



PREPARING FOR CLIMATE CHANGE

An Implementation Guide
for Local Governments
in British Columbia

Prepared by
West Coast
Environmental Law



PREPARING FOR CLIMATE CHANGE:
An Implementation Guide for Local Governments in British Columbia

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This report was prepared by Deborah Carlson at West Coast Environmental Law.

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West Coast Environmental Law
200 – 2006 West 10th Avenue, Vancouver, BC Canada, V6J 2B3
Phone: 604-684-7378, Toll-free in BC: 1-800-330-WCEL
Fax: 604-684-1312
Email: admin@wcel.org

www.wcel.org



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IMPORTANT NOTE!

This guide focuses on ways to implement climate change adaptation strategies. A very brief overview of climate change impacts and climate change assessment processes is also provided in Part 1.

Further information about past and future climate change and potential impacts in BC regions is available from the Pacific Climate Impacts Consortium. <http://pacificclimate.org/tools-and-data/plan2adapt>

Further resources to assist in understanding how a changing climate will affect communities in BC, assessing vulnerabilities or risks, and setting adaptation priorities can be found in the Appendices to this guide.



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Introduction

This guide identifies the tools that local governments can use to implement climate change adaptation strategies.

BC's climate is changing, and scientists who study the climate are projecting further changes over the next decades. Preparing for these changes and the impacts they will have on natural systems and human communities is usually called "climate change adaptation," and is the subject of this guide. Understandably, much attention has been focused to date on "climate change mitigation," or efforts to reduce greenhouse gas (GHG) emissions in the atmosphere and help slow the rate of climate change.¹ However, no matter how successful we are at reducing GHG emissions, we still face climate change impacts linked to past and ongoing GHG emissions that will be present in the atmosphere for many years to come. This means that both types of climate action are necessary: mitigation to avoid even more dangerous impacts, and adaptation to deal with the inevitable level of change that scientists advise we will continue to face for the next century or longer.

Preparing for Climate Change: An Implementation Guide for Local Governments in BC is designed to assist local government elected officials and staff, including planners, engineers, chief administrative officers, financial officers and others, to plan and act in ways that will make their communities more resilient to the impacts of climate change.

The effects of a changing climate vary and will continue to vary significantly from region to region in BC, from sea level rise and flooding in some areas to drought and increased risk of wildfire and invasive species in others. Local governments can access information about regional climate change impacts in BC through Plan2Adapt <http://pacificclimate.org/tools-and-data/plan2adapt>, the website specially developed for BC communities by the Pacific Climate Impacts Consortium based at the University of Victoria. As well, a number of publications and approaches have been developed to assist local governments in understanding the risks they face, how vulnerable they are, and how to set priorities for action. This guide also provides a very brief overview of processes for assessing risk and vulnerability to climate change impacts and prioritizing actions, but it is expected that local governments will rely on other resources to guide them in these areas. Appendix A offers information on further resources on all of these topics.

This resource identifies the tools that local governments can use to implement climate change adaptation strategies. Preparing for and responding to climate change impacts will, in most communities, engage a wide range of existing local government services

1 Resources to help local governments reduce their GHG emissions can be found in the BC Climate Action Toolkit www.toolkit.bc.ca.



and responsibilities, such as, for example, land use planning, transportation systems, infrastructure, emergency response planning and delivery, community services, corporate services and management, financial planning and asset management.

Wherever possible, this guide provides concrete examples, drawing on the growing experience of local governments in BC, and also some examples from outside the province. Many of the strategies that can help to address a changing climate are also good practices that will benefit communities regardless of the climate change impacts they face. These benefits may assist local governments in developing a “business case” for climate change adaptation action. For example, using green infrastructure solutions like topsoil requirements, rain gardens, bioswales and other measures can provide greater resilience with respect to increased precipitation. At the same time, in some instances they can also save local governments money as a result of the reduced life cycle costs associated with these measures compared to traditional pipe and drain infrastructure.

There is no one way to prepare for climate change, however there are emerging practices that can be followed or modified to fit local circumstances. It is hoped that this guide will help local governments better understand the scope and nature of the challenge that a changing climate presents, and how they can use existing tools and resources to implement climate change adaptation strategies.

Wherever possible, this guide provides concrete examples, drawing on the growing experience of local governments in BC, and also some examples from outside the province.

Understanding climate change adaptation

SETTING THE CONTEXT: A CHANGING CLIMATE IN BC

Climate is usually defined as the “average weather” in a given location, over a period of time ranging from months up to thousands of years. Temperature, precipitation, humidity, cloudiness, air pressure and wind are some of the aspects of climate that are measured.

“Climate change” refers to a change in the mean state of the climate, or in climate variability, that persists for decades or longer. Thus climate change can mean general warming in mean annual air temperature, or warmer winters, but also changes in the frequency and intensity of extreme weather events, including heat waves, heavy rain and snow storms, and drought. The global climate has changed over long periods of time as a result of natural causes. However, more recent and rapid climate change is being attributed to human activities, such as burning fossil fuels and land use changes.²

Historical measurements indicate that British Columbia’s climate has changed over the past century: average annual temperature increased by 0.6°C on the coast, 1.1°C in the interior and 1.7°C in northern BC. Much of the warming was likely due to an increase in nighttime minimum temperatures.³

Lakes and rivers now become free of ice earlier in the spring, on average, and two large BC glaciers have each retreated by more than a kilometre. The Fraser River discharges a larger share of its total annual flow sooner in the year, and has warmer water in summer. Since the beginning of the 1900’s, average sea levels have risen by 4 to 12 centimeters along most of the coast, with maximum levels up 16 to 34 cm in the Vancouver area. Average coastal sea surface temperatures are 0.9°C to 1.8°C higher.⁴

Climate change science suggests that by mid-century (2050s), mean annual temperatures across BC will be 1.4°C to 3.7°C warmer, on average. Extremely warm temperatures will become more frequent. A warmer climate will result in more growing degree days and frost free days — increasing the potential for plant growth. At the same time, in winter,

While these changes in temperature and precipitation may seem small, they will have significant impacts on natural systems.

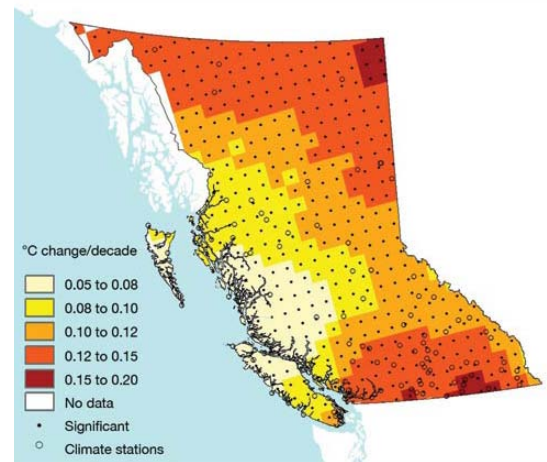
- 2 Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.), *Climate Change 2007 — Synthesis Report Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: IPCC, 2007. www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
- 3 British Columbia Ministry of the Environment; *Indicators of Climate Change for British Columbia, 2002*. www.env.gov.bc.ca/cas/pdfs/indcc.pdf
- 4 *Ibid.*, and Bornhold, Brian D. (2008) *Projected Sea Level Changes for British Columbia in the 21st Century*. Fisheries and Oceans Canada, Natural Resources Canada and the Government of British Columbia. www.env.gov.bc.ca/cas/pdfs/sea-level-changes-08.pdf

most of BC will likely receive more precipitation (up to 26% more in some locations). In summer, northern BC maybe up to 15% wetter, while southern BC may be up to 20% drier. In winter and spring, snowfall will decrease.⁵

While these changes may seem small, they will have significant impacts on natural systems. Water resources and the hydrologic cycle, for example, are highly sensitive to year-to-year climate variability as well as long term changes in climate. Changes in air temperature and precipitation patterns are already having noticeable effects on weather, water cycles and ecology, which in turn have impacts on forests, fisheries, agriculture, recreational opportunities and other resource-based sectors.

Many of the most costly impacts of climate change are associated with increased frequency and intensity of extreme weather events. Heavy “pineapple express” rainfall events have caused widespread urban flooding in the Lower Mainland in recent years, and may have heightened the risk of slides on steep slopes in some communities.⁶ However, gradual changes will also have significant impacts over time. Some examples are set out below:

- The mountain pine beetle infestation, linked to milder winters and decades of forest fire suppression, has significantly affected ecosystems, communities, and the economy;
- Sea level rise associated with warming, combined with higher storm surges, increases the likelihood of flooding and erosion in low lying coastal communities;
- The 2003 and 2009 wildfire seasons were the most dangerous and expensive on record; as summers continue to warm and become drier, such seasons will likely become more frequent;
- Smaller snow packs and shrinking glaciers contribute to lower summer stream flows and increased probability of summer water shortages in some regions; and
- The seasonal droughts of 2003 and 2009 demonstrate the vulnerability of water supplies. BC can expect droughts like this to become more frequent.



CLIMATE CHANGE: GLOBAL PROBLEM, REGIONAL IMPACTS

While climate change is a global problem, the way the climate changes, and its impacts on natural systems, varies from region to region. Sea level rise is an issue for coastal communities in BC, for example, while increased wildfires are more likely to be a problem in the interior regions. As well, in some cases geographic features or settlement and land use patterns might mean that even nearby communities face different challenges. In the Lower Mainland, sea level rise creates different issues for Surrey and Delta, with direct impacts to agricultural lands, compared to Vancouver where urban areas will be most affected.

5 Zwiers, F.W., Schnorlous, M.A., & Maruszoczka, G.D. (2011), *Hydrologic Impacts of Climate Change on BC Water Resources, Summary Report for the Campbell, Columbia and Peace River Watersheds*, Annex 1: Climate Projections for BC. Pacific Climate Impacts Consortium. The summary of future climate change also includes information from the Pacific Climate Impacts Consortium Regional Analysis Tool <http://pacificclimate.org/tools-and-data/regional-analysis-tool> and Plan2Adapt <http://pacificclimate.org/tools-and-data/plan2adapt> websites.

6 Nicholas Heap (2007) *Hot Properties: How Global Warming Could Transform B.C.'s Real Estate Sector*. David Suzuki Foundation, Vancouver, p. 19.

Map figure from: *British Columbia in From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush. Government of Canada, Ottawa ON, pp. 329-386

WHAT IS CLIMATE CHANGE ADAPTATION AND WHY IS IT IMPORTANT FOR LOCAL GOVERNMENTS IN BC?

Defining climate change adaptation

The most widely used definition of climate change adaptation is from the Intergovernmental Panel on Climate Change:

adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.⁷

According to this definition:

- Adaptation involves “adjustment,” or change;
- Both natural and human systems adapt;
- They adapt to climate change and/or to its impacts;
- Adaptation includes adjusting to actual climate change after the fact, and also preparing for expected climate change before it happens; and
- Adaptation can moderate harm or take advantage of new opportunities.

Natural systems will only respond to climate change as it happens. By contrast, human systems, including local governments, can use increasingly reliable information from climate scientists about future climate and its impacts to be pro-active, anticipate and prepare ahead. Local governments can consider the costs and benefits of taking action in advance compared with making adjustments after the climate changes.

Climate change adaptation and local governments

The provincial government has a climate change adaptation strategy⁸ that recognizes local governments as important decisionmakers with respect to climate adaptation. BC local governments have powers and responsibilities related to land use, public infrastructure and finances, and a range of services, from emergency management to economic, cultural and social programs that can be used to develop and implement an integrated approach to local climate change adaptation.

For local governments, putting adaptation to climate change into practice will mean enhancing the resilience of the built and natural environments within their jurisdictions, managing risk, making sound capital investments, managing infrastructure costs,

“Successful adaptation does not mean that impacts will not occur, only that they will be less severe than would be experienced had no adaptation occurred.”

— D.S. Lemmen, F.J. Warren and J. Lacroix, *From Impacts to Adaptation: Canada in a Changing Climate 2007*. www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/132

7 Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.), *Climate Change 2007 — Synthesis Report Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: IPCC, 2007. www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm [accessed April 2012]

8 *Preparing for Climate Change: British Columbia's Adaptation Strategy* at www.livesmartbc.ca/attachments/Adaptation_Strategy.pdf



ensuring service continuity, advancing public health and safety, reducing liability, and maintaining or enhancing the liveability of communities.

Adaptation actions can include changes in policy, technology, behaviour, management, or regulation. While the tools used by local government will be familiar ones, there are some important new considerations:

- The time horizon for adaptation planning will in many cases be much longer than the typical five-year cycles of official community plans or financial plans;
- The past will no longer be a reliable indicator of the future, particularly with respect to natural hazards and conditions and the demands they place on infrastructure. While there is uncertainty about future climate change impacts, scientific information about trends is available and in most cases enough to begin preparing; and
- Community consultation and engagement in solutions will be more important than ever, particularly because of the potential trade-offs that will be required.

The goal of adaptation is to reduce vulnerability and risk associated with climate change. Some possible examples include:

- Adapting to more extreme precipitation by increasing the area of permeable surface to slow run-off and decrease erosion;
- Adapting to sea level rise by buffering shorelines or considering alternative strategies;
- Adapting to increased wildfire risks by developing a fuel treatment program and making changes to zoning and development permitting; and
- Adapting to more frequent water shortages by improving water conservation and planting drought-tolerant species.

Adaptation may also include actions that realize any opportunities presented by climate change—for example, longer growing seasons may present enhanced opportunities for local market gardening.

PLANNING FOR (CLIMATE) CHANGE

Local governments already plan for medium- and long term change — whether it is population growth, shifting demographics, new economic drivers or changing social needs — and climate change is just another factor of change that will need to be accounted for.

PHOTO COURTESY
CIBOULETTE/FLICKR

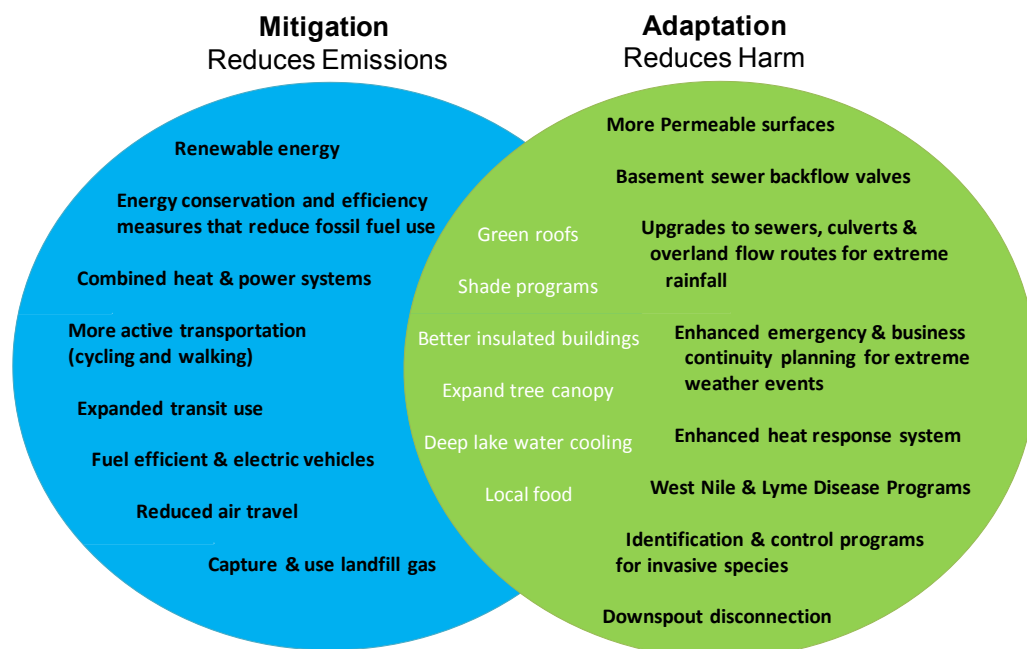
Climate change adaptation and climate change mitigation

Climate change adaptation and climate change mitigation (reducing greenhouse gas emissions) are related, and both are important for local government. However, they serve different ends: climate change adaptation is about dealing with the problems created by climate change, and climate change mitigation is about not making the problem worse.

While adaptation and greenhouse gas reduction decisions often occur within the same contexts — land use, infrastructure, park, water use, and other planning processes — there may or may not be obvious practical linkages.

For example, addressing increased flooding risks by raising dikes or changes to zoning and requirements for development permits does not directly affect the greenhouse gas emissions produced by a community. On the other hand, planting urban trees helps communities cope with more frequent heat waves and increased stormwater run-off, while at the same time removing carbon from the atmosphere as the trees grow — a case where climate change mitigation and adaptation overlap.

Generally speaking, this guide favours approaches to adaptation that increase overall community resiliency, and have multiple benefits, however the first priority for adaptation actions should be to effectively address the climate change impacts that the community has identified as needing attention. It would be ideal if all the adaptation actions local governments choose to implement also reduced greenhouse gas emissions, for example, or had other important co-benefits. However, many adaptation actions will likely be neutral with respect to greenhouse gas emissions. The diagram below outlines how some adaptation and mitigation policies overlap, and some do not.



Source: J. Penney 2008. *Climate Change Adaptation in the City of Toronto: Lessons for the Great Lakes Communities*. Clean Air Partnership. Toronto, Canada, [www.cleanairpartnership.org/files/Climate%20Change%20Adaptation%20in%20the%20City%20of%20Toronto%20-%20Lessons%20for%20Great%20Lakes%20Communities%20\(Penney,%20J.%202008\).pdf](http://www.cleanairpartnership.org/files/Climate%20Change%20Adaptation%20in%20the%20City%20of%20Toronto%20-%20Lessons%20for%20Great%20Lakes%20Communities%20(Penney,%20J.%202008).pdf)

Benefits of a strategic approach to climate change adaptation

Because the climate is changing, and will continue to change, local governments will find themselves adapting to the changes, whether they have planned to do so, or not. What is at stake is how successful local governments will be at minimizing the potential negative impacts of climate change on their communities, and realizing any opportunities that may arise.

To make the best use of scarce resources, local governments can plan ahead and use a strategic approach to climate change adaptation. Of course, after weighing options, a local government may still decide to take no action with respect to a future climate impact, but there is an important distinction between deciding not to act, and not acting because of inertia or failing to consider alternatives.⁹

A strategic, or planned approach to climate change adaptation has a number of key benefits for local governments:

- Greater opportunities for adopting measures that have co-benefits and align with other community goals can be explored;
- Time can be taken to evaluate and address potential insurance and liability issues arising from climate change impacts;
- Cost savings can be realized by considering climate change impacts in the regular maintenance/updating/renewal schedule of existing infrastructure and by planning for new infrastructure to avoid expensive upgrades later;
- Adaptation measures that have unintended adverse impacts are more likely to be avoided if they have been identified and evaluated in advance;
- Emergency needs can be identified and prioritized in advance of crises;
- Opportunities for cooperation with other governments and agencies can be explored;
- Communities can be consulted and engaged in developing and implementing responses;
- Steps can be taken to enhance the resilience of vulnerable ecosystems before environmental thresholds are reached; and
- Local governments can avoid committing to development patterns or development in areas that will pose significant risks for inhabitants over the longer term as a result of climate change impacts.



Because the climate is changing, and will continue to change, local governments will find themselves adapting to the changes, whether they have planned to do so, or not.

The table on the following pages is based on materials from Canada's National Assessment for British Columbia and a format prepared for King County, Washington. The table lists some potential climate impacts in different sectors that are relevant to local governments in BC. It should be noted that not all impacts listed will occur in all regions.

