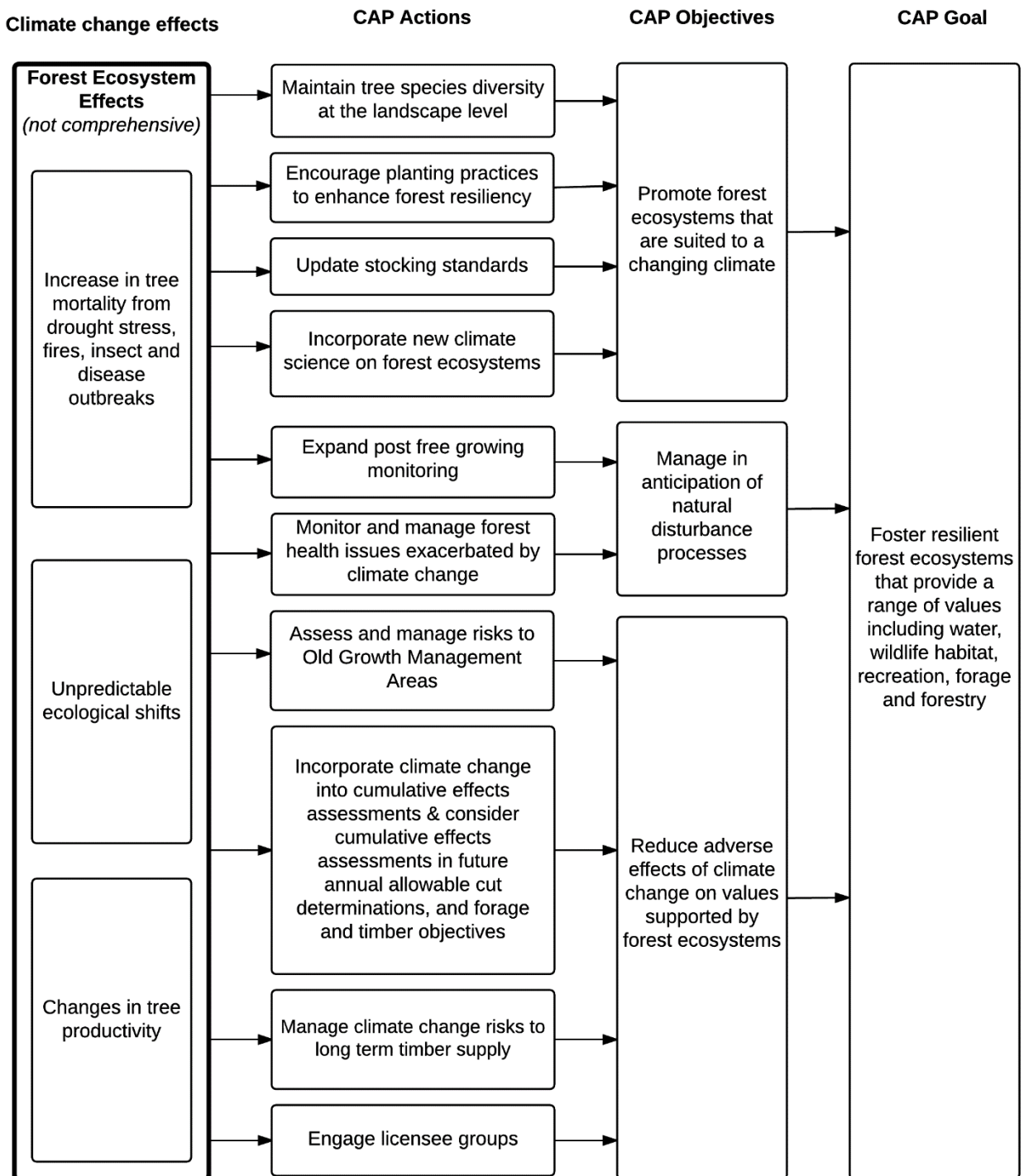


FIGURE 5: SUMMARY DIAGRAM – GRASSLAND ECOSYSTEMS

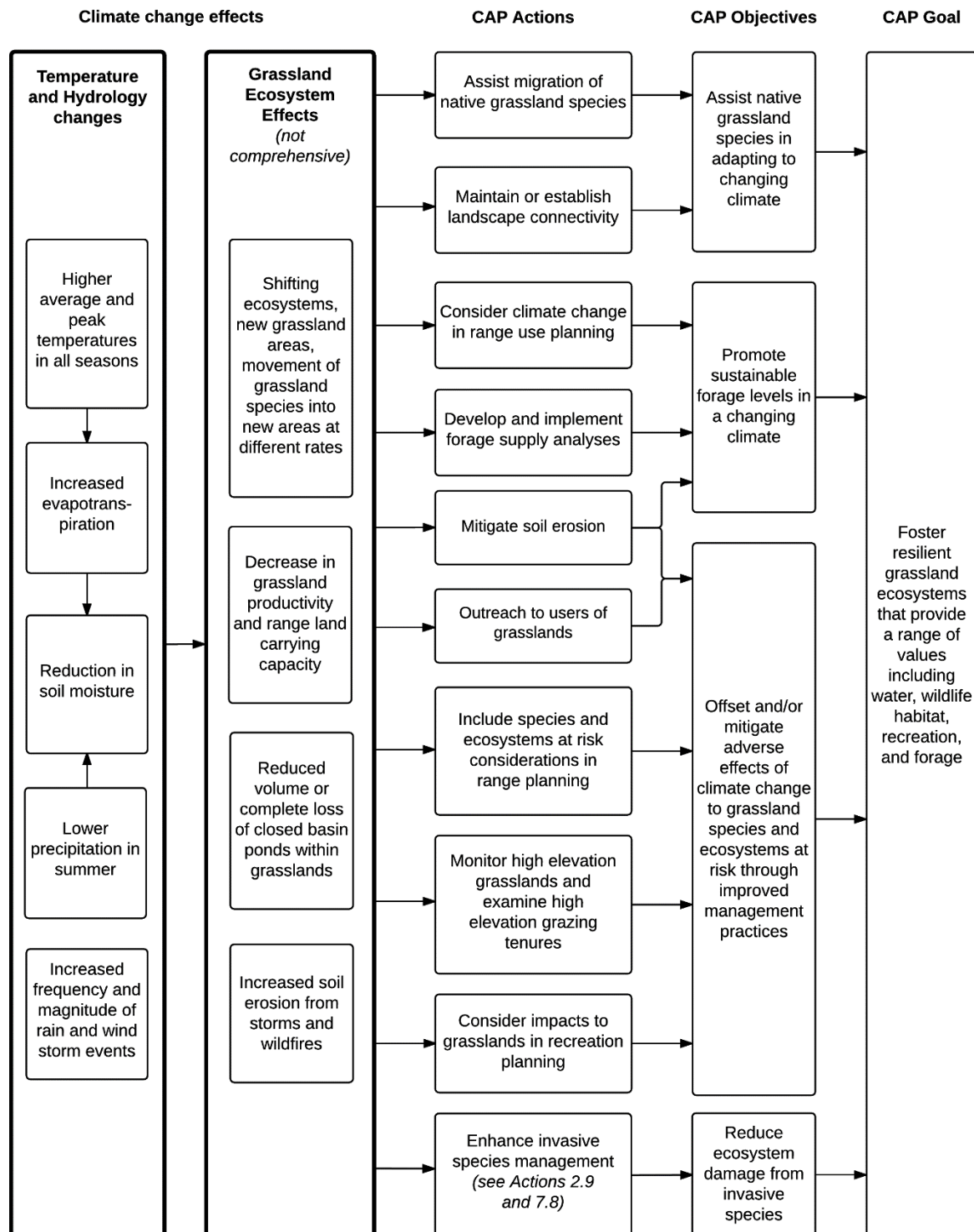


FIGURE 6: SUMMARY DIAGRAM – NATURAL DISASTER MANAGEMENT, PUBLIC SAFETY AND INFRASTRUCTURE

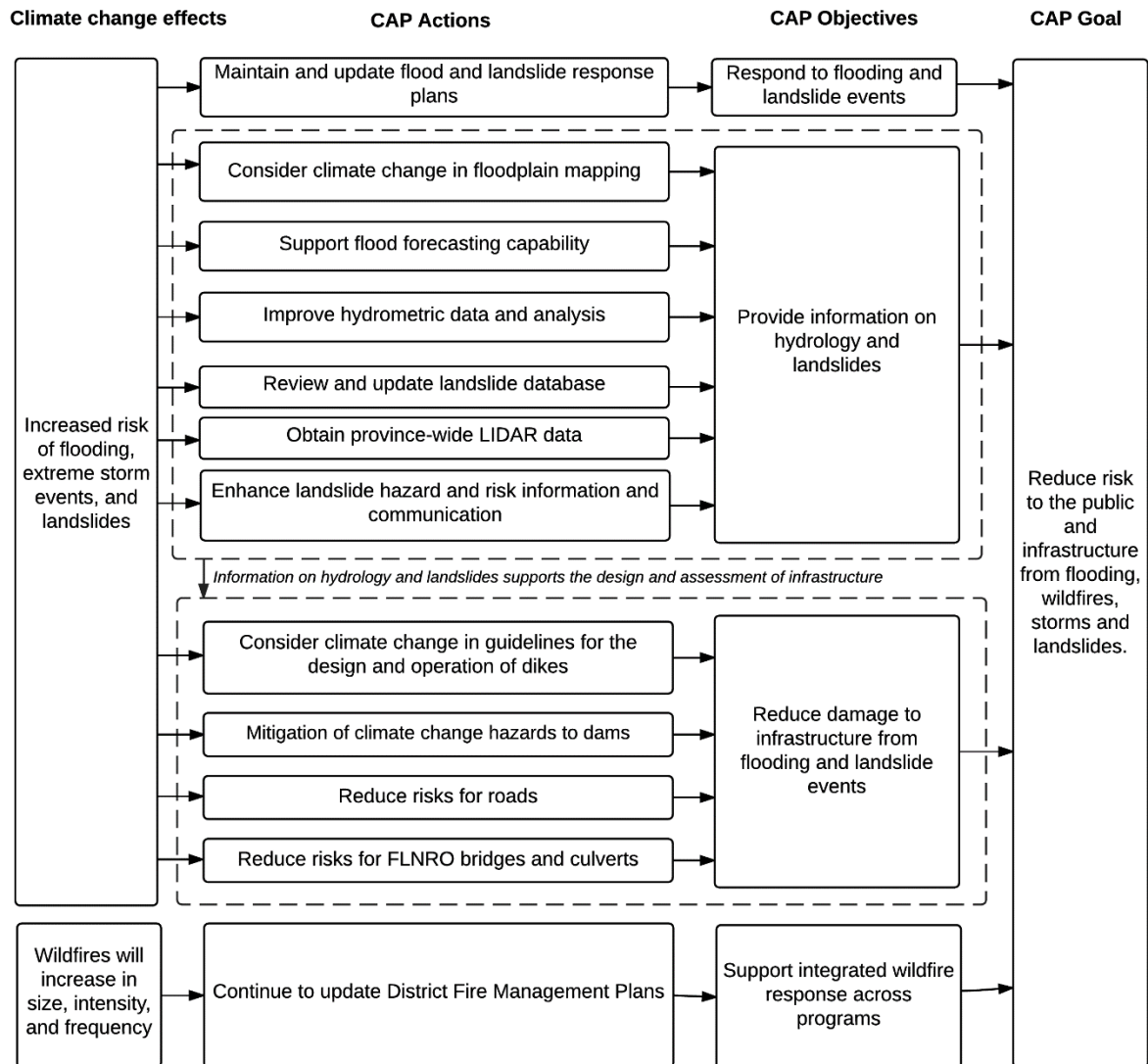
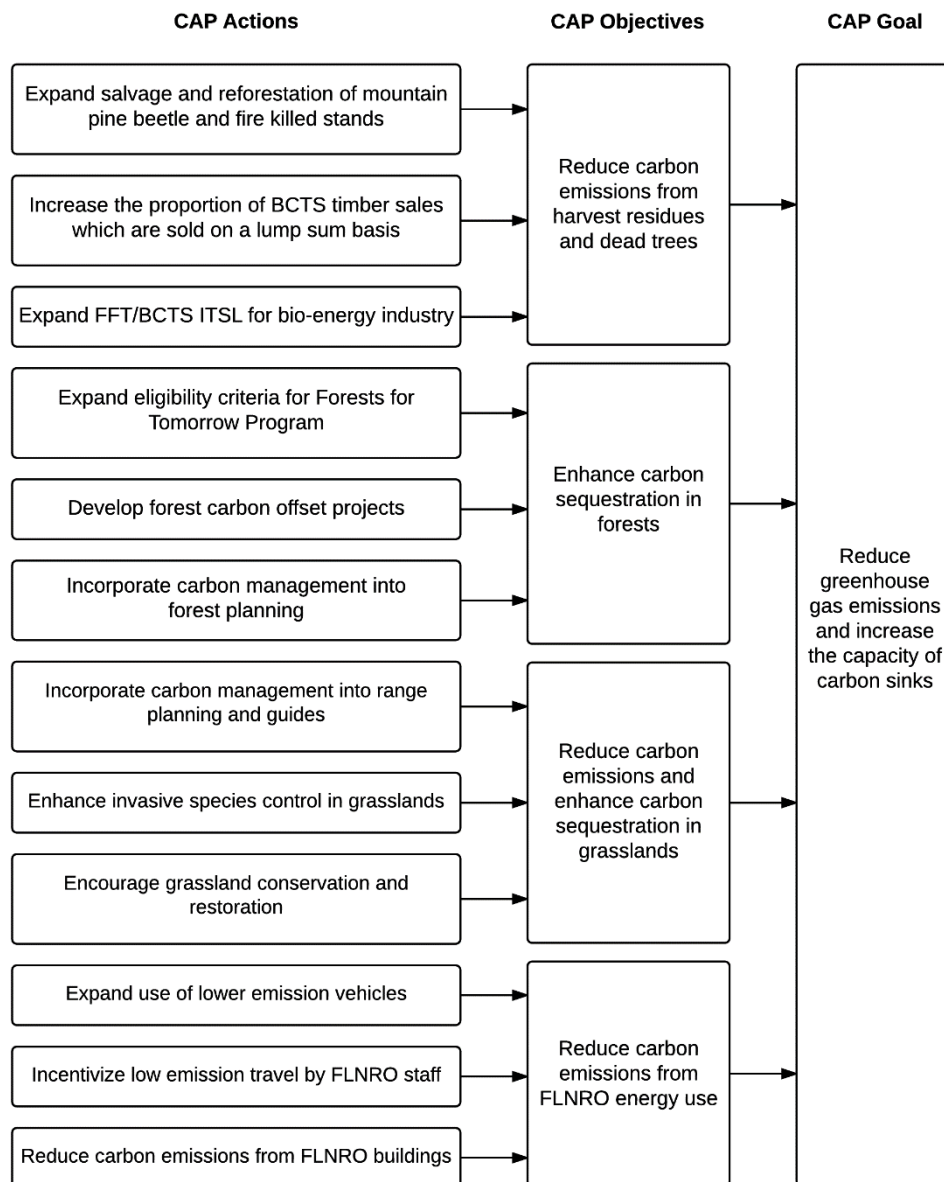


FIGURE 7: SUMMARY DIAGRAM – CLIMATE CHANGE MITIGATION



THOMPSON / OKANAGAN CLIMATE ACTION PLAN

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Climate actions were developed through collaboration between the CAP lead, CAP team, and regional staff and managers. Special acknowledgement is made to the following staff for their contributions to reviewing and writing up the climate actions:

- **Water Resources:** Rick Sommer, Rich McCleary, Patrick Farmer, Eric Valdal, Phil Belliveau, Nicole Pyett, Skye Thomson
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- **Wildlife:** Michael Burwash, Paul Blomberg, Orville Dyer
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- **Grassland Ecosystems:** Reg Newman, Orville Dyer, Brian Wallace, Amy Tipler
- **Natural Disaster Management, Public Safety and Infrastructure:** Drew Alway, Ken Conway-Brown, Barry Markin, Tim Giles, Mike Noseworthy, Darren Bennet, Jephtha Ball, Lyle Unwin, Paul Blueschke, Brian Moore
- **Climate Change Mitigation:** Mike Madill, Reg Newman, Leith McKenzie
- **First Nations:** Rob Purdy

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THOMPSON / OKANAGAN CLIMATE ACTION PLAN

INTRODUCTION

BC's climate has already changed and will continue to change. The Ministry of Forests, Lands and Natural Resource Operations' (FLNRO's) responsibility to current and future generations as natural resource stewards requires coordinated province-wide action on climate change.

Adapting to and mitigating climate change in the natural and heritage resource sectors requires an understanding of the potential long term impacts of climate change, variability, and the actions we take or go without today. Our natural and heritage resource sectors must prepare for extreme events in the short term; plan activities to best match our long-term climate outlook; and pursue mitigation and adaptation opportunities. The way we manage climate change will have long-term implications for the sustainability of resource values and communities.

In 2008, the Province of British Columbia released a [Climate Action Plan](#) outlining strategies for reducing greenhouse gas emissions, as well as educating and engaging British Columbians to adapt to the realities of climate change and its impact on the province. Several pieces of legislation and initiatives¹ have since been developed to facilitate the achievement of government's commitment to reduce GHG emissions at least 33 per cent below 2007 levels by 2020.

In 2010, acknowledging that climate change was real and will result in unavoidable impacts, the BC government released a document entitled "Preparing for Climate Change, British Columbia's Adaptation Strategy". British Columbia's over-arching *Climate Change Adaptation Strategy* calls upon government to:

1. Build a strong foundation of knowledge and tools to help public and private decision-makers across B.C. prepare for a changing climate;
2. Make adaptation a part of B.C. Government's business; and,
3. Assess risks and implement priority adaptation actions in key climate sensitive sectors.

In 2012, the Ministry of Forests, Lands, and Natural Resource Operations (FLNRO) released its [Forest Stewardship Action Plan for Climate Change Adaptation](#). While this action plan is consistent with the higher level *Climate Change Adaptation Strategy*, it outlines a new vision and signals an important new policy direction for climate change adaptation within the sphere of forest management in British Columbia.

¹ Greenhouse Gas Reductions Target Act, Greenhouse Gas Reduction (Cap and Trade) Act, Greenhouse Gas Reduction (Vehicle Emissions Standards) Act, Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act, 2008 Utilities Commission Amendment Act, Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act, Local Government (Green Communities) Statutes Amendment Act 2008, Carbon Tax Act (and tax cuts funded by the revenue-neutral carbon tax on fossil fuels), creation of the Pacific Carbon Trust, new Green Building Code, development of an Innovative Clean Energy Fund, Bioenergy Network, and creation of the Pacific Institute for Climate Change Solutions, Net-zero deforestation policy, large investment in the Forests for Tomorrow program, Trees for Tomorrow program, a BC Bioenergy Strategy, and the development of the Live Smart BC initiative.

In 2013, FLNRO released its [Climate Change Strategy](#), which is an agency wide strategy that outlines the following goals for responding to climate change over the 2015 to 2020 period and beyond:

1. Manage climate change as a core part of FLNRO's business.
2. Increase the use of climate relevant science, data and knowledge to better understand the environmental, social and economic implications of climate change on core business.
3. Climate change adaptation and mitigation is integrated into program areas, operations, resource management decisions and actions.