⁹ A central government perspective on climate change impacts, vulnerability and adaptation, Andy Reisinger, Policy Analyst/Science Adviser, New Zealand Climate Change Programme, www.lgnz.co.nz/library/files/store_001/impacts-of-climate-change.pdf

INITIAL SCOPING: A SAMPLE OF SECTORS AND POTENTIAL CLIMATE CHANGE IMPACTS

Sector	Impacts in some regions could include...
Hydrology and water resources	• Reduced snowpack and earlier snowmelt, meaning earlier spring flows and reduced April to September streamflows • Increased risk of drought (more prolonged and intense) in some areas • Increased risk of flooding in some areas • Increased competition for water with implications for local and regional allocations, as well as transborder agreements • Warmer water temperatures in lakes and rivers • Changes in water quality • Hydrological changes in watersheds affected by mountain pine beetle resulting from tree mortality and increases in logging activity • Reduced groundwater recharge and discharge, while at the same time increased demands for groundwater as a result of reduced surface water flows • Increased contamination of surface water due to flooding • Aquifer contamination or depletion; saltwater intrusion in coastal areas
Agriculture	• Increased demand for irrigation for the south coast and southern interior regions at the same time that summer flows will be decreasing • Increased pest pressure resulting from winter survival of pests and diseases • More frequent and sustained droughts • Increased salinity in coastal areas • Waterlogged soils in some areas due to flooding and increased winter precipitation • Increased flooding leading to increased leaching of agricultural chemicals • Increased risk of smoke-damaged crops in some regions • Possible increase in productivity for some crops and new opportunities for heat-requiring species in some areas • Potential opportunities for new crops in northern areas resulting from longer growing seasons, depending on soil suitability, water availability and other factors
Biodiversity	• Shift in the distribution and range of species • Loss of species not able to adapt to changes • Increased competition from invasive species • Loss and fragmentation of habitat • Increased wildfire frequency and severity, which will challenge some ecosystems but may benefit fire-maintained ecosystems • Large-scale pest outbreaks • Challenges to the capacity of BC's system of protected areas as species are forced to migrate

Sector	Impacts in some regions could include...
Forests, forest industry, parks and urban trees	• Ongoing impacts from the mountain pine beetle outbreak • Losses in productivity in drier and warmer regions • Shift in the distribution and range of species • Increased risk of insect outbreaks • Increased risk of forest fire, and potential for larger fires of higher intensity • Increased competition from invasive species • Potential reduction in access to timber resulting from warmer, wetter weather in winter, and increased risk of wildfire in summer • Extreme winds leading to windfall • Drier conditions leading to increased maintenance needs for urban trees (water, mulching, replacement) • Modest increases in productivity in northern BC where soil moisture is adequate and fire risk is low
Tourism and recreation	• Reduced opportunities for cold season recreation due to inadequate snowfall, rising snowlines and/or reduced snow or ice quality • Increased reliance on snow-making at ski areas, requiring significant capital and water resources and favouring larger ski operators • Decreased opportunities for warm season activities during the hottest part of the year, particularly in southern areas (e.g., from heat, forest fires, low water levels, reduced air quality) • Coastal erosion and flooding affecting tourism in coastal communities, such as vacation housing and resort infrastructure • Increased need for hazard reduction and emergency management in the tourism and recreation sector to deal with increased floods, landslides, wildfires and avalanches • Increased opportunities for warm season activities in some regions
Energy	• Risk of decreased hydroelectric generating capacity due to water shortages resulting from reduced snow packs, declining glacier contributions and frequent drought • Reduced heating demand during winter months • Increased cooling demand during summer months • Potential for increasing energy prices due to carbon pricing policies within BC and outside BC • Increased likelihood of grid power interruption from extreme weather events • Emerging incentives to develop district energy systems and decentralized renewable energy sources that are less vulnerable to large-scale disruptions • Ongoing incentives from utilities to encourage energy efficiency

Sector	Impacts in some regions could include...
Transportation	• More travel disruptions associated with landslides, road washouts, flooding, ice jams and wildfires • Increased road surface damage from higher temperatures • Increased frequency of freeze-thaw cycles and damage to roads • Increased maintenance requirements and brushfires for roadside and median strip vegetation • Potential reductions in water-based navigation due to lower summer stream flows • Need for alternate modes of transportation of food/medical supplies to communities that rely on ice roads for access in winter • Milder winter weather leading to reductions in motor vehicle accidents
Infrastructure	• Increased risk of windstorms, forest fires, storm surges, landslides, snowstorms, ice jams, hail and floods • Increased demands on storm water management systems with the potential for more combined storm water and sewer overflows, and need to explore integrated storm water management practices • Reduced effectiveness of sea walls as a result of sea level rise • Need for new or upgraded flood control and erosion control structures or alternative strategies • Need for retrofit upgrades of existing vulnerable infrastructure, including port facilities, transportation network, electricity and communications distribution infrastructure • Potential for more green infrastructure and low impact development due to greater resilience to climate change impacts offered by these practices
Coastal resources and ecosystems	• Increased erosion or damage to coastal infrastructure, dunes, beaches, and other natural features due to sea level rise and storm surge • Loss of coastal wetlands and other coastal habitats due to sea level rise and increased storm surges contributing to erosion • Increased costs for maintenance and expansion of coastal erosion control (natural or man-made) • Saltwater intrusion into coastal aquifers • Potential increased risk of pollution from coastal industrial sites due to sea level rise • Loss of cultural and historical sites on coastline due to sea level rise and related impacts • Coastal squeeze implications, i.e. loss of coastal habitat in areas where man-made defensive structures or natural features form a barrier along the coast that prevents the landward movement of ecosystems and habitats in response to sea level rise • Increased salinity of low-lying farmland

Sector	Impacts in some regions could include...
Aquatic ecosystems and fisheries	• Shifts in species range and distribution • Invasion of coastal waters by exotic species • Rising ocean and freshwater temperatures leading to increased stress on coldwater species such as salmon • Changes in the amount, timing and temperature of river flows • Potential increased conflicts of fisheries with other water uses (e.g. hydroelectric power generation, irrigation, drinking water), particularly in the southern interior
Business	• Price volatility in energy and raw product markets due to more extreme weather events • Increased insurance premiums due to more extreme weather events • Impacts on business infrastructure located in floodplains or coastal areas • Decreased availability of water resources potentially affecting water-intensive activities, such as agriculture, pulp and paper processing, fish hatcheries, food processing, mining, chemical and petrochemical processing and manufacture, small and large hydro installations and airport operations • Potential for business interruption due to extreme events and the subsequent need for business continuity planning • Concern from business community regarding security of investments and assets in face of climate change impacts
Health	• More heat-related stress, particularly among seniors, children, those with low income, and other vulnerable segments of the population (e.g. homeless) • Fewer extreme cold-related health risks • Increase in diseases spread by water, air and vectors (e.g. West Nile) • Reduced air quality in urban areas such as Greater Vancouver, Prince George and the Okanagan Valley • Reduced air quality due to increases in forest fire frequency • Increased risks for vulnerable populations as a result of extreme weather or related events (e.g. special evacuation needs, access to regular medical care and prescription drugs) • Reduced drinking water security in water-stressed regions
Emergency response	• Increased demands on emergency response services related to extreme weather events (e.g., heat, flooding, storms) and forest fires • Heightened vulnerability of remote communities dependent on limited essential services and infrastructure in case of extreme weather events and natural hazards • Greater possibility of simultaneous multiple impacts • Greater need to coordinate emergency response across regions

Table adapted from Snover, A.K., L. Whitely Binder, J. Lopez, E. Willmott, J. Kay, D. Howell, and J. Simmonds. 2007. *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*. In association with and published by ICLEI—Local Governments for Sustainability, Oakland, CA. pp. 40-42, with materials from Walker, I.J. and R. Sydneysmith. 2008. *British Columbia in From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush. Government of Canada, Ottawa ON, pp. 329-386.

AN OVERVIEW OF THE ADAPTATION PROCESS

Identifying climate change impacts and assessing risks and vulnerabilities

The first stage in local government adaptation is to assess how climate change will likely affect the community so that priorities for action can be identified. Climate change and its impacts vary from one location to another, and communities vary in their exposure and ability to cope. In order to develop a climate change adaptation strategy, a local government will need to learn about the potential regional impacts facing its community, identify ways in which the community is vulnerable, and quantify risk related to climate change. *Appendix A* identifies resources that can help local governments carry out or participate in assessments of vulnerability and risk.

Good information about climate change is the foundation for this stage in the adaptation process.

Additional scientific information, in particular on the regional impacts of climate change, exists in various forms, mostly technical reports and analyses. The amount available in plain language, however, is currently limited, but growing. Appendix A includes a few key sources of such information, including the comprehensive high level summary of the scientific literature on climate change impacts in BC produced by Natural Resources Canada.¹⁰

Plan2Adapt
interactive
planning tool
website

WHERE TO FIND INFORMATION ABOUT REGIONAL CLIMATE CHANGE IMPACTS

The Pacific Climate Impacts Consortium (PCIC) at the University of Victoria produces regionally and locally relevant information about past and future climate and some of its impacts on hydrology and ecosystems. PCIC also aims to “bridge the gap” between climate science experts and decisionmakers, by supporting the two-way transfer of knowledge, and by making scientific information more accessible.

Some communities in BC have engaged PCIC to produce information specific to their communities, while others have relied on “off the shelf” information about regional climate change available from the Plan2Adapt website. The website provides access to climate data tables, user-friendly graphs and maps of future temperature, precipitation, snowfall, and other climate variables, and written summaries of this information. For example, Plan2Adapt indicates that mean annual temperature in the Peace River Regional District will be 1.4°C to 2.8°C warmer in the 2050s. Users can download contents for further analysis, reporting, and for use in presentations. See <http://pacificclimate.org/tools-and-data/plan2adapt>.



10 D.S. Lemmen, F.J. Warren and J. Lacroix (2007), *From Impacts to Adaptation: Canada in a Changing Climate 2007*. www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/132



Despite the uncertainty in projections of future climate, most experts agree there is enough information for decisionmakers to start to prepare.

PHOTO COURTESY
ECSTATICIST/FLICKR

Local observations and expertise are also an important source of information about climate change impacts and vulnerabilities. Making a connection between local knowledge and higher-level scientific information will both enhance understanding of the impacts of a changing climate and help to engage the community in considering adaptation strategies.¹¹

Uncertainty about the rate of climate change, and severity of impacts

There are two main sources of uncertainty in scientific climate projections. First, climate change is linked to the concentrations of greenhouse gases in the atmosphere, and future levels depend on how successful the global community is at reducing greenhouse gas emissions in coming years. Second, scientists obtain information about future climate change from computer models of the global climate system, and these models, though sophisticated, may not fully reflect the intricacies of the climate system.

Despite the uncertainty in projections of future climate, most experts agree there is enough information for decisionmakers to start to prepare. The uncertainty is not whether the climate is changing, but how rapidly. It is important to view adaptation as a process; as new information becomes available or certain physical changes become apparent, actions can be re-evaluated and updated.

Some of the resources in Appendix A discuss uncertainty and provide guidance on how local governments can address it in their assessment and planning processes. Section 4 of this guide also provides an introduction to ways that local governments can build adaptive capacity and resilience in their communities so that they can better cope with uncertainty. Part 2 looks at ways to implement climate change adaptation strategies, and integrate climate change adaptation into local government planning and decision-making. It also considers how certain approaches, for example, green

¹¹ See, for example, Ingrid Liepa (2009) *Adapting to Climate Change in Kimberley, BC, Executive Summary*. www.city.kimberley.bc.ca/sites/kimberley.civicwebcms.com/files/media/iWeb/%7B0647EEC8-854E-424A-A28A-026746766D52%7DExecutiveSummary-June30.pdf



PRIORITIZING ACTIONS IN KIMBERLEY, BC

In 2008–2009 the City of Kimberley was a pilot community in the Columbia Basin Trust's *Communities Adapting to Climate Change Initiative*. Working with climate information prepared by the Pacific Climate Impacts Consortium, combined with local input, the community identified three priority issue areas: Water and Forests, Municipal Infrastructure, and Tourism. A series of working groups identified vulnerabilities in these areas and came up with recommendations for adaptive actions. www.city.kimberley.bc.ca/sites/kimberley.civicwebcms.com/files/media/iWeb/%7B0647EEC8-854E-424A-A28A-026746766D52%7DExecutiveSummary-June30.pdf

PHOTO COURTESY
CITY OF KIMBERLEY

infrastructure measures (relying on natural and engineered features to more closely mimic the natural hydrologic cycle), offer greater flexibility in the face of uncertainty around future climate change projections as opposed to making changes to conventional pipe and drain infrastructure.

Identifying and evaluating adaptation options

After assessing risk and vulnerability, the next stage is to identify and evaluate community adaptation options, strategies, and actions. It should be emphasized that the scientific information about climate change in a region or local area will not in itself determine the action that needs to be taken. As with any matter within their jurisdiction, local governments will still need to consider the relevant information and make policy choices about the actions that are most appropriate for their communities.

This guide provides many practical ideas about how communities can increase their resilience and manage risk related to climate change, and ways to deliver adaptation strategies. Local government case studies, sector-specific guides, and other resources identified in Appendix A are other good sources of adaptation ideas. Many communities, once they understand their vulnerabilities, can identify adaptation options and priorities through consultation and discussion in their communities.

Not all adaptation options are equally cost-effective or appealing. Vision, values, risk tolerance, priorities, resources, and other factors vary from one community to another, so even those facing similar risks and opportunities may make different adaptation choices. Actions that address current issues at the same time as potential future climate change impacts are particularly effective. In some cases, science can help to inform decisions about which adaptation options to select; for example an engineering study might provide solid information about the cost and effectiveness of several different engineered solutions to urban flooding. In other cases, for example where there are difficult trade-offs to be made, significant community engagement and consultation may be required. Robust adaptation strategies typically include a range of adaptation measures or actions to be implemented.



Implementing, monitoring, and updating adaptation strategies

Finally, the adaptation process involves implementing strategies, monitoring results, and updating strategies and decisions over time to reflect new information, priorities, and resources.

Some communities have chosen to directly address the climate change vulnerabilities they have identified through modifications to existing plans and strategies for land use, infrastructure, parks, stormwater and other areas of responsibility. This is sometimes called “mainstreaming” and is addressed further in Section 4. Alternatively, some communities choose to first develop stand-alone “adaptation plans.” In this case further steps are necessary to integrate the actions identified in the adaptation plans into planning documents and decision-making processes.

In terms of monitoring results, there is no standard measure of adaptation success. In general, the goals of adaptation are to increase community resilience, reduce risk, and advance opportunities. Many adaptation actions will also advance broader sustainability goals. In practice, the results of adaptation will look different for every community, based on how local impacts are addressed.

Over time, climate change adaptation strategies and actions will need to be regularly updated and refined to take into account both new information and evolving realities about climate change impacts. They will also need to reflect other factors that may be relevant in a given community, such as increasing or decreasing populations and shifting demographics, changing economic drivers, new technologies, opportunities for cooperation or funding, and others. Adaptation is a process. Local governments and their communities will need to continue to be engaged with assessing climate change impacts, prioritizing actions and implementing responses, as long as the climate continues to change.

Adaptation is a process. Local governments and their communities will need to continue to be engaged with assessing climate change impacts, prioritizing actions and implementing responses, as long as the climate continues to change.

CHETWYND
PHOTO COURTESY
ENERGETICCITY/FLICKR

BUILDING ADAPTIVE CAPACITY AND RESILIENCE

Because adaptation to climate change needs to be ongoing, successful adaptation will require not only good information about climate change, and prioritization of actions, but also the ability to implement responses and modify those responses over time. “Adaptive capacity” refers to the capabilities of a region, community or group to implement effective adaptation actions.¹²

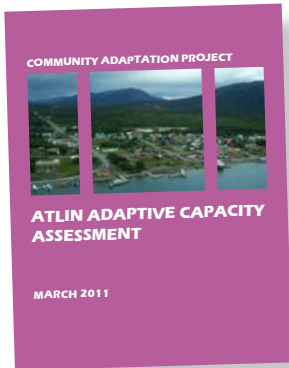
Most practitioners and experts working in this field seem to agree that it is useful to consider how local government services and functions can continue to be delivered in the face of a range of plausible climate change outcomes. As one commentator has observed, the question to ask is not “What are all the changes that will happen and how can we respond?” but “What do we do, and how should we adjust that for the reality of climate change.” The idea is to integrate climate change adaptation into existing activities.¹³

Once they have assessed risk and vulnerability to impacts, it may be useful for local governments to undertake a “capacity assessment.” This can look at adaptive capacity both from a broader community perspective, as well as with respect to the main institutional bodies in a community, including local government. An example is the Atlin Adaptive Capacity Assessment.¹⁴ In looking at ways to strengthen adaptive capacity, communities might want to consider how they responded to events in the past that were similar to those expected in the future, such as natural hazards like flooding or wildfire. It is important to build on existing strengths and programs within the community.

Three related approaches that can help strengthen adaptive capacity across local government are discussed below: “mainstreaming” climate change adaptation into local government planning and decision-making; adaptive management, a way to incorporate innovation and responsiveness into planning and decision-making; and cooperating and collaborating.

Mainstreaming

“Mainstreaming” adaptation means ensuring that planning and decision-making take climate change impacts and vulnerability assessment into account wherever relevant. It puts in place an integrated response to a changing climate, assists in ensuring that opportunities to address vulnerabilities are explored, and also helps to avoid policies and projects that have an adverse effect on adaptation because climate change impacts were not considered. Mainstreaming will not happen overnight, but it is an open-ended process that can be improved over time.



The Atlin Climate Change Project assessed the extent to which the community of Atlin, BC was vulnerable to the impacts of a changing climate and evaluated adaptive capacity, as the first stage in developing a community climate adaptation plan.

Northern Climate Exchange,
Atlin Adaptive Capacity Assessment, March 2011.
www.taiga.net/nce/adaptation/Atlin_Adaptive_Capacity_Assessment.pdf

12 Definition taken from Natural Resources Canada, *Adaptive Capacity in Canada*, www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/adaptation102/218

13 Hoffman, J. (2010). *Adapting your work to climate change*. EcoAdapt. Retrieved from CAKE: www.cakex.org/virtual-library/2355

14 Northern Climate Exchange, *Atlin Adaptive Capacity Assessment*, March 2011. www.taiga.net/nce/adaptation/Atlin_Adaptive_Capacity_Assessment.pdf



Once they have assessed risk and vulnerability to impacts, it may be useful for local governments to undertake a “capacity assessment.” PHOTO COURTESY BC HYDRO

In general, mainstreaming climate change adaptation involves the following:

- Obtaining the relevant climate information in a form that can be used by local government staff and decisionmakers;
- Developing adequate knowledge and understanding of climate change impacts on the part of local government land use and financial planners, engineers and decisionmakers in relation to their areas of responsibility. This will likely mean consulting with climate scientists and other scientific and technical specialists who have relevant expertise;
- Creating appropriate triggers in planning and decision-making processes — for example, including climate change impacts on development checklists, or having a certain level of investment in infrastructure trigger a requirement that any climate change impacts be considered in the context of infrastructure vulnerabilities. Even where climate change impacts have already been identified, these types of triggers are important to ensure that current measures are periodically reassessed in the context of updated climate science;
- Carrying out robust community consultation processes so that businesses, households, individuals and community groups understand the basic science and will participate to some degree in developing and implementing adaptation strategies; and
- Cooperating and collaborating with other local governments, provincial and federal governments, government agencies, First Nations, and local associations to access adequate resources and capacity to assess climate change impacts and implement effective responses.

CLIMATE CHANGE ADAPTATION RESEARCH AND POLICY

Some of the many actors involved in climate change adaptation research and policy include:

- Ministry of Community, Sport and Cultural Development
- BC Climate Action Secretariat
- Natural Resources Canada
- Pacific Climate Impacts Consortium
- Pacific Institute for Climate Solutions
- Environment Canada
- Planning Institute of BC
- Engineers Canada
- Columbia Basin Trust
- Fraser Basin Council
- Okanagan Basin Water Board
- Asset Management BC
- Agriculture and Agri-Food Canada
- Ministry of Forests, Lands and Natural Resource Operations
- Canadian Water Resources Association
- Canadian Standards Association
- Canadian Forest Service
- FORREX
- Universities and colleges across BC

...and others.

For more information see *Appendix A*.

Adaptive management¹⁵

Adaptive management is a way to continuously adapt and improve a system or a policy framework. Managers actively plan to revise policies on a regular basis using updated information about performance as well as about external circumstances that affect performance. It is sometimes referred to as “learning by doing.” Adaptive management was developed to accommodate the complexity and uncertainty associated with natural systems. It may be a useful approach to help better meet management objectives over time in the context of a changing climate.

For adaptive management to work, practical and contextual information needs to flow to managers that are designing policies so that guidance for operational-level decisions can be improved. For example, in terms of climate change, as more information about climate change impacts becomes available, this could be used to adjust and refine policies.

Adaptive management is already being applied in the development of green infrastructure. While the expected performance of different rainfall capture methods aimed at protecting water quality

and habitat can be modeled, all the real-life variables that affect performance can never be fully simulated, or predicted. Through adaptive management, performance can be monitored and evaluated, and adjustments made as necessary. The experience gained can also be used to inform the design of future systems.

Adaptive management is a more flexible approach than trying to predict all future conditions and design a perfect set of policies.



SOURCE: WWW.FOR.GOV.BC.CA/HFP/AMHOME/ADMIN/INDEX.HTM

ADAPTIVE MANAGEMENT IN THE PROPOSED CITY OF VICTORIA OFFICIAL COMMUNITY PLAN (APRIL 2012)

“An adaptive management approach involves deliberately learning from implementation successes and failures to improve subsequent policies and actions over time. It is based on the notion that policies are developed with inherent uncertainties and that the wider social, cultural, economic and ecological environment inevitably changes over time. Change can originate from external factors such as climate change or global economic crisis, or from factors particular to Victoria, such as changes to the city’s socio-economic conditions, community values or a localized natural disaster. Changes of this kind may undermine the goals, broad objectives and policies of this plan and impede progress towards their achievement. Anticipating and responding to potential changes or risks is fundamental to the adaptive management framework and policies that follow. A system of regular plan review, monitoring and adjustment enables the City to incorporate new information, prepare for uncertainty and adapt to change.”

www.shapeyourfuturevictoria.ca/wp-content/uploads/2012/03/OCP_Section22.pdf

15 This section is based primarily on materials developed by West Coast Environmental Law. See “Address risk.” www.wcel.org/address-risk, and *The Green Infrastructure Guide*, s.6.4. www.wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories See also ICLEI Oceania, *Local Government Climate Change Adaptation Toolkit*, www.iclei.org/fileadmin/user_upload/documents/ANZ/CCP/CCP-AU/Projects/AI/AdaptationToolkit/Toolkit_CCPAdaptation_Final.pdf, and www.for.gov.bc.ca/hfp/amhome/Admin/index.htm



In 2011, the City of Duncan, Cowichan Tribes, Cowichan Valley Regional District, and District of North Cowichan signed an MOU to help manage increased flood risks in the region.

PHOTO COURTESY COWICHAN VALLEY REGIONAL DISTRICT

Collaboration

Most local governments, when confronted with the challenge of climate change, will have to deal with capacity issues related to expertise and resources. They may also grapple with issues related to jurisdiction, where some of the information needed to assess impacts or levers needed to implement responses lie with other governments or agencies.

One way to enhance the capacity of local governments to assess impacts is to work collaboratively, with other local governments, provincial and federal governments, government agencies, First Nations, the academic community and professional associations, many of which are already working to understand how the climate is changing and what the impacts will be. A number of these groups are already working with various local governments in BC.

Collaboration is also a way to coordinate responses to climate changes that have impacts across a region, and require a larger-scale response in order to be effective. They can ensure increased resources and coordinated action in a larger geographic area.

For example, facing increased wildfire risks in the region, the City of Kamloops has recognized the need to work with the Thompson-Nicola Regional District, the Ministry of Forests and the Kamloops Indian Band to develop cross-jurisdictional community fuel breaks along City of Kamloops municipal boundaries.¹⁶ In the Okanagan, the Okanagan Water Basin Board¹⁷ brings together local government and community representatives in an innovative collaborative organization that engages in research and outreach designed to support the sustainable management of water resources in the region. The Board and its members are actively working on a number of initiatives relating to climate change, and they also work together with other levels of government and various government agencies, academics and associations on different projects.

Facing increased wildfire risks in the region, the City of Kamloops has recognized the need to work with the Thompson-Nicola Regional District, the Ministry of Forests and the Kamloops Indian Band to develop cross-jurisdictional community fuel breaks along City of Kamloops municipal boundaries.

¹⁶ www.city.kamloops.bc.ca/fire/rescue/pdfs/cwpp.pdf

¹⁷ www.obwb.ca

Implementing climate change adaptation strategies

INTRODUCTION TO PART 2

Local governments have many tools at their disposal to implement climate change adaptation strategies. Of course, it is also true that local governments have a lot to consider in order to ensure that their communities are prepared for climate change. The good news is that a number of BC local governments have already begun to take action to address the impacts of a changing climate, and local governments that are just getting started have a growing number of examples to consult. The information that is provided in this part of the guide is complemented by references to many of these examples.

Part 2 first examines the higher-level community plans under the *Local Government Act* that local governments can use to implement climate change adaptation strategies. Regional growth strategies and official community plans can provide a supportive framework for the development and implementation of integrated climate change adaptation strategies. The policy guidance offered by these documents can help direct action with respect to land use planning and other areas of local government jurisdiction such as infrastructure, emergency management planning, asset management and financial planning, the protection of biodiversity, and community and economic development services.

Also important for developing an integrated response to a changing climate are the tools that can be used to implement land use planning, such as development permits, zoning, and various other measures as outlined below. Some local governments may be tempted to carry on with *status quo* land use plans for their communities. However, the decisions made today about land use will have long term consequences, enduring until later this century when some of the more significant impacts of a changing climate will have become a reality.

Local governments need to start planning now for a climate that is outside the range of what has been “normal” for the past century or longer here in BC. As well, planning for the “new normal” in an integrated way will mean more opportunities to be proactive, create additional community benefits and save costs down the road. And while liability related to climate change impacts is still a very new area of the law, it would be wise for local governments to act prudently in light of projected impacts. For these reasons it is important to begin thinking about how climate change preparedness can be integrated into land use planning policies and regulations. A

number of BC local governments are leading the way, and some of their actions are discussed below. There are many ways that governments can use land use planning and related regulatory powers to help make their communities more resilient to climate change impacts over time.

Adaptation brings home the need to break down silos within local governments. Climate change impacts cut across nearly every area of local government service and responsibility.

For example, planning for infrastructure that will be resilient to future climate change impacts raises questions about capacity and vulnerability, patterns of development and green infrastructure options, costs of maintenance, operation, upgrading and replacement, options for financing, and operations during emergencies. Engineers, land use planners, asset managers or financial planners and emergency planners all need to be engaged at some stage. Internal communications are very important. Some communities have found it useful to develop a climate change adaptation committee or team that can explore how to identify and manage climate change impacts and responses across a local government. Building communities that are resilient in the face of future changes will require internal cooperation and collaboration in addition to the external collaboration described in Part 1.

In terms of adaptation strategies themselves, several themes emerge from practices and experience to date:

- Approaches that maintain and enhance the interconnectedness of communities with natural systems — low impact development, green infrastructure for rainwater management, protecting ecological values within urban boundaries — seem to offer increased resilience to a changing climate as well as important co-benefits;
- Strategies that emphasize more efficient use of resources and operation of equipment and facilities are also important for improving resilience where the impacts of climate change may result in shortages of resources such as energy or water, or increased demands on infrastructure during extreme weather event; and
- The need to adapt to a changing climate points towards regional scale responses in certain areas: for example, watershed management, food security and emergency planning and response.

All of these themes are illustrated with references to examples from BC and in some cases elsewhere in Canada.

Not all of the examples provided in Part 2 were developed specifically as climate change adaptation strategies, but they have been included because they nonetheless offer significant adaptation benefits, and can be considered to be part of the toolkit available to local governments developing climate change adaptation strategies.

Part 2 concludes with a brief discussion of some of the legal liability and insurance issues that may arise for local governments in the context of climate change adaptation.



Part 2 first examines the higher-level community plans under the *Local Government Act* that local governments can use to implement climate change adaptation strategies.

ANNACIS ISLAND PHOTO
COURTESY LORI&TODD/Flickr

LAND USE PLANNING

Regional Growth Strategies

Integrating climate change adaptation into regional growth strategies or regional-scale planning

There are three main areas where regional growth strategies can promote climate change adaptation:

1. Regional growth strategies should require that regional district policies, plans and regulations consider climate change impacts.
 - The Okanagan Similkameen Regional District regional growth strategy states that the region's vulnerability to climate change should be considered in planning. *South Okanagan Regional Growth Strategy* (amended September 2011). www.rdosmaps.bc.ca/min_bylaws/contract_reports/planning/Regionalgrowth/RGSBYLAW2421_ScheduleA_071008reread2nd_forOct22BoardAgenda.pdf
 - Metro Vancouver's regional growth strategy states that climate change and natural hazard risk assessments should be incorporated into the planning and location of Metro Vancouver utilities, assets and operations. *Metro Vancouver 2040, Shaping Our Future* (adopted July 2011). www.metrovancouver.org/planning/development/strategy/RGSDocs/RGSAdoptedbyGVRDBoardJuly292011.pdf
 - Policy documents prepared in 2010 for the development of the regional growth strategy for the Capital Regional District also propose that climate change adaptation be considered in all decision-making, planning and regulatory measures. *Climate Change* (Fall 2010). http://sustainability.crd.bc.ca/media/1280/climate_change_policy_brief_small.pdf
2. High level objectives regarding climate change impacts of common concern among local governments within a regional district should be established.
 - The Comox Valley Regional District regional growth strategy identifies water supply shortages as an issue that is being exacerbated by climate change in the region and sets out a number of high-level policies targeted at water conservation. *Comox Valley Regional Growth Strategy* (adopted March 2011). www.comoxvalleyrd.ca/uploadedFiles/Regional_Growth_Strategy/RGS/120_Comox_Valley_Regional_Growth_Strategy_2010_1.pdf
3. Regional scale climate change issues should be addressed, to ensure that local approaches have a coordinated and mutually beneficial effect overall.
 - The Comox Valley Regional District proposes regional floodplain mapping and management to deal with climate change and sea level rise. *Comox Valley Regional Growth Strategy* (adopted March 2011). www.comoxvalleyrd.ca/uploadedFiles/Regional_Growth_Strategy/RGS/120_Comox_Valley_Regional_Growth_Strategy_2010_1.pdf



Approaches that maintain and enhance the interconnectedness of communities with natural systems — low impact development, green infrastructure for rainwater management, protecting ecological values within urban boundaries — seem to offer increased resilience to a changing climate as well as important co-benefits.

- The Capital Regional District is proposing to support coordinated efforts to plan for and protect the region's urban forests and environmentally sensitive and significant areas. *Climate Change* (Fall 2010) http://sustainability.crd.bc.ca/media/1280/climate_change_policy_brief_small.pdf
- Promoting connectivity at the landscape level to enhance the resilience of natural ecosystems, managing invasive species, and investigating the impacts of climate change on water supply and the natural environment in the region are identified as priorities for regional management in the *Squamish-Lillooet Regional District Regional Growth Strategy*. (adopted June 2010) www.slrd.bc.ca/files/%7B44E626F3-81DC-4A10-90E5-7D66BAA6882C%7DBL1062.pdf

To consider:

Many regional districts in BC do not have regional growth strategies. However, preparing for climate change may offer cost savings and synergies if undertaken at a regional level, both with respect to assessing impacts and implementing responses. Without a regional growth strategy this can still be reflected in regional level policy or in a regional-scale climate change adaptation strategy. See, for example, the Cariboo-Chilcotin Climate Change Adaptation Strategy. www.retooling.ca/_Library/docs/Executive_Summary_-_Cariboo_Chilcotin_Climate_Change_Adaptation_Strategy_-_September_2011.pdf

REGIONAL GROWTH STRATEGIES

Local Government Act, ss. 848-871

Regional growth strategies (optional for regional districts) are land use plans and policies designed to apply broadly across regional districts in BC, to “promote human settlement that is socially, economically and environmentally healthy and makes efficient use of public facilities and services, land and other resources.” Regional growth strategies are required to cover a broad range of topics related to regional sustainability (sprawl, pollution, adequate, affordable housing, public health concerns, efficient use of energy, protection of water and environmentally sensitive areas, waste management, efficient movement of goods and people, sustainable transportation options). They should provide a comprehensive statement of policies and objectives for the region covering a period of at least 20 years.

Regional growth strategies are adopted after an iterative process in which “all reasonable efforts” are made by regional boards and affected local governments to reach agreement on their contents. Consultation with citizens, First Nations, district boards and other levels of government is required, but no public hearing is necessary before adoption.

All bylaws and services undertaken by a regional district must be consistent with its regional growth strategy, and each municipality must include a regional context statement in its OCP describing the relationship between the OCP and regional growth strategy and how the OCP will be made consistent with the regional growth strategy over time.



Preparing for climate change at a regional level may offer cost savings and synergies, both with respect to assessing impacts and implementing responses.

PHOTO COURTESY
CITY OF COURTENAY

Official Community Plans

Integrating climate change adaptation into an OCP

An Official Community Plan is one of the key planning tools available to a local government to put in place climate change adaptation strategies that will be reflected in decision-making about land use and development within its jurisdiction. Both the planning process and the product are important. Depending on how far a local government has advanced in assessing climate change impacts and developing climate change adaptation strategies, an OCP can be used in different ways to support action:

- When a local government has already assessed its risks and vulnerabilities to climate change impacts, or is prepared to undertake this process together with a significant revision of its OCP, there is the possibility to address climate change adaptation *comprehensively* across the policies and objectives within the OCP, and mainstream associated action throughout all guidelines and regulations; or
- For local governments that are just beginning to look at climate change impacts and the risks and vulnerabilities in their community, and have limited resources, the OCP can be used to frame specific climate change adaptation objectives to advance climate change assessment and planning, and/or to modify specific policies and objectives to incorporate adjustments to climate change impacts where there is enough existing information to do so; or
- For local governments that develop stand-alone plans the OCP will need to be amended to include the appropriate policies, objectives, maps and related material.

Whichever approach is selected, the goal over time should be for local governments to develop a comprehensive approach to managing climate impacts, and to have this reflected in the OCP. Climate change impacts cut across different local government policy areas and functions, and through its OCP a local government can put in place a holistic and integrated approach to addressing impacts across its jurisdiction. It is a way to support the mainstreaming of climate change adaptation into local government



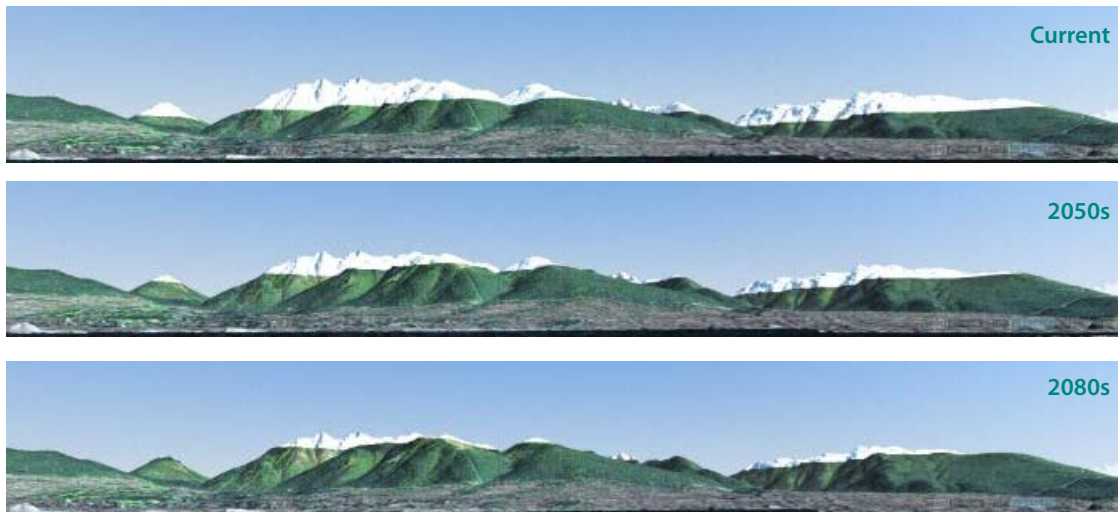
Over time local governments should aim to mainstream climate change adaptation into local government policy and decision-making, incorporating input from climate science experts.

NELSON PHOTO COURTESY
78SPEED/FLICKR

OFFICIAL COMMUNITY PLAN

Local Government Act, ss. 875-884

An official community plan (OCP) is a forward-looking document that sets out overarching policies and objectives that apply to land use and development within the area covered by the plan. It also addresses infrastructure, housing, and greenhouse gas reduction targets, and can extend to social needs, agriculture and environmental protection and other matters. The OCP provides the framework for local government decision-making: all bylaws and local government decisions, including capital expenditures, must be consistent with the OCP, once it has been legally adopted by a local government. As well, an OCP is developed through a process that includes public consultation, and this provides an opportunity to have a community dialogue about climate change impacts and possible actions. OCP policies and objectives can also inform considerations of public interest made by Approving Officers with respect to subdivision applications.



Visualization of snowpack reductions on the North shore mountains of the District of North Vancouver, under a “do nothing” baseline scenario, courtesy Collaborative for Advanced Landscape Planning, UBC

decision-making. Although the OCP itself does not legally bind a local government to proceed with any project, putting climate change adaptation policy objectives in the OCP ensures that subsequent legal enactments, such as zoning bylaws, must be consistent with those objectives.

The OCP can offer a relatively long term planning horizon, and local governments could consider a planning horizon of 50–100 years in relation to the development of climate change policies and objectives aimed at shifting developments and land use patterns over time. It is important to anticipate future climate impacts now, before decisions made today result in safety hazards or expensive damage to infrastructure over the longer term. The draft City of Prince George OCP indicates, for example, that the climate change impact priorities it has identified should be considered in new development proposals.¹⁸

Having climate change adaptation objectives identified in the OCP can also provide ongoing momentum for local government action, and a rationale for committing resources for adaptation work. The Thetis Island OCP states that “The Local Trust Committee should consider the development of new criteria for assessing official community plan or land use bylaw amendment applications from the perspective of climate change adaptation and mitigation.”¹⁹

An OCP can also direct a local government to take action to further its own strategic objectives through cooperation and partnership with other governments and organizations. The draft Victoria OCP offers this policy:

Continue and enhance partnerships with senior, regional and local governments, public agencies, community organizations, businesses and individuals for the efficient and effective coordination of climate change and energy resiliency plans, policies and initiatives including...[r]isk and vulnerability assessment of local climate change impacts.²⁰

Although the OCP itself does not legally bind a local government to proceed with any project, putting climate change adaptation policy objectives in the OCP means that subsequent legal enactments, such as zoning bylaws, must be consistent with those objectives.

18 Draft City of Prince George OCP (November 2011) www.mypg.ca/progress/Documents/BL8383_The%20BYLAWOCP_Merged.pdf

19 Thetis Island OCP www.islandstrust.bc.ca/ltr/th/pdf/thbylbaseocp0088.pdf

20 Draft City of Victoria OCP (April 2012), s 12.1 www.shapeyourfuturevictoria.ca/wp-content/uploads/2012/03/OCP_Section12.pdf

The District of North Vancouver OCP directs its local government to “work with the North Shore Emergency Management Office and service organizations to prepare for and respond to emergencies created by extreme weather events.”²¹

Some examples of OCPs with integrated climate change adaptation strategies:

- The District of Elkford has developed an OCP with a fully integrated climate change adaptation strategy (see www.elkford.ca/official_community_plan). Some of the policies included in the Elkford OCP include protecting water resources over the long term through aquifer mapping and reductions in community water consumption, addressing the increased risk of wildfire and flooding, and exploring economic opportunities associated with adaptation.
- The City of Richmond City Centre Area Plan (a local area plan that is a Schedule to its OCP) included a direction to explore adaptation strategies that would strengthen community resiliency to climate change. www.richmond.ca/___shared/assets/city_centre556.pdf
- The City of Prince George is continuing to develop its climate change adaptation strategy; its draft OCP (November 2011) has incorporated a number of policies and objectives related to climate change impacts. See www.mypg.ca/progress/Documents/BL8383_The%20BYLAWOCP_Merged.pdf
- The Village of Kaslo OCP includes a number of key policies supporting climate change adaptation. Council must consider climate change impacts when reviewing new development applications and when undertaking long term planning initiatives, and bids, tenders and contracts for planning and development must reference climate change and Kaslo’s Climate Change Adaptation Strategy. No development will be considered for lands subject to significant increased risks due to natural hazards related to climate change without mitigation measures. <https://kaslo.civicweb.net/Documents/DocumentDisplay.aspx?Id=1838>

The District of Elkford OCP, with integrated climate adaptation strategy, has been featured by the UN Framework Convention on Climate Change in a new guidebook.

CONSULTATION

The consultative process that is generally undertaken to develop or significantly revise an OCP is an excellent opportunity to have a dialogue with the public about climate change impacts occurring and expected to occur in the community, and to build support for policies and measures to address those impacts. Consultation also needs to include climate scientists and others with relevant expertise, such as emergency planners and responders, and staff responsible for infrastructure asset management, finances and parks. Sufficient time and space will need to be allocated to consider potentially challenging material and the range of policy areas and decision-making in the community that will be affected.

PHOTO COURTESY MICHELLE LAURIE



²¹ The District of North Vancouver 2011 OCP, s. 10.4.1 <http://identity.dnv.org>

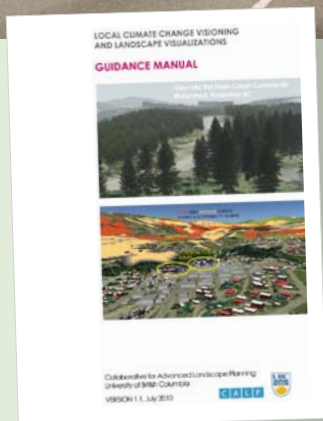


Climate scientists and local experts can provide information about regional climate change impacts.

PHOTO COURTESY
PROVINCE OF BC

To consider:

- Input from climate science experts is essential: developing policies and objectives related to climate change impacts requires broader consultation than typically undertaken for OCPs. Climate scientists and local experts can provide information about regional climate change impacts. The Pacific Climate Impacts Consortium has developed regional climate scenarios and tools that local governments can use to help understand climate impacts in their regions. Historical conditions and projected scenarios are available by regional district. Some potential impacts are also listed. <http://pacificclimate.org/tools-and-data/plan2adapt>
- Public consultation about climate change impacts and adaptation strategies requires a thoughtful approach. Strong community buy-in helps to ensure support for and implementation of adaptation measures. At the outset some community members might not be well informed about the science of climate change, even if they have valuable personal observations about changing weather patterns. It might be helpful to start with familiar local weather-related events (e.g. wildfire, extreme weather events, flooding, drought) and how these may be expected to become more frequent or more severe as a result of climate change, using climate science from Plan2Adapt and other scenarios.
 - To develop its climate change adaptation strategy and updated OCP, the District of Elkford, assisted with resources and funding from the Columbia Basin Trust, pursued a varied community engagement strategy that included a community advisory committee, mall displays, paper and web-based surveys and kitchen table meetings, as well as extensive involvement of climate scientists and local experts. www.elkford.ca/include/get.php?nodeid=93
- If a local government is not ready to fully implement a climate change adaptation strategy, it can use the OCP to identify specific actions or planning processes that it commits to undertake. For example, the District of Saanich's OCP (2008) included the objective "Prepare and implement Saanich's "Climate Change Adaptation Plan" (and a plan has now been drafted). www.saanich.ca/living/community/ocp/ocp_adopted_jul808_amended_may1710.pdf
- A local government might not be prepared to engage in a revision or update of its OCP. In that case other tools may be more appropriate to use to begin integrating climate change adaptation measures into local government policy and practice; it isn't essential to begin with the OCP. It is important to start with climate science, assess the risks and vulnerabilities and determine how best to proceed.



At one Community Open House, 90% of participants indicated that visualizations helped — 29% said they helped a little and 61% said they helped a lot.



LOCAL CLIMATE CHANGE VISIONING AND LANDSCAPE VISUALIZATIONS: GUIDANCE MANUAL

Visualization tools increase community and practitioner awareness and understanding of local climate change impacts and response options. The BC Ministry of Community, Sport and Cultural Development supported the development of the *Local Climate Change Visioning and Landscape Visualizations: Guidance Manual*, which offers material on processes and the use of tools that will be available (free of charge) to local governments in BC to use with existing planning resources including Google Earth, GIS and CommunityViz capabilities. The Manual will help to build resilient communities by building support for local climate change adaptation and mitigation policies. It was developed by the Collaborative for Advanced Landscape Planning at University of British Columbia (CALP).