As a first step toward coordinated action on climate change across the Ministry, all regions and program areas are required to develop climate action plans (CAPs) that address the goals and objectives of the Climate Change Strategy. This **Thompson / Okanagan Region Climate Action Plan** will satisfy these requirements and will provide guidance towards addressing climate change risks in our day to day operations.

PURPOSE

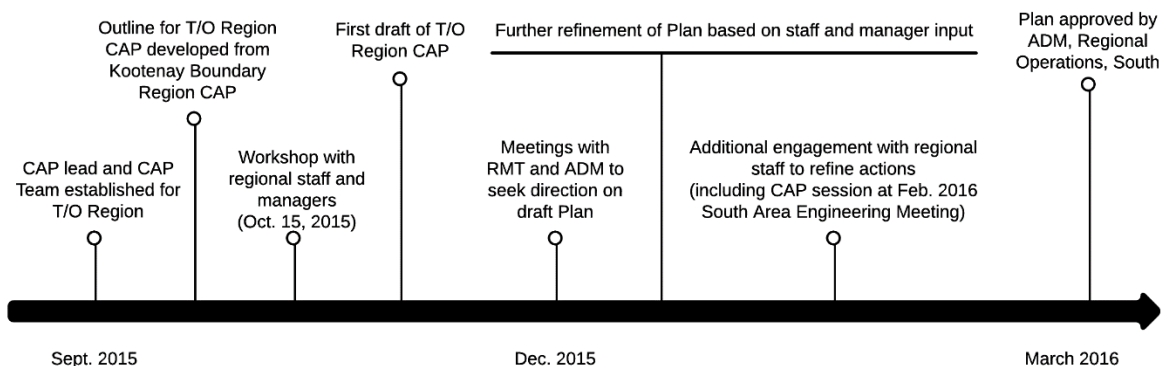
The purpose of this Action Plan is to foster the adoption of climate change mitigation and adaptation actions into the Thompson/Okanagan (T/O) regional business processes while ensuring consistency and alignment with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) Service Plan and associated Provincial and FLNRO climate change strategies and action plans.

A key principle in developing and implementing the Thompson/Okanagan Region Climate Action Plan is to embed climate change action in our day to day business. While this plan proposes several actions to help adapt to and mitigate the effects of climate change, the key is to integrate climate change into day to day operations. Overall the plan is meant to ensure climate change is being used as a lens to help coordinate activities within and amongst regions.

PLANNING PROCESS AND PLAN STRUCTURE

The development of this plan occurred in the Fall and Winter of 2015/16. The planning process activities are summarized in Figure 8.

FIGURE 8: T/O REGION CAP PLANNING ACTIVITIES



The Plan was approved by Rick Manwaring, ADM for Regional Operations Division – South Area on March 16, 2016. The Plan is meant to be a living document and will be updated as needed to reflect the T/O Region’s response to climate change.

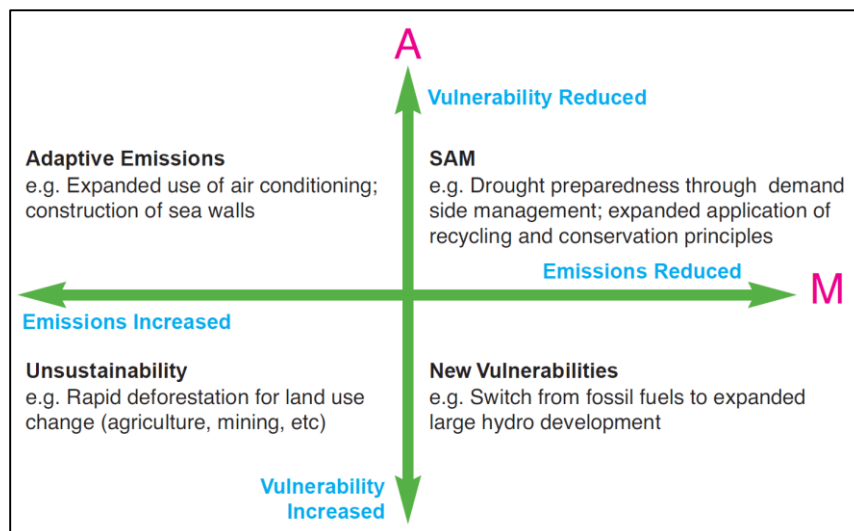
The CAP for FLNRO’s T/O Region identifies actions that the Ministry can take in the region to both adapt to and mitigate climate change over the 2016 to 2020 time period. The Plan and the planning process considers adaptation and mitigation separately as follows:

- **Adaptation:** The plan will assess climate change effects in the region and will identify actions for responding to these effects. Climate change effects will be categorized as either *adverse effects*, meaning effects that have a negative impact on a resource value or management goal/objective, or *opportunities*, meaning effects that could be beneficial.
- **Mitigation:** The plan identifies greenhouse gas (GHG) sources and carbon sinks that the region has influence over, and recommends actions that the region could take to reduce greenhouse gas concentrations in the atmosphere. The plan considers GHG sources and carbon sinks where the Ministry has a direct influence in the region, such as GHG emissions from Ministry vehicles and buildings, as well as where the Ministry has an indirect influence, such as carbon sinks in land managed by the forest industry.

It is now widely accepted that we need both adaptation and mitigation actions. Without mitigation, a magnitude of climate change is likely to be reached that makes adaptation impossible for some natural systems, while even the most stringent mitigation efforts cannot avoid further impacts of climate change in the next few decades which makes adaptation unavoidable (Klein *et al.*, 2007).

While the Plan’s structure separates adaptation and mitigation actions, the planning process emphasized the need to consider both adaptation and mitigation goals when recommending actions. Figure 9 illustrates the relationship between adaptation and mitigation. The upper quadrants represent actions that reduce vulnerability to climate change and make a distinction between adaptive actions that reduce GHGs and those that increase GHGs. The Thompson/Okanagan region CAP strives to identify actions in the upper right quadrant of the diagram, avoiding “adaptive emissions” (upper left quadrant) and “new vulnerabilities” (lower right quadrant).

FIGURE 9: TYPES OF CLIMATE ACTIONS



Climate change actions are organized in this Plan around nine themes. Each theme has a goal that represents the desired management outcome for the theme (see Table 1).

For the climate change **adaptation** themes, the goals represent what the Thompson/Okanagan Region works towards regardless of whether climate change is occurring. The planning process then focused on identifying the risks and opportunities that climate change poses with respect to these goals, and then recommends actions to respond to these risks and opportunities.

The goals for the climate change **mitigation** themes reflect the goals of the broader Provincial Climate Action Plan and FLNRO Climate Change Strategy, namely to reduce greenhouse gas emissions and enhance the capacity of carbon sinks to sequester carbon dioxide (CO₂).

An additional theme focused on general staff awareness and resources was added in recognition that a planning process is incapable of foreseeing all of the risks and opportunities related to climate change and is also limited in mobilizing the necessary action. Enhancing the capacity of staff to adapt to climate change in their day to day work is critical for the successful implementation of the actions within this CAP and for the management of risks and opportunities that are at this point unforeseen.

TABLE 1: THOMPSON / OKANAGAN REGION CAP THEMES AND GOALS

Theme	Goal
Climate Change Adaptation	Water Resources Ensure there is sufficient high quality water to maintain ecological and social values associated with water resources.
	Fish & Aquatic Ecosystems Maintain or enhance aquatic ecosystems, including fish habitat, for a diversity of species assemblage.
	Wildlife Maintain or promote native wildlife populations and habitat.
	Forest Ecosystems Foster resilient forest ecosystems that provide a range of values including water, wildlife habitat, recreation, forage, and forestry.
	Grassland Ecosystems Foster resilient grassland ecosystems that provide a range of values including water, wildlife habitat, recreation, and forage.
	Natural Disaster Management, Public Safety and Infrastructure Reduce risk to the public and infrastructure from flooding, wildfires, storms, and landslides.
Climate Change Mitigation	Reduce greenhouse gas emissions and increase the capacity of carbon sinks.
First Nations	Ensure First Nations cultural values are being managed and maintained in a changing climate.
Staff Education, Action, and Resources	Enhance the capacity of Thompson/Okanagan Region staff to consider climate change in their day to day operations.

CAP IMPLEMENTATION & RESOURCING

This Plan recommends actions for the 2016 to 2020 period. Each action is binned into one of the four following implementation categories:

1. **Current actions:** CAP actions that the T/O Region is implementing currently or will implement in the next fiscal year and can be resourced with existing resources.
2. **Future actions:** CAP actions that the T/O Region will implement over the next 2 to 5 years and can be resourced with existing resources.
3. **CAP actions that cannot be supported with current resources.** T/O Region would implement these actions if additional resources were available.
4. **CAP Actions that require initiative from other work units or other ministries.** These are actions that cannot be implemented by the T/O Region on its own. They require coordination with other FLNRO work units, or with other ministries or external agencies for successful implementation.

Where possible, each action has also been assigned a priority label of high, medium and low. For the most part, activities that are already underway or planned in the near future with existing resources are a high priority. There is more variability in priority designations among the actions that are not currently resourced. Some criteria used to assess priorities include:

- **Risk level:** risk is defined as the product of likelihood and magnitude of damage. For instance, a high level of risk would be impacts that have a high likelihood of occurring and that will create significant losses for key resource values. If impacts are very likely but losses are moderate or low (or vice versa), the risk level is medium.
- **Urgency:** the action needs to be undertaken soon (next 1-5 years), either because it's already a problem, or because management decisions being made now (e.g. licenses) are going to constrain responses to emerging or future climate problems.
- **Shared benefits:** the action provides other useful management benefits besides climate change response.

THOMPSON / OKANAGAN REGION

The Thompson/Okanagan region (Figure 10), in the southern interior of the province, is comprised of the Cascades, Okanagan Shuswap, and Thompson Rivers Resource Districts.

The region includes the Thompson/Okanagan plateau as well as portions of the Coast and Cascade mountains to the southwest and the Columbia Ranges to the northeast. The topography is incised by several large lakes, including Okanagan and Shuswap, and rivers, including the Thompson, Shuswap and Fraser. Lying in the rain shadow of the Coast and Cascade Mountains, this region has some of the warmest and driest ecosystems in BC.

FIGURE 10: THOMPSON / OKANAGAN REGION MAP



At the broadest scale, the region can be divided into three sub-regions: eastern portions of the Coast and Cascade Mountains, the central Thompson plateau, and a western portion of the Columbia Ranges. These divisions, defined by ecoregion boundaries, represent enduring features that will shape ecosystems in any climate. The leeward western sub-region is mostly dry, although some moist Pacific air travels through low passes. The rolling plateau includes north-south valleys associated with large river systems that carry warm dry air from the Columbia Basin. Pacific air brings high precipitation to the mountainous eastern sub-region.

Vegetation communities form an intricate mosaic in the Thompson-Okanagan, varying with latitude and elevation from open bunchgrass steppes in the hot, dry valleys of the south, through transitional parkland with widely-spaced ponderosa pines and Douglas-firs, to inland temperate rainforests of western red cedar and western hemlock at low elevations in the Columbia Ranges and dense coniferous in the cold, wet higher elevations.

With a population of approximately 530,000 (2011), approximately 75% live in urban centers while the remaining 25% live in rural areas. The economy of this region is based on agriculture, the service sector, logging and manufacturing.²

² <http://www.welcomebc.ca/Live/about-bc/regions/thompson-okanagan.aspx>

CLIMATE CHANGE TRENDS & PROJECTIONS

This section provides a high level overview of climate change trends, projections and effects for the Thompson/Okanagan region. For more detailed information, please see the original reference sources for this section, which includes the Pacific Climate Impacts Consortium's (PCIC's) [Plan2Adapt Tool](#)³, [PCIC's Climate Summary for the Thompson/Okanagan Region](#),⁴ and the FLNRO extension note titled "Adapting forest and range management to climate change in the Thompson-Okanagan Region".

HISTORICAL TRENDS

The historical annual trend for the Thompson/Okanagan region (based on the CANGRID dataset) indicates that just over 1°C of warming has already occurred during the 20th century and that the warming trend is greater over the 1951-2009 period compared to the 1901-2009 period.⁵

FUTURE CLIMATE PROJECTIONS

The following climate change projections are from the Pacific Climate Impacts Consortium's [Plan2Adapt Tool](#). This tool presents the results of 15 different Global Climate Models (GCM) that each run two different scenarios for what atmospheric GHG concentrations will be in the future. The A2 scenario represents roughly business as usual GHG emissions that result in atmospheric GHG concentrations of 1250 ppm CO₂e (carbon dioxide equivalent) by 2100. The B1 scenario represents a more optimistic scenario with about ½ of the emissions of business as usual, resulting in atmospheric GHG concentrations of 600 ppm CO₂e by 2100. For reference, in 2014, atmospheric greenhouse gas concentrations were 481 ppm CO₂e, of which 397 is CO₂ alone and the remainder are other greenhouse gases (methane, aerosols, etc).⁶ In 1950, the atmospheric concentration of CO₂ was 312 ppm.⁷

By modeling these two scenarios in 15 different global climate models, the Plan2Adapt tool is presenting a wide range of possible futures. Table 2 presents a summary of climate projections for the Thompson/Okanagan region for the 2050s. To interpret the model results from the Plan2Adapt tool for planning purposes, keep the following in mind:

- Plan2Adapt results are reported as averages over three planning horizons:
 - **2020s** → 2010 to 2039
 - **2050s** → 2040 to 2069
 - **2080s** → 2070 to 2099
- Do not interpret the "median" in the following results as a "best estimate". The median is simply the middle value when the results from the 30 different model runs are ordered from lowest to highest, meaning 50% of the results fall above this value and 50% of the results are

³ See website: <https://www.pacificclimate.org/analysis-tools/plan2adapt>

⁴ See website: https://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-Thompson-Okanagan_0.pdf

⁵ *Ibid.*

⁶ <http://www.esrl.noaa.gov/gmd/aggi/>

⁷ For more information on atmospheric GHG trends, see:

<http://www3.epa.gov/climatechange/science/indicators/ghg/ghg-concentrations.html>

below. The 10th percentile is the value that 10% of model results are below, or conversely 90% of the model results are above. Likewise, the 90th percentile is the value below which 90% of the model results fall.

- The median, 10th percentile and 90th percentile are all still average values over the planning horizon. Be aware that these average values do not reflect potentially large changes in variability that could occur due to climate change. Seemingly small increases in mean values of climate variables can substantially increase the probability of an extreme event. For example, increasing the mean by one standard deviation can lead to a more than 10-fold increase in extremes so that a 1 in 100 year event (e.g. flood, heatwave) can become a 1 in 10 year event (FLNRO 2015).

TABLE 2: SUMMARY OF CLIMATE PROJECTIONS FOR THE THOMPSON-OKANAGAN FOR THE 2050s*

Climate Variable	Median Change in Thompson/Okanagan (10 th to 90 th percentile)	Variation within region
Temperature (°C)		
Annual	+1.8 (1.1 to 2.7)	Slightly higher in south
Summer	+1.9 (1.3 to 2.7)	Slightly higher in south
Winter	+1.6 (0.8 to 3.0)	Slightly lower in south
Precipitation (%)		
Annual	+6 (-1 to 11)	Consistent over region
Summer	-9 (-19 to 1)	Biggest decrease in north
Winter	+7 (-4 to 15)	Consistent over region
Snowfall (%)		
Winter	-11 (-20 to 0)	Biggest decrease in south
Spring	-55 (-75 to -12)	Consistent over region
Snowpack	Decrease	Become intermittent or disappear at lower elevations
Frost-free days	+24 (14 to 35)	Greater increase at lower elevations and in south
Growing Degree Days	+319 (183 to 482)	Greater increase at lower elevation and in south
Extreme weather	More heat waves	Particularly at lower elevations

*Changes calculated against 1961-1990 baseline data. Projected changes in temperature continue to increase past 2050. Source: PCIC Plan2Adapt tool. Median of 30 model runs (15 global climate models each running 2 scenarios, the A2 and B1 scenarios) with range (in brackets) showing the 10th and 90th percentile of projected changes.

A summary of climate change projections and effects specific to the Thompson/Okanagan region has already been produced and will not be reproduced in this document. Please see the extension note produced by FLNRO's Climate Solutions group titled "Adapting forest and range management to climate change in the Thompson/Okanagan Region: considerations for planners and practitioners" (FLNRO, 2015).

1) WATER RESOURCES

GOAL – ENSURE THERE IS SUFFICIENT HIGH QUALITY WATER TO MAINTAIN ECOLOGICAL AND SOCIAL VALUES ASSOCIATED WITH WATER RESOURCES.

OBJECTIVES

- Improve water data and tools for planning and management
- Plan for and mitigate adverse effects from drought
- Enhance water conservation
- Improve understanding and management of cumulative impacts on water resources

Projected changes to the hydrological regime in the Thompson/Okanagan include:⁸

- Reduced snowpack in some areas
- Changes in timing and intensity of peak flows
- Longer summer dry season, more drought events
- Earlier spring freshet will lower summer low flows, lengthen the low-flow period, and decrease groundwater storage
- Higher winter precipitation, with more precipitation falling as rain rather than snow
- Earlier onset of spring peak and reduced late summer/fall flows, particularly in drier subzones
- Reductions in water quality
- More rapid streamflow response to intense storms
- Increased occurrence of extreme events
- Changes in water use patterns due to longer summer dry season
- Initial accelerated glacial melt contributions to water supply and then eventual loss of glacial melt contributions

OBJECTIVE: IMPROVE WATER DATA AND TOOLS FOR PLANNING AND MANAGEMENT

ACTION 1.1 – ENHANCE STREAMFLOW TRACKING

WHAT IS TO BE DONE

1. **Confirm Stream Watch List:** Identify streams prone to shortages of water for meeting environmental flow needs or water user needs – for example, streams which may be disproportionately impacted by climate change and streams hydraulically connected to aquifers in high groundwater use areas. Streams with a history of environmental flow deficiencies within the Thompson-Okanagan Region are well-documented in various Ecosystems section reports. Streams with a history of shortages for meeting water user needs are also detailed in Water Stewardship Division Records. These are streams that have been subject to regulation using

⁸ Source: FLNRO extension note titled “Adapting forest and range management to climate change in the Thompson-Okanagan Region” & Engagement with T/O Region staff who work in this area during the planning process (October to November 2015)

First-in-Time, First-in-Right (FITFIR). Flow sensitive streams are captured on the Regional Stream Watch List.

2. **Implement every summer:** Consider tracking streamflow on all flow sensitive streams or at least on a priority level during every summer season rather than initiating monitoring only during drought years.
3. **Establish permanent stations:** Partner with stakeholders, other government agencies, and First Nations to establish a network of streamflow monitoring sites on key watersheds.
4. **Data collection system:** Develop a system to facilitate data collection, quality assurance, provision of data to drought response team for decision making and long-term data storage.
5. **Training program:** Develop a training program to create a team of technicians capable of collecting streamflow data. Candidate technicians include FLNRO staff, summer students, First Nations workers, consultants.