The Manual:

- Addresses the visioning process, citizen participation, participatory scenario building, data and modelling and final visioning packages;
- Provides a platform for discussing and evaluating adaptation and mitigation options;
- Shows how visualizations can enhance the communication of and engagement with complex and future-oriented information within a local setting: people may for the first time “see” future climate change in their own backyards, and better understand their choices; and
- Was based on use of the model in a number of communities and on a variety of climate change impacts including: snow pack melt/ snow line projections (District of North Vancouver), sea level rise/ flood adaptation (Delta), wildfire events (Kimberley) and FireSmart actions, multiple events (tree blow down, pests and diseases) and biomass production potential (Prince George). See the Executive Summary www.calp.forestry.ubc.ca/wp-content/uploads/2010/02/CALP-Visioning-Guidance-Manual-Version-1.1_EXEC_SUMMARY1.pdf and Guidance Manual www.calp.forestry.ubc.ca/wp-content/uploads/2010/02/CALP-Visioning-Guidance-Manual-Version-1.1.pdf

Development Permit Areas

Creating a DPA is a way to shape the development or redevelopment of a given area, and guidelines for the DPA (in the OCP or in a zoning bylaw) can include both broad prescriptions for land use as well as site specific requirements. Preparing for climate change impacts may mean updating existing DPAs to account for different levels of risk or changes to best practices, or in some cases developing new DPAs.

There is already well-established practice in BC with respect to using DPAs to manage land use in areas with defined hazards, such as interface wildfires, or slope stability issues — and many examples to draw on. DPAs for wildfire hazards may also include requirements about landscaping and the siting, form, exterior design and finish of buildings. DPAs can also be used to restrict development and protect and/or restore natural features and areas, and can be used to help protect key natural ecosystems in the face of climate change.

DPAs can offer local governments a more flexible approach to regulating development than zoning because guidelines can specify results and allow site-specific solutions. For example, a DPA can specify a certain level of onsite stormwater infiltration, while a zoning bylaw could only specify the site coverage allowed.

The *Local Government (Green Communities) Statutes Amendment Act* (2008) created the opportunity for new types of DPAs, including those designed to promote energy and water conservation. Local governments can employ these DPAs to help make their communities more resilient to climate change impacts like water shortages and potential disruptions in centralized energy supply due to heavy seasonal demand or extreme weather events. Like DPAs for wildfire hazards, they may also include requirements about landscaping and the siting, form, exterior design and finish of buildings to further energy and water conservation and greenhouse gas reduction goals. For more information see <http://toolkit.bc.ca/resource/development-permit-areas-climate-action>



DPAs can offer local governments a more flexible approach to regulating development than zoning because guidelines can specify results and allow site-specific solutions.

CLOVER POINT, VICTORIA PHOTO
COURTESY NRTPHOTOS/Flickr

DEVELOPMENT PERMIT AREAS (DPAS)

Local Government Act, ss. 919.1-920

In an OCP a local government may designate areas within its jurisdiction where development permits are required before any subdivision, rezoning, construction or (in some cases) any disturbance of the land may occur, the reason the development permit is required, along with guidelines outlining the requirements for obtaining a development permit (which may be in the OCP or a zoning bylaw). The range of purposes that may be relied on for creating development permit areas is quite broad. Those of most interest with respect to climate change adaptation measures are likely protection of the natural environment, protection of the community from hazardous conditions, and establishing objectives to promote conservation of water and energy.

DPA for energy and water conservation may also establish restrictions on the type and placement of trees and other vegetation in proximity to the buildings and other structures in order to provide for the conservation of energy, which can be considered in the context of reducing the heat island effect in urban areas.

DPA can be used together with complementary measures such as servicing requirements, development cost charges and other local government tools to achieve climate change adaptation objectives.

Some examples of how DPAs can be used to address climate change impacts:

- Interface wildfire hazards:
 - The City of Langford prepared a study that discusses local government powers and practices with respect to managing wildfire hazards, and includes a model DPA. www.cityoflangford.ca/assets/Documents~Library/Brochures/fire-hazard-planning-model.pdf
 - The District of Elkford Wildfire DPA includes requirements for pre-development hazard and risk assessments, that FireSmart building materials and construction practices be used, and that new developments include roads and trails that can function as firebreaks and access corridors. <http://elkford.ca/include/get.php?nodeid=203>
 - The City of Williams Lake OCP has a Wildfire Interface DPA with comprehensive guidelines for development that recognize the risks in forested communities. The guidelines note that climate change is one of the factors that may alter the fire hazard over time. www.williamslake.ca/files/1/doc_OCP_Final_Chapter_7_Development_Permit_Areas.pdf
- Steep slope hazards:
 - The District of North Vancouver is proposing several Natural Hazards DPAs including one for slope hazards that will minimize development on steep slopes, manage development on and near steep slopes, and ensure on-going maintenance and monitoring of steeply sloped lands. www.dnv.org/article.asp?a=5018&c=1024
- Water shortages / increased precipitation:
 - The Resort Municipality of Whistler, Water Conservation Area (draft OCP, November 2011): DPA includes requirements for landscaping, using drought-tolerant, native vegetation, adequate topsoil to assist in infiltration, rainwater capture systems, onsite use of stormwater, maximizing pervious surfaces and measures like bioswales and rain gardens. www.whistler2010.com/pdf/maps11-15/Draft%20Development%20Permit%20Area%20Guidelines.pdf
 - The City of Castlegar, Energy, Water and GHG Reduction Development Permit Area: DPA requires a landscape plan prepared by a qualified professional that includes hydrozones, site grading that minimizes disruption of natural drainage patterns, stormwater best management practices, and the use of native vegetation and xeriscaping. See www.castlegar.ca/pdfs/OCP_Bylaw_1150.pdf



DPAs of most interest with respect to climate change adaptation measures are likely protection of the natural environment, protection of the community from hazardous conditions on land, and establishing objectives to promote conservation of water and energy.

OKANAGAN PHOTO COURTESY
YOUIGUE_STYLE/FLICKR

- Aquifer protection:
 - Local governments have used DPAs to protect aquifers by helping to maintain the groundwater absorption capacity of land, protecting water quality and limiting demand for groundwater. Possible measures include restricting development, setbacks from watercourses, requiring hydrologic studies, retaining vegetation, etc. See www.obwb.ca/fileadmin/docs/4.7_Aquifer_Protection_Development_Permit_Areas.doc
 - Regional District of Nanaimo, Yellow Point Aquifer Protection DPA www.rdn.bc.ca/cms/wpattachments/wpID402atID4292.pdf
- Flood hazards:
 - The District of Sechelt DPA for Watercourses (Habitat protection and creek hazards) requires that a hazard assessment report accompany applications for DPs, and that it “[A]ssess long term risks or changes to the defined floodplain or slope stability, including potential increases in rainfall, flood frequency or flood severity associated with climate change” www.district.sechelt.bc.ca/Portals/0/Public%20Document%20Library/Community%20Plans/DPA%20%20Watercourses.pdf
 - The District of Elkford Climate Adaptation Strategy proposes a requirement that natural vegetation be maintained or enhanced to support the ability of the riparian area to mitigate flooding. www.elkford.ca/include/get.php?nodeid=93
- Climate change impacts on the natural environment:
 - The City of Comox DPA for Garry Oak Habitat justification notes that most Garry Oak ecosystems have been destroyed or significantly degraded, and “Less than 5% remains in near-natural condition, and ecosystems at extremes, such as those in Comox, are especially vulnerable. Ecosystems at the edges of their distribution typically contain high biodiversity and have important adaptive value in the face of climate change.” <http://comox.ca/hall/bylaws/official-community-plan-ocp-bylaw-1685-consolidated/>
 - Thetis Island, Islands Trust is considering a Marine Shorelands Development Permit Area, investigating options to protect sensitive terrestrial ecosystems as sea level rises and shorelines shift inland. www.islandstrust.bc.ca/lrc/th/pdf/thstrptmarineshoredpajan262011.pdf
 - The West Howe Sound, Sunshine Coast Regional District OCP has a Shoreline Protection and Management DPA aimed at protecting the ecological values in the shoreline and foreshore, as well as hazards to the built environment. Development permits must include an assessment by a professional of the impact of the proposed development on “[e]xisting and anticipated shoreline processes, including erosion and deposition of land and beach materials, given projected environmental trends including climate change and sea level rise.” [www.scrd.ca/files/File/Community/Planning/WHS%20OCP%2011%20-%20Development%20Permit%20Areas%202011\(2\).pdf](http://www.scrd.ca/files/File/Community/Planning/WHS%20OCP%2011%20-%20Development%20Permit%20Areas%202011(2).pdf)
- Energy efficiency and resiliency:
 - The City of Castlegar OCP has an Energy, Water and Greenhouse Gas Reduction DPA that applies to a number of different zones within the municipality and includes objectives regarding passive solar design, green roofs, building orientation, landscaping, and renewable energy generation. www.castlegar.ca/pdfs/OCP_Bylaw_1150.pdf



Thetis Island, Islands Trust is considering a Marine Shorelands Development Permit Area, investigating options to protect sensitive terrestrial ecosystems as sea level rises and shorelines shift inland.

PHOTO COURTESY LIANNE504/FLICR



To consider:

Given evolving understanding of climate change impacts, it would be wise to consider reviewing DPAs and DPA guidelines with regards to climate change impacts at least every five years, or sooner if new and pertinent information becomes available.

COBBLE HILL PHOTO
COURTESY SAM BEEBE,
ECOJUST/FLICKR

- DPAs are most useful in areas where significant development and re-development is anticipated.
- There may be challenges in developing guidelines due to the level of technical expertise required. For areas where natural hazards are present, it may be useful to have requirements that qualified third-party professionals assess whether proposed development or re-development adequately mitigates risk, as well as making reference to external standards or practices.²² Local governments could require an assessment by a hydrologic engineer where increased risk of flooding as a result of climate change is at issue.
- Legal enforcement of DPAs and DPs may be challenging, requiring a court injunction. However, local governments may require that security be posted with respect to performance of specific conditions, including landscaping, safety, and damage to the natural environment (*Local Government Act*, s.925). A municipality may also withhold an occupancy permit until DP conditions are met. Additionally, regulatory bylaws with permitting and enforcement provisions may supplement the DP process.
- Given evolving understanding of climate change impacts, it would be wise to consider reviewing DPAs and DPA guidelines with regards to climate change impacts at least every five years, or sooner if new and pertinent information becomes available.
- Because of their far-reaching impact on development within a community, and potential costs to developers and property owners, it is important to incorporate meaningful stakeholder consultation into the creation of new DPAs.
- When creating the guidelines for DPAs appropriate exemptions should be specified, i.e. activities that do not trigger the requirement for a development permit. Factors to consider include the scale or location of the development, for example, and whether it is likely to significantly affect the objectives of the DPA or face risks related to natural hazards.

²² For example, the forthcoming Association of Professional Engineers and Geoscientists of BC guidelines for flood hazard management.

DEVELOPMENT APPROVAL INFORMATION AREAS (DAIAs)

Local Government Act, ss. 920.01, 920.1

In an OCP local governments may designate areas or specify circumstances where applicants for zoning bylaw amendments, development permits, or temporary use permits must provide, at their expense, specific impact information, usually reports prepared by qualified professionals. The OCP must set out the justification for the DAIA, and a separate bylaw is needed to establish the process for requiring the information and the substance of the information that is required. Development Approval Information Areas are sometimes used by local governments to obtain information about the potential impact of proposed new developments on environmentally sensitive areas, or how risks related to natural hazards will be handled.

Development Approval Information Areas

Development approval information areas can be used to require professional impact assessment at a site-specific level that can help inform local government decision-making about the conditions to place on development, before development takes place.²³

They may be useful in cases where climate change is anticipated to increase the vulnerability of environmentally sensitive areas to development, or to affect natural hazards in a given area, or to affect the availability of critical resources, such as groundwater.

To consider:

- A local government may require that the professional carrying out any required impact assessment has relevant expertise in relation to climate change impacts.
- The Development Approval Information Area requirements should not be used as a replacement for the broader process of community risk and vulnerability assessment with respect to climate change, but could potentially be used to help understand site specific impacts related to proposed development or activities.

Examples:

- The Village of Port Alice has used development approval information areas to obtain information about interface wildfire hazards. http://portalice.ca/wp-content/uploads/569-DAIA-OCP_Bylaw.pdf See also the City of Chilliwack bylaw: www.chilliwack.com/main/attachments/files/363/BL%203815%20Development%20Approval%20Information%20Bylaw.pdf
- The North Pender Island Local Trust Area has designated areas and circumstances where development approval information is required, including information about sensitive ecosystems and hazardous conditions. www.islandstrust.bc.ca/lrc/np/pdf/npdaibasebyl0134.pdf



A local government may require that the professional carrying out any required impact assessment has relevant expertise in relation to climate change impacts.

PHOTO COURTESY
WRIGHTWOOD CROSSING

23 Deborah Curran, Doug Geller, Barbara Everdene, Kellie Garcia and Nelson R. Jatel, (2009) *Groundwater Bylaws Toolkit*. Okanagan Basin Water Board. Kelowna. Section 4.8. www.obwb.ca/fileadmin/docs/groundwater_bylaws_toolkit.pdf

Zoning (or land use) bylaws and density bonuses

Where hazards resulting from or amplified by climate change can be identified for specific geographic areas within a community, zoning can be used to delineate those areas and provide requirements that apply uniformly to all development within each zone. In the case of wildfire hazards, for example, zoning can be used to direct new residential, commercial and industrial development to lower risk areas, and reserve high risk areas for parks and open spaces for other activities, such as grazing, golf courses, airstrips, tennis courts, sports field and swimming pools. These areas can also function as firebreaks.²⁴

A number of water-related climate impacts (decreased freshwater supplies, increased erosion from run-off during storms, saltwater intrusion in aquifers, and others) may be at least partly addressed through the use of the zoning power. Through zoning a local government can limit site coverage, or the impervious “footprint” of buildings, structures, and paved parking areas and in this way promote onsite rainwater infiltration. As well, in areas where climate change is predicted to reduce the available supply of freshwater enough to have a significant negative impact on the availability of water, a local government could consider the option of low-density zoning to match demand to water supply.²⁵

Along marine shorelines, zoning can include requirements for density, buildings and site coverage aimed at creating resilient development in the face of climate impacts like sea level rise and the potential for increased storm intensity. Sensitive shoreline areas can be designated as conservation areas to protect habitat and species. Setbacks within a zone can be used to require that buildings and structures are a certain distance back from sensitive marine and lakeside areas, although those setbacks do not apply to landscaping and the removal of vegetation.²⁶

ZONING OR LAND USE BYLAWS

Local Government Act, s.903

With zoning or land use bylaws local governments can regulate development by establishing permitted (and prohibited) land uses, densities, and the siting, size and dimensions of buildings and their uses. A range of measures that may be relevant for implementing climate change adaptation strategies can be accomplished through the local government zoning power, from setbacks to prohibiting uses that may increase risk of harm in sensitive areas. It is likely that this power will be most effective when used together with other local government tools such as development permit areas that can provide site-specific guidelines aimed at addressing climate impacts and changing environmental conditions.

24 See FireSmart: Protecting Your Community from Wildfire www.firesmartcanada.ca/resources-library/protecting-your-community-from-wildfire

25 Supra note 23.

26 To address landscaping and vegetation local governments must rely on DPAs or bylaw powers under s. 909 of the *Local Government Act*. See The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories www.wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories



To address concerns about drought in the Comox Valley the Regional District created a “Water Supply and Resource Area” zone, where density is limited to a single family dwelling on any lot. www.comoxvalleyrd.ca/uploadedFiles/Community_Planning/Bylaws/2781/Bylaw%202781%20Complete.pdf

COMOX PHOTO COURTESY
MISS604/FLICKR

To consider:

- Local governments can also re-zone/pre-zone areas to increase the density or type of development in existing zones as they are redeveloped over time, lessening development pressure on areas that will be subject to greater risk from hazards (e.g. wildfire, flood, sea level rise) over time as a result of climate change.
- Energy use in communities will be affected both directly and indirectly by climate change. Hotter summers may drive up energy demand for cooling, for example, while carbon pricing policies within BC and globally are likely to increase the cost of traditional energy sources. Greater resiliency to these changes might be achieved through measures to relax some common zoning requirements. For example, setbacks can be reduced to allow buildings with thicker walls, or building height requirements adjusted to allow solar energy installations. See www.toolkit.bc.ca/diverse-zoning-strategies-diverse-communities#zoning%20for%20low%20carbon%20bldgs
- While it may be possible to take a “wait and see” approach to dealing with climate change impacts in some circumstances, zoning requirements have long term impacts themselves. For example, structures built today in a certain area, or respecting a given setback, are likely to be around for 50–100 years or more, and will need to be safe and viable over *at least* that time period. The provision of local government services

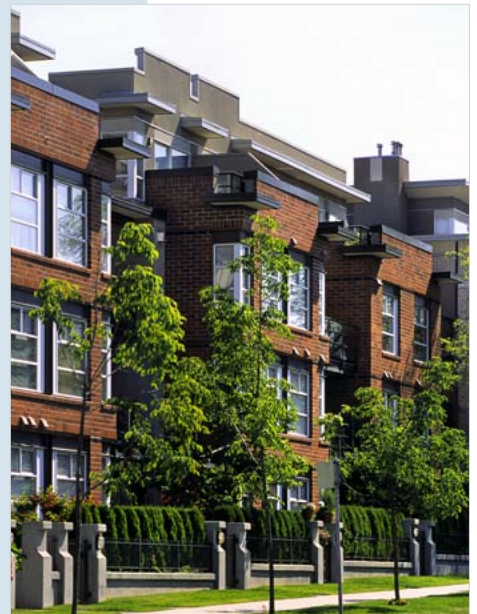
A reminder: new or revised DPAs and guidelines may require amendments to the zoning bylaw to ensure consistency. All local government enactments must be consistent with OCP.

DENSITY BONUSES

Local Government Act, s.904

Local governments can designate zones where increased density, up to a specified amount, is available to applicants in exchange for providing community amenities, or contributing to a fund that will be used by the local government to create amenities. In the climate change context local governments must be careful to ensure that density is not being increased in areas that are prone to greater risks of natural hazards, such as flooding.

There may be opportunities to use density bonuses to assist in implementing climate change adaptation measures through the provision of amenities, such as acquiring/developing land for community gardens to enhance food security, creating greenways that connect natural areas and enhance the resilience of natural species. Gardens and greenways may also have important cooling benefits in urban areas subject to rising temperatures. Parks and greenways can protect environmentally sensitive areas that are at even greater risk as a result of climate change, and preserving trees and natural vegetation can contribute to rainwater management. It should be noted that density bonusing can be controversial, and the process should involve community dialogue. Good practices would include setting an upper limit on density and where it will be located in the OCP after public dialogue, and creating a public and transparent process for calculating the value of increased density. See www.wcel.org/sites/default/files/publications/TheGreenBuildingsGuide.pdf





Food security has been identified in a number of communities in BC as a climate change impact of concern. The City of Castlegar has proposed changes to its zoning bylaw to allow greenhouses in certain areas and community gardens in parks. www.cbt.org/uploads/pdf/Castlegar_Climate_Change_Adaptation_Report_Final.pdf. The City of Parksville has already amended its zoning bylaw to allow urban food gardens. www.civicinfo.bc.ca/weekly/Parksville_Urban_Gardens.pdf



There may be opportunities to use density bonuses to assist in implementing climate change adaptation measures through the provision of amenities, such as acquiring/developing land for community gardens to enhance food security, creating greenways that connect natural areas and enhance the resilience of natural species. PHOTOS COURTESY DORYWITHSERIFS/FLICKR

associated with any zone will also need to be considered with this longer term climate change lens. For this reason a precautionary approach based on hazard mapping informed by up-to-date climate modeling data, or other pertinent information, is prudent. As well, periodic reviews of zoning requirements should be undertaken to ensure that they are informed by current information about climate impacts.

- When defining zones, planners need to work with others who have the appropriate expertise. In terms of wildfire hazards, for example, fire and forestry officials should be involved in the planning process at the earliest stages so that hazards are well articulated before developments are planned. The costs of not mitigating hazards must be evaluated. As well, both the suitability of the zone itself for a given type of development, and access to the area for the provision of emergency services and secondary evacuation routes needs to be considered.
- Zoning requirements may be seen by local governments as less resource-intensive to administer when compared to development permits. However, the zoning powers (uses, density, and siting, size and uses of buildings) also offer less opportunity to tailor development to site specific environmental conditions which may be important from the point of view of climate change adaptation. For example, zoning can address the density and type of development in areas prone to wildfire hazards, but it cannot specify the type of landscaping that must be carried out, exterior materials that must be used on buildings, the types of reports that must be prepared and submitted, etc. For this reason zoning bylaws will likely be more effective in terms of implementing climate change adaptation measures when used in concert with development permit areas and other local bylaw powers.

DEVELOPMENT COST CHARGES

Local Government Act, ss.932–937

Local governments in BC have the power to enact bylaws to set development cost charges (DCCs). DCCs are one-time charges imposed at the time of subdivision approval or the issuance of a building permit to help cover the capital costs of infrastructure associated with new subdivisions and buildings, including water, sewer, drainage, roads and parkland. Development cost charge (DCC) rates can be set for different geographic areas in a community and can vary by land use and density. DCCs are subject to the approval of the Inspector of Municipalities. The Ministry publishes “best practice” guidance for local governments considering DCCs. www.cscd.gov.bc.ca/lgd/finance/development_cost_charges.htm

Development cost charges

Where DCCs are in place, local governments have the power to lower DCCs or create exemptions for certain types of development, including subdivisions of small lots designed to have low greenhouse gas emissions and developments designed to result in a low environmental impact. Both of these types of developments may be considered as possible climate change adaptation measures. For example, an adaptation strategy may involve using subdivisions of small lots to create greater density in certain areas of the community and avoid the need to have development in areas vulnerable to natural hazards. As well, creating incentives for low impact developments can have multiple benefits in terms of climate change, by decreasing reliance on energy sources that may become more costly, using less water, managing storm-water more efficiently and others.

Examples:

- The City of Penticton reduced DCCs for low impact developments by 50%. [www.penticton.ca/assets/City~Hall/Bylaws/Land~Use/Development%20Cost%20Charge%20Reduction%20\(Bylaw%202010-11\).pdf](http://www.penticton.ca/assets/City~Hall/Bylaws/Land~Use/Development%20Cost%20Charge%20Reduction%20(Bylaw%202010-11).pdf)
- The City of Surrey has used development cost charges to help finance sustainable drainage infrastructure. See pp. 34-35 in The Green Infrastructure Guide. www.wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories
- The District of Elkford has proposed using DCCs to help fund the improved development of parks, trails and greenspace in riparian areas along with design features that will help retain water during flooding, as a means to help mitigate flooding in other areas. www.elkford.ca/include/get.php?nodeid=93

To consider:

- Reducing DCCs will mean a loss of revenue for local governments.



Creating incentives for low impact developments can have multiple benefits in terms of climate change.

PHOTO COURTESY SVR DESIGN

Flood plain regulation

Flood plain designation is a way to help reduce the risk of flooding for any new development or re-development. Local governments will want to consider how a changing climate might impact any designated flood plains, whether any revisions to the area designated are called for, and whether any new areas should now be designated as flood plains.

“Sea level rise planning areas” have been proposed as a potential tool to deal with coastal areas affected by future sea level rise associated with climate change. The boundaries of these areas would be revised periodically over time as sea levels rose. Local governments could use tools such as OCPs, zoning and DPAs to regulate setbacks and the types of development that would be allowed within sea level rise planning areas.²⁷

Local governments will want to consider how a changing climate might impact any designated flood plains, whether revisions are called for, and whether any new areas should be designated as flood plains.



PHOTO COURTESY
BC MINISTRY OF
TRANSPORTATION

Examples:

- The City of Vancouver is proactively encouraging a 1m increase in flood construction levels in flood prone areas in the interim while updating flood proofing policies. The interim measure is to incorporate sea level rise projected for 2100 and is in response to the Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use released in May 2011 by the Ministry of Environment. www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/sea_dike_guidelines.pdf
- The City of Prince George updated its flood plain bylaw in 2010 as part of a broader strategy to manage flood hazards developed after the 2007-2008 Nechako River ice jam and flood event. <http://princegeorge.ca/environment/climatechange/adaptation/pages/default.aspx>

To consider:

- Watersheds where forests have been devastated by mountain pine beetle may be subject to increased flooding risks downstream.²⁸
- For planning purposes in coastal areas, provincial guidelines regarding sea level rise are currently 1m by 2100 and 2m by 2200. See www.env.gov.bc.ca/wsd/public-safety/flood/pdfs_word/sea_dike_guidelines.pdf

FLOOD PLAIN REGULATION

Local Government Act, s. 910

Local governments have the exclusive power within their jurisdictions to designate flood plains, after considering guidelines established by the Minister of the Environment (see www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/sea_dike_guidelines.pdf). Within the flood plain area the local government can specify the flood level and setback required for buildings. Requirements can vary for different locations within the floodplain and according to the type of structure and use.

²⁷ www.env.gov.bc.ca/cas/adaptation/pdf/SLR_webinar_DavidReid-SLRPlanningGuidelines.pdf

²⁸ See Walker, I.J. and R. Sydneysmith. 2008. *British Columbia in From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush. Government of Canada, pp. 329-386.



Subdivision and servicing bylaws

In regions where increased precipitation and extreme storm events are likely to result from climate change, using a subdivision and servicing bylaw to require green infrastructure can help decrease the future burden on what is sometimes referred to as “grey” infrastructure (pipes and drains) by reducing the amount of water that the conventional infrastructure needs to handle. Other benefits include reducing erosion, limiting pollution and helping to protect sensitive streams and wildlife habitat. Subdivision servicing bylaws can specify measures such as bioswales, boulevards, rain gardens, topsoil requirements, sloping streets to drain into infiltration areas, landscaping requirements to increase onsite infiltration, and others. Much work has already been done on green infrastructure approaches in BC with valuable experience gained, and there are many examples and resources available to assist communities.

SUBDIVISION AND SERVICING BYLAWS

Local Government Act, s. 938

Subdivision and servicing bylaws set out the infrastructure requirements for subdivisions, buildings and other structures in the case of new developments and redevelopment. These bylaws usually contain engineering specifications for roads and trails, street lighting, water distribution, and sewage and drainage systems, and provide an opportunity to incorporate green infrastructure and low impact design parameters into new developments. Subdivision and servicing bylaws can also include infrastructure specifications that will help make communities more resilient to hazards such as interface wildfires. Subdivision and servicing bylaws can have different requirements for different geographic areas within a local government’s jurisdiction.

Using a subdivision and servicing bylaw to require green infrastructure can help decrease the future burden on what is sometimes referred to as “grey” infrastructure (pipes and drains) by reducing the amount of water that the conventional infrastructure needs to handle.

INLAND KENWORTH
BIOSWALE/POND, NANAIMO.
PHOTO COURTESY
INLAND KENWORTH

Subdivision servicing bylaws can specify measures such as bioswales (see photo), boulevards, rain gardens, topsoil requirements, sloping streets to drain into infiltration areas, landscaping requirements to increase onsite infiltration, and others.



Certain aspects of wildfire hazards can also be addressed through subdivision and servicing bylaws. For example, the District of Elkford's climate change adaptation strategy recommends updating subdivision and servicing requirements to ensure that sidewalks, boulevards and highways serve as firebreaks and so that they will provide effective fire evacuation routes. Trails, particularly in perimeter areas can also be useful firebreaks. It is also important that roads be designed to provide access for firefighting efforts, that there is an adequate water supply for fire suppression, and that fire hydrants are provided where appropriate. Underground wiring may be specified.²⁹

Examples:

- The District of North Vancouver's Development Servicing Bylaw incorporates the Provincial Stormwater Guidebooks criteria as a reference for design professionals. www.dnv.org/upload/pcdocsdocuments/11bg01!.pdf

NEW TECHNIQUES OFFER WAYS TO IMPROVE PLANNING AND RESOURCE ALLOCATION

Researchers are developing innovative ways to evaluate the performance of drainage systems and assess how they will deal with increased precipitation. Taylor David (a LIDAR applications specialist with Terra Remote Sensing Inc.) and Chris Jensen (currently, Policy Analyst, Integrated Policy Branch, MCSCD) used integrated airborne remote sensing to get a better understanding of how the Bowker Creek watershed handles major storm events. See *Climate-Change Adaptation Planning: Reducing Uncertainty via Integrated Airborne Remote Sensing* www.geoplace.com/ME2/dirmod.asp?sid=&nm=&type=MultiPublishing&mod=PublishingTitles&mid=13B2F0D0AFA04476A2ACC02ED28A405F&tier=4&id=E87ED4FF165D47898D9D0D55A5FC3323

29 District of Elkford: Climate Change Adaptation Strategy www.elkford.ca/include/get.php?nodeid=93

- The District of Lantzville Subdivision and Development Bylaw incorporates green infrastructure measures for rainwater management and requires the developer to post security equivalent to the cost of three years of maintenance, to ensure that the measures are operational. www.lantzville.ca/cms/wpattachments/wplD478atID3187.pdf
- The District of Sooke is drafting a new Subdivision and Development Standard Bylaw that promotes green infrastructure for rainwater capture, and will likely include a requirement for developers to employ the Water Balance Model (a decision support tool that looks at rainwater management and stream health protection, <http://bc.waterbalance.ca/>) for new developments. www.sooke.ca/EN/main/government/devservices/environment/lwm_rain.html
- The City of North Vancouver amended its Subdivision and Development Control Bylaw to ensure greater resilience in its energy infrastructure after a 2008 windstorm caused trees and branches to fall on overhead power lines, resulting in neighbourhood power outages. Underground power and communications connections are now required for some developments. www.cnv.org/c//data/1/84/subdivision%20&%20development%20control%20bylaw%208014,%202010.pdf

To consider:

- The decisions made about infrastructure in new developments and re-developed areas will have long-lasting consequences — what is specified today will need to perform well in conditions decades from now, and to be resilient to the future impacts of climate change. Retrofits to existing infrastructure can be very costly, so it will be important to employ design approaches that offer flexibility, anticipate a range of possible climate change impacts and reduce the risk of infrastructure failures.
- Pedestrian and bike friendly neighbourhoods where motorized transportation is less necessary will be more resilient to rising energy costs, an indirect impact of climate change, and subdivision servicing bylaws can include requirements for pedestrian and bike trails, and roads that are safe and attractive for pedestrian and bicycle use. The City of Courtenay OCP was recently amended to promote such measures.³⁰



Subdivision servicing bylaws can include requirements for pedestrian and bike trails, and roads that are safe and attractive for pedestrian and bicycle use.

FOR MORE INFORMATION ON GREEN INFRASTRUCTURE AND SUBDIVISION AND SERVICING BYLAWS SEE:

- The Partnership for Water Sustainability in BC: Guidance and Resources: www.waterbucket.ca/guidance-resources.htm
- The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories www.wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories
- The Water Balance Model <http://bc.waterbalance.ca/>
- Okanagan Basin Water Board Groundwater Bylaws Toolkit www.obwb.ca/fileadmin/docs/4.9_Subdivision_Servicing_Bylaws.doc

³⁰ www.courtenay.ca/media/161500/2638%20%20ocp%20amendment%20climate%20action-final.pdf

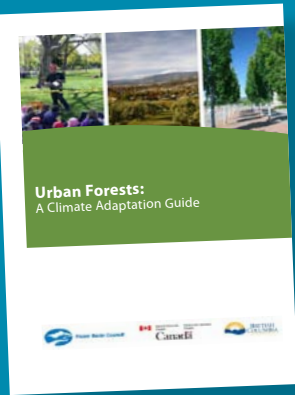
SPECIFIC REGULATORY POWERS

Tree protection

Trees with their canopies and roots are increasingly understood to be important for addressing the impacts of climate change. For example, trees help to cool urban areas, absorb rainwater, protect steep slopes from sliding and reduce soil erosion. Intact forests in watersheds are also important for maintaining water quality. And trees provide important co-benefits including wildlife habitat, aesthetic value and carbon sequestration.

To consider:

- Tree protection bylaws can focus on preserving natural species of trees.
 - The District of Esquimalt has a Tree Protection Bylaw that requires a permit for any activities that may damage or alter trees defined as “protected,” which include native species of a certain size or greater on both private and municipal property. www.esquimalt.ca/files/PDF/Bylaws/2664_Tree_Protection_Bylaw.pdf
- Some municipalities have bylaws and policies that target only trees on municipal property, which may nonetheless be significant in number.
 - The City of North Vancouver has a Street Tree Master Plan and has implemented a number of measures to protect its urban trees. The Plan also suggests a number of non-regulatory approaches to encourage the planting and retention of trees on private property, including design guidelines for multi-residential developments that encourage planting



See the Ministry of Community, Sport and Cultural Development publication *Urban Forests: A Climate Adaptation Guide* for a number of examples of local regulations and policies in BC. www.retooling.ca/_Library/docs/Urban_Forests_Guide.pdf

TREE PROTECTION

Community Charter, ss.8(3)(c),50-52,73(1)(c); Local Government Act, s.923

Under the *Community Charter*, municipalities have relatively broad powers related to tree regulation. They may use bylaws to establish licensing and permitting requirements for tree-cutting, and they may also impose requirements with respect to tree planting, provided that the requirements do not prevent uses or density permitted under the zoning bylaw, unless compensation is provided. For example, a municipality might decide that a development permit over a certain value triggers the requirement to plant a certain number of trees on that property.

It should be noted that regional districts do not have the same broad powers regarding trees. Instead, under the *Local Government Act*, regional districts may designate areas of land that they consider to be subject to flooding, erosion, land slip or avalanche as tree cutting permit areas, and regulate or prohibit cutting down trees in those areas, provided there is evidence that the area is subject to the specified hazard.



native conifer species or in lieu contributions to a tree fund, and public education about the benefits of tree planting and retention coordinated with the zoning, subdivision and building permit processes. www.cnv.org/c/data/3/509/Street%20Tree%20Master%20Plan%202004.pdf

- Local governments facing pest infestations or increased interface fire risks may need to consider an approach that includes thinning trees in some areas.
 - Prince George has an exemption to its tree protection bylaw to address mountain pine beetle infested trees. Any applications for the exemption must also address slope stability issues. http://princegeorge.ca/environment/urbanforestry/mountainpinebeetlecontrol/Documents/circular_exemptions_tree_protection.pdf
 - Prince George also has a Wildland/Urban Interface Wildfire Management Strategy that has provided the basis for its thinning and pruning activities to reduce interface wildfire risk that was exacerbated by mountain pine beetle infestation. http://princegeorge.ca/environment/urbanforestry/urbanwildland/Documents/Wildland_Urban_Interface_Wildfire_Mgmt_Plan.pdf

An urban forest strategy prepared for the City of Kelowna recommended modifying species selection and increasing diversity where possible to increase resilience to climate change. www.babblackwell.com/forestry_reports/City_of_Kelowna_Urban_Forest_Strategy.pdf

PHOTO COURTESY MISTER WIND-UP BIRD/FLICKR

URBAN TREES ADD VALUE

The City of North Vancouver had a consultant put a value on the services provided to the City by its 5,415 trees. It was calculated that the benefits from the trees amounted to \$501,000 per year, which would total \$25 million over 50 years. The maintenance and replacement costs associated with the trees only cost \$94,000 per year. The services provided by the trees included energy savings as a result of their cooling effect in summer, GHG reductions, air quality enhancement, stormwater management, and increased liveability and property values.



Run-off control, landscaping, and soil removal and deposit

There are a number of ways that these regulatory powers can be used to help address climate change impacts:

- Managing increases in precipitation — as climate change is expected to increase precipitation and extreme storm events in some regions, putting in place requirements to increase onsite infiltration and retention by improving the depth and quality of topsoil, for example, and lessening the burden on the conventional drainage system can help mitigate the need to make upgrades to pipes and other infrastructure.
- Managing drought and decreased water supply — well-rooted, climate tolerant landscaping requires less irrigation water, stays green longer during a drought, and contributes to sustainability of water supply.
- Reducing urban heat island effects — shade and evapo-transpiration from green roofs and landscaped areas have the potential to cool urban areas.
- Protecting streams and waterways from increased risk of contamination — increasing onsite filtration can reduce the contaminants that find their way into streams and waterways without infiltration. Increased precipitation could lead to more surface contamination from impermeable surfaces being flushed into streams, while droughts could mean lower water levels and greater sensitivity to contaminants.
- Increasing connectivity — landscaping can increase availability and connectivity of habitat for local species.
- Enhancing local food security by providing opportunities for urban gardens — green roofs and other green spaces have the potential to provide space to grow food.



Landscaping and run-off bylaws can apply to all properties, while DPs only apply to new development and re-development.

RUN-OFF CONTROL, LANDSCAPING, AND SOIL REMOVAL AND DEPOSIT

Local Government Act, ss. 907, 909; Community Charter, s.195; Local Government Act, s.723

Local governments have a number of specific bylaw powers relating to run-off, landscaping, and soil within their jurisdictions (in addition to the more broadly framed powers discussed above with respect to development permits, and subdivision and servicing requirements):

- They can regulate how new paved and roofed areas manage and dispose of surface water run-off and stormwater, and can set the maximum area of land that can be covered by impermeable material.
- They also have the power to set standards for, or regulate the provision of landscaping in relation to zones and within zones for the purpose of masking or separating uses, protecting, restoring or enhancing the natural environment, or to prevent hazardous conditions.
- Local governments have the power to regulate the deposit and removal of soil, subject to approval by the province.

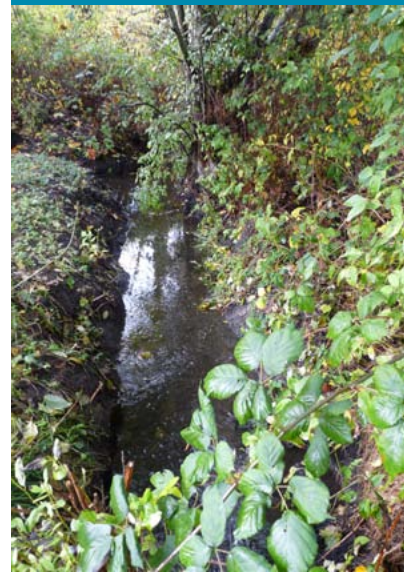
- Additional water absorption — permeable surfaces and swales can ensure additional water absorption during heavy precipitation events that assists both with flood reduction and recharge of groundwater/aquifers.

Examples:

- The City of Surrey Soil Conservation and Protection Bylaw recognizes that soil is an important resource in the City and its unregulated deposit may obstruct water courses or aquifers, and have an impact on flood control strategies. www.surrey.ca/bylawsandcouncillibrary/BYL_reg_16389.pdf
- The District of Central Saanich has an award-winning ISMP (Integrated Stormwater Management Plan) for rainwater management. The bylaw requires rainwater capture, encourages use of the Water Balance Model. www.centalsaanich.ca/hall/Departments/Engineering___Public_Works/Integrated_Stormwater_Management_Plan___ISMP___Study.htm www.centalsaanich.ca/hall/Departments/Administration/bylaws_and_policies.htm
- The City of Richmond identified green roofs as a key way to manage and reduce run-off in industrial areas outside the city centre, where the surface is mostly covered by buildings, paved parking areas, loading bays and outside storage areas, and other options to manage and reduce run-off were limited. The Richmond bylaw takes a flexible approach, and provides several options for compliance with run-off and landscaping requirements, including the construction and maintenance of a green roof on 75% of the roof area of a new building. www.richmond.ca/___shared/assets/Bylaw_838521490.pdf
- The City of Toronto has a green roof bylaw that applies to all new commercial, industrial and residential buildings over a certain size. The bylaw was enacted after a study from Ryerson University showed that green roofs could have significant benefits to the City related to stormwater management and reduction of the urban heat island and associated energy use. www.toronto.ca/greenroofs/findings.htm
- Regulation of landscaping and irrigation is a key tool for local governments to achieve water conservation, especially in drier climates. The City of Kelowna was one of the first to build this approach into landscaping and irrigation bylaws. www.cwra.org/publications/bookstore/assets/CanWaterResAbstract.pdf

To consider:

- A number of similar objectives with respect to landscaping and run-off can be achieved through the development permitting process or landscaping and run-off bylaws. In practice, combining a planning (development permits) and regulatory (bylaw) approach may be most effective. Bylaws can include permitting requirements (a possible revenue opportunity) and fines, apply to landscaping of existing development, and may also require financial security for performance. Landscaping and run-off bylaws can apply to all properties, while DPs only apply to new development and re-development. For a discussion of



A study carried out at the University of Victoria demonstrated that in the Bowker Creek watershed on southern Vancouver Island just three green infrastructure tools — rain gardens, green roofs and absorbent landscaping — could mitigate 95% of the peak flows estimated to result from increased precipitation due to climate change by 2080. www.obwb.ca/fileadmin/docs/rain_to_resource/2010_10_29_technical_5_chris_jensen_bigger_pipes_or_greener_communities.pdf

BOWKER CREEK WATERSHED PHOTO
COURTESY ALEXABBOUD/FICKR

Landscaping and run-off bylaws can apply to all properties, while development permits only apply to new development and re-development.

some of these considerations in the context of promoting topsoil requirements, see Topsoil Law and Policy Primer: <http://wcel.org/sites/default/files/publications/Topsoil%20-%20Law%20and%20Policy%20Primer%20for%20Rainwater%20Management%20and%20Water%20Conservation.pdf>

- Some local governments may be reluctant to try new approaches to dealing with stormwater management, for example, because of a fear of liability. However, there are a number of ways to manage risks that can be explored. Relying on certificates from third parties such as engineers or architects, obtaining insurance, implementing pilot projects to evaluate performance, and “over-engineering” to provide a back-up in case of failure are all possibilities. For more information see “The Liability Elephant” in the Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories www.wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories
- BC’s Living Water Smart website includes information and resources for local governments, such as the Water Conservation Calculator, a tool for small water purveyors and local government conservation initiatives. http://livingwatersmart.ca/business/becoming_efficient.html
- Public education and citizen engagement can complement regulatory measures. Okanagan Basin Water Board *Homeowner’s Guide to Using Rain as a Resource* www.okwaterwise.ca/pdf/HomeDrainageGuide_Okanagan.pdf



ELECTRONIC ARTS GREEN ROOF

Electronic Arts, the City of Burnaby and BCIT Centre for Architectural Ecology collaborated on a green roof project for a new studio facility in Burnaby. After construction BCIT monitored performance, and in 2007 it was found that the green roof delayed run-off for three hours and reduced peak flow by 90%. During the summer, temperatures of the membrane under the green roof fluctuated by 3°C instead of 41°C.

Source: www.burnaby.ca/Assets/city+services/planning/Environmental+Planning/Electronic+Arts+Green+Roof.pdf

Animal control bylaws

With risks to food security being identified as a climate change impact in a number of BC communities, there is growing interest in small-scale urban agriculture, such as poultry and beekeeping. Depending on community support and interest, this may be an option for local governments to explore.

Examples:

- A number of BC local governments have animal control bylaws that allow citizens to keep “backyard chickens,” bees and other livestock in limited numbers, subject to conditions regarding lot size, zoning, registration, enclosures, etc. See, for example, District of Saanich www.saanich.ca/living/pdf/animals8556.pdf and the amendments to the City of Vancouver animal control bylaw and zoning and development bylaw. <http://vancouver.ca/commsvcs/LICANDINSP/animalcontrol/chicken/index.htm>

A number of BC local governments have animal control bylaws that allow citizens to keep “backyard chickens,” bees and other livestock in limited numbers.