RATIONALE

Climate change projections indicate extended periods of low streamflow to occur during periods of peak demand (summer months) in the Thompson/Okanagan region. *Water Sustainability Act* requires staff to account for Environmental Low Flows (based on Mean Annual Discharge (MAD)) in the adjudication of water licence applications. As a result, improved water data is needed for managing water licences and for drought response.

Current information gaps for managing water withdrawals include:

- Streamflow data gaps;
- Actual water usage (surface and groundwater);
- Methods to extrapolate data to ungauged basins or region-specific hydrologic model.

There is currently no single water tool in the region that defines what is available in a stream, what has been allocated, and what is being used. Tracking streamflow on an annual basis would also expand the number of trained technicians and reduce reliance upon consultants during drought emergencies.

IMPLEMENTATION & RESOURCING

Action	Implementation & Resourcing	Priority
1. Confirm stream watch list	Draft completed.	Medium
2. Implement every summer	Additional resources are required.	High
3. Establish permanent stations	Need an external contract to create manual based on 2015 work.	High
4. Data collection system	Started to implement with existing resources. Additional GIS work is required.	High
5. Training program	Initiated work with Splatshin First Nation. A plan is required.	High

RESPONSIBILITY

- Water Allocations Staff
- Ecosystems staff

- First Nations
- FLNRO Geospatial Services

ACTION 1.2 – EXPAND THE GROUNDWATER MONITORING WELL NETWORK

WHAT IS TO BE DONE

- Identify priority areas for the development of new groundwater monitoring wells.
- Expand the groundwater observation well network in key areas, including highly developed or stressed aquifers and indicator aquifers, integrated with meteorological monitoring locations (precipitation, snow pack) with a view to monitoring impacts of climate change in the region.
- Obtain baseline water quantity, water quality and hydrogeological data from key aquifers.

RATIONALE

The Groundwater Observation Well Network in the Thompson-Okanagan has been ongoing since 1961. The network monitors groundwater level and water quality of key aquifers, providing information on baseline and temporal trends. The data are collected for use by government and the public, including natural resources-based industries, environmental management-related government agencies, academia, and various private organizations. The data collected from the network are archived in provincial databases and made available to the general public. Population pressures within the region will likely to increase demand on groundwater resources while climate change may further negatively impact groundwater availability. Groundwater decreases may also impact surface water flows as groundwater provides stream baseflow during low-flow periods. The network is a key data source for assessing climate change impacts, understanding the groundwater resource, and will be a critical tool for groundwater allocation authorization decisions under the *Water Sustainability Act*.

IMPLEMENTATION AND RESOURCING

- Identify priority areas for the development of new groundwater monitoring wells. This task was partially completed in 2011, and will need to be reviewed in light of new groundwater regulation accountabilities under the *Water Sustainability Act*. This is a high priority.
- Explore external partnership opportunities (e.g., Okanagan Basin Water Board, Regional Districts) in order to expand strategic meteorological monitoring (precipitation, snowpack) and groundwater resources monitoring.
- Additional capital costs would be required to expand the Groundwater Observation Well Network. Capital costs include drilling and equipping the observation well with monitoring equipment. Costs for drilling vary depending on location and well depth, but typically range from \$10-20K per well.
- Operating (monitoring) costs are currently provided by the MOE (through annual funding) and coordination with MOE would be required. Network expansion may require monitoring equipment support from MOE (~\$8k), with operational contributions from FLNR. Total costs will vary with the number of wells and the type of monitoring equipment.
- Expansion of the network would likely require support from FLNR groundwater staff to oversee and supervise contracts. Explore opportunities to engage auxiliary and/or co-op student opportunities to provide additional project support (contract monitoring and field drilling supervision).

- Note: Groundwater staff support the 3 regions (Thompson-Okanagan, Cariboo, and Kootenay-Boundary Regions) within the South Area; therefore, resourcing discussions should occur at the Area level. It is anticipated that additional resources (1 FTE FLNR regional groundwater staff) would be required to support the overall expansion of the Groundwater Observation Well Network across the South Area.

RESPONSIBILITY

- Regional Water Management

LINKAGES

- *Water Sustainability Act*
- Ministry of Environment – Environmental Monitoring, Reporting, and Economics Section
- Ministry of Environment (2014). Assessment for Adding Existing Wells to the Provincial Groundwater Observation Well Network.

ACTION 1.3 – IMPROVE KNOWLEDGE OF GROUNDWATER RESOURCES

WHAT IS TO BE DONE

- Characterize and assess the groundwater resource and develop and maintain an up-to-date and comprehensive inventory of developed aquifers to inform allocation decisions and manage groundwater.
- Synthesize available groundwater data and identify data gaps in relation to current aquifer mapping.
- Identify groundwater recharge areas for priority aquifers.
- Develop aquifer water budgets, and models (conceptual and numerical) for priority aquifers.
- Compile information submitted by clients to further knowledge of the resource.

RATIONALE

The *Water Sustainability Act* (WSA) establishes a regulatory framework for groundwater extraction and the sustainable management of water resources. With the implementation of the WSA, decision makers will be dealing with increasingly complex water authorisation decisions related to groundwater withdrawals. This is compounded by significant knowledge gaps in our understanding of the resource (e.g., aquifer supply/demand, connectivity with surface water, quantifying groundwater availability) which presents challenges for the sustainable management of this resource. Developing tools and overseeing groundwater science functions contributes to our understanding of the resource and supports priority groundwater licensing.

Presently our understanding of groundwater-surface water interactions in the region is focussed on individual areas, and accomplished via a number of separate studies by different authors. This is a disjointed, somewhat simplified and coarse level of understanding of the resource. Integrated surface water-groundwater numerical models are commonly implemented when the water resource is under significant development pressure (e.g., the Athabasca Oil Sands).

IMPLEMENTATION AND RESOURCING

- Explore options for auxiliaries and/or co-op students to compile available groundwater information in a central repository. Data sources include other agencies, Health Authorities, Local Governments and water purveyors. This is a high priority.
- Fund regional ground and surface water interaction studies in priority areas. These studies would analyze cumulative impact of groundwater extraction on stream-flow and aquatic habitat on priority river systems. This is a high priority.
- Continue support of development of water budgets, water balances and conceptual/numerical models and work towards operationalizing their use in water allocation (contracts currently ongoing with water budget partnerships with MOE (Aquifer Science) and the Okanagan Basin Water Board). Capital costs are currently provided through MOE Aquifer Science; future FLNRO studies could leverage existing MOE funds. This is a high priority.
- Develop staff expertise/knowledge/training of priority aquifers to support decision makers.
- Support internal computer-related services (database and internet connections for data receiving and storage)
- Develop a conceptual model of groundwater-surface water flow and interactions in the region, taking into account various groundwater budgets commissioned by FLNRO and other publically available groundwater and surface water information. This would form the basis for construction of a future numerical model.

RESPONSIBILITY

- Regional Water Management
- Water Stewardship Division
- Ecosystems
- First Nations
- FLNRO Geospatial Services
- Ministry of Environment- Aquifer Science

LINKAGES

- *Water Sustainability Act*
- iMap BC and other GIS-based electronic resources

ACTION 1.4 – DEVELOP A WATER SUPPLY TOOL

WHAT IS TO BE DONE

Develop a water tool that performs the following functions:

- Collates flow data from multiple sources that exist;
- Applies methods for estimating flow in data-poor areas;
- Defines environmental flow needs in a stream (and considers temperature in determination of environmental flow needs);
- Defines what is available in a stream;
- Records what has been allocated;

- Records what is currently being used.

Use this tool to adjudicate water license applications. Note that there are very few new water license applications in the region. Most water applications are amendments to existing water licenses. Applications for amendments are an opportunity to upgrade license document to higher standards of management.

Note that development of this tool is currently being considered for the Southern Interior.

RATIONALE

The water supply tool will enable more informed water management decisions.

IMPLEMENTATION & RESOURCING

- This action requires additional resources to implement.
- This action is considered to be a high priority. Without such a tool, water allocation decisions are made with inadequate information.

RESPONSIBILITY

- Water Allocations Staff
- Ecosystems Section

LINKAGES

- Okanagan Basin Water Management Tools
- Nicola Water Management Tool (under development)

OBJECTIVE: PLAN FOR AND MITIGATE ADVERSE EFFECTS FROM DROUGHT

ACTION 1.5 - UPDATE DROUGHT RESPONSE IMPLEMENTATION PLAN

WHAT IS TO BE DONE

The Thompson/Okanagan region is currently developing a Drought Response Implementation Plan that outlines a proactive approach to resolving conflicts during times of water scarcity. This plan is complimentary to the Provincial Drought Response Plan (2015). The region should review and update this drought response plan in collaboration with stakeholders.

RATIONALE

Climate change projections for the Thompson/Okanagan region include increased frequency of drought events. The 2015 summer drought event in the region can be thought of as an analogue or “fire drill” for the future. Experience with the Summer 2015 drought event exposed deficiencies in the region’s drought response planning/activities, such as establishing sub-basin specific flow thresholds, developing effective two-way communication systems with potentially affected irrigators and water users that promote proactive responses during drought, expanding the hydrometric network and active streamflow measurement team to provide the data required to support sub-basin scale drought response.

IMPLEMENTATION & RESOURCING

- The Plan identifies a core team of Regional Specialists and District Water Officers who will respond to drought conditions across the Region.
- The Plan is being updated this fiscal (2015/16) and is considered a high priority.
- A plan that can guide drought response at the sub-basin scale will entail working closely with other governments (e.g., First Nations, Regional Districts, Municipalities, and Water Purveyors) and stakeholders (e.g., agricultural, industrial and domestic users) to detail all response activities including communication systems. A multi-year collaborative effort is required to accomplish this goal. Progress on revisions during 2015/16 is limited by resources that are available during this fiscal year. A workplan is required that clearly describes the components of the plan. Additional resources are required to: (1) develop conceptual vision of the final plan; and (2) work collaboratively to complete the plan.

RESPONSIBILITY

- Regional Management Team
- Ecosystems Section
- Water Allocations Staff
- Ministry of Agriculture
- First Nations
- Regional District and Municipalities
- Water purveyors
- External partners including Okanagan Basin Water Board, BC Cattleman's Association, BC Dairy Association

LINKAGES

- Drought Response Implementation Plan

ACTION 1.6 – BRING TOGETHER WATER USERS TO DISCUSS DROUGHT ISSUES AND IDENTIFY SOLUTIONS

WHAT IS TO BE DONE

- Develop a forum for bringing together water users to discuss drought and flooding issues and identify solutions in the context of a changing climate.

RATIONALE

Thompson/Okanagan Region has a role in increasing the awareness among water users on the implications of climate change and in engaging these water users to develop solutions. Potential solutions that could come out of these discussions include:

- Partnerships between T/O region and the agriculture sector to consider alternate crops and practices that are less susceptible to drought related impacts
- Increased use of water bailiffs to manage water use on streams

IMPLEMENTATION & RESOURCING

- Additional resources would be needed to hold workshops (~\$10,000 to \$20,000).

RESPONSIBILITY

- District Managers
- Water Allocations section
- Ecosystems section

LINKAGES

- Drought Response Implementation Plan

OBJECTIVE: ENHANCE WATER CONSERVATION

ACTION 1.7 – AMEND OR UPGRADE WATER LICENSE DOCUMENTS

WHAT IS TO BE DONE

- License documents need to be amended or upgraded to ensure water is being managed properly. This is currently carried out when an amendment is initiated due to incorrect or new information, or an application for an amendment is made by a licensee. Further information gathering and amendment work is required to target water sources with water shortages.
- Implement Water Licence Amendment Lean project across the region.

RATIONALE

Climate change will put increased pressure on water supply especially on sources that historically experience water shortages. Currently, there is limited information on which licences are in use and which are dormant. This creates a large gap in water supply/demand calculations and modelling.

Applications from licensees are often incomplete resulting in large amounts of staff time being required to update the application information.

IMPLEMENTATION & RESOURCING

- Additional resources are required to take on additional work to amend water licences in order to facilitate better water management. Additional staff (1-2 FTE per district) will be required to gather information and update licences on streams with water shortages. This activity is currently limited and restricted to licensee driven applications. This should be considered the highest of priorities to gain better understanding of the water balance on our threatened streams.
- Implement Licence Amendment LEAN initiative to put more ownership on client supplied information. No resources required only training or further discussion. This should also be a high priority.

RESPONSIBILITY

- Water Allocations staff
- Front Counter BC staff
- Water Managers

LINKAGES

- Water Licence Amendment Lean Project
- Amendments of Unused Water Licences (Provincial Policy)

ACTION 1.8 – EXPAND WATER METERING

WHAT IS TO BE DONE

Implement the Thompson Okanagan Regional Metering Policy to expand water metering of withdrawals. Content of this policy includes:

- Requiring new licenses and licenses requiring amendments to meter water use unless there is a rationale for the exemption of metering.
- Outlines how metering may be carried out.
- Potential wording for clauses to be used if metering is required
- Requirement of record keeping of water use

Create metering plan:

- Identify watersheds where water use data is needed and try to achieve voluntary implementation of metering on existing licences/sources
- Develop a communication strategy to inform licensees how and why this strategy is being implemented
- Large users are important to pay attention to but the cumulative use of small users must also be weighed
- Database for metering records.

RATIONALE

The metering policy helps licensees affect active management by highlighting usage rates and facilitating conservation. Currently, most water licence holders do not have a water measurement device and have a limited understanding of how much water they use. Measurement has been known to increase appreciation of the water resource, resulting in improved water usage over the long term. By requiring measurement, licence holders will develop a better understanding of their usage. Records produced from this activity will help in the development of Water Sustainability Plans and lead to better watershed management. Application of this policy will promote a consistent water licensing approach within the Thompson Okanagan Region.

The benefits of this policy will be realized over time, as it will take a few years to bring enough licences under the metering/measuring umbrella to analyze a large pool of data. Over time however, this policy will help educate licensees on their water use, facilitate better conservation and management of a finite resource and assist the resource managers with regulation and enforcement endeavors.

IMPLEMENTATION & RESOURCING

- Currently, the requirement for metering is being done on an ad-hoc basis across the region. If the Thompson/Okanagan Metering policy is adopted, most new surface water and groundwater licences and licences being amended will have a metering and record keeping requirement.
- Additional resources would be required to engage existing licensees on sources where water metering is required (0.25 FTE per district). This is a high priority.
- Additional resources to audit or request records of water usage would also be required (0.5 FTE per district). This is a high priority.
- Contacting licensees to engage with voluntary metering (0.25 FTE per district). Medium Priority.

RESPONSIBILITY

- Water Allocations staff
- Water managers to ensure policy implementation

ACTION 1.9 – ENHANCE MONITORING AND ENFORCEMENT OF WATER USERS

WHAT IS TO BE DONE

- Continue to evaluate whether beneficial use of water is occurring for existing licences.
- Increase use of water bailiffs to manage water use on streams

RATIONALE

Some people have water licenses but are not using the water. A license can be cancelled if the licensee has not used the water for three years. The Ministry should monitor to confirm whether or not the water license is being used. Reducing the number of water licenses will streamline water management, especially during periods of drought.

Water bailiffs create a local “eyes and ears” within a watershed where a large number of water licensees exist. The bailiffs create that operational linkage where share works are used to deliver water to multiple water licensees. An example is Robbins Creek where a large volume of storage on Little Disdero Lake is used by multiple water licensees with different priority dates. The priority dates create senior and junior water rights that need to be managed at the local level during periods of water scarcity.

IMPLEMENTATION & RESOURCING

- This action is ongoing and can be implemented with existing resources. Most bailiffs are in place however connection between FLNRO and bailiffs needs to be strengthened.
- It is a high priority action that will help prepare for the next drought event.

RESPONSIBILITY

- Water Allocations staff

LINKAGES

- This action has an indirect linkage to Environmental Flow Needs work.

ACTION 1.10 – ENHANCE WATER CONSERVATION EDUCATION

WHAT IS TO BE DONE

- Provide education on the value of water conservation to water staff, water licensees, government, and the public.
- Link education efforts to World Water Day.
- Promote Living Water Smart, the Provincial Governments vision for sustainable water stewardship.
- Create presentation to use at public functions/meetings.

RATIONALE

There is a lack of awareness on how water use can negatively affect other societal values, especially in the context of a changing climate (e.g. impact on fish habitat). Need to raise awareness around the benefits of water conservation in the Thompson/Okanagan Region.

IMPLEMENTATION & RESOURCING

In order for education to occur other work units or Ministries need to be engaged. More information must be given to Water Allocations staff in order for them to be able to pass that information on.

- Additional resources (0.25 FTE per district) are required or a shift in priority must occur in order for more education to occur to licensees from Water Allocations Staff.
- A presentation would need to be created by someone to outline conservation programs and information about water use.
- This action is a Medium Priority. It is important to show the public the importance of water conservation in a changing climate so they can start making the changes and to bring forward any further information that is available. In a changing climate, there is a need for the public to understand that historical levels of water use may not be sustainable into the future. Water availability and the need for water will change with the changing climate and ultimately get more variable and unpredictable in the Thompson/Okanagan Region.

RESPONSIBILITY

- Water Managers
- Water Allocations staff

LINKAGES

- *Water Sustainability Act*
- Living Water Smart Program
- Fraser Basin Council /Nicola Steering Committee
- Nicola Watershed Community Roundtable
- BC Environmental Farm Plan Program

OBJECTIVE: IMPROVE UNDERSTANDING AND MANAGEMENT OF CUMULATIVE IMPACTS ON WATER RESOURCES

ACTION 1.11 – CONSIDER WATER QUANTITY AND WATER QUALITY IMPACTS IN PLANNING AND MANAGING LAND-BASED RESOURCE ACTIVITIES

WHAT IS TO BE DONE

Share best management practices for how industrial land users can work together to consider water quantity and water quality impacts in their planning.

RATIONALE

Climate change will make it harder to achieve water supply goals. To improve the ability to achieve water supply goals, the interaction of land-based activities and water supply needs to be better recognized, understood and managed. For instance, forest licensees already consider hydrology impacts in their plans, but licensees are not coordinating among each other. As a result, there is gap in planning at the watershed level, meaning that there is a lack of strategizing around the cumulative impact of land activities on water supply and water quality.

IMPLEMENTATION & RESOURCING

- This action can be completed with existing resources over the next 2 to 5 years.

RESPONSIBILITY

- Stewardship District staff
- Water Allocations staff
- Research and Silviculture Section

ACTION 1.12 – FACTOR CLIMATE CHANGE EFFECTS ON WATER IN HAZARD MODELS USED FOR WATERSHED ASSESSMENTS

WHAT IS TO BE DONE

- Continue the development of hazard models to characterize the condition of watersheds according to the following components: water availability, water quality, stream flow, fish habitat. Include climate change in the characterization of hazard levels for these components

RATIONALE

Climate change requires increased levels of effort and rigour to manage water resources, however, staff and financial resources are limited. Priorities need to be identified to ensure resources are directed to the highest risk watersheds. Hazard modeling at the watershed scale is an ongoing effort within FLNRO's Cumulative Effects Program to provide managers with the information they need to make decisions and prioritize efforts. To date, the development of these hazard models has focused on characterizing the current condition of watershed. Future developments of these hazard models will forecast watershed conditions. In these forecasts, climate change will be a key factor to include.

IMPLEMENTATION & RESOURCING

- This action can be implemented with existing resources through the Cumulative Effects Program.

RESPONSIBILITY

- Cumulative Effects staff

2) FISH & AQUATIC ECOSYSTEMS

GOAL - MAINTAIN OR ENHANCE AQUATIC ECOSYSTEMS, INCLUDING FISH HABITAT, FOR A DIVERSITY OF SPECIES ASSEMBLAGE.

OBJECTIVES

- Provide information and analysis to inform decisions on how to best direct resources
- Offset adverse climate change effects on aquatic ecosystems with improved management practices and ecosystem restoration projects
- Reduce damage to ecosystems from invasive species

Projected changes that could impact fish include:⁹

- Earlier spring freshet and lower summer precipitation will lower summer low flows, lengthen the low-flow period, and decrease groundwater storage
- Some perennial streams may become intermittent or ephemeral
- Temperature will increase in some streams and lakes, posing risk to temperature sensitive fish; many low elevation streams in warm subzones could reach lethal temperatures for sensitive aquatic species (some are already affected)
- Variability in peak flow will likely increase, leading to unstable stream morphology in some systems
- Increased flashiness could disturb streambed and spawning habitat
- Changes in water quality may affect aquatic ecosystem health and productivity
- More frequent occurrences of winter kill in lakes
- Expanding range of invasive fish species and warm-water fish species. Species assemblage will shift to warm-adapted species

OBJECTIVE: PROVIDE INFORMATION AND ANALYSIS TO INFORM DECISIONS ON HOW TO BEST DIRECT RESOURCES

ACTION 2.1 – PRIORITIZE AQUATIC SPECIES AND AQUATIC HABITAT

WHAT IS TO BE DONE

- Direct limited resources to highest priority aquatic species and aquatic habitat.

⁹ Source: FLNRO extension note titled “Adapting forest and range management to climate change in the Thompson-Okanagan Region” & Engagement with T/O Region staff who work in this area during the planning process (October to November 2015)

- Consider climate change in prioritizing aquatic species and aquatic habitat.

RATIONALE

- Regional fisheries staff report that many small lakes are experiencing potential widespread impacts to fisheries values, which have implications to local social and economic values.

IMPLEMENTATION & RESOURCING

- Need additional resources to implement action.
- This action is a high priority due to rapid unprecedented changes to recently stable systems. The action dovetails with hydrologic and limnological impact effects currently being studied.

RESPONSIBILITY

- Fisheries Program with assistance from other Resource Management expertise and outside institutions

LINKAGES

- Cumulative effects, Watershed Hydrological Research, Fisheries Program Planning

ACTION 2.2 – OBTAIN BASELINE WATER TEMPERATURE AND WATER QUALITY DATA

WHAT IS TO BE DONE

Obtain baseline data on sub-regional stream and lake temperatures and expand training on data storage systems:

- Risk-rank streams and lakes for susceptibility to increased temperature.
- Obtain baseline temperature data for the most susceptible streams and lakes
- Obtain baseline data for small lakes: temperature, Ph, ice-free period changes, thermocline depth changes with inflow temperature changes.
- Expand Aquarius (provincial system for storing and managing streamflow, temperature and other time series data) so that district and regional staff are properly trained to upload and archive data.

RATIONALE

In some water bodies, lower low-flows in summer along with an overall warming trend will increase water temperatures, impacting fish suitability due to temperatures outside of the ecological amplitude of a number of native fish species. Ecological processes that occur in aquatic systems are significantly controlled by water temperature. If the natural trend of temperature and nutrient inputs is changed, the entire ecological process can be changed, having an effect on all organisms within that waterbody. We have begun to see trout kills occur in lakes that have never had kills in the past; or at times of the year which are totally unexpected. Unlike streams, where the water is regularly changing, or large lakes, where the volumes and depths of water tend to buffer climate change impacts, small lakes are a relatively small, shallow pockets of still water that often have a slow exchange rate. These waters are more easily influenced by climate change events, and the chemical and ecological processes (particularly in productive waterbodies) very complex and potentially devastating to the organisms living in the waterbody.

IMPLEMENTATION & RESOURCING

- Implementing this action would require additional resources.

RESPONSIBILITY

- Fish and Wildlife Section

OBJECTIVE: OFFSET ADVERSE CLIMATE CHANGE EFFECTS ON AQUATIC ECOSYSTEMS WITH IMPROVED MANAGEMENT PRACTICES AND ECOSYSTEM RESTORATION PROJECTS

ACTION 2.3 – INITIATE THE TEMPERATURE SENSITIVE STREAM PROTOCOL

WHAT IS TO BE DONE

- Initiate the Temperature Sensitive Stream (TSS) Protocol for the region. The Nicola River watershed is an example of a pilot project where TSS has included working to establish a GAR order. Consider additional candidate watersheds.

RATIONALE

Stream temperature conditions are critical for fish, and temperature shifts associated with climate change are predicted to be an important factor in various physical and biological watershed processes (Pike et al. 2010). It is envisioned that, by implementing existing and proposed regulations that help mitigate stream temperature sensitivity and by ensuring that appropriate management strategies are used at the operational level, maintaining riparian thermal buffering functions will help mitigate the predicted impacts of climate change ([Reese-Hansen et al. 2012](#)).

IMPLEMENTATION & RESOURCING

- For the Nicola watershed Pilot Project: Currently doing or start doing in current fiscal year with existing resources;
- For future candidate watersheds identification: Start in 2 to 5 years with existing resources or additional resources.
- Additional resources may be required if other watersheds are deemed Temperature Sensitive, but no other watershed has been identified in the region as this point. Once the Nicola designation is completed, investigation will begin into other potential watersheds.
- This is a high priority as it is already underway for the Nicola watershed and water temperature data is limited but does exist for other watersheds which would allow investigation to begin. Other factors that contribute to high priority level includes temperature related fish kill documented in the region this summer which would indicate potential temperature sensitivity.

RESPONSIBILITY

- Ecosystems Section

ACTION 2.4 –ESTABLISH LOW-FLOW THRESHOLDS

WHAT IS TO BE DONE

- Establish low flow thresholds from *Water Sustainability Act*, “Environmental Flow Needs Policy”.

RATIONALE

- Lower summer low-flows will decrease fish habitat.
- Sections 86-87 of the *Water Sustainability Act* provide protection of critical flows to ensure conservation of fish populations.
- Stream specific critical environmental flow thresholds must be provided to the Minister and the Comptroller in each case where drought threatens a fish population.
- Theoretical critical flow thresholds have been set using general guidelines (e.g., 5% of long-term mean annual discharge); however, these thresholds have not been tested or confirmed for individual streams.
- Furthermore, these thresholds do not vary according to water quality parameters (e.g., temperature) that are known to affect the quantity of flow required to sustain fish. Additional research is required to validate the flow thresholds.

IMPLEMENTATION & RESOURCING

- Work on setting critical flow levels is ongoing.
- There is interest in the university research community to advance the science in this area; however, seed money suitable for obtaining matching grants is limited.
- Steady long-term funding is required to advance projects on priority streams.
- When critical flow thresholds are not met and regulation of water licences results, there are significant economic losses to the agriculture sector. Therefore, sound science in this area is required to ensure the hardships are justified and environmental benefits are achieved.
- This is high priority for action based on input from ranchers impacted in 2015 by flow restrictions in the Coldwater River and based on concerns expressed by First Nations in Nicola, Shuswap and Okanagan.

RESPONSIBILITY

- Ecosystems
- First Nations
- Fraser Basin Council
- Ministry of Agriculture

ACTION 2.5 – MITIGATE ADVERSE EFFECTS FROM ADVANCE OF FRESHET

WHAT IS TO BE DONE

- Develop a guidance document outlining best management practices to delay freshet by select harvesting according to elevation and aspect.

RATIONALE

The advance of freshet timing will cause disruption to fish emergence, migration, feeding, and shifts in range of species. Research shows that if you log at lower elevations, the freshet can be delayed (depending on where you log and de-synchronization).

IMPLEMENTATION & RESOURCING

- This action can be completed within the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Stewardship staff

LINKAGES

- Harvesting Plans

ACTION 2.6 – PROMOTE IMPLEMENTATION OF BEST MANAGEMENT PRACTICES TO PROTECT AQUATIC ECOSYSTEMS

WHAT IS TO BE DONE

- Promote implementation of guidance documents outlining best management practices to reduce the risk of increased stream and lake temperature (e.g. lakeshore guidelines, work by J. Rex in Prince George).
- Work with qualified professionals to better implement riparian retention prescriptions.

RATIONALE

The promotion of best management practices will increase awareness among qualified professionals of riparian protection practices and improve implementation of these practices. For example, there is currently no regulatory requirement for riparian reserve on S4 streams. Research shows that a riparian reserve is necessary on S4 streams to avoid fish impacts. Best management practices have been established to reflect this research, but the best management practice needs to be promoted among qualified professionals.

IMPLEMENTATION & RESOURCING

- This action can be completed with existing resources and is a high priority. One upcoming opportunity to promote implementation of these best practices is the expiry, review and renewal of Forest Stewardship Plans occurring in the next couple of years. In this review, staff should raise awareness among licensees of the added vulnerability of streams should be considered and encourage licenses to commit to best management practices.

RESPONSIBILITY

- Stewardship staff
- Range staff
- Tenure staff

LINKAGES

- Rex *et al.* (2011). FLNRO Extension Note: [Small Stream Riparian Retention: The Prince George Small Streams Project](#).
- Tschaplinski, Peter J. (2010). [State of Stream Channels, Fish Habitats, and their Adjacent Riparian Areas](#): Resource Stewardship Monitoring to Evaluate the Effectiveness of Riparian Management, 2005–2008.

ACTION 2.7 – EXPAND DEVELOPMENT OF ENVIRONMENTAL FARM PLANS

WHAT IS TO BE DONE

- Encourage development of Environmental Farm Plans to provide farmers with financing to undertake riparian restoration.

RATIONALE

The Temperature Sensitive Stream designation currently applies only to the management of riparian areas on Provincial forest lands, not on private lands. The valley bottom streams with extensive private land ownership often have the highest values for salmonid spawning and rearing (e.g., Nicola, Salmon, Bessette, Louis) yet there are limited legal protections of those riparian areas on private lands. A currently available tool to manage riparian areas on private lands is the development of Environmental Farm Plans. Once an Environmental Farm Plan is in place, a farmer is eligible to receive funding for riparian restoration projects.

IMPLEMENTATION & RESOURCING

- There is funding available to ranchers to do riparian restoration but they must have an Environmental Farm Plan first.
- Encouraging the development of Environmental Farm Plans and riparian restoration can be done with existing resources.

RESPONSIBILITY

- Range staff
- Ecosystems Section

LINKAGES

- Environmental Farm Plans (provide financing for riparian restoration)

ACTION 2.8 – RESTORE FISH HABITAT LOST THROUGH INCREASED STORM AND FLOOD INTENSITY AND FREQUENCY

WHAT IS TO BE DONE

Fish habitat protection and restoration from increased flood intensity and frequency:

- Identify vulnerable systems for productivity monitoring;
- Inventory impacts and potential restoration approaches;
- Inventory ecosystems for vacant areas such as lakes, spawning and rearing habitat for potential stocking.

RATIONALE

Increased storm and flooding intensity is projected, which can cause reduced channel stability and structure, increase sediment loading, and decrease egg to fry survival.

IMPLEMENTATION & RESOURCING

- This action can be commenced in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Fish and Wildlife Section

OBJECTIVE: REDUCE DAMAGE TO ECOSYSTEMS FROM INVASIVE SPECIES

ACTION 2.9 – ENHANCE INVASIVE SPECIES MANAGEMENT

WHAT IS TO BE DONE

- Continue monitoring and mapping invasive species (terrestrial and aquatic species) infestations
- Identify non-native species that may increase in prevalence and distribution with climate change. Limit risk of introductions for these non-native species.
- Increase invasive species management beyond current levels to more proactively reduce the risk to ecosystems and resource use:
 - Increase operational trials with control methods for invasive species and create a strategy for effective management
 - Establish road density goals which fix or minimize the negative effects on the land base by controlling or reducing the spread of invasive species
 - Control recreation activities
 - Appropriately expand control of invasive plants beyond biocontrol to minimize the spread of invasive plants to protect ecosystems and resource use
- Promote the use of [BC Invasive Species Reporting Apps](#)

Report Priority Invasive Species



- **Report-Invasives BC** app for [iPhone](#); Android version to be released soon!
- **Report-A-Weed BC** apps for [iPhone](#) or [Android](#)
- The **Report-a-Weed** tool in the online [IAPP Map Display](#) application
- Our [online report form](#)
- **Invasive Mussel Reports:** BC Conservation Officer Services Hotline: **1-877-952-7277**

RATIONALE

Climate change will increase the amount of habitats that will be susceptible to the spread of invasive plants, putting wildlife, ecosystems and the associated resource uses at risk.

IMPLEMENTATION & RESOURCING

- There is currently considerable effort to reduce invasive weeds and efforts within the Fish and Wildlife Section. For example, this section has worked with the border agency to proactively prevent the spread of the quagga mussel by stopping boats at the border to check for the invasive mussel.
- Additional resources would help expand current efforts.
- This action is a high priority. The magnitude of damage with the introduction of an invasive species is high and control is difficult once species is introduced.

RESPONSIBILITY

- Ecosystems section
- Fish and Wildlife
- Range
- Stewardship

3) WILDLIFE

GOAL: MAINTAIN OR PROMOTE NATIVE WILDLIFE POPULATIONS AND HABITAT

OBJECTIVES

- Address gaps in knowledge, planning, and management around climate change risks to native species
- Enhance ability of wildlife to adapt to climate change

Projected changes that could impact wildlife include:

- Wildlife and trophic interactions (e.g. predation) will be particularly affected by changes in snowpack and freeze-thaw regimes (impacts vary by species)
- Increased fire could affect caribou habitat negatively and moose habitat positively
- Increased disturbance (and salvage harvesting) of old-growth management areas will result in decline of old seral forest and affect the character of reserved areas
- Wildlife tree patches face increased risk of tree mortality that will affect their value
- Deciduous trees, including trembling aspen and paper birch, that provide critical habitat for many birds and other species, may be lost from dry ecosystems
- Increase in wildlife diseases and other wildlife health issues
- Increase in functional winter range
- Increase in non-native species
- Increased temperatures could strongly and negatively impact wildlife associated with alpine habitat

OBJECTIVE: ADDRESS GAPS IN KNOWLEDGE, PLANNING AND MANAGEMENT AROUND CLIMATE CHANGE RISKS TO NATIVE SPECIES

ACTION 3.1 – MONITOR AND ASSESS CLIMATE CHANGE RISKS TO NATIVE SPECIES & INCORPORATE CLIMATE CHANGE INTO SPECIES RECOVERY OR MANAGEMENT PLANS

WHAT IS TO BE DONE

- Identify, native species most at risk from climate change and clarify adaptation priorities. Use this information to inform species management decisions (e.g. maintaining or enhancing habitat protection and connectivity).
- Incorporate climate change considerations into species management plans, e.g. recovery strategies, and management plans.

RATIONALE

There are gaps in knowledge on how wildlife will respond to climate change and what wildlife species are most sensitive to climate change. Consequently, many species management plans do not incorporate climate change considerations.

IMPLEMENTATION & RESOURCING

- Many broad, climate actions for species at risk are already mentioned in planning documents because benefits go beyond climate change (e.g. habitat protection, connectivity, reducing

cumulative effects to promote resilience. Etc.). Some work is currently being done by staff directly or through partnerships with other Ministry's (e.g. MoE-BC Parks) universities or other groups.

- Additional resources to conduct a preliminary assessment of climate risk and issues, based on collating existing information from other sources including partnerships, is estimated at \$20k for 40 threatened or endangered species.
- Priority is estimated as medium. Threatened or endangered species already are at high risk nationally, based on COSEWIC assessment. Climate issues are not expected to impact these species immediately but planning and implementation takes substantial time so should begin soon.

RESPONSIBILITY

- Fish & Wildlife, Ecosystems

LINKAGES

- [Climate Change Vulnerability Database](#)
- [Washington Wildlife Habitat Connectivity Working Group](#)
- Trans-boundary Climate Connectivity Project

ACTION 3.2 – PROMOTE AWARENESS OF SPECIES AT RISK NEEDS IN A CHANGING CLIMATE AMONG LAND MANAGERS

WHAT IS TO BE DONE

- Provide information relating to species at risk needs in a changing climate to land managers.

RATIONALE

There is a lack of awareness among land managers around the needs of species at risk under a changing climate.

IMPLEMENTATION & RESOURCING

- The main decision makers for species at risk needs in a changing climate include First Nations, provincial Crown, local government and private land managers. FLNRO has the greatest opportunity to influence decisions on provincial Crown land, which it manages, but partnerships with First Nations, other provincial government ministries and local government also are important. Front counter BC staff, forestry and range managers are key target audiences within FLNRO. Transportation and Highways and Agriculture are key audiences in other Ministries.
- Activities in this area are ongoing in some parts of the region but could be expanded across the whole region. In the Okanagan, the ecosystems section hosts workshops with qualified professionals and local government on best management practices for development on private land. Species needs in a changing climate could be a focus or topic at these workshops, and these workshops could occur in other parts of the region. This action will be implemented over the next 2 to 5 years and can be resourced mostly with existing resources. This workshop could be extended to other programs in FLNRO, other Ministries and First Nations.
- Signed stewardship agreements have been developed with local government and other Ministries for protection and specific management commitments for species at risk habitat at

key sites that do not have other available protection mechanisms. These agreements provide site specific detailed information to key managers and could be expanded to other groups. Funding has been available through LBIS and internal budgets.

- Numerous partnerships provide conservation information to local government and private land stewards (e.g. South Okanagan Similkameen Conservation Program, Okanagan Similkameen Stewardship Society, Okanagan Similkameen Conservation Alliance, etc.). Consistent messaging could be provided to these, and other groups for dissemination. They often obtain funding from outside sources but capacity could be extended if additional funds are available.
- Priority is estimated as medium. Threatened or endangered species are already at high risk nationally, based on COSEWIC assessment. Climate issues are not expected to impact these species immediately but planning and implementation takes substantial time so should begin soon.
- Additional resources to extend internal capacity and leverage outside funds are estimated at \$5000/year

RESPONSIBILITY

- Ecosystems Section, Fish & Wildlife

LINKAGES

- Qualified Professional Workshops
- Referrals on local government official community plans
- Stewardship agreements with local government
- Environmental Farm Plan
- Private land Conservancies (i.e. The Nature Trust of BC, The Nature Conservancy of Canada)
- Stewardship Partnerships (e.g. South Okanagan Similkameen Stewardship Program, Okanagan Collaborative Conservation Partnership)

ACTION 3.3 – MONITOR AND RESEARCH WILDLIFE DISEASES

WHAT IS TO BE DONE

- Monitor for outbreaks of wildlife disease
- Increase research on wildlife disease (for e.g. how to treat new diseases)

RATIONALE

Disease vectors may thrive in warmer climates and not go through winter die-offs as has happened in the past. A warming climate may increase wildlife pathogens, e.g. BTH, EHD (blue tongue), tick borne diseases.