To consider:

- Backyard chickens and other types of urban livestock activities can be controversial, and local governments that are considering the regulation of these activities in their communities would be well advised to carry out adequate community consultation. For a description of the consultation process from the District of Saanich, see www.saanich.ca/living/community/chickensurvey.html
- Support for community members engaging in urban livestock activities will likely be required, in terms of education, inspection and disposal options.



VANCOUVER CHICKENS
PHOTO COURTESY BRENT
GRANBY/Flickr

ANIMAL CONTROL

Community Charter, s.8(3)(k); Local Government Act, ss. 702.1, 703

Local governments have the power to enact bylaws to regulate, prohibit and impose requirements in relation to animals. “Wildlife” is subject to concurrent jurisdiction with the provincial government, but animals not defined as wildlife in the *Wildlife Act* are under local government jurisdiction.

Some notes on permitting and enforcement

Local governments have permitting and enforcement powers available to supplement land use and other regulatory powers that may offer opportunities to support the implementation of climate change adaptation measures.

For example:

- As discussed above, trees in urban areas can offer valuable services related to climate change adaptation: cooling, reducing soil erosion, and absorbing rainwater, for example. Municipalities can establish a system of permitting for tree-cutting activities.
- Development permits over a certain value might be used to trigger tree-planting or other required green infrastructure measures on existing properties. This approach is being explored in the District of North Vancouver.
- Soil removal permitting can be used to help control the loss of soil where soil stability is a concern.
- Climate change impacts that lead to reductions in water supply may create greater concern about industrial effluent or other waste discharges, or about the rate of local consumption of water. Local governments may wish to increase enforcement activities related to regulation of discharges and consumption.
- In some cases local governments can require that covenants under s.219 of the Land Title Act be registered before permits for new developments are issued.



Soil removal permitting can be used to help control the loss of soil where soil stability is a concern.

- The City of Kamloops Community Wildfire Protection Plan describes the city's Wildland-Urban-Interface covenant, which stipulates that landowners must agree to wildfire mitigation measures before a building or subdivision permit will be issued, and also notes proposed updates to the covenant wording. www.city.kamloops.bc.ca/firerescue/pdfs/cwpp.pdf
- The City of Surrey uses a suite of restrictive covenants and easements to promote water quality and sediment control, storm drainage detention and a combined swale and pipe system in new developments. See, for example: www.surrey.ca/files/Interim_Storm_Drainage_Detention.pdf



EMERGENCY MANAGEMENT PLANNING

Under BC's *Emergency Program Act* local governments are obliged to prepare a local emergency management plan respecting "...preparation for, response to and recovery from emergencies and disasters." As well, subject to any provincially-directed emergency measures, a local authority is at all times responsible for the direction and control of the local authority's emergency response.

While climate change is not specifically mentioned in the *Act*, to adequately plan for emergencies and disasters local governments will have to assess the potential impacts of climate change on their communities in terms of changed and possibly increased risks. The Local Authority Emergency Management Regulation specifies that the local emergency management plan must take into account the "potential emergencies and disasters that could affect all or any part of the jurisdictional area for which the local authority has responsibility, and the local authority's assessment of the relative risk of occurrence and the potential impact on people and property of the emergencies or disasters" and that it must be reviewed and updated periodically.

Why look at emergency planning as part of climate change adaptation:

Climate change will both exacerbate existing risks to people and property and create new ones, and local emergency planning needs to be reviewed in light of a hazard risk and vulnerability analysis that takes into account climate change impacts in the region.

Some examples of potential climate-related hazards include:

- More frequent flooding.
 - The City of Grand Forks recently experienced two 1-in-100 year floods within five years. www.cbt.org/uploads/pdf/Kimberley_CACCI_Phase_1_Adaptation_Report.pdf

**The Local Authority
Emergency
Management
Regulation
specifies that the
local emergency
management plan
must be reviewed
and updated
periodically.**

PHOTO COURTESY PUBLIC
SAFETY CANADA



The Kelowna area fires of 2003, which resulted from drought and long periods of hot weather, caused \$700 million in damage.

KELOWNA PHOTO
COURTESY AWWWS/FLICKR

- A 2009 hazard and risk analysis for the Regional District of Nanaimo identified long term risks related to water supply, increased incidence and severity of flooding due to increased precipitation and run-off, and potential compounding effects of greater storm surges due to sea level rise, high tides, and increased precipitation. Changing weather patterns might also be increasing the risk of devastating ice storms similar to those previously experienced in Eastern Canada that cut off power supplied from the grid. www.rdn.bc.ca/cms/wpattachments/wpID141atID2769.pdf
- Landslides on steep slopes after heavy precipitation events. Nicholas Heap, *Hot Properties, How Global Warming Could Transform B.C.'s Real Estate Sector* www.davidsuzuki.org/publications/downloads/2007/DSF_HotProperties_final1.pdf
- Increased risk of forest fire, and potential for larger fires of higher intensity. The Kelowna area fires of 2003, exacerbated by drought and long periods of hot weather, caused \$700 million in damage. http://act-adapt.org/wp-content/uploads/2011/03/PDF-WeatherSession_SummaryReport.pdf And see Walker, I.J. and R. Sydneysmith. 2008. *British Columbia in From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush. Government of Canada, pp. 364.
- Heat-related stress and illness, particularly for vulnerable members of the population. After the heat wave of 2005, Toronto identified heat stress as a major climate change impact for its community. http://act-adapt.org/wp-content/uploads/2011/03/PDF-WeatherSession_SummaryReport.pdf

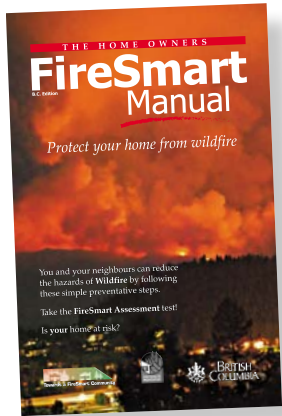
To consider:

- The anticipated frequency and or severity (or both) of extreme weather events and other climate-related hazards experienced by a community may increase as result of climate change. This in turn means greater demands for personnel, training, equipment, public education, etc. Emergency management teams have not traditionally viewed impacts as climate change-related and will likely require training to ensure they understand the concept and its implications, as well as new response mechanisms and planning. Local governments also need to look at the implications for insurance costs and coverage.
 - The Cariboo-Chilcotin adaptation strategy recommends that human resources capacity for emergency services be increased at times in the year when that region is most at risk: the wildfire season and during spring freshet. It also suggests temporarily reassigning other staff to emergency services during peak times and providing necessary training. <http://pacificclimate.org/sites/default/files/publications/RAC.CCCCAdaptationStrategy.Sep2011.pdf>
 - Communications needs will likely be increased, for example to advise the community about evacuation notices, water quality issues, road closures, etc. There may be opportunities to expand communication capacity through the use of social media.
 - Emergency staff themselves may be affected during extreme heat events, and this needs to be taken into consideration in emergency response planning.
 - The BC Provincial Emergency Program (PEP) has a tool to assess community preparedness for emergencies. www.pep.gov.bc.ca/cepr/review.html



- How emergency response measures are delivered should also be considered: for example, the location of flooding or wildfire hazards might shift or grow and make planned emergency routes impassable or strand fire stations, police stations, hospitals, clinics, ambulance stations, care facilities, transition houses, homeless shelters, pharmacies, airports, water treatment plants, pumping stations, works yards, utilities and other critical facilities.
 - In Kamloops the Community Wildfire Protection Plan recommends that new municipal water systems supplying water to new developments in areas identified for wildfire hazard should require emergency generators for all pumps to ensure continuous water supply in the event of power loss during a wildfire event. Kamloops Community Wildfire Protection Plan www.city.kamloops.bc.ca/fire/rescue/pdfs/cwpp.pdf
- Certain members of the community might require special consideration.
 - Public transit and other needs of low-income, disabled and at-risk persons need to be considered in evacuation planning.
 - Evacuation or other options for vulnerable elderly or sick people living at home might need to be considered.
 - The needs of non-English-speaking members of the community should also be considered.
 - The needs of tourists should be included in emergency planning.
 - The City of Toronto has developed a “Hot Weather Response Plan” that outlines measures to be taken to protect vulnerable community members during a heat wave. www.toronto.ca/health/heatalerts/pdf/hwr_plan_2009.pdf

UBCM provides funding for interface fire prevention planning and implementation
www.ubcm.ca/assets/Funding~Programs/LGPS/SWPI/Applications2011/swpi-2011-cwpp-guide.pdf



The BC Forest Service — Protection Branch has developed a FireSmart manual for homeowners. www.pssg.gov.bc.ca/firecom/pdf/homeowner-firesmart.pdf

- Potential indirect impacts of increased hazards also need to be considered.
 - The District of Kimberley is looking at the need to plan for alternative drinking water sources in the event of wildfires in local watersheds. www.cbt.org/uploads/pdf/Kimberley_CACCI_Phase_1_Adaptation_Report.pdf
- The interaction of multiple climate events and other types of hazards needs to be assessed:
 - Prince George has identified a need to investigate the future impacts on river flood flows as a result of the pine beetle infestation, climate change and Nechako Reservoir regulation. http://princegeorge.ca/infocentre/communications/Lists/Recent%20News/Attachments/18/Report_FloodMitigation_StrategicPlan_2010-06-24.pdf
 - Increased precipitation from storms can lead to greater run-off in rivers, and be combined with storm surges from coastal waters to produce more serious flooding in some coastal areas.
 - In Saanich a Hazard, Risk and Vulnerability Analysis concluded that the District was reasonably well-equipped to respond to a single event, but if two emergencies occurred simultaneously, such as a heat wave and an earthquake, emergency response could be compromised. Both Saanich and Prince George recommended regional emergency response initiatives with increased resources for training and action as a possible solution to limited local capacity. www.saanich.ca/living/climate/pdf/saanich_adaptation_plan_web_adopted_oct2411.pdf
 - The City of Vancouver is looking at improving cross-departmental responses to emergencies. For example, if the engineering department already has heavy equipment out in the City for regular operations and an emergency arises, it may be possible to coordinate use of the equipment to move fallen trees and other debris from storms.³¹
- Citizen education can play an important role in emergency prevention and response.
 - Many local governments already have an emergency preparedness guide for the community; this can be updated along with the emergency management plan. Halifax Regional Municipality has a citizen guide that specifically looks at preparing for climate change-related risks. www.halifax.ca/climate/documents/ClimateSmartGuide_Final_PressRes.pdf
 - The BC Forest Service — Protection Branch has developed a FireSmart manual for homeowners. www.pssg.gov.bc.ca/firecom/pdf/homeowner-firesmart.pdf
- Cooperation with other levels of government and responsible agencies will be important, particularly for regional scale emergencies.
 - The District of Saanich climate change adaptation strategy proposes working with the Ministry of Health, the Capital Regional District and other municipalities to address extreme heat weather events through a health monitoring alert and response system. www.saanich.ca/living/climate/pdf/saanich_adaptation_plan_web_adopted_oct2411.pdf

31 Personal communication from Tamsin Mills, Climate Change Adaptation Initiative, City of Vancouver, January 25, 2012.



LONG TERM FINANCIAL PLANNING AND REPORTING

Local governments are required to prepare, each year, a financial plan setting out the objectives and policies for the planning period as well as the proposed expenditures, proposed funding sources and proposed transfers to or between funds. The planning period for a financial plan is five years. *Community Charter*, s.165, *Local Government Act*, s. 815.

Municipalities are also required to prepare an annual report that includes both audited financial statements and information about reaching the previous year's objectives and measures, and how it will measure progress in meeting objectives for the next two years. *Community Charter*, s. 98.

Why look at long term financial planning part of climate change adaptation:

Dealing with climate change impacts may have significant financial implications for local governments, in terms of increased expenditures, whether from managing increased risk and occurrence of natural hazards, dealing with greater wear-and-tear on infrastructure or the need to increase infrastructure capacity, training staff to understand and manage climate change impacts, training staff or hiring consultants to assess risk and vulnerability, engaging with the public around impacts and goal-setting, and others. Planning ahead will provide opportunities, for example, to identify investments that can enhance resiliency of infrastructure to climate change impacts and to identify co-benefits or costs savings.

Climate change may also have an impact, possibly negative, on local government revenues. Areas of fiscal risk and exposure need to be identified as part of the assessment of impacts a community will face as a result of climate change. As well, if a local government decides to increase property taxes to modify or expand local government services to address climate impacts, it will need to ensure that this measure is accompanied by adequate public education about the climate impacts that are behind this decision.

Including financial planning in climate change adaptation strategies will allow decision-making about adaptation options to be better informed. In choosing adaptation measures to be implemented, and weighing trade-offs, a key factor will be the financial resources available, and whether a given measure has any other benefits (e.g. economic development, savings on maintenance and operation costs, community liveability benefits.)

Planning ahead will provide opportunities, for example, to identify investments that can enhance resiliency of infrastructure to climate change impacts and to identify co-benefits or costs savings.

MOBERLEY LAKE PHOTO
COURTESY ENERGETICCITY

To consider:

- There are important links between a financial plan and an OCP. All bylaws enacted after the adoption of the OCP must be consistent with the OCP, and, prior to its adoption (after first reading of the OCP bylaw), the OCP must be considered in conjunction with the financial plan. Local governments should ensure that the financial plan adequately addresses the needs created by the climate change adaptation policies and actions set out in the OCP.
- The City of Victoria has discussed the possibility of updating the procurement and tendering process for capital projects to consider climate change impacts and adaptation, and requiring an impact and adaptation assessment for internal capital projects. www.shapeyourfuturevictoria.ca/wp-content/uploads/2010/01/HBLVictoriaClimateEnergyEDRevision.pdf
- According to the *Community Charter*, financial plans are only required to have a five-year horizon, and other fiscal policy and decision-making might be even shorter-term. However, climate change impacts, just beginning to be felt, will only intensify for the next 50–100 years. Local governments will ideally want to look at financial implications beyond five years, to ensure they can support service levels and community quality of life into the future.
- While there may be little funding available specifically for climate change adaptation measures, most communities receive investment from both government and private sources for development and redevelopment activities. Incorporating climate change adaptation measures into development policies and related regulations will ensure that both public and private sector investments contribute to the implementation of climate change adaptation strategies. Further, to the extent that a local government has a climate change adaptation strategy that favours measures that have multiple benefits (for example, water conservation and energy efficiency), and improves the overall efficiency and performance of land use and infrastructure, this will increase



The City of Victoria has discussed the possibility of updating the procurement and tendering process for capital projects to consider climate change impacts and adaptation.

VICTORIA PARKSIDE
LEED BUILDING, PHOTO
COURTESY PAUL P/FLICKR

CLIMATE CHANGE IMPACTS ON LOCAL ECONOMIES

The Cariboo Regional District has concluded that its tax base is likely to shrink as a result of climate change impacts on the forest industry in its region leading to less timber available for harvest and reduced activity. To deal with this several options have been proposed, such as developing a strategic plan to address an evolving tax base or reducing the level of essential services provided in the region. <http://pacificclimate.org/sites/default/files/publications/RAC.CCCCAadaptationStrategy.Sep2011.pdf>





the resilience of the community to a range of risks, both climate-related and otherwise. www.iclei.org/fileadmin/user_upload/documents/Global/Publications/Report-Financing_Resilient_City-Final.pdf

- Financial planning needs to adequately and accurately address the maintenance, upgrade and replacement costs for infrastructure, which is part of asset management, discussed below. In many cases climate change will increase the rate of deterioration of existing infrastructure, and have an impact on infrastructure capacity, design and location for the future. There will also be instances where existing infrastructure will no longer be sufficient, whether adequately maintained or not, such as the case where changed sea level design guidelines apply. See www.env.gov.bc.ca/wsd/public_safety/flood/structural.html#climate

While there may be little funding available specifically for climate change adaptation measures, most communities receive investment from both government and private sources for development and redevelopment activities.

IMAGES COURTESY CITY OF HAMILTON (TOP) AND BC MINISTRY OF FORESTS (BOTTOM)

FINANCING RESPONSES TO CLIMATE CHANGE

When faced with the need to address a greatly increased urban/interface forest fire hazard due to mountain pine beetle damaged trees, the City of Prince George negotiated a Community Forest Agreement with a five-year replaceable license to manage Crown forest lands. While some of its “urban” logging was estimated to cost as much as six times as conventional logging, Prince George obtained funding from a variety of sources including, UBCM, NRCAN, the provincial government and others. www.env.gov.bc.ca/cas/adaptation/pdf/adamson.pdf



ASSET MANAGEMENT

Climate change is likely to have significant impacts on local government infrastructure in BC, the largest asset managed by most local governments. At the same time, most communities currently have infrastructure assets that are nearing the end of their service life, but face challenges in renewal or replacement of those assets. It is an opportunity to explore alternative options for renewing infrastructure and at the same time plan for climate resilience. One promising approach is to coordinate land use planning with longer term financial and infrastructure planning in order to better understand the life cycle costs of infrastructure and look at ways to reduce or recover some of the costs.³²

Currently, in most communities the initial capital cost of municipal infrastructure related to development or re-development is covered by developers and property owners, while local governments become responsible for the long term cost associated with operation, maintenance and replacement of infrastructure assets. These long term costs are typically as much as four times the initial capital costs for conventional infrastructure. Green infrastructure options, which can have important climate change adaptation benefits (see section on Infrastructure), may reduce life cycle costs while increasing resilience to climate change, and this can be explored in the context of long term planning for asset management. See Kim A. Stephens, *Integrated Rainwater Management: Move to a Levels-of-Service Approach to Sustainable Service Delivery*. www.civicinfo.bc.ca/Library/Asset_Management/Newsletters/AMBC_Newsletter_Issue_No._2--LGAMWG--Jan_2011.pdf

To consider:

- In New Zealand, it is suggested that any significant investment in infrastructure should be preceded by a risk assessment that builds in climate change implications and a cost-benefit analysis. *Climate Change Effects and Impacts*

ASSET MANAGEMENT

Asset Management BC defines asset management as:

An integrated approach involving planning, finance, engineering and operations to effectively manage existing and new infrastructure to maximize benefits, reduce risks and provide satisfactory levels of service to community users in a socially, environmentally and economically sustainable manner.

(Source: assetmanagementbc.ca)

BC local governments are also required to follow Public Sector Accounting Board Standard PSAB 3150 – Tangible Capital Assets. (Community Charter, s.167(2))

For discussion about the advantages to local governments of taking a longer term approach to asset management in light of challenges such as climate change, see Kim Fowler, *Local Government Land Use and Asset Management Planning in BC: Proposed Sustainable Service Improvements*. www.waterbucket.ca/rm/sites/wbcrim/documents/media/165.pdf

PHOTO: SEWAGE PIPES TO HANDLE CLIMATE CHANGES AND EXTREME RAIN, COURTESY TOMMELISE84/DENMARK/FLICKR

32 Asset Management BC, "The State of Asset Management in BC" www.civicinfo.bc.ca/Library/Asset_Management/Tools_and_Resources/The_State_of_Asset_Management_in_BC--LGAMWG--September_2010.pdf



One of the benefits of looking at climate change adaptation through the lens of asset management is the increased ability to effectively communicate the longer term costs and benefits of action to decisionmakers.

PHOTO COURTESY
WILL MERYDITH/FICKR

Assessment, A Guidance Manual for Local Government in New Zealand, 2nd edition. www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/climate-change-effect-impacts-assessment-may08.pdf

- One of the benefits of looking at climate change adaptation through the lens of asset management is the increased ability to effectively communicate the longer term costs and benefits of action to decisionmakers. Some climate change impacts will only become significant over the longer term, i.e. within the next 50–100 years. This is within the life cycle of most infrastructure, and, ideally, infrastructure planning should account for climate change impacts. However, budget cycles are typically much shorter, making it easy in practice to defer action, unless the longer term costs and risks are well understood. Robert Hicks, Senior Engineer, Policy and Planning Department, Metro Vancouver. *Climate Change: Risk Management by Local Governments* www.powershow.com/view/14d5ce-NGZjN/Climate_Change_Risk_Management_by_Local_Governments_flash_ppt_presentation
- Canada Mortgage Housing Corporation (CMHC) has designed a tool to compare the life cycle costs of different infrastructure options for major community developments, and this tool may be useful in the context of climate change adaptation. Life Cycle Costing Tool for Community Infrastructure Planning www.cmhc-schl.gc.ca/en/inpr/su/sucopl/licycoto/index.cfm
- Asset management may also be addressed in other local government planning processes. Metro Vancouver's Integrated Liquid Waste and Resource Management Plan requires that asset management plans for wastewater treatment plants be updated to address risks, including climate change and seismic events, and maintain performance in wet weather. www.metrovancouver.org/about/publications/Publications/ILWRMP.pdf

Existing infrastructure, even if well-designed to take into account historically relevant environmental factors, may be vulnerable to future climate impacts.

PHOTO COURTESY
DAILY/FLICKR



INFRASTRUCTURE

Local governments have important responsibilities related to infrastructure within their communities, including water supply and treatment, transmission and delivery, storm-water and liquid waste management, watershed protection, solid waste management, roads and other transportation infrastructure, and energy infrastructure.