IMPLEMENTATION & RESOURCING

- Additional resources are needed to implement this action.

RESPONSIBILITY

- Fish and Wildlife section

LINKAGES

- Provincial Veterinarian

OBJECTIVE: ENHANCE ABILITY OF WILDLIFE TO ADAPT TO CLIMATE CHANGE

ACTION 3.4 – ENHANCE HABITAT CONNECTIONS AND REDUCE HABITAT FRAGMENTATION

WHAT IS TO BE DONE

Based on an understanding of what species are most at risk from climate change, provide habitat connections (e.g. suitably sized habitat corridors, artificial wetlands for amphibian connectivity, crossing structures for highways) at key places to facilitate wildlife movement. Specific actions/considerations to enhance habitat connections include:

- Identify and protect, or manage better, wildlife habitats that are resilient to climate change;
- Work with BC Parks and private conservancies to enhance habitat connectivity through:
 - Replicate protected movement paths for species so that there is redundancy and increased resilience;
 - Determine land ownership adjacent to key crossing areas to identify pieces of land that are key to wildlife movement and at risk to being developed or in some way alienated from providing wildlife connectivity. Protect these key areas;
 - Improve management of the habitat matrix around and between protected areas to increase wildlife movement through the landscape.

RATIONALE

- Past human activities have degraded and fragmented habitat, making dispersal in response to climate-related disturbance more difficult for specialist species.

IMPLEMENTATION & RESOURCING

- Some actions are underway now using staff resources, inter-ministry communications (e.g. MOE-BC Parks) and partnerships (e.g. UBC Okanagan, Central Okanagan Regional District, The Nature Trust, The Nature Conservancy of Canada). Additionally, more site specific work is needed to identify the best options, land ownership, high risk areas, and practical options for corridor protection.
- Additional resources will be needed to identify best options through GIS analysis (internal and partnerships) and especially for stewardship approaches to develop support for and implement protection (e.g. establish stewardship agreements, section 16 land act reserves, etc.) and management activities (e.g. habitat maintenance and enhancement, invasive plant control, road de-activation, etc.). Costs are estimated at \$10k/yr for planning. Enhancement funds may be considerable but should be identified more accurately after planning is complete. Funds may be obtained through retargeting existing resources, partnerships or external enhancement programs such as Habitat Conservation Trust Fund)
- Priority is estimated as high. Threatened or endangered species already are at high risk nationally, based on COSEWIC assessment. Climate issues are not expected to impact these species immediately but planning and implementation takes substantial time so should begin soon. In addition, low elevation habitats, particularly grasslands and dry forests, have more cumulative effects and are at greater risk of permanent loss than other bio-geoclimatic zones, thus reducing options for corridor protection, if it is not considered reasonably soon.

RESPONSIBILITY

- Ecosystems Section, Fish & Wildlife

ACTION 3.5 – REDUCE DAMAGE TO WILDLIFE FROM WILDFIRE

WHAT IS TO BE DONE

- Conduct analysis of risk to habitat from wildfire, especially habitat for species at risk. Consider the sensitivity of species to catastrophic fire (e.g. burrowing owl is especially sensitive).
- In wildfire planning, create safe areas for wildlife (e.g. wildlife staff to consider providing input into District Forest Management Plans on high priority wildlife areas).
- Proactive fuel management.

RATIONALE

- Climate change will increase the frequency, intensity, and magnitude of wildfire, which will increase mortality of wildlife.

IMPLEMENTATION & RESOURCING

- Additional resources are needed to implement this action.

RESPONSIBILITY

- Fish and Wildlife Section
- Stewardship Staff

ACTION 3.6 – OFFSET AND MITIGATE ADVERSE EFFECTS ON WETLANDS

WHAT IS TO BE DONE

- Identify highest risk wetlands (e.g. small and shallow wetlands), and minimize impacts on these wetlands from other activities (e.g. cattle watering, recreation)
- Habitat enhancement for wetland or wetland creation
- Assisted migration/transplant
- Enhance wetland connectivity to ensure dispersal corridors are maintained for amphibians between breeding wetlands and upland living and dispersal routes. Consider needs of waterfowl for wetland connectivity as well.

RATIONALE

Wetlands and species living in wetlands could be adversely affected by climate change because of reduced water levels and isolation of wetlands in lower elevations.

IMPLEMENTATION & RESOURCING

- Additional resources are required to implement.
- Wetland conservation is a high priority, driven by moose habitat requirements and First Nations moose hunting activities.

RESPONSIBILITY

- Ecosystems Section
- Range staff
- Recreation Sites and Trails Branch

4) FOREST ECOSYSTEMS

GOAL - FOSTER RESILIENT FOREST ECOSYSTEMS THAT PROVIDE A RANGE OF VALUES INCLUDING WATER, WILDLIFE HABITAT, RECREATION, FORAGE, AND FORESTRY

OBJECTIVES

- Promote forest ecosystems that are suited to a changing climate (suited equates to healthy, productive and resilient)
- Manage in anticipation of natural disturbance processes, including fire, insects, pathogens and abiotic factors
- Reduce adverse effects of climate change on values supported by forest ecosystems

Projected changes that could impact forest ecosystems include:¹⁰

- It is anticipated that ecosystems will undergo unpredictable ecological shifts. As ecological communities disassemble and reassemble, species will decline, move or adapt. Many species will not be able to migrate quickly enough to keep pace with suitable climate. During this transition, ecosystems will be strongly influenced by increasing natural disturbances, such as fire, drought and forest health issues.
- Increased tree mortality from fires and drought stress. Pulses of mortality will coincide with warmer, drier climatic cycles and follow insect and disease outbreaks. Drought-stressed trees are more susceptible to certain insects and pathogens; e.g., lodgepole pine is susceptible to a range of disturbance agents when stressed.
 - In dry ecozones, risk to stand establishment and mortality could be very high.
- Ecosystems may shift and productivity could change dramatically.

OBJECTIVE: PROMOTE FOREST ECOSYSTEMS THAT ARE SUITED TO A CHANGING CLIMATE

ACTION 4.1 – MAINTAIN TREE SPECIES DIVERSITY AT THE LANDSCAPE LEVEL

WHAT IS TO BE DONE

Incorporate landscape level tree species diversity into planning and monitoring systems:

- Encourage licensees, BCTS, and FFT programs to retain naturally-occurring and regenerating species, including deciduous trees and shrubs and to plant a diverse mix of species at the landscape scale.
- Systematically analyze trends in regeneration performance to evaluate the success of enhanced diversity efforts.

¹⁰ Source: FLNRO extension note titled “Adapting forest and range management to climate change in the Thompson-Okanagan Region” & Engagement with T/O Region staff who work in this area during the planning process (October to November 2015)

RATIONALE

This action recommends enhancing tree species diversity at the *landscape level* rather than the *stand level*. While “Enhancing tree species diversity” is a common solution identified for enhancing resiliency in forests, it is important to understand that this principle may get applied differently depending on the natural tree species composition for an area. In the Thompson/Okanagan region, it is quite natural for some stands to be dominated by pine species. At other sites (such as the Interior Cedar Hemlock), diversity is naturally occurring within stands.

IMPLEMENTATION & RESOURCING

- This action is ongoing and will continue over the next five years. The action can be resourced with existing resources.
- This is a high priority. The magnitude of potential damage is high (for example, experience with Mountain Pine Beetle) and the changing climate increases the risk of forest pests and diseases that may impact one species but not others.

RESPONSIBILITY

- Stewardship and Silviculture staff

LINKAGES

- [Chief Forester Guidance on Tree Species Composition at Stand and Landscape Level](#)

ACTION 4.2 – ENCOURAGE PLANTING PRACTICES TO ENHANCE FOREST RESILIENCY

WHAT IS TO BE DONE

- Use orchard (Class A) seedlots where available.
- Where orchard seedlots are not available for cutblocks over 5 ha, encourage licensees, and require FFT and BCTS foresters, to use 2 natural stand (Class B or B+) seedlots, preferably from elevations lower than the cutblock, while complying with the Chief Forester Standards for Seed Use.

RATIONALE

- Orchard seedlots have a wider adaptive range and greater growth rates or pest resistance compared with natural stand seedlots, and should always be used when available.
- Movement of seed upward will help match seedlots to the climates that they are best adapted to over the rotation, and should therefore reduce the risk associated with extreme climate events and pest outbreaks.
- Using two Class B seedlots (where Class A seed is not available) will widen the range of climate tolerance, and help buffer climate uncertainty.

IMPLEMENTATION & RESOURCING

- This action can be implemented over the next 2 to five years with existing resources.
- This is a high priority action because of the extent of planting going on in the Region and the cost to having significant impacts to timber supply.

RESPONSIBILITY

- Stewardship
- BCTS
- Forests for Tomorrow

LINKAGES¹¹

- Pedlar, John H., *et al.* (September 2012). "Placing Forestry in the Assisted Migration Debate". *BioScience*, Vol. 62, No. 9, pg. 835-842.
- Leech, Susan March, *et al.* (2011) "Assisted Migration: Adapting forest management to a changing climate". *BC Journal of Ecosystems and Management*. Volume 12 (3), pg. 18-34.
- Assisted Migration Bulletin. (2013). "Assisted Migration Adaptation Trial". January 2013, Issue 2.

ACTION 4.3 – UPDATE STOCKING STANDARDS

WHAT IS TO BE DONE

- Update existing stocking standards to address the new BEC and provide guidance with respect to promotions and demotions of tree species based on climate change projections.
- Consider increasing planting density to buffer drought mortality in the future.
- Work with licensees to develop single set of updated stocking standards for the Region.

RATIONALE

- Stocking standards have not previously considered climate change.

IMPLEMENTATION & RESOURCING

- Research section is continually updating BECs based on PEMs and field monitoring, and updating stocking standards. This activity will continue over the next five years and can be implemented with current resources.
- This action is a high priority.
- A deliverable that will be completed within the next 1-2 years are updated stocking standards for the Thompson/Okanagan region.

RESPONSIBILITY

- Research and Silviculture Section

ACTION 4.4 – INCORPORATE NEW CLIMATE SCIENCE ON FOREST ECOSYSTEMS

WHAT IS TO BE DONE

- Use Provincial Research Teleconference to have an annual discussion on new climate science and implications for management.
- Present latest findings at the Southern Interior Silviculture Conference.
- Communicate implications for management.

¹¹Documents can be found here: <https://www.for.gov.bc.ca/hre/forgen/interior/AMAT.htm>

RATIONALE

There's currently no mechanism to ensure that new and relevant climate change science developments are incorporated into management considerations.

IMPLEMENTATION & RESOURCING

- This action will be implemented over the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Research and Silviculture

OBJECTIVE: MANAGE IN ANTICIPATION OF NATURAL DISTURBANCE PROCESSES

ACTION 4.5 – EXPAND POST-FREE GROWING MONITORING

WHAT IS TO BE DONE

- Continue with the updated Stand Development Monitoring under the FREP program as a priority protocol.
- Investigate better methods for more widely monitoring post-free growing stands (e.g. Change Management Inventory and Young Stand Monitoring).
- Integrated Monitoring team to consider post-free growing monitoring review project.

RATIONALE

There is currently little systematic monitoring of post-free growing stands. Current timber supply estimates are based on assumptions with non-verified field data. Original silviculture plans did not consider climate change.

IMPLEMENTATION & RESOURCING

- Internally, a small amount of stand development monitoring is occurring with the FREP Program.
- Additional data could be collected through contracting out additional stand development monitoring.

RESPONSIBILITY

- Stewardship staff
- Forest Health
- Research and Silviculture staff

LINKAGES

- [FREP Program Stand Development Monitoring Protocol](#)

ACTION 4.6 – MONITOR AND MANAGE FOREST HEALTH ISSUES EXACERBATED BY CLIMATE CHANGE

WHAT IS TO BE DONE

- Continue aerial overview and detailed surveys, continue management treatments as appropriate.

- Determine likely increases in forest pathogens and pest incidence based on projected climate change.
- Within forest health strategies, identify or recommend potential management practices to address new or anticipated forest health issues.
- Encourage management of forest health.
- Long-term research on emerging pests.

RATIONALE

Increasing forest insects and diseases in a changing climate poses a risk to future timber supply.

IMPLEMENTATION & RESOURCING

- This is a high priority action that is ongoing within T/O Region. The Forest Health group is actively analyzing climate change implications for forest health (e.g. pest and insect outbreaks).
- Additional resources may be needed to support ongoing research on new threats (~30,000 to \$50,000 / year)

RESPONSIBILITY

- Forest Health

LINKAGES

- Overview of Forest Health Conditions in Southern British Columbia

OBJECTIVE: REDUCE ADVERSE EFFECTS OF CLIMATE CHANGE ON VALUES SUPPORTED BY FOREST ECOSYSTEMS

ACTION 4.7 – ASSESS AND MANAGE RISKS TO OLD GROWTH MANAGEMENT AREAS

WHAT IS TO BE DONE

Determine how to maintain old growth management area expectations with a changing climate:

- Utilize report on FREP Landscape Level Biodiversity to determine current baseline levels
- Conduct a longer term risk assessment for likelihood of OGMA persistence given projected increase in natural disturbance under changing climate
- Use Integrated Monitoring Team's OGMA Assessment in TOR and follow recommendations
- Establish a strategy for recruitment post-disturbance

RATIONALE

Old forest will decline due to increased disturbance and harvesting, threatening associated old forest values. In 2014, the Integrated Monitoring Team completed an assessment on OGMA's and recommendations in this report have not yet been implemented.

IMPLEMENTATION & RESOURCING

- Additional resources are required to complete this action. The Region needs to contract a biologist to do inventory of OGMA values. Having this inventory will allow for better forest planning around how to maintain and replace OGMA values that may be vulnerable to natural

disturbance. Approximately \$30,000 to \$50,000 / year for 3 years would be needed to complete this action.

- High – medium priority, to be completed in next couple of years.

RESPONSIBILITY

- Cumulative Effects Section (Land and Resource Specialist)

LINKAGES

- Assessment of OGMA within Thompson/Okanagan Region (July 2014)

ACTION 4.8 – INCORPORATE CLIMATE CHANGE INTO CUMULATIVE EFFECTS ASSESSMENTS & CONSIDER CUMULATIVE EFFECTS ASSESSMENTS IN FUTURE ANNUAL ALLOWABLE CUT DETERMINATIONS, AND FORAGE AND TIMBER OBJECTIVES

WHAT IS TO BE DONE

- Incorporate climate change into cumulative effects assessments.
- Use cumulative effects assessments for timber supply and other relevant values (e.g. fish and wildlife) to inform future supply estimates and annual allowable cut determinations.
- Consider an integrated strategy that establishes forage and timber objectives for all habitat types in consideration of cumulative effects assessments (that incorporate climate change) on forage and timber values as well as other resource values. Recommendations for this strategy include:
 - Look for opportunities to increase the economic return and crop diversity on cut-blocks by integrating forage and timber objectives;
 - Forage and timber objectives should consider the amount of forage required by wildlife populations and to encourage a world competitive ranching sector and timber processing industry;
 - Adjust forage supply and allocations to meet economic and stewardship objectives for livestock and wildlife.

RATIONALE

Forage and timber supply objectives are not being proactively integrated to meet government's stewardship and economic mandates.

IMPLEMENTATION & RESOURCING

- Cumulative effects assessments are ongoing and are resourced. Integrating climate change into cumulative effects assessments is on current workplans within the next 5 years.

RESPONSIBILITY

- Cumulative Effects Section
- District Managers and staff
- Forest Health

LINKAGES

- [BC Cumulative Effects Framework](#)

ACTION 4.9 – MANAGE CLIMATE CHANGE RISKS TO LONG TERM TIMBER SUPPLY

WHAT IS TO BE DONE

- Identify threats to a viable long term timber supply in the region.
- Add to Timber Supply Review (TSR) additional sensitivity assessments to gauge greater fire risk and uncertainty on timber supply.
- Consider climate change in forest health strategies to best maintain the timber supply over time in the region.
- Consider climate change in integrated silviculture strategies.

RATIONALE

The risks to regional timber supply from climate change are not well understood at this point in time.

IMPLEMENTATION & RESOURCING

- This action can largely be completed in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Stewardship and Silviculture
- Forest Health
- Cumulative Effects

LINKAGES

- [BC Integrated Silviculture Strategies](#)
- Overview of Forest Health Conditions in Southern British Columbia

ACTION 4.10 – ENGAGE LICENSEE GROUPS

WHAT IS TO BE DONE

Organize discussions with licensee groups (TSA committees) to promote harvest practices appropriate to changing climate, including:

- Enhanced soil conservation and protection;
- Windfirm block boundaries and windfirm riparian management areas;
- Adequate road drainage structures and rehabilitation measures;
- Forest cover retention adjacent to wetlands, seepage areas and streams;
- Timely action to mitigate insect/disease outbreaks;
- Alternative harvesting on dry sites to retain shelter and moisture.

RATIONALE

Lack of awareness and action among licensee groups around the consequences of climate change for the forest industry and adaptation actions that can be taken to reduce negative effects.

IMPLEMENTATION & RESOURCING

This action will be implemented over the next 2 to 5 years. Expected deliverables under the action include workshops with TSA committees in the region on adapting forestry to changing climate. Existing

resources will fund a few workshops and additional resources (~\$10,000 to \$30,000) would allow for more workshops.

RESPONSIBILITY

- District Managers and staff
- Research and Silviculture staff

LINKAGES

- [ABCFP Position – Climate Change, Forests and the Practice of Professional Forestry](#)

5) GRASSLAND ECOSYSTEMS

GOAL - FOSTER RESILIENT GRASSLAND ECOSYSTEMS THAT PROVIDE A RANGE OF VALUES INCLUDING WATER, WILDLIFE HABITAT, RECREATION, AND FORAGE

OBJECTIVES

- Assist native grassland species in adapting to changing climate
- Promote sustainable forage levels in a changing climate
- Offset and/or mitigate adverse effects of climate change to grassland species and ecosystems at risk through improved management practices
- Reduce ecosystem damage from invasive species

Projected changes that could impact grassland ecosystems include:¹²

- Ecosystems may undergo regime shifts (e.g. from forest to shrubs or grassland).
- Increased risk of drought and increased evapotranspiration from higher temperatures will reduce soil moisture.
- Productivity will decrease at lower elevations due to increased soil moisture deficit. Plant communities will be altered toward more drought-tolerant species with possible increases in invasive plants. Livestock grazing may exacerbate these effects if not properly managed. Deeply rooted perennial grasses will be the most resistant to climate change effects.
- Many desirable native plant species, including bunchgrass and rough fescue, may be unable to migrate quickly enough to follow the climate envelopes to which they are adapted and will not out-compete faster-dispersing invasive plants such as cheatgrass.
- Carrying capacity on crown range tenures may increase or decrease.
- Closed basin ponds may be reduced or lost resulting in loss of livestock watering sources and aquatic/riparian habitat.
- Climate change will increase degradation of rangeland through:
 - Increased soil moisture deficit will reduce productivity and shift plant communities to more drought-tolerant species;

¹² Source: FLNRO extension note titled “Adapting forest and range management to climate change in the Thompson-Okanagan Region” & Engagement with T/O Region staff who work in this area during the planning process (October to November 2015)

- Extreme events, e.g. soil erosion during intense rainstorms and wildfires;
 - Creation of gaps that are susceptible to colonization by invasive species.
- Degradation of rangeland has implications for the long term supply of forage.