Why look at infrastructure as part of climate change adaptation:

- Existing infrastructure, even if well-designed to take into account historically relevant environmental factors, may be vulnerable to future climate impacts.
 - For example, a study of the Vancouver Sewerage Area System identified vulnerabilities related to storm surges and sea level rise at the wastewater treatment plant, and the possible need to accelerate ongoing work to separate combined sewers and to address increased precipitation over time. www.metrovancouver.org/planning/ClimateChange/ClimateChangeDocs/Vulnerability_climate_change.pdf
 - Engineers Canada is developing the PIEVC (Public Infrastructure Engineering Vulnerability Committee) protocol aimed at obtaining a more detailed technical vulnerability analysis for infrastructure: www.pievc.ca
- Climate change impacts can create potential catastrophic risks to infrastructure that arise from inadequate design and vulnerable location — losses associated, for example, with flooding, violent winds, temperature extremes and sea level rise.
 - In Kimberley municipal infrastructure including local chlorination plants was found to be vulnerable to wildfire. www.cbt.org/uploads/pdf/CACCI_Kimberley_CaseStudy.pdf

- Climate change impacts may be less dramatic, but still significant in terms of infrastructure maintenance and performance.
 - In Williams Lake, increased freeze-thaw cycles resulted in accelerated road and airport runway deterioration, and also required improved ice and snow control measures and upgraded equipment.³³
 - Infrastructure is also exposed to risks in a changing climate as a result of existing inefficiencies in terms of energy and water use and others. This type of “systemic under-performance” means that when the availability of inputs like energy and water are decreased due to ecological or economic pressures resulting from climate change, the infrastructure is vulnerable to failure. http://iclei.org/fileadmin/user_upload/documents/Global/Publications/Report-Financing_Resilient_City-Final.pdf
 - In Castlegar it was found that decreased summer precipitation and increased residential water use could lead to infrastructure malfunction with respect to the water supply system. www.cbt.org/uploads/pdf/Castlegar_Climate_Change_Adaptation_Report_Final.pdf



Climate change impacts can create potential catastrophic risks to infrastructure that arise from inadequate design and vulnerable location.

PHOTO COURTESY
PROVINCE OF BC

GREEN INFRASTRUCTURE RESOURCES

- Stormwater Planning: A Guidebook for British Columbia www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/
- Beyond the Guidebook 2010: Implementing a New Culture for Urban Watershed Protection and Restoration in British Columbia www.waterbucket.ca/rm/?sid=45&id=642&type=single
- Water Balance Model <http://bc.waterbalance.ca/>
- The Green Infrastructure Guide: Issues, Implementation Strategies and Success stories <http://wcel.org/resources/publication/green-infrastructure-guide-issues-implementation-strategies-and-success-stories>
- Convening for Action on Vancouver Island – Leadership in Water Sustainability www.waterbucket.ca/cfa/?sid=19&id=176&type=single
- Topsoil-Law and Policy and Technical Primers <http://wcel.org/resources/publication/topsoil-law-and-policy-primer-rainwater-management-and-water-conservation>
- Water Sensitive Urban Design www.cmhc-schl.gc.ca/en/inpr/bude/himu/coedar/upload/OAA_WaterSensitiveUrbanDesign_EN_july11_w.pdf
- The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits www.cnt.org/news/2011/01/21/new-guide-helps-municipalities-monetize-the-value-of-green-infrastructure-2/
- The Value of Green Infrastructure for Urban Climate Adaptation www.ccap.org/docs/resources/989/Green_Infrastructure_FINAL.pdf

33 Presentation by Brian Carruthers, Chief Administrative Officer, City of Williams Lake at PICS Forum on Resilient Communities, June 15, 2011, Vancouver

To consider:

- Green infrastructure for stormwater management is a network of engineered and natural features that aims to mimic the natural hydrologic cycle and increase onsite capture and infiltration, through measures such as topsoil requirements, rain gardens, permeable pavement, landscaping, green roofs and others — as contrasted with “grey infrastructure,” pipes and drains that remove rainwater from sites and send it directly to watercourses and treatment plants. Green infrastructure may offer more climate resilient options for local governments and communities, and green infrastructure specifications can be incorporated into land use planning and regulation of new developments and areas being re-developed.
- Local engineers and planners need to use design values and information that account for a changing climate so that they avoid building infrastructure to suit historical conditions that will be vulnerable to future realities. Sources to consult for more information include:
 - Engineers Canada, www.engineerscanada.ca/files/w_Climate_Change_en_2010.pdf
 - Engineering Assessment of the Vulnerability of Infrastructure to Climate Change: Implementing Action at the Local Level, Brent Burton, M. A.Sc./P.Eng. www.env.gov.bc.ca/cas/adaptation/pdf/burton.pdf
 - Canadian Standards Association; www.csa.ca/cm/ca/en/standards
- In some cases local governments may be lacking the local information needed to adequately assess the vulnerability of infrastructure to climate change, and so the first measures undertaken will involve research and data collection related to existing infrastructure.
 - In Castlegar, for example, action items include monitoring flows in its stormwater system, and obtaining downscaled information about relevant future climate impacts from the Pacific Climate Impacts Consortium. www.cbt.org/uploads/pdf/Castlegar_Climate_Change_Adaptation_Report_Final.pdf
 - In Saanich the local government will work with Environment Canada, BC Environment, and the Capital Regional District to review the adequacy of precipitation monitoring in the district. www.saanich.ca/living/climate/pdf/saanich_adaptation_plan_web_adopted_oct2411.pdf
- Relatively low cost adaptation measures for infrastructure include actions such as analyses of infrastructure failures; regular infrastructure maintenance; community disaster management planning; updating climatic design values and engineering codes and standards; and improving the quality and length of climate data records. Auld, H. and D. MacIver. *Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure*. Occasional Paper 3. Environment Canada, Adaptation and Impacts Research Group, 2005) www.ec.gc.ca/Publications/default.asp?lang=En&xml=6D51BE52-A4CF-4F73-ADF1-818F78E59E47
- Mainstreaming climate change adaptation into design, maintenance and restoration of infrastructure will require more, and better communication between climate change researchers, policy makers, engineers, architects, operators and asset managers. This will include both information sharing and education. *Adapting Infrastructure to Climate Change in Canada's Cities and Communities*. Research & Analysis Division, Infrastructure Canada, December 2006. http://ipcc-wg2.gov/njlite_download.php?id=6305



Local governments may be lacking the local information needed to adequately assess the vulnerability of infrastructure to climate change, and so the first measures undertaken will involve research and data collection.

PHOTO COURTESY
MIKE COGH/FLICKR



Local governments can define acceptable practices and standards for the construction and retrofitting of civic buildings.

WHISTLER LEED PUBLIC LIBRARY PHOTO COURTESY BEN ROTHNIE/FLICKR

CIVIC BUILDING POLICY AND BUILDING REGULATION

Local governments can define acceptable practices and standards for the construction and retrofitting of civic buildings, either for specific buildings or with a civic building policy, such as a *green building policy*.³⁴

Local governments also have limited authority to regulate private building construction activities. A municipality may — with provincial approval (because this is an area of concurrent authority) — use its bylaw powers to establish a standard that exceeds Building Code requirements. However, local governments may also indirectly affect private building design and construction through development permits, development cost charge reductions or waivers that incentivize specific practices, fast tracking of development permits where buildings incorporate specific features, or revitalization tax reductions for certain types of construction or retrofitting.³⁵

To consider:

- There are many ways that buildings can be adapted to a changing climate, and made more resilient to higher temperatures, extreme weather events, water shortages, flooding and wildfire. See www.buildinggreen.com/auth/article.cfm/2009/8/28/Design-for-Adaptation-Living-in-a-Climate-Changing-World

³⁴ <http://toolkit.bc.ca/tool/civic-green-building-policy>

³⁵ Susan Rutherford (2009) *Bill 27: Opportunities and Strategies for Green Action by BC Local Governments*. West Coast Environmental Law. Vancouver. <http://toolkit.bc.ca/resource/bill-27-opportunities-and-strategies-green-action>



A municipality could create a revitalization tax exemption for buildings that install renewable energy sources, such as solar panels.

DOCKSIDE GREEN, VICTORIA PHOTO COURTESY JAYSCRATCH/FLICKR

- A changing climate will mean that heating and cooling demands will also change considerably over the coming 50–100 years, and this should be considered in the design of HVAC (heating, ventilation and air conditioning) systems for new civic buildings and retrofits.
- Greater demands for energy due to hotter summers and greater cooling demands may be offset in part through increased energy efficiency in buildings. Improving building energy efficiency and encouraging renewable energy use can also decrease the vulnerability of a community to disruptions in grid energy as a result of natural disasters and extreme weather events.
 - A municipality could create a revitalization tax exemption for buildings that install renewable energy sources, such as solar panels. (Community Charter, s. 226) www.brownfieldrenewal.gov.bc.ca/docs/community_charter_revital_tax_exemptions.pdf
 - A review of options for local governments to require or incentivize renewable energy and energy efficiency in buildings is found here: www.greenbuildingleaders.ca/docs/gbl-discussionpaper-withcover.pdf
- Green roofs and onsite rainwater harvesting may assist in managing increases in precipitation, as well as improving resistance to drier conditions by increasing soil moisture and groundwater recharge levels. As discussed above local governments can promote this type of design and construction in their communities through development permitting and bylaw powers related to run-off control.
- Constructing and retrofitting civic buildings and facilities can be an opportunity to showcase good practices to the community, generate public discussion about preparing for climate change, and encourage the development of relevant local expertise.
- In many communities there may be a lack of local knowledge about alternatives to conventional building practices and the advantages they can offer. Local governments can play a role in overcoming these types of barriers, by showing leadership with civic building policy, as noted above, and also through outreach and support for local training initiatives.
 - In its draft OCP (January 2012) the City of Campbell River proposes to work with partners to support local training related to green building practices, including both information about energy retrofits and renewable energy deployment, and the financial analysis to support these practices. <http://sustainablecampbellriver.ca/?p=633>

WATERSHED MANAGEMENT PLANNING

Climate change will significantly affect water resources in most regions of BC, as a result of increased and more severe storm events, changing run-off patterns, droughts, increased forest fires in watersheds, and other impacts. Areas prone to flooding may face increased risks, complicated further in coastal areas by sea level rise and storm surges. To deal effectively with these challenges local governments may wish to look at how their watersheds can be managed more effectively.

In some smaller watersheds, local governments may have jurisdiction over most or all of the watersheds for their communities, and watershed management can be accomplished using the tools described in Part 2 of this guide, and in particular through land use planning. However, many local governments in BC share jurisdiction over their watersheds with other local governments, the provincial and/or federal governments, First Nations, government agencies, and in some cases, private landowners. In these cases, watershed management planning can be challenging. Even in Metro Vancouver and the Capital Regional District, where most upstream areas of the watershed are under regional district ownership or control, there are jurisdictional issues involved in downstream areas of the respective watersheds. Watershed management planning thus requires coordination and collaboration to be successful.

To consider:

- Management at the watershed scale may require new or more detailed information than has previously been available. The Okanagan Water Supply and Demand Project is using various models and computer technology to estimate Okanagan water availability for the future, taking into account climate change and population growth. Project partners include the Okanagan Water Basin Board, BC Ministry of the Environment, BC Ministry of Agriculture, the BC Ministry of Community, Sport and Cultural Development, Environment Canada, Agriculture Canada, Fisheries and Oceans Canada, the Okanagan Nation Alliance, UBC-Okanagan, SFU, the BC Agriculture Council, and the Water Supply Association of BC, www.obwb.ca/wsd/
- Watershed management may also require new collaborative forms of governance that include not only governments and government agencies, but also increased participation of communities and stakeholder groups. See, for example, the Cowichan Water Management Plan. www.livingrivers.ca/dox/081106Cowichan%20Water%20Management%20Plan%20-%20Wightman%20presentation%20.pdf
- Examples of different approaches to watershed management in BC with specific reference to the context of climate change adaptation have been compiled in a new resource. See *Rethinking Our Water Ways: A Guide to Water and Watershed Planning for BC Communities in the Face of Climate Change and Other Challenges*. www.fraserbasin.bc.ca/publications/documents/waterguide_oct-2011.pdf



Management at the watershed scale may require new or more detailed information than has previously been available. The Okanagan Water Basin Board and the Ministry of the Environment are working to estimate Okanagan water availability for the future, taking into account climate change and population growth.

PHOTO COURTESY
MOIZISSIMO/FLICKR



Green infrastructure solutions generally have lower maintenance and operational costs, and can also offer greater flexibility compared to conventional infrastructure (such as pipes and drains).

LIQUID WASTE MANAGEMENT PLANS

According to the *Environmental Management Act*, s.24, local governments may prepare liquid waste management plans for their jurisdictions.

Liquid waste management plans (LWMPs) can establish long term, integrated strategies for rainwater management and the protection of natural watercourses, which will help make communities more resilient to the impacts of climate change on water supply and precipitation events. LWMPs are an excellent opportunity to provide the framework for developing green infrastructure. Green infrastructure solutions generally have lower maintenance and operational costs, and can also offer greater flexibility compared to conventional infrastructure (such as pipes and drains) in the face of uncertainty about the amount of change that infrastructure will need to accommodate as a result of a changing climate.

Examples:

- The District of Sooke recently completed the final phase of developing a liquid waste management plan and became the first community in BC to integrate sanitary and rainwater management plans. www.sooke.ca/EN/main/government/devservices/environment/lwm_rain.html
- Metro Vancouver's new Integrated Liquid Waste and Resource Management Plan includes measures aimed at helping address the impacts of climate change and climatic variability on local water resources, and designing and adapting infrastructure to address climate change risks. www.metrovancouver.org/about/publications/Publications/ILWRMP.pdf

To consider:

- Climate change may have important consequences for liquid waste management plans, which may need to be updated in light of projected climate change impacts affecting water supply, precipitation and sea level rise, depending on the region. New plans should also take into account these impacts.



AIR QUALITY PLANNING

Regional districts may make regulations related to emissions of smoke, dust, gas, sparks, ash, soot, cinders, fumes or other effluvia (*Local Government Act*, s. 725(1)(g)) if they provide a related service. (s.797.1(1)(d)). The Greater Vancouver Regional District (Metro Vancouver) has a specific power to provide the service of air quality management within its jurisdiction (*Environmental Management Act*, s. 31)

Municipalities also have broad powers under the *Community Charter* (ss. 8(3),(i),(j) and (h) and s. 64) with respect to public health and public nuisances that can be applied to address air quality issues such as backyard burning and wood burning appliances.

The Greater Vancouver Regional District (Metro Vancouver) has a specific power to provide the service of air quality management within its jurisdiction.

VANCOUVER
PHOTO COURTESY
ECSTATICIST/Flickr

Why look at air quality planning as part of climate change adaptation:

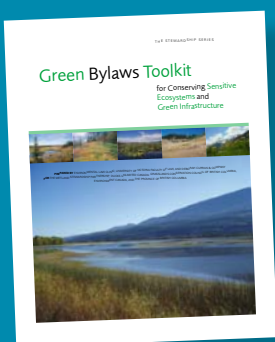
- Rising temperatures may contribute to increased air pollution and in particular higher ozone levels, which in turn may lead to public health concerns. Air quality impacts of climate change in the Fraser Valley are currently being studied. <http://summit.sfu.ca/item/2270>

Examples:

- The Clean Air Bylaws Guide provides a number of examples from across BC of local governments taking action to regulate air pollution within their communities. www.wcel.org/sites/default/files/publications/The%20Clean%20Air%20Bylaws%20Guide.pdf
- See also the provincial inventory of air quality bylaws in BC www.env.gov.bc.ca/epd/bcairquality/topics/municipal-smoke-bylaws.html

To consider:

- Air quality planners should be assessing the potential impact of rising temperatures, both average and extreme, and applying the information obtained to update or revise air quality plans.



Local governments can adopt policies to protect biodiversity and sensitive habitats. A key resource for these measures is the Green Bylaws Toolkit. www.greenbylaws.ca

BEAR PHOTO COURTESY
BRUCE MCKAY/Flickr

BIODIVERSITY AND CONSERVATION

Local governments have many options to protect biodiversity and promote conservation within their jurisdictions, such as park and greenbelt planning; parkland acquisition; protection of watercourses, streamside areas and wetlands; coastal planning; urban forest management; and the designation of urban containment boundaries. Local governments can adopt policies to protect biodiversity and sensitive habitats in their OCPs, through the use of Environmental DPAs, zoning, by requiring impact assessments for applications for rezoning and development permits, and using bylaw powers related to landscaping, tree protection, soil removal and deposit, watercourse protection, alien invasive species and pesticide use. A key resource for these measures is the Green Bylaws Toolkit. www.greenbylaws.ca

Urbanization has been identified as one of the top contributors to habitat loss and ecosystem degradation affecting species in BC, and climate change will add a further stress. *Taking Nature's Pulse, Section 3: Threats to Biodiversity in BC.*³⁶ Urban areas may face serious consequences related to climate change, some of which include more invasive species, loss of urban and park trees, problems with waste water treatment dealing with new types of microorganisms, and public health risks associated with diseases transmitted by immigrating species like mosquitoes.³⁷

Local governments can do their part to help species adapt by reducing existing stresses related to pollution and habitat loss, by restricting or prohibiting land uses that may contribute to pollution, and expanding conservation and restoration efforts in sensitive areas. Maintaining parks and greenbelts can have multiple climate change adaptation benefits, providing habitat and connectivity, stormwater and floodplain management, infiltration and drainage, and opportunities for public education around climate change. www.metrovancouver.org/services/parks_lscr/ParksManagementPlan/Documents/RegionalParksPlan.pdf

36 *Taking Nature's Pulse, Section 3: Threats to Biodiversity in BC* www.biodiversitybc.org/EN/main/downloads/tnp-3.html#s33

37 www.countdown2010.net/2010/wp-content/uploads/FS6Climate_small.PDF

To consider:

- Mapping sensitive ecosystems within local government jurisdictions provides information that can be used to guide land use policies, such as Natural Environmental Development Permit Areas, minimum setbacks, restoration and enhancement activities, and others, and can also be used to establish a baseline for monitoring and evaluation of future climate impacts.
 - The City of Kelowna has been recognized for its work in ecosystem mapping and inventory. www.iclei.org/fileadmin/user_upload/documents/Canada/Individual_Cases/Cities_and_Biodiversity_Case_Study_Series_en_kelowna.pdf
 - The City of Prince George has mapped climate change-related impacts on soil moisture and considered forest and sensitive ecosystem resilience. <http://princegeorge.ca/environment/climatechange/adaptation/pages/default.aspx>
- The Ministry of the Environment has compiled information about species at risk and other issues of environmental concern broken down by region, along with guidance for environmental planning. *Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia* www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop_with_care_intro.html
- As populations grow, there is increasing pressure to develop land in urban and agricultural areas. Understanding the services that healthy ecosystems can provide in urban areas, as well as ways that developed areas can contribute to healthy ecosystems will be key in identifying solutions.
 - The City of Surrey completed an Ecosystem Management Study that included a Green Infrastructure Opportunities Map that covers the entire city area. The map identifies both “hubs”—intact ecosystems—and “corridors”—physical or functional linkages between the hubs—and recognizes that both developed and undeveloped parts of the city can contribute to ecological sustainability. www.surrey.ca/plans-strategies/1332.aspx
 - Local governments can increase the resilience and adaptive capacity of ecosystems by improving the “connectivity” of natural landscapes within their jurisdictions, and allowing species the opportunity to shift to more suitable habitats as the climate changes. Biodiversity corridors can be established along rivers, roads, and trails. www.countdown2010.net/2010/wp-content/uploads/FS6Climate_small.PDF
 - Protecting natural ecosystems can help manage risks from natural disasters. A healthy forest ecosystem has a high capacity to absorb torrential rain, by reducing erosion, slowing run-off and reducing the risk of flash floods and mudslides. Natural vegetation and wetlands in coastal areas can reduce the impact of storm surges, and vegetation along waterways can help decrease the impact of flooding. Healthy forest ecosystems can also protect slopes from erosion and lessen the risk of landslides. www.countdown2010.net/2010/wp-content/uploads/FS6Climate_small.PDF
- Climate change will mean increasing problems with invasive species in BC. The Invasive Species Council of BC has assembled research about invasive species in BC, and resources for community groups. www.bcinvasives.ca/



Mapping sensitive ecosystems within local government jurisdictions provides information that can be used to guide land use policies.

KELOWNA SENSITIVE ECOSYSTEM MAPPING

COMMUNITY AND ECONOMIC DEVELOPMENT SERVICES

Local governments' purposes include fostering the economic, social and environmental well-being of the community (*Local Government Act*, s. 2; *Community Charter*, s.7). To that end, communities invest in important infrastructure projects such as the construction of airports and public transportation, dedication of parks, building community centres and other public facilities, launching programs to support a range of activities in the community ranging from business to social initiatives to the arts. Some local governments develop local or regional economic development plans or strategies.

Changing weather patterns as a result of climate change may open up new economic opportunities, or affect the viability of existing economic activities.

- BC has already experienced the devastating impacts of the mountain pine beetle and the economic and social impacts on forest-dependent communities.
- Regions where the winter sports industry and related tourism are an important economic driver will particularly want to consider the possible impacts of warmer winters. See *On Thin Ice: Winter Sports and Climate Change* www.davidsuzuki.org/publications/downloads/2009/DSF-OnThinIce-Web.pdf
- Drier summers and water shortages may affect recreational facilities. Penticton pioneered the use of water sources other than drinking water for the irrigation of parks and recreation areas. www.penticton.ca/EN/main/community/parks-trails-beaches/xeriscape-garden.html
- Warmer, longer growing seasons, or changes in precipitation patterns could open up opportunities to grow new kinds of crops in the region, or significantly enhance or reduce the ability to irrigate or produce existing crops. www.bcagclimateaction.ca/why/adaptation/impacts-on-agriculture/
- Some northern locations in BC may become more attractive to human migrants than previously as a result of warmer temperatures. See David Dyer, *Adapting to Climate Change in Prince George*. www.obwb.ca/fileadmin/docs/rain_to_resource/2010_10_29_policy_6_david_dyer_climate_change_adaptation_in_prince_george.pdf

Measures to enhance food security might include protecting agricultural land and agricultural uses, supporting markets for local produce, making land available for community gardens, and educating citizens about the benefits of supporting local agriculture given future uncertainties around imported food products.³⁸

Climate change impacts may disproportionately affect more vulnerable sectors of the population, and local governments will want to develop community services, programs and policies accordingly. For example, compromised water quality is a particular concern for the young, elderly and those with health conditions, and may result from increased run-off, landslides, and warmer water temperatures.³⁹ Elderly, isolated people, particularly

38 *Climate Change and Food Security in British Columbia* http://pics.uvic.ca/sites/default/files/uploads/publications/WP_Food_Security_November2011.pdf

39 *Water Quality and Quantity and Human Health: Risk in a Changing Climate in British Columbia* www.sfu.ca/ccirc/node/5



Regions where the winter sports industry and related tourism are an important economic driver will particularly want to consider the possible impacts of warmer winters.

BIG WHITE PHOTO COURTESY
HAMEDOG/FLICKR



in low-income neighbourhoods, are also particularly vulnerable to heat waves. In the case of flooding, lower-income households are less able to floodproof their property, purchase insurance, or re-locate.⁴⁰ Community members with health challenges will be affected differently by climate change, and their needs will require special attention.⁴¹

Transportation networks and hubs may be in vulnerable locations, meaning that they are subject to ongoing disruptions from climate change impacts that can have negative consequences for any economic or community activities that rely on them. An adaptation measure might involve first identifying these vulnerable locations and then working, together with partners (e.g. Ministry of Transportation), as appropriate, to develop responses.

Compromised water quality is a particular concern for the young, elderly and those with health conditions, and may result from climate change impacts such as increased run-off, landslides and warmer water temperatures.

STEWART, BC PHOTO
COURTESY PROVINCE OF BC

FOOD SECURITY

- Much of the most productive agricultural land in BC is located in areas that are also densely populated, creating pressures on agricultural uses. Through planning and land use regulation, local governments can help to protect agricultural lands and uses. See Deborah Curran, *Protecting the Working Landscape of Agriculture* www.wcel.org/issues/urban/sbg
- Community engagement around local food production is increasing in BC. See, for example, the Capital Regional District <http://crd.bc.ca/media/2012-03-06-growing-solutions-for-climate-change.htm>; the Kaslo Food Security Project <http://nklcss.org/food.php>; the City of North Vancouver www.cnv.org/CityShaping/papers/Discussion%20Brief%20-%20Food%20Security.pdf



40 See *Climate Change, Justice and Vulnerability* www.jrf.org.uk/publications/climate-change-justice-and-vulnerability

41 See *Climate Change Adaptation and Healthy Equity* www.cleanairpartnership.org/files/Climate%20Change%20and%20Health%20Equity%20Summary%20Report%20May%2024%202011.pdf

LEGAL LIABILITY

This section does not constitute legal advice, nor should it be taken as a description of legal liability issues that face any particular local government in BC or elsewhere, or as guidance on how to avoid legal liability. It is intended to illustrate some of the areas where there may be new or heightened potential for legal liability as a result of climate change and to encourage local governments to take steps to evaluate and address their own circumstances. Local governments should consult with their own lawyers to obtain legal advice appropriate to their circumstances.

How local governments respond to the impacts of climate change is also important from the point of view of legal liability. Liability for local governments in the context of climate change impacts is most likely to arise in the form of claims against the local government for negligence or nuisance.

A local government can be found to be negligent if it can be shown that, in exercising its powers, it failed to exercise reasonable care towards people to whom it owes a duty of care.⁴² A key consideration is whether the harm in question was reasonably foreseeable.⁴³ While there is still some degree of uncertainty associated with future climate change, the scientific evidence and related information that is now available make a range of climate change impacts increasingly foreseeable for local governments. Accordingly it is becoming less likely that a local government would be able to successfully defend a negligence claim if it failed to take those impacts into account when exercising its statutory authority.⁴⁴

Local governments can also be exposed to nuisance claims, which are based on an interference with the use or enjoyment of private property.⁴⁵ A typical example is where a local government sewerage or drainage system fails and causes property damage. With climate change posing increasing challenges for local government infrastructure, there may be more nuisance claims of this type arising.

A local government can be found to be negligent if it can be shown that, in exercising its powers, it failed to exercise reasonable care towards people to whom it owes a duty of care.

VANCOUVER LAW COURTS,
PHOTO COURTESY ALEX
MAHAN/FLICKR

42 While the courts have made a distinction between policy and operational decisions, holding that only operational decisions attract liability, this is a relatively complex area of law and the subject of significant litigation. In general, once a local government has decided to offer a program or service, it should ensure that the program or service is offered with reasonable care to those likely to be impacted by the program or service.

43 See *Mustapha v. Culligan of Canada Ltd.*, [2008] 2 S.C.R. 114.

44 In Australia, planning tribunals have already recognized that climate change will affect coastal developments. In *Gippsland Coastal Board v South Gippsland SC & Ors* (No 2) [2008] VCAT 1545 (29 July 2008), an appeal tribunal overturned plans to build six seaside homes partly due to climate change considerations. The case summary states: "The case is of particular interest because of potential sea level rises due to the effects of climate change. We conclude that sea level rise and risk of coastal inundation are relevant matters to consider in appropriate circumstances. We accept the general consensus that some level of climate change will result in extreme weather conditions beyond the historical record that planners and others rely on in assessing future potential impact. The relevance of climate change to the planning decision making process is still in an evolutionary phase. Each case concerning the possible impacts of climate change will turn on its own facts and circumstances. However, in the present case, applying the precautionary principle, we consider that increases in the severity of storm events coupled with rising sea levels create a reasonably foreseeable risk of inundation of the subject land and the proposed dwellings, which is unacceptable." Decision is online at www.austlii.edu.au/au/cases/vic/VCAT/2008/1545.html

45 Lawsuits based on "public nuisance"—the interference with a public right in respect of public spaces or resources—are also possible, but less likely due to restrictions on the ability of the general public to bring such claims.

While in some cases local governments can claim statutory immunity from nuisance claims, the courts have indicated that they will interpret the statutory immunity narrowly.⁴⁶ Damages related to flooding, in particular, can be extremely costly. The City of Stratford, Ontario (with a population of around 30,000) paid \$7.7 million to settle a class action lawsuit arising from flooding in its jurisdiction in 2002, in addition to \$1.3 million already paid out as emergency compensation. It will spend around \$50 million over several years to improve its flood protection measures to meet a 250 year storm event standard.⁴⁷

Local governments will want to carefully review services, operations and permitting processes in light of climate change. Both increased community hazards and heightened demands on services and infrastructure should be considered.

Some examples of areas that local governments might wish to review in the context of potential legal liability and a changing climate include:

- Vulnerability of existing infrastructure — local governments might wish to investigate whether rising temperatures or other climate change impacts will result in significant infrastructure failures that would not have been predicted based on historical data;
- New infrastructure — new sewer systems, water or drainage facilities, dikes and roads that are insufficiently designed to take into account the impacts of climate change could lead to liability for damages in the case of failure;⁴⁸
- Permitting and inspections — failing to take into account the risks associated with climate change could potentially lead to liability for any losses resulting from permitted construction and other activities; and
- Approval of development in areas subject to increased risk of natural hazards like flooding, landslides and wildfires linked to climate change impacts — this could potentially expose local governments to liability.⁴⁹

In addition to the possibility that a local government will be liable for failing to adapt effectively to climate change, in some cases local governments may have the basis for a claim themselves if they suffer losses related to climate change impacts that could have been prevented by appropriate adaptation by others.



NATURAL HAZARDS MANAGEMENT IN THE DISTRICT OF NORTH VANCOUVER

After a landslide in 2005 in a residential area resulted in the death of one resident, the District of North Vancouver developed a Natural Hazards Management Program, and uses the CAN/CSA Q850-97 risk management framework. Since 2009 the District has had a policy for risk tolerance criteria that can be applied to building permits, subdivision and development applications for sites exposed to landslide and debris flow hazards. The District also has a GeoWeb Hazards application that shows areas prone to natural hazards, as well as areas where hazard and risk assessments have been completed. The District is developing new DPAs for different types of natural hazards.

46 While the *Local Government Act*, section 288 provides immunity to an action where damages arise as a result of a “breakdown or malfunction” of a sewage system, drainage facility, dike or road, the courts have held that there is not immunity where damages arise from an insufficient design that is simply inadequate for the purpose it was meant to fulfill. See *Medomist Farms Ltd. v. Surrey (Dist.)* (1991), 62 B.C.L.R. (2d) 168 (C.A.)

47 See www.city.stratford.on.ca/documents/press_releases/Stratford_Flood_Settlement_Press_Release.pdf

48 See note 46, *supra*.

49 Philippa England (2006) *Climate Change: What are Local Governments Liable for?* Urban Research Program, Griffith University, Brisbane. www.griffith.edu.au/__data/assets/pdf_file/0011/48566/urp-ip06-england-2007.pdf

The insurance industry has been speaking out with respect to the need to take action to address climate change.



INSURANCE

Local governments rely on insurance to help cover what may be infrequent or unforeseeable losses. Natural hazards, like floods and fire, are often the immediate cause of these losses. These types of events can cause severe and widespread damage to local infrastructure and property, particularly when infrastructure fails as a result, not to mention the public safety issues. An unusually violent and heavy rain storm in Toronto in August 2005 was estimated to have cost \$547 million.⁵⁰ Fire services attended to more than 1,000 calls, and rainfall in North York was measured at 103 mm in one hour, much greater than a one in one hundred year storm.⁵¹

Because local governments are responsible for local infrastructure, and it would be difficult or impossible to maintain sufficient financial reserves to account for their losses related to these types of catastrophic events, they have traditionally relied on insurance to at least partly recover costs.

The insurance industry has been speaking out with respect to the need to take action to address climate change. According to the Insurance Bureau of Canada, in recent years the frequency and severity of sewer backup damage and claims has risen sharply across the country. Water damage is now the leading cause of property damage in Canada, totalling around \$1.7 billion/year.⁵²

Faced with higher levels of risk, insurers have two options: restrict coverage, or increase premiums. To maintain insurance coverage at an affordable rate, local governments would be prudent to review their insured assets in light of climate change and determine

50 *Climate liability: municipal responsibilities in a changing climate* www.fcm.ca/home/resources/multimedia/climate-liability-municipal-responsibilities-in-a-changing-climate.htm

51 Environment Canada, Ontario's Most Expensive Weather Disaster, www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=B0F843F5-1

52 www.abc.ca/en/Media_Centre/Hot_Topics.asp. See also Institute for Catastrophic Loss Reduction for Insurance Bureau of Canada (2012) *Telling the Weather Story* www.abc.ca/en/Natural-Disasters/documents/McBean-Report.pdf

how vulnerabilities could be addressed. The Insurance Bureau of Canada is currently developing an infrastructure risk assessment calculator aimed at helping local governments identify areas of greatest weakness and target improvements accordingly.⁵³

If local governments fail to take action to reduce climate change-related risks, there could be indirect consequences if insurance coverage cannot be maintained. It has been noted that areas subject to “non-renewal” of policies by insurers could experience a decrease in assessed value, regardless of whether they experience any actual physical damage.⁵⁴

INSURERS REACT TO CLIMATE CHANGE

Insurance premiums are being affected by climate change. “In the past 23 years [in Toronto], there has been seven events that are only supposed to happen every 50 years and two events that are supposed to happen every 100 years. It’s essentially rain intensity,” says Michael Tremblay of the Insurance Bureau of Canada, pointing to one flash flood in Toronto in 2005 that caused \$500 million in damage. “The why we don’t know. The climate has changed. What fed it? I don’t know. What we do here is risk management and the risk is higher.” <http://business.financialpost.com/2011/11/17/climate-change-blamed-for-spike-in-home-insurance-premiums/>



Faced with higher levels of risk, insurers have two options: restrict coverage, or increase premiums.

PHOTO COURTESY IAN BC NORTH/FLICKR

FINAL THOUGHTS

Local governments already plan for medium- and long term change, i.e. population growth, shifting demographics, new economic drivers and changing social needs. More recently local governments in BC have been mandated to plan to reduce their greenhouse gas emissions, by setting greenhouse gas reduction targets. However, while efforts to slow climate change are critical, it is also necessary to plan for the climate change that we already face.

The basis for good planning about adapting to climate change is good information, obtained through Plan2Adapt and other sources, and updated regularly. Each community needs to assess and monitor its vulnerabilities in light of the climate information it obtains. Climate change means that the past is no longer a good predictor of the future. Some impacts, such as sea level rise or increased wildfire risk, may require specific responses. Adaptation strategies that enhance overall resilience are also being explored in a number of communities, as outlined in this guide. Low impact development and green infrastructure, emphasizing efficiencies in operations and the use of resources, and finding ways to cooperate and collaborate with neighbouring communities are all strategies that may increase community resilience in a changing climate.

53 20 Canadian municipalities will be involved in collecting data to support the development of the tool. www.ibc.ca/en/Natural_Disasters/Municipal_Risk_Assessment_Tool.asp

54 Nicholas Heap (2007) *Hot Properties, How Global Warming Could Transform B.C.'s Real Estate Sector*. David Suzuki Foundation. Vancouver. www.davidsuzuki.org/publications/downloads/2007/DSF_HotProperties_final1.pdf

APPENDIX A

Further resources

Fraser Basin Council. *Retooling for Climate Change* [website], www.retooling.ca/

Jenny Fraser and Matthew Strand. *Climate Change Adaptation for Local Government: A Resource Guide* [annotated list of resources for local governments], http://pics.uvic.ca/sites/default/files/uploads/publications/Adaptation_Resources_June2011.pdf

Pacific Climate Impacts Consortium (PCIC). *Plan2Adapt tool*, <http://pacificclimate.org/tools-and-data/plan2adapt>

Robert A. Black, James P. Bruce and Mark Egner. *Adapting to Climate Change, A Risk-based Guide for Local Governments*, www.nrcan.gc.ca/sites/www.nrcan.gc.ca/earth-sciences/files/pdf/projdb/pdf/ris_e.pdf

Cindy Pearce and C. Callihoo. *Pathways to Climate Change Resilience: A Guidebook for Forest-based Communities*, www.modelforest.net/pubs/Pathways_to_Climate_Change_Resilience_FINAL_Feb_2011.pdf

Livia Bizikova, Tina Neale and Ian Burton. *Canadian Communities Guidebook for Adaptation to Climate Change*, www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/295

Ajit Krishnaswamy, Ellen Simmons and Larry Joseph. *Increasing the resilience of British Columbia's rural communities to natural disturbances and climate change*. BC Journal of Ecosystems and Management 13:1, 2012, p. 1–15, www.jem.forrex.org/index.php/jem/article/view/168/115

Institute for Sustainable Communities. *Promising Practices in Adaptation and Resilience*, www.iscvt.org/who_we_are/publications/Adaptation_Resource_Guide.pdf

Engineers Canada. *Public Infrastructure Engineering Vulnerability Committee Protocol*, www.pievc.ca/e/index_.cfm

ICLEI Canada. *Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation*, www.iclei.org/index.php?id=11710

City of Vancouver, Climate Change Adaptation Strategy. <http://former.vancouver.ca/ctyclerk/cclerk/20120724/documents/rr1.pdf>

Columbia Basin Trust. Climate Change. *Impacts and Adaptation in the Canadian Columbia Basin, From Dialogue to Action*. www.cbt.org/uploads/pdf/DialoguetoAction_Final_lo-res.pdf

Three land use scenarios: Planning for climate change in BC communities

Climate change is a global problem, but the impacts of climate change will vary regionally, depending on local weather patterns, natural features, settlement patterns, economic activities and other factors. Local governments can help prepare their communities for climate change impacts over both the short and long term by making sure that decisions about land use in their jurisdictions take these impacts into account. This can be accomplished most effectively by integrating climate change adaptation into existing regulatory tools and policies.

What is new about climate change adaptation is the need to look at longer term horizons, and to add climate experts and additional public consultation to existing planning processes. There are innovative new tools available to local governments in BC, such as climate projections from Plan2Adapt, and new guides and studies that can assist with the place-based analysis that is required to understand impacts and prioritize actions. To be effective, adaptation strategies need to be integrated across local government areas of responsibility and service, and mainstreamed into practice. It is important for local governments to recognize that the uncertainty associated with climate change, as well as the need to fully consider the consequences of climate change impacts in their communities will necessarily make local government analysis and decision-making more involved than in the past.

Three land use scenarios that look at land use planning in the context of climate change are provided below:

1. Mainstreaming climate change adaptation into land use planning — Example: District of Elkford
2. Incorporating climate science about natural hazards into land use planning — Example: City of Prince George
3. Using innovative tools to engage the community in understanding and responding to climate change — Example: District of Kimberley

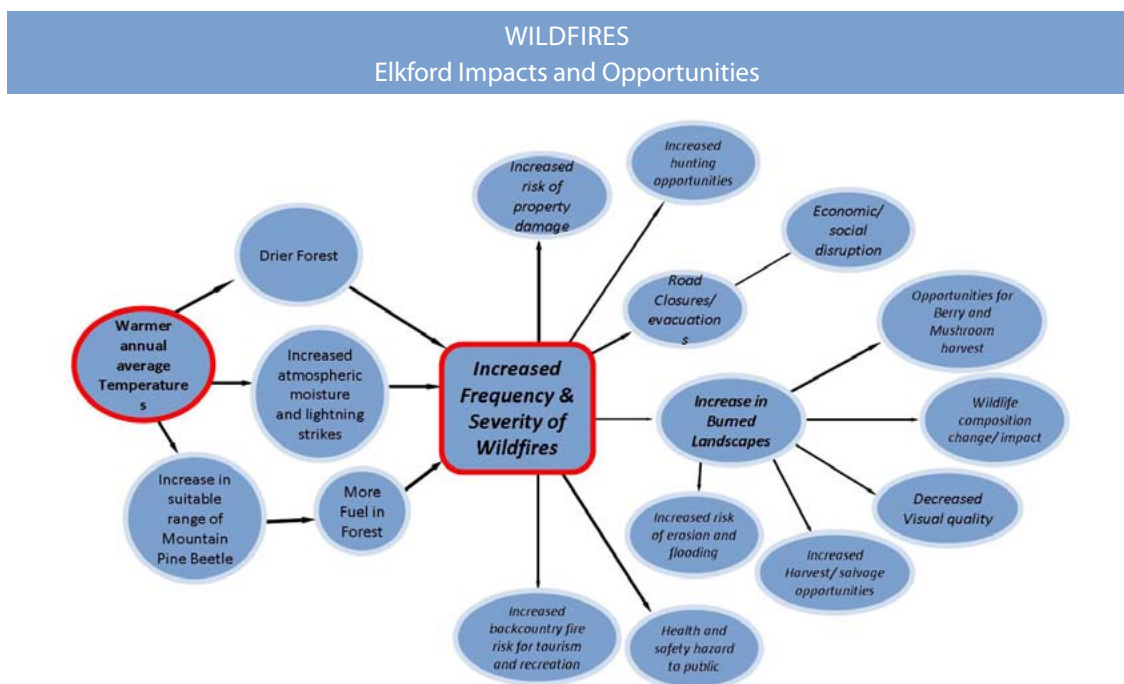
LAND USE SCENARIO 1: MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO LAND USE PLANNING

One way for a community to be more prepared for a changing climate is to “mainstream” climate change adaptation into key community planning documents such as the Official Community Plan (OCP). The OCP is a forward-looking document prepared by local governments that sets out overarching policies and objectives that apply to land use and development within their jurisdictions. Once the OCP has been adopted in a bylaw, all other bylaws must be consistent with the OCP, such as land use and zoning bylaws, for example. The OCP also creates development permit areas (DPAs) where specified guidelines for development must be followed. Local governments have the power to create DPAs to protect the natural environment, to protect the community from hazardous conditions on land, and to establish objectives to promote conservation of water and energy.

Some local governments that have developed or revised their OCPs in recent times have begun to expand the timeline covered by the OCP beyond the five- or 10-year planning horizon that has previously been more typical. It is possible to consider timelines of 50–100 years. This recognizes that decisions about land use, for example, have long term impacts in a community and can benefit from a long term vision. This approach is very compatible with preparing for the impacts of climate change, which may also be gradual, but significant over the longer term. For example, it is important that planning protect the community in areas that may be subject to increased risks of flooding or sea level rise over the longer term as a result of climate change.

Using an OCP to help mainstream climate change adaptation into land use planning by a local government is more likely to be successful when climate change adaptation is fully integrated into the OCP, and the process and the product linked to different policy areas and objectives. It may be useful to discuss climate change adaptation in the opening section of the OCP, to indicate that it is a priority across all relevant policies and objectives contained in the OCP. A stand-alone section with climate change adaptation goals and policies can provide additional direction.

Source: District of Elkford



Another critical part of the mainstreaming process is educating local government councils or boards, staff and the community about the projected climate change impacts in their community, and having them motivated to develop responses and able to implement them. The consultation undertaken as part of the process to revise or develop a new OCP needs to be broadened to include education around climate change projections, impacts and strategies, and to include access to climate scientists and local experts.

Example: District of Elkford Official Community Plan 2010¹

In 2008, the District of Elkford, a small mountain town in the Eastern Kootenays, was undertaking a revision of its OCP. The District decided to integrate climate change adaptation planning into its OCP as a result of its participation in an initiative of the Columbia Basin Trust, *Communities Adapting to Climate Change* (CCAC), that aimed to identify projected local climate