ACTION 5.1 – ASSIST MIGRATION OF NATIVE GRASSLAND SPECIES

WHAT IS TO BE DONE

- Explore the development of a strategy to assist in migration of the most vulnerable and important native grassland species, particularly bunchgrasses.

RATIONALE

Some important native grassland species will not be able to migrate/adapt to a changing climate as quickly as invasive grassland species. FLRNO does not currently have a strategy to assist native grassland species in migration.

IMPLEMENTATION & RESOURCING

- Implementing this action will require additional resources. Implementation would involve the development of bunchgrass plug nurseries, research on strategies and methods for planting plugs, and operational planting. Additional resources required for research and pilot projects would be in the range of \$25,000 - \$150,000. Full implementation at a moderately aggressive level would cost up to \$1 million per year.
- Priority:
 - Research and pilot projects: high priority. This should start early to ensure we are ready when full implementation is needed.
 - Full implementation: low – medium priority. Not immediately necessary, but we should proceed in stages in the medium term.

RESPONSIBILITY

- Range staff/Regional forest science programs: TOR Research staff to work with Kalamalka Research Station to develop technology for growing bunchgrass plugs, and share this information with industry to encourage creation of private nurseries. TOR Research staff to devise strategies and methods for planting plugs, and implement pilot projects. Regional staff administer planting contracts.

ACTION 5.2 – MAINTAIN OR ESTABLISH LANDSCAPE CONNECTIVITY

WHAT IS TO BE DONE

- Clearly identify optimal grassland connectivity corridors based on ecological mapping, rare species occurrences, movement barriers and opportunities.
- Consider cumulative effects of climate change combined with other activities in connectivity and fragmentation of grassland ecosystems (habitat) in management decisions.
- Work with BC Parks, land conservancies, and local governments to maintain or establish landscape connectivity for grassland ecosystems.

RATIONALE

Grasslands are rare on the landscape in BC (<2%), one of 2 biogeoclimatic zones in BC considered Red listed (considered endangered or threatened) due to cumulative effects and support about 1/3 of BC Species at Risk. The distribution of grasslands is expected to expand due to climate change. However, individual species are expected to move at different rates, depending on their dispersal capabilities. This may result in dramatic changes to ecological communities that some species can't survive. Other species may not be able to move in response to new climatic conditions unless movement corridors are available.

IMPLEMENTATION & RESOURCING

- Additional resources would be required to implement this action.
- This is a high priority action due to the rarity of grassland, importance for numerous species at risk, high cumulative effects and high risk.

RESPONSIBILITY

- Ecosystems
- Range staff
- Regional forest science programs

LINKAGES

- Partnerships like Nature Trust and Nature Conservancy of Canada

ACTION 5.3 – CONSIDER CLIMATE CHANGE IN RANGE USE PLANNING

WHAT IS TO BE DONE

Realign range use planning to be responsive to climate change effects, including the consideration of the following:

1. Should the recommended season of grazing use in the range tenure change?
2. Are the recommended utilization levels still appropriate?
3. Do fencing, water developments and salt locations need to be changed to promote more complete utilization of the range tenure area and minimize areas of overgrazing?
4. Is the mapping of forage plant communities within the tenure still accurate?
5. Are water sources in the range tenure adequate for the planned use and environmental flow needs currently and over the long term?
6. Are actions needed to prevent or remove invasive species?
7. Is there a plan for the unexpected loss of forage to natural events?

RATIONALE

Current range use planning may address some of the effects of climate change without realizing the cause. Other effects may be overlooked. Building a climate change focus into range use planning will create awareness and ensure that all potential effects of climate change are addressed.

IMPLEMENTATION & RESOURCING

1. Existing resources.

2. Existing resources.
3. Existing resources.
4. Additional resources.
5. Existing resources.
6. Existing resources.
7. Existing resources.

RESPONSIBILITY

1. District range staff
2. District range staff
3. Tenure holder/District range staff
4. Range Branch
5. Tenure holder/District range staff
6. Invasive Plant program/District range staff
7. Range Branch/District range staff

LINKAGES

- Range Use Planning Guidelines

ACTION 5.4 – DEVELOP AND IMPLEMENT FORAGE SUPPLY ANALYSES

WHAT IS TO BE DONE

- Complete forage supply analyses with adjustment factors for possible climate change effects.
- Reduce Animal Unit Month (AUM) allocation where necessary.

RATIONALE

- Forage supply analyses currently do not consider potential future changes due to climate change. Forage supply analyses could provide additional information by looking into the future based on likely climate change scenarios. The status quo output would relate to current and short-term management, while other versions of output would relate to medium-term management under moderate and extreme climate changes scenarios. This creates awareness and is useful for proactive planning for future reductions or increases.
- Where identified by forward looking forage supply analyses, AUM reductions could be initiated progressively and with sufficient lead time to reduce impacts on the tenure holder's business.

IMPLEMENTATION & RESOURCING

- Some additional resources are required to implement. In order to accomplish predictions of future forage supply, work is required to develop supporting information on the effects of climate change scenarios on:
 - 1) changes to forage production across different vegetation types;
 - 2) changes to cattle access; and
 - 3) changes to livestock water sources.
 - This could be delivered by a two-year contract of \$80,000 - \$150,000.

- Priority:
 - A contract to develop information on the response of forage to predicted climate change is a high priority. It may take 3-4 years before information supplied by this process is in a useable form.
 - Forage supply analyses are time consuming and may take a decade to complete for all TOR. Already completed forage supply analyses could be retro-fitted to add climate change adjustments under a medium priority.
 - The process of reducing AUM allocation where necessary if identified by a forage supply analysis is already in place for current management and so problems are being resolved regardless of the cause. It is a medium priority to start to address potential AUM reductions resulting from predicted changes to forage supply.

RESPONSIBILITY

- Range staff/District staff

LINKAGES

- Current forage supply analysis procedures used by Range Branch.

ACTION 5.5 – MITIGATE SOIL EROSION

WHAT IS TO BE DONE

Increase effort in mitigating soil erosion on grasslands by:

- Identifying vulnerable areas to soil erosion (through soil mapping)
- Identifying how activities in the entire watershed may affect the soil-water regime (i.e. upland harvesting, grazing, recreational use, etc.)
- Managing grazing distribution to ensure that the level of use is still appropriate with changing climate

RATIONALE

There is an increased risk of soil erosion due to climate change because of the predicted change in the timing and amount of precipitation and increase in wildfires. The productive capacity of grassland areas would be greatly diminished because of soil erosion, which then has implications for carbon storage, wildlife habitat, and forage availability.

IMPLEMENTATION & RESOURCING

- Additional resources would be necessary to identify and map vulnerable areas with respect to soil and hydrological values. Predictive soil mapping is a tool that could be used along with LiDAR mapping of the grassland area that could accurately identify high-risk areas of concern. A contractor or graduate student with a high level of consultation with FLNRO research staff could implement this action.
- This is a high priority action because soil types and landscape hydrology are not changing, but this data would be valuable for decades. The occurrence of several high intensity rainstorm

events in the last two years have resulted in extensive soil erosion in southern interior grassland areas also emphasizes the importance and urgency of this work.

RESPONSIBILITY

- Range staff/District staff
- Forest science program

LINKAGES

- This initiative would link well with current and future range use planning as well as the predictive ecosystem mapping (PEM) that is being carried out by forest science researchers.

ACTION 5.6 – INCLUDE SPECIES AND ECOSYSTEMS AT RISK CONSIDERATIONS IN RANGE PLANNING

WHAT IS TO BE DONE

- Identify potential impacts from range management on species and ecosystems at risk from recovery planning documents and the BC Conservation Framework,
- Identify specific locations where risks are high using ecosystem mapping, conservation land and forage analysis using GIS.
- Identify and implement actions to reduce risks through range planning (e.g. rest rotation, seasonal timing, etc.)
- Conduct research to clarify potential impacts and effectiveness of mitigation through monitoring and adaptive management

RATIONALE

Impacts to grasslands from climate change will increase stress on species and ecosystems at risk, especially where cumulative effects are high.

IMPLEMENTATION & RESOURCING

- Actions to identify impacts, priorities and mitigation options are likely best done internally, with GIS support. However, staff capacity may benefit from contract support to address the large area and many tenures under consideration. A rough estimate of additional resources needed is \$10k per year.
- This is a high priority action due to the rarity of grassland, importance for numerous species at risk, high cumulative effects and high risk.

RESPONSIBILITY

- Range, Ecosystems, Fish & Wildlife

LINKAGES

- BC Parks

ACTION 5.7 – MONITOR HIGH ELEVATION GRASSLANDS AND EXAMINE HIGH ELEVATION GRAZING TENURES

WHAT IS TO BE DONE

- Monitor high elevation plant communities that are grazed. If losses occur, then consider reduction or elimination of grazing in these areas.

RATIONALE

High elevation grasslands will likely shrink in a changing climate. High elevation soils are sensitive to grazing. High elevation grasslands contain unique plant and animal species that do not occur on lower elevation grasslands. Climatic conditions are too harsh for tree growth and also result in slow recovery of the plant community from damage. A warming climate will result in encroachment of coniferous tree species, shading of the understorey, and eventual loss of many grassland plant species. Unlike the situation in lower elevation grasslands, there is no higher elevation (cooler) zone for highland species to escape to in a warming climate.

IMPLEMENTATION & RESOURCING

- Additional resources would be required to implement this action, such as additional staff or contractor to undertake monitoring. This action is a medium priority.

RESPONSIBILITY

- Range staff/District staff
- Regional forest science programs

LINKAGES

- Range Monitoring Guidelines

ACTION 5.8 – CONSIDER IMPACTS TO GRASSLANDS IN RECREATION PLANNING

WHAT IS TO BE DONE

- Avoid developing recreational opportunities in rangelands with lower levels or invasive plants or site gradation. Manage recreational opportunities to reduce the introduction and spread of invasive plants.

RATIONALE

Introduction of invasive plants is increasing as recreational use, particularly motorized recreation, grows. Climate change is also expected to exacerbate the spread of invasive species and be a stressor on many desirable native plant species. In the Thompson/Okanagan region there are many recreational users in lower elevation grasslands near the larger population centres. There are many examples of unmanaged recreation (areas where there are not legally established trail networks for motorized or non-motorized use). Steps need to be taken to avoid and/or have managed recreational activities only in areas where there is low risk of introduction and spread of invasive plants.

IMPLEMENTATION & RESOURCING

- Implementation could begin now, by coordinating with some existing planning processes such as the Thompson Rivers Natural Resource District ORV management strategy.
- In the next 2 to 5 years planning processes could be initiated for recreation/access management planning in the Okanagan Shuswap Natural Resource District and the Cascades Natural Resource District. For any new planning processes there would need to be resources associated as typically any recreation management would require resourcing for the infrastructure (such as staging areas, trail upgrades, outhouses etc) and/or any motorized closure typically has advertising costs associated as well as any archaeological work that may be required. It is difficult to estimate the cost without fully understanding the scope of recreational management needed in the Okanagan Shuswap and the Cascade natural resource districts, however it is likely that it could cost \$30K-\$50K/district to implement any recreation management actions.
- **Priority: Medium.** The impact is very likely from recreational activities however the losses are moderate to low as in many areas the recreation is occurring on pre-existing disturbed and established trails.

RESPONSIBILITY

- The planning portion of the action would be the responsibility of the planning staff (under the Resource Management group) with the direction from the Regional Management Team.
- The implementation of the actions from the planning would be the responsibility of district staff and the Recreation Sites and Trails staff.

ACTION 5.9 – OUTREACH TO USERS OF GRASSLANDS

WHAT IS TO BE DONE

- Prepare range clients for what they can expect in a changing climate. Engage in discussions on how herd management practices can adapt to unpredictable and episodic events such as droughts.
- Outreach to recreational user groups, especially motorized recreation groups, about the cumulative effects of recreational use and climate change on grassland ecosystems.

RATIONALE

- Climate change effects to grassland productivity may result in the need to reduce AUMs, which would have a significant impact on range clients. Proactive engagement around potential adverse effects from climate change will help to prepare range licensees for any necessary changes.
- Cumulative effects to grasslands may require extra management actions that may affect motorized recreation groups.

IMPLEMENTATION & RESOURCING

- This action can be completed in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Range staff/District staff
- Recreation Sites and Trails

6) NATURAL DISASTER MANAGEMENT, PUBLIC SAFETY & INFRASTRUCTURE

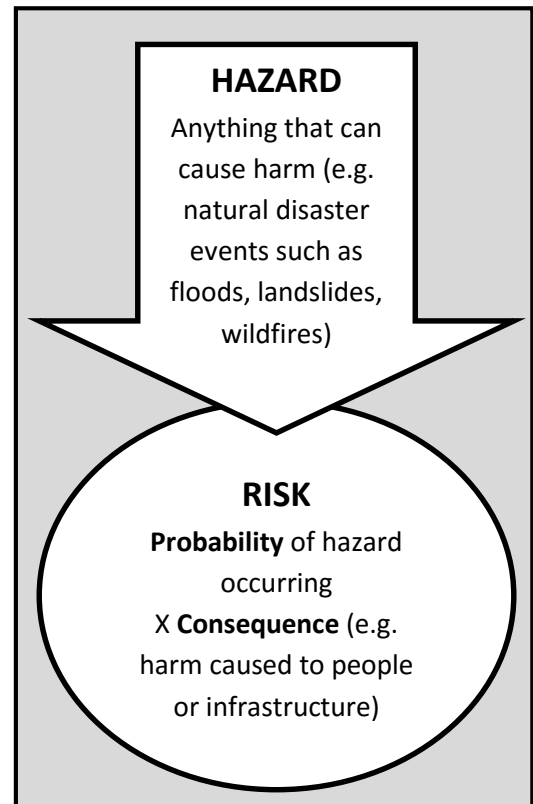
GOAL – REDUCE RISK TO THE PUBLIC AND INFRASTRUCTURE FROM FLOODING, WILDFIRES, STORMS, AND LANDSLIDES

OBJECTIVES

- Respond to flooding and landslide events
- Provide information on hydrology and landslides
- Reduce damage to infrastructure from flooding and landslide events
- Support integrated wildfire response across programs

Projected climate change effects relevant to public safety and infrastructure include:

- Increase in frequency and severity of storms will increase the frequency and severity of flooding and landslides (especially following periods of drought) (FLNRO 2015).
- Increases in temperature, lightning strikes and summer droughts will increase the potential for forest fires (MOE 2007). A higher probability of droughts will have an effect on the prevalence of pestilence and other forest related stresses leading to increased wildfire hazard. Both wildfires and increased timber removal can lead to significant changes in the runoff regime, significantly affecting watershed hydrographs.



OBJECTIVE: RESPOND TO FLOODING AND LANDSLIDE EVENTS

ACTION 6.1 – MAINTAIN AND UPDATE DISTRICT-LEVEL FLOOD AND LANDSLIDE RESPONSE PLANS

WHAT IS TO BE DONE

- Maintain and update district flood and landslide response plans.
- Ensure the necessary staff are familiar with the contents of these plans.
- Ensure there are updated lists of who, by office, is a flood/landslide responder and of what items are available to responding staff (e.g. signage, ribbons, barricades).

RATIONALE

- All three districts have flood and landslide response plans. These plans should be reviewed and updated as necessary and staff need to continue to be familiar with these plans.

IMPLEMENTATION & RESOURCING

- This is an ongoing responsibility and activity at the district level and can be done with existing resources.
- These plans are a high priority because when an event happens, staff need to know what to do to ensure necessary actions are taken.
- The district level plans are linked to provincial level emergency response plans.

RESPONSIBILITY

- District engineering staff
- Branch engineering staff (for major events)

LINKAGES

- [British Columbia Flood Response Plan](#) (2013)

OBJECTIVE: PROVIDE INFORMATION ON HYDROLOGY AND LANDSLIDES

ACTION 6.2 – CONSIDER CLIMATE CHANGE IN FLOODPLAIN MAPPING

WHAT IS TO BE DONE

- Update/develop floodplain maps that consider how climate change is projected to change the frequency and magnitude of peak flows.
- Map fluvial and alluvial fans. Identify hazard areas and complete risk ratings for the fans.
- Make flood hazard information available to local governments and other agencies (e.g. Ministry of Transportation and Infrastructure).

RATIONALE

Climate change is expected to increase the frequency and magnitude of flooding in the region. Since the termination of the Floodplain Mapping Agreement in 2003, the BC Government has not actively maintained floodplain maps for most river systems and no longer has a role in overseeing development in floodplains (Regional Districts and local governments are now responsible). Floodplain mapping is typically completed for the large rivers (e.g. Thompson, Fraser), however there is no floodplain mapping for smaller systems (Shuswap, Salmon, Coldwater River, etc).

IMPLEMENTATION & RESOURCING

- Floodplain mapping projects should be prioritized according to the level of risk – probability of event multiplied by expected damage of an event.
- Additional resources would be required to implement this action. Floodplain mapping costs approximately \$50,000 to \$100,000 per river system for a contractor along with FLNRO staff to coordinate the project.
- Review approach taken by the Alberta government for flood hazard mapping and communication for potential lessons BC could utilize.

RESPONSIBILITY

- Regional water management staff

LINKAGES

- Water Management Branch [website](#) for Flood Emergency Preparedness and Response
- FLNRO [website](#) on floodplain mapping
- [Alberta government flood hazard mapping](#)
- Watershed Risk Assessments (Doug Lewis)

ACTION 6.3 – SUPPORT FLOOD FORECASTING CAPABILITY

WHAT IS TO BE DONE

Improve flood forecasting capability by:

- Forecasting non-freshet peaks as well as freshet peaks;
- Collecting additional snow pack data (e.g. Automated Snow Pillow and snow course networks);
- Improving the ability to predict water levels at specific locations (through development of local models and higher resolution of spatial data); and,
- Adding surface water and groundwater monitoring at locations that will improve predictive capacity for how river systems will respond to storm events.

RATIONALE

Climate change will increase the frequency and magnitude of peak flows (both during freshet and non-freshet periods). Accurate flood forecasting is important for organizing flood response activities (e.g. evacuations, road shutdowns, etc.). Regional FLNRO staff have a role in providing on the ground data to improve flood forecasts done by the River Forecast Centre.

IMPLEMENTATION & RESOURCING

- The Provincial River Forecast Centre would initiate activities listed under this action.
- Regional FLNRO staff to provide input on priority river sections to improve forecasting.

RESPONSIBILITY

- Provincial River Forecast Centre and Regional Flood Hazard Staff.

LINKAGES

- BC Flood Plan

ACTION 6.4 – IMPROVE HYDROMETRIC DATA AND ANALYSIS

WHAT IS TO BE DONE

- Install additional stations on streams to collect hydrometric data (water levels and flow volumes) as well as additional rain gauges and snow pillows.
- Complete statistical analysis of hydrometric data to generate revised BC streamflow maps and station tables for 1 in 10 year and 1 in 100 year flows.
- Complete statistical analysis of additional rain gauges to generate Rainfall Intensity-duration Frequency (IDF) curves and tabulations.

RATIONALE

Over the last decade, hydrometric monitoring stations have decreased in numbers across the province. In a changing climate, having current hydrometric data is increasingly important for the design of infrastructure affected by hydrology (esp. bridges, roads, and culverts).

IMPLEMENTATION & RESOURCING

- This action would need to be initiated outside of the Thompson/Okanagan Region.

RESPONSIBILITY

- Ministry of Environment
- River Forecast Centre

ACTION 6.5 – REVIEW AND UPDATE LANDSLIDE DATABASE

WHAT IS TO BE DONE

- Undertake a review, including cost-benefit analysis, to determine how the existing landslide database should be updated. In reviewing the landslide database, need to determine how the information in the database will be used and determine what data fields (eg landslide type) should be recorded in the database based on current science and intended use.

RATIONALE

Recording landslides is helpful for providing information on landslide prone areas and having a complete record of landslides assists in identifying trends (e.g. is the number of landslides increasing over time?). However, due to both technical and human resource issues, the current landslide database has been mostly idle since 2012. For most districts in the South Area, landslides are entered into the current landslide database in an ad-hoc, sporadic manner.

IMPLEMENTATION & RESOURCING

- An update to the landslide database requires additional technical and human resources to implement and maintain. The ongoing review of the current landslide database will identify the level of resources required for the update and long term maintenance based on intended use.
- When/if the landslide database is updated, mechanisms to share information with other agencies (e.g. Ministry of Transportation and Infrastructure) should be developed and implemented.

RESPONSIBILITY

- Regional/District engineering staff (for updating database and entering landslide data)
- Engineering, geoscience, and other technical staff (for analyzing and making use of the data)

ACTION 6.6 – ENHANCE LANDSLIDE HAZARD AND RISK INFORMATION AND COMMUNICATION

WHAT IS TO BE DONE

Enhance landslide risk information:

1. Map fluvial and alluvial fans, identify hazard areas, and complete risk ratings for the fans

2. Undertake LIDAR assessments of highest risk landslide areas (i.e. where public safety is a concern)

Enhance communications on landslide hazards and risks:

3. Make landslide hazard and risk information available to local governments and/or property owners at risk. As this information can affect property values, an operational policy or protocol would need to be developed to guide the dissemination of information on landslide risks.
4. Consider implementing signage or gates in high risk areas.

RATIONALE

Recent climate change models project that British Columbia will experience more frequent and severe rainstorm events and years with higher snowpacks at high elevations. The models also project earlier onset freshets and more prevalent summer droughts and wildfires. These projections have the potential to increase the likelihood of landslides occurring (FLNRO, 2013). The increased likelihood of landslide events, combined with ever-increasing pressure for more development in areas potentially exposed to landslide hazards, enhances the need for high quality information that can be used to inform preparation and planning measures to reduce the landslide risks to existing and future developments. LIDAR assessments provide the necessary data to promote preventative actions to reduce landslide risks.

As stated in the Review of Landslide Management in BC (2013) conducted after a series of landslides in 2012, landslide and flood hazard maps have been created in the past to help inform development decisions however the management of the information is relatively uncoordinated making it difficult to access. Furthermore, resources for mapping programs have been reduced over time. The Review of Landslide Management in BC (2013) provided several recommendations for improving hazard mapping and making hazard information publicly accessible.

IMPLEMENTATION & RESOURCING

	Action	Priority	Resourcing
1	Fluvial and alluvial fan mapping and risk ratings	High	Contract - ~\$100,000 to scope, millions of dollars to implement
2	Undertake LIDAR assessments	Moderate	\$30,000 - \$60,000 per area (~100 km ²) – costs can vary depending on partnership. Costs can also be lower if LIDAR survey has been done in an area and data just needs to be re-purchased.
3	Provide landslide information to local governments	High	0.5 - 1 FTE
4	Signage or gates in high risk areas	High	Can be done with existing resources.

RESPONSIBILITY

- District engineering staff

LINKAGES

- [Review of Landslide Management in BC \(2013\)](#)
- [Landslide Risk Case Studies in Forest Development Planning and Operations \(2004\)](#)
- [Review of the Testalinden Dam Failure \(2010\)](#)

ACTION 6.7 – OBTAIN PROVINCE-WIDE LIDAR DATA

WHAT IS TO BE DONE

- Develop a BC Government province-wide LIDAR database that can be accessed by any agency with a need for high resolution 3-D terrain data. In particular, make the database available to FLNR engineers engaged in assessing and mitigating flooding and landslide risks.

RATIONALE

LIDAR surveys produce precise, three-dimensional information about the shape of the Earth and its surface characteristics. LIDAR data can be used to make predictions on how any type of flow event (water, debris, industrial waste) would travel through the environment. Cadastral data can be linked to LIDAR data to determine what properties and infrastructure would be impacted by an event of a given size. Having province-wide LIDAR data would facilitate more accurate small watershed boundary mapping and modeling, which would improve the reliability of flood plan and watershed assessment works across the province. Province-wide LIDAR data could be used for other purposes in addition to assessing landslide and flood risks, such as assessing the impact of spills and dam breeches.

IMPLEMENTATION AND RESOURCING

- Additional resourcing would be required to obtain a complete province-wide LIDAR dataset. The costs would depend on the extent to which LIDAR data can be re-purchased from companies that have completed LIDAR surveys in an area for other purposes (e.g. for forest licensees).
- Additional human resources would also be required for a lead agency to manage the LIDAR database and coordinate with database users from other agencies.
- BC could learn from the experiences of other provinces who have implemented similar initiatives. For example, following the extensive flooding experienced in Alberta in 2013, the Alberta Government hired BGC Engineering to develop a fan inventory database that could be served up in a workspace for engineers. To rate the risk associated with particular fans, cadastral data was linked to fan boundaries, providing information on how costly an event at that fan would be. For this project, BGC was provided with a 1 m resolution LIDAR from the province for the whole study area.¹³

RESPONSIBILITY

- One agency to lead and coordinate (possibly Emergency Management BC)

LINKAGES

- Alberta Government Fan Inventory ([project](#) by BGC Engineering Inc.)

¹³ Link to BGC project description: http://www.bgcengineering.com/geomatic_aesrd.html

PHOTO 1: JOHNSONS LANDING LANDSLIDE



The July 12, 2012 landslide at Johnsons Landing destroyed four houses and killed four people. Johnsons Landing is located on the east side of Kootenay Lake. An evacuation order on properties near the landslide was in place for two years after the event.¹⁴

OBJECTIVE: REDUCE DAMAGE TO INFRASTRUCTURE FROM FLOODING AND LANDSLIDE EVENTS

ACTION 6.8 – CONSIDER CLIMATE CHANGE IN GUIDELINES FOR THE DESIGN AND OPERATION OF DIKES

WHAT IS TO BE DONE

Assist in updating existing guidelines for the design and operation of dikes to include information on climate change adaptation. Updated guidelines would:

- Encourage diking authorities to plan for the possibility of having to raise dikes in the future;
- Provide advice on best management practices for structure design, operation and maintenance.

RATIONALE

More frequent and severe storms will put more stress on dikes, including more regularly occurring high velocity flow. Guidelines are used to provide advice to local diking authorities on the safe design and operation of dikes.

IMPLEMENTATION & RESOURCING

- This action can be completed with existing resources.

¹⁴ Canadian Press, “Johnsons Landing evacuation order lifted 2 years after fatal landslide”, July 30, 2014. <http://www.cbc.ca/news/canada/british-columbia/johnsons-landing-evacuation-order-lifted-2-years-after-fatal-landslide-1.2723388> . Link accessed: Nov. 26, 2015.

- Updating the guidelines is a high priority. Currently guidelines are over 10 years old and are not considering climate change for interior regions.

RESPONSIBILITY

- Inspector of Dikes (for updating guidelines)
- Regional water management staff provide input on guidelines to Inspector of Dikes and distribute guidelines to local diking authorities

LINKAGES

- Note that flood plain elevations are necessary information for implementing the guidelines, thus Action 6.2 – “Consider Climate Change in Floodplain Mapping” supports the implementation of this action.
- [BC Dike Management and Safety](#)
- [Public Safety: Floods, Dikes, Dams, & Droughts](#)

PHOTO 2: DEBRIS FLOW NEAR TESTALINDEN CREEK CAUSED BY A DAM FAILURE



On June 13, 2010, a dam failure caused a debris flow near Testalinden Creek (just south of Oliver, B.C.), destroying five homes.

ACTION 6.9 – MITIGATION OF CLIMATE CHANGE HAZARDS TO DAMS

WHAT IS TO BE DONE

Promote the BC Dam Safety Regulation and develop climate change guidelines for achieving excellence in dam engineering, construction and operation of dams in BC.

- Encourage dam operators to plan for changing hydrology under climate change through the development of training modules and guidance documents.
- Provide best management practices for design, operation, maintenance and surveillance of dams.
- Foster increased collaboration between dam owners and local governments related to emergency preparedness planning.

RATIONALE

Increases in frequency, severity, and duration of storms can be expected to likewise increase the frequency and severity of flooding, landslides and other natural hazards. This in turn poses an additional risk to the safety of dams in BC. Through education and dam safety assessments based on current climate change knowledge, measures can be taken by dam owners to mitigate potential impacts of climate change.

IMPLEMENTATION & RESOURCING

- Explore options for auxiliaries and/or co-op students to assess spillway capacity for all dams of low to significant consequence. This is a high priority.
- Encourage the Victoria Dam Safety group to develop new or reference existing climate change documents and post to the Dam Safety Program website. High priority.
- Explore options for auxiliaries and/or co-op students for education opportunities for dam owners specifically related to potential climate change effects. This is a medium priority, especially in light of any changes to the amended Dam Safety Regulation under the WSA. These efforts would go a long way towards preparing dam owners for any new requirements, as well as identifying any areas that were deficient under the old regulations.
- Expanding on HYDROMETEOROLOGICAL REPORT NO. 57, (NOAA, 1994) explore studying all-season general-storm probable maximum precipitation (PMP) estimates for the Thompson Okanagan Region. This is a medium priority.

RESPONSIBILITY

- Dam Safety Program in Victoria with support from Regional Dam Safety Officers

LINKAGES

- *Water Sustainability Act*
- Canadian Dam Association
- Association of Professional Engineers and Geoscientists in BC
- National Oceanic and Atmospheric Administration (NOAA) - HYDROMETEOROLOGICAL REPORT NO. 57

ACTION 6.10 – REDUCE RISKS FOR ROADS

WHAT IS TO BE DONE

- Develop Access Management Plans to aid in prioritizing resource roads under FLNRO jurisdiction for engineering vulnerability assessments. Complete engineering vulnerability assessments (PIEVC) for those roads assessed to be high priority (e.g. Capitalized FSR road networks).
- Reduce risks identified through vulnerability assessments. Possible approaches include:
 - Replant decommissioned resource roads
 - Maintain natural drainage patterns through the use of cross ditching and other water control measures deemed necessary through assessment
 - Stabilization techniques
 - Bridge and culvert upgrades based on current science
- Develop a MFLNRO best practices document for adapting transportation infrastructure to climate change (similar to BC Ministry of Transportation and Infrastructure's *Best Practices Document*).
- Consider establishing an inter- and intra-agency working group to coordinate stream crossing capacities for roads and bridges (especially relevant where dams exist upstream and are being upgraded but downstream roads/bridges are not upgraded to same level, and for consideration of bed load).

RATIONALE

Across the region, there is a lack of infrastructure vulnerability assessments, adaptation activities and access management planning for resource roads managed by FLNRO.

IMPLEMENTATION & RESOURCING

- The T/O region would require additional resources to identify priority roads for vulnerability assessments and to complete vulnerability assessments. One possible starting point is to have a contractor carry out a region wide risk rating for the road system to guide prioritization. Contractor would identify high risk areas for road maintenance and rehabilitation projects and would prioritize bridge replacements (\$100,000+ over 1 year).
- Note that the Engineering Branch's Climate Action Plan has also requested funding for road vulnerability assessments (the Engineering Branch CAP requests funds to do Public Infrastructure Engineering Vulnerability Committee (PIEVC) case studies) and the Thompson/Okanagan region would like to undertake in PIEVC assessments.

RESPONSIBILITY

- District engineering staff

LINKAGES

- Actions 6.2 to 6.7 would provide information for designing new roads and assessing existing roads.
- BC Ministry of Transportation and Infrastructure's [*Considerations for Addressing Climate Change Adaptation for Transportation Infrastructure in Highway Management, Design, Operation and Maintenance in British Columbia: Best Practices Document*](#) (2014)
- Engineering Canada's [*Public Infrastructure Engineering Vulnerability Committee*](#) (PIEVC) protocols

- [Engineering Branch Manual](#)
- [Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC](#) (APEGBC, FLNRO, NRCan)

ACTION 6.11 – REDUCE RISKS FOR FLNRO BRIDGES AND CULVERTS

WHAT IS TO BE DONE

1. Develop updated Peak Flow – Culvert Design Tables for the Thompson Okanagan Region based on current professional practice guidelines and revise station data on the CulvertBC website
2. Update the forest service bridge design and construction manual, specifically with regard to hydrologic design standards that consider climate change effects to regional hydrology.
3. Assess bridges and culverts for their stability in response to events and identify high risk structures
4. Consider establishing an inter- and intra-agency working group to coordinate stream crossing capacities for roads and bridges (also included in Action 6.11 – Reduce Risks for Roads)
5. Implement PIEVC on at least one road network in the Thompson Okanagan Region in 2016/17

RATIONALE

- Across the region, there is a lack of infrastructure vulnerability assessments and adaptation activities for bridges.

IMPLEMENTATION & RESOURCING

Action		Priority	Resourcing	Responsibility
1	Peak Flow Culvert Design Tables	High	Work can be contracted out with existing resources, but the project would be better served with an additional FTE tasked with related work (e.g. dedicated hydrologist)	Engineering staff/District staff
2	Forest Service Bridge Design and Construction Manual	Medium	Can be done with existing resources over the next 2 to 5 years.	Engineering staff/District staff
3	Assess bridges and culverts	High (some of these crossings, if compromised, could have a large impact on access and downstream values)	Additional resources for contract: \$100,000 to \$300,000 for a review of all structures in T/O Region (the region has ~1000 major structures on forest service roads).	Engineering staff/District staff
4	Intra-agency working group	Medium	Existing Resources	Engineering staff/District staff
5	PIEVC projects	High (will address some of the highest risk roads/structures in the region)	Work can be contracted out but additional financial resources are required to fund contract and additional time from ministry staff is required to oversee projects.	Engineering staff/District staff

LINKAGES

- Actions 6.2 to 6.7 would provide information for designing new bridges and culverts and assessing existing bridges and culverts.
- [Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC](#)

ACTION 6.12 – DISCUSS CLIMATE CHANGE EFFECTS AT ANNUAL ENGINEERING SOUTH AREA MEETING

WHAT IS TO BE DONE

- Include a discussion on climate change effects and adaptation at the annual Engineering South Area Meetings.

RATIONALE

FLNRO engineers need to be considering climate change in their day to day business to reduce risks to public safety and infrastructure. An annual discussion will provide an opportunity to share best practices and strategies for adapting to climate change.

IMPLEMENTATION & RESOURCING

- This action will be implemented with current resources.

RESPONSIBILITY

- Engineering staff/District staff

OBJECTIVE: SUPPORT INTEGRATED WILDFIRE RESPONSE ACROSS PROGRAMS

ACTION 6.13 – CONTINUE TO UPDATE DISTRICT FIRE MANAGEMENT PLANS

WHAT IS TO BE DONE

- Keep District Fire Management Plans up to date.
- These plans could be enhanced through more localized landscape fire planning where there is risk around communities.

RATIONALE

In a changing climate, wildfires will increase in size, intensity, and frequency; the risk of large wildfires is particularly high in dry ecozones with lodgepole pine. The purpose of Fire Management Plans is to provide support to decision makers for integrated wildland fire response and resource management activities. These plans are intended to ensure collaboration occurs across programs within the scope of this policy while working towards cost efficient and effective protection of resource values.

IMPLEMENTATION & RESOURCING

- This action is ongoing and can be completed with existing resources.

RESPONSIBILITY

- District Stewardship staff

LINKAGES

- [FLNRO Policy 9.4 – Fire Management Plans](#)
- [Landscape Fire Planning](#)

7) CLIMATE CHANGE MITIGATION

GOAL - REDUCE GREENHOUSE GAS EMISSIONS AND INCREASE THE CAPACITY OF CARBON SINKS

OBJECTIVES

- Reduce carbon emissions from harvest residues and dead trees
- Enhance carbon sequestration in forests
- Reduce carbon emissions and enhance carbon sequestration in grasslands
- Reduce carbon emissions from FLNRO energy use

OBJECTIVE: REDUCE CARBON EMISSIONS FROM HARVEST RESIDUES AND DEAD TREES

ACTION 7.1 – EXPAND SALVAGE AND REFORESTATION OF MOUNTAIN PINE BEETLE AND FIRE KILLED STANDS

WHAT IS TO BE DONE

Support, participate and lead the process of using the BC Timber Sales (BCTS) / Forests for Tomorrow (FFT) Innovative Timber Sales Licence (ITSL) mechanism to salvage, and reforest stands killed by Insects (primarily Mountain Pine Beetle) and fires. These are stands that because of their low timber values would be too expensive to pay stumpage on and pay for the reforestation of. These stands would therefore otherwise not be salvaged or reforested. The dead trees would decompose quickly once they fall over and release carbon into the atmosphere. The areas would take decades to regenerate due to low seed viability of the dead timber. This initiative/program reduces both carbon emissions and sequesters carbon. It does this by:

- Harvesting dead timber that otherwise would be left to decay and release CO₂. The carbon associated to that portion of the stand that which is salvaged and manufactured into a wood product will be captured in that wood product for the life of that wood product.
- The amount of forest acting as a carbon sink will be increased. Under this initiative, areas killed by fire or Mountain Pine Beetle that are not naturally regenerating and would take decades to regenerate without artificial planting are being regenerated and within a few years growing vigorously and sequestering carbon.

CO₂ REDUCTION POTENTIAL: **HIGH**

Over the past 5 years this program has salvaged and reforested between 3 to 5 thousand hectares of insect killed timber a year. At this time, there still remains thousands of hectares of insect killed timber in the Thompson/Okanagan region. If government made this program a higher priority the amount of area salvaged and reforested could be doubled over the next 5 years.

Prior to the Mountain Pine Beetle epidemic in BC, BC interior Pine Forests were a Carbon Sink. After the epidemic they have become a net carbon emitter. Salvage and reforestation of these stands will reduce carbon emissions and increase carbon sequestering.

IMPLEMENTATION & RESOURCING

Regional and District FLNRO staff in the TOR have partnered with BC Timber Sales to identify, develop, salvage and reforest insect and fire killed timber that would otherwise not be salvaged and reforest.

At the current resourcing between 2 to 3 thousand Ha's a year of insect and fire killed timber will be salvaged and reforested every year for at least the next 5 years.

The funding for the reforestation of these stands comes from the Provincial Forests for Tomorrow Reforestation Program.

Resourcing for the development and salvaging of the dead timber is provided by BC Timber Sales. BC Timbers Sales recovers their development cost from the revenue earned from the sale of the dead timber.

RESPONSIBILITY

- Regional and District staff
- BC Timber Sales staff

LINKAGES

- [Memorandum of Understanding](#) between Forests for Tomorrow (FFT) Program and BC Timber Sales (BCTS) with respect to the Cooperative Use of Innovative Timber Sales Licences in Conjunction with FFT Stand Rehabilitation

ACTION 7.2 – INCREASE THE PROPORTION OF BCTS TIMBER SALES WHICH ARE SOLD ON A LUMP SUM BASIS

WHAT IS TO BE DONE

The amount of slash and forest fibre piled and burnt can be dramatically reduced by increasing the number of Timber Sales sold on *lump sum* basis. Under the lump sum method, the logger (licensee) pays a fixed amount for the stand. There is therefore a financial incentive to remove as much fiber as possible from the stand as no additional stumpage is paid. Alternatively, a licensee pays for every log put on a truck under the weight scale stumpage system. This results in only the higher value logs being removed. Lower value logs and fiber is piled and burnt. The option for BCTS to put Timber Sales up as lump sum sales exists today; however most sales are not done on a lump sum basis.

CO₂ REDUCTION POTENTIAL: **MEDIUM**

- If all BCTS sales were done on a lump sum basis, CO₂ emissions reductions could be quite significant; however, it is likely that only a modest increase in lump sum sales would be realized.

IMPLEMENTATION & RESOURCING

- No additional resources are required. Strategic discussions need to occur between BCTS and FLNRO as to why lump sum sales are beneficial from the perspective of reducing the amount greenhouse gases being emitted.
- High priority action given the big reductions in greenhouse gas emissions that can be realized by this change in stumpage methods.

RESPONSIBILITY

- BCTS
- FLNRO

ACTION 7.3 – EXPAND FFT/BCTS ITSL FOR BIO-ENERGY INDUSTRY

WHAT IS TO BE DONE

To be viable, the bio-energy industry needs to be competitive against hydro and natural gas electricity generation. The only way to be competitive is for bio-energy operators to obtain their fiber for very low stumpage rates. FFT/BCTS ITSL is a mechanism to sell low value fibre to industry at the lowest possible rate. BCTS/FFT ITSL can have an upset bid price (stumpage rate) well below the lowest Fibre Forestry Licence to Cut (FFLTC) or Fibre Supply Licence to Cut (FFSLTC) total costs because the Crown is relieving the Timber Sales Manager of his reforestation obligations (which are picked up by the Crown through FFT).

CO₂ REDUCTION POTENTIAL: **MEDIUM**

- The expansion of bio-energy plants is limited due to the low price of natural gas. Even with wood fiber costs set at a substantially low rate, only a limited expansion of bio-energy plants is expected. Increasing the number of bioenergy plants may require the crown paying operators to remove the timber (i.e. negative stumpage fees).

IMPLEMENTATION & RESOURCING

- A proportion of the fiber from FFT/BCTS ITSL sales are already going to bio-energy plants such as the Domtar power plant in Kamloops.
- Additional resources would likely be needed to expand this activity.

RESPONSIBILITY

- Timber Tenures and Revenue

LINKAGES

- [Memorandum of Understanding](#) between Forests For Tomorrow (FFT) Program and BC Timber Sales (BCTS) with respect to the Cooperative Use of Innovative Timber Sales Licences in Conjunction with FFT Stand Rehabilitation

OBJECTIVE: ENHANCE CARBON SEQUESTRATION IN FORESTS

ACTION 7.4 – EXPAND ELIGIBILITY CRITERIA FOR FORESTS FOR TOMORROW PROGRAM

WHAT IS TO BE DONE

Revise Forests for Tomorrow (FFT) Program Reforestation Funding Eligibility Criteria to include more area. Under the current FFT eligibility criteria in order to qualify for FFT reforestation funding a stand must be at least 70% dead. There is a magnitude greater number of stands which are NSR, are uneconomic but have greater than 30 % live stems.

CO₂ REDUCTION POTENTIAL: **HIGH**

- Revised FFT funding eligibility criteria would allow the crown to reduce greenhouse gases through salvage and increase carbon sequestering by establishing young thrifty stands.

IMPLEMENTATION & RESOURCING

- Expanding the amount of area that is eligible for FFT reforestation funding would require additional resources to implement. The amount would depend on how much eligibility criteria are adjusted.
- This action is a high priority given the associated carbon benefits and other benefits to reforestation.

RESPONSIBILITY

- FFT section within the Resource Practices Branch

LINKAGES

- Forests for Tomorrow Program

ACTION 7.5 – DEVELOP FOREST CARBON OFFSET PROJECTS

WHAT IS TO BE DONE

Region to issue tenure, cutting authority (and appraisal) for activity-based forest carbon projects:

- Work with Competitiveness and Innovations (C&I) Division staff to determine eligible project types, and the process for managing Forest Carbon Offset Projects
- Identify eligible projects within the region (activity-based and non-activity based)
- Roll-up and report eligible project to C&I Division
- Issue tenure, cutting authority (if required) and review site plans

CO₂ REDUCTION POTENTIAL: **LOW**

- Low potential because implementation of these types of projects is quite difficult and likely only a few will get implemented.

IMPLEMENTATION & RESOURCING

- This action can be implemented in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Tenures staff
- Stewardship staff

LINKAGES

- [BC Forest and Land Carbon](#)

ACTION 7.6 – INCORPORATE CARBON MANAGEMENT INTO FOREST PLANNING

WHAT IS TO BE DONE

Incorporate carbon management considerations into Forest Planning, such as:

- Harvest dead trees after a fire;
- Reforest roads and landings that are no longer in use;
- Plant not satisfactorily restocked (NSR) areas;
- Consider planting higher densities of seedlings;
- Increase fibre utilization and reduce burning.

CO₂ REDUCTION POTENTIAL: **MEDIUM**

- If incorporated across the region, would result in moderate levels of CO₂ reduction.

IMPLEMENTATION & RESOURCING

- This action can be implemented in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Tenures staff
- Stewardship staff

LINKAGES

- FLNRO (2013). [Climate mitigation potential of British Columbian forests: Growing carbon sinks.](#)
- Mike Greig and Gary Bull (2009). [Carbon Management in British Columbia's Forests: Opportunities and Challenges.](#)

OBJECTIVE: REDUCE CARBON EMISSIONS AND ENHANCE CARBON SEQUESTRATION IN GRASSLANDS

ACTION 7.7 – INCORPORATE CARBON MANAGEMENT INTO RANGE PLANNING AND GUIDES

WHAT IS TO BE DONE

Incorporate carbon management into the following:

- Grazing Management Plans
- Rangeland Health Field Guide

CO₂ REDUCTION POTENTIAL: **LOW**

Improved grazing management has the potential to improve the vigour of existing perennial grasses and to move the plant community toward a greater proportion of large, deep rooted perennial grasses. This will result in greater aboveground and belowground plant biomass (carbon capture), some of which will become part of long-term soil organic matter (carbon sequestration). It is known that 50% - 70% of bunchgrass roots die annually thereby contributing to soil organic matter. The potential for increased carbon storage is greater in soils which are degraded below their equilibrium carbon storage capacity. Plant community-soil systems in moderate-to-good condition have lower potential to store additional carbon because they are close to their maximum limit for soil carbon storage.

IMPLEMENTATION & RESOURCING

- This action could be started in the next 2 to 5 years with additional resources. Guidelines should first be developed in house on the best management strategies to increase carbon sequestration

through amendments to Grazing Management Plans. Rangeland Health Field Guides already assess soil health, soil erosion, and plant community health so few changes in this procedure would be required to address current carbon storage versus potential carbon storage.

- Dedicated staff time or contractor would be needed to assist in the development of guidelines.
- Priority: Low

RESPONSIBILITY

- TOR Research staff collaborating with District staff and Range staff.

LINKAGES

- Existing range management planning guidelines and range health field guides.

ACTION 7.8 – ENHANCE INVASIVE SPECIES CONTROL IN GRASSLANDS

WHAT IS TO BE DONE

Control invasive grassland species (e.g. cheatgrass) that do not sequester as much CO₂ as native grassland species, and enhance native grassland species through other measures (e.g. assisted migration). Cheatgrass does not have a big root system, so it does not store CO₂.

CO₂ REDUCTION POTENTIAL: **LOW**

- CO₂ reduction potential is low because the total area affected by invasive species is low compared to the areas affected by other mitigations actions proposed here.
- Annual invasive species like cheatgrass do not allocate many resources to roots in comparison to perennial plant species. Therefore areas of dense annual weed infestation may over the long-term lose soil carbon storage because of reduced carbon inputs. The lack of deep, dense roots also exposes the site to erosion of carbon rich top soil. Control of annual invasive species if followed by recovery of deep rooted perennial species has the potential to increase carbon sequestration and protect against losses of top soil.

IMPLEMENTATION & RESOURCING

- This action would require additional resources to implement. Weed control actions include dispersal of biocontrol agents and application of herbicides where appropriate.
- Priority: Low. Extensive weed control is expensive and would need to be followed up by restoration to a healthy plant community. The potential increases in carbon sequestration are low in comparison to costs.

RESPONSIBILITY

- Range staff/District Staff

LINKAGES

- Current policies on invasive plant management.

ACTION 7.9 – ENCOURAGE GRASSLAND CONSERVATION AND RESTORATION

WHAT IS TO BE DONE

- Encourage grassland conservation to reduce conversion of grasslands to houses and roads. One way to do this would be to encourage private land conservancies.
- Restore degraded grasslands.
- Co-benefits for climate change adaptation would occur if grassland conservation and restoration occurs on high priority sites for wildlife climate connectivity.

CO₂ REDUCTION POTENTIAL: LOW

- CO₂ reduction potential is low because discouraging development/conversion of grassland is not completely under FLNRO control because it often involves municipal land and/or private land. The scale of land affected by this action is also minimal compared to other actions.
- Grassland conversion changes the site from a net CO₂ sink to a net CO₂ source by removing above and belowground biomass production, and potentially removing the carbon rich top soil. The conversion is often permanent when converted to housing and roads. There are immediate and significant CO₂ benefits to reducing grassland conversion depending on the total area conserved.
- Restoration of degraded grasslands will require invasive species control, a process to re-establish perennial native plants if their densities are below a threshold level, followed by improved range management. If these measures are successful there will be additional soil carbon storage over the medium to long-term (see above actions).

IMPLEMENTATION & RESOURCING

- Restoration of degraded grasslands will require significant additional resources. Costs will depend on the total area treated.
- Priority – Low. Success is not ensured (for encouraging conservation) and benefits are low compared to costs (for implementing restoration).

RESPONSIBILITY

- Ecosystem restoration program of Range Branch, Districts

LINKAGES

- Action 7.7 – Incorporate carbon management into range planning and guides
- Action 7.8 – Enhance invasive species control in grasslands

OBJECTIVE: REDUCE CARBON EMISSIONS FROM FLNRO ENERGY USE

ACTION 7.10 – EXPAND USE OF LOWER EMISSION VEHICLES

WHAT IS TO BE DONE

- Invest in lower GHG emission vehicles for FLNRO use (e.g. hybrids and electric vehicles).

CO₂ REDUCTION POTENTIAL: **LOW**

- Gasoline consumption by FLNRO vehicles could be cut in half with hybrid vehicles or reduced altogether with electric vehicles. CO₂ reductions would depend on the number of vehicles switched from gasoline to lower-emission vehicles
- There is symbolic value to driving lower emission vehicles (especially electric vehicles that have low market share). The more that people see these vehicles being driven, the more likely it will be for them to buy a lower-emission vehicle themselves (this is called the “neighbour effect” in new technology uptake literature).

IMPLEMENTATION & RESOURCING

- No additional resources are needed to implement this action. The increased capital costs of hybrid and electric vehicles would be offset by lower fuel costs over time.

RESPONSIBILITY

- Corporate Services

ACTION 7.11 – INCENTIVIZE LOW EMISSION TRAVEL BY FLNRO STAFF

WHAT IS TO BE DONE

Implement incentives to encourage low to zero emission travel by FLNRO staff. Examples include:

- Transit passes
- Subsidized bike costs
- Higher parking fees
- Allow working from home

CO₂ REDUCTION POTENTIAL: **VERY LOW**

- The reduction potential of these actions would be very low because they would only influence FLNRO staff and research shows that people attach a high value to driving, meaning it is difficult to influence a switch in behaviour from driving to other modes
- The action would have symbolic value in encouraging others to engage in low/zero emission travel

IMPLEMENTATION & RESOURCING

- Additional resources are required to implement the action.
- Low priority action due to low emission reductions.

RESPONSIBILITY

- Regional Management Team



These solar thermal panels are used to heat water for the research centre and the silo contains a furnace that uses local wood-pellets as fuel.

ACTION 7.12 – REDUCE CARBON EMISSIONS FROM FLNRO BUILDINGS

WHAT IS TO BE DONE

Explore opportunities to reduce GHG emissions from energy consumption in FLNRO buildings through:

- Solar panels to reduce natural gas use for heating
- Energy efficiency upgrades for energy services fueled by natural gas or oil (improved insulation, equipment, etc.)
- Maintain an internal building temperature of 19°C. Note: This will only reduce CO₂ emissions if buildings are heated with natural gas or oil.

CO₂ REDUCTION POTENTIAL: LOW

- The reduction potential of these actions would be very low because they would only affect FLNRO buildings.
- The actions would have symbolic value in encouraging others to also implement these actions.
- Note that electricity efficiency upgrades (e.g. more efficient lighting) and renewable electricity (e.g. PV solar panels) have very little effect on CO₂ emissions because BC's electricity has very low carbon intensity (tonnes CO₂/kwh) and has a clean electricity standard to maintain a low carbon intensity even with increasing electricity demand.

IMPLEMENTATION & RESOURCING

- Additional resources are required to implement.

RESPONSIBILITY

- Corporate Services

8) FIRST NATIONS

GOAL - ENSURE FIRST NATIONS CULTURAL VALUES ARE BEING MANAGED AND MAINTAINED IN A CHANGING CLIMATE

ACTION 8.1 – COLLABORATE WITH FIRST NATIONS ON CLIMATE CHANGE

WHAT IS TO BE DONE

- Collaborate with First Nations in the Region on the final planning and implementation phases of the Thompson/Okanagan Region Climate Action Plan

First Nations would be interested in the draft TOR-CAP. TOR could develop a letter presenting the draft plan and ask for feedback from First Nations. The letter could suggest one meeting within each of the four First Nation's 'nation level' territories that overlap with TOR.

- At the meeting the idea of an inter-nation committee could be proposed – two people from each of the four nations that overlap with TOR;
- Work with the inter-nation committee to finalize and implement/monitor the TOR-CAP.

RATIONALE

First Nations and stewardship perspectives are often aligned, and since First Nations have constitutionally protected aboriginal interests, collaboration helps to ensure that stewardship initiatives are more successful in the face of competing interests for natural resources. Moreover, collaborative approaches help to build trust and relationships, thereby avoiding conflicts on the land base.

IMPLEMENTATION & RESOURCING

The CAP Lead can be responsible for this initiative or a dedicated First Nations senior advisor reporting to the CAP Lead can project manage the First Nations engagement initiative. This project would require ½ FTE for the next few years.

RESPONSIBILITY

- First Nations Liaison to initiate
- CAP lead to support

9) STAFF EDUCATION, ACTION & RESOURCES

Within a government ministry, there are two main pathways for generating action on climate change – a *bottom-up pathway* that relies on the voluntary initiative of managers and staff to recognize the relevance of climate change to their work and consider the implications of climate change in their day-to-day operations; and a *top-down pathway* that provides mandatory directives on how managers and staff must respond to climate change. The set of actions within this theme include two bottom-up actions (Action 9.1 and 9.2) and one top-down action (Action 9.3).

GOAL - ENHANCE THE CAPACITY OF THOMPSON/OKANAGAN REGIONAL STAFF TO CONSIDER CLIMATE CHANGE IN THEIR DAY TO DAY OPERATIONS.

ACTION 9.1 – RAISE AWARENESS ABOUT HOW CLIMATE CHANGE AFFECTS FLNRO’S RESPONSIBILITIES

WHAT IS TO BE DONE

- Hold workshops to share climate change research and generate discussion among staff about climate change.
- Use these workshops to extend research efforts by regional staff and make connections with researchers external to the region that have relevant expertise.

RATIONALE

Workshops would raise awareness around how resource and environmental values managed by FLNRO are affected by climate change. The workshops would also support connections across FLNRO work units. Such connections (e.g. between researchers and resource managers) are often necessary for supporting science-based responses to climate change.

IMPLEMENTATION & RESOURCING

- Additional resources are required to implement this action (~\$10,000/year to hold workshops)

RESPONSIBILITY

- Research group

ACTION 9.2 – PROMOTE ACTION ON CLIMATE CHANGE AMONG REGIONAL STAFF

WHAT IS TO BE DONE

- Go beyond information-based initiatives and promote action on climate change through systematic and targeted engagement initiatives that address the specific barriers to incorporating climate change into day to day operations.

RATIONALE

This action is based on the premise that simply raising awareness about climate change through information sharing initiatives is necessary, but not sufficient, for generating action by regional staff. While information sharing can be effective in creating awareness and changing attitudes, research shows that behaviour change rarely occurs as a result of simply providing information (McKenzie-Mohr and Smith, 1999). Engagement approaches that go beyond just information-sharing will be needed to induce widespread voluntary action among managers and staff to incorporate climate change into their work.

Engagement approaches such as community-based social marketing¹⁵ may provide methods for being more effective at inducing the desired behaviour change. Community-based social marketing (CBSM) is based upon research in the social sciences that demonstrates that behaviour change is most effectively achieved through initiatives that focus on removing barriers to an activity while simultaneously enhancing

¹⁵ <http://www.cbsm.com/public/world.lasso>

the activities benefits. A CBSM approach involves spending time upfront to identify the barriers/benefits that prevent/support a desired behaviour and using this information to develop an engagement strategy that will be targeted to a particular group.

IMPLEMENTATION & RESOURCING

- Additional resources are required to implement this action (e.g. dedicated staff person to lead development of a strategy to promote action)

RESPONSIBILITY

- Climate Solutions

LINKAGES

- CAP Community of Practice

ACTION 9.3 – CONSIDER INCLUSION OF CLIMATE CHANGE AS AN ACTIVITY IN STAFF’S E-PERFORMANCE

WHAT IS TO BE DONE

- Consider including climate change as an activity in staff’s e-performance

RATIONALE

- Inclusion of climate change in staff e-performance will encourage conversations between managers and staff about how climate change will be incorporated into day to day operations.

IMPLEMENTATION & RESOURCING

- This action can be implemented in the next 2 to 5 years with existing resources.

RESPONSIBILITY

- Business Leadership Team

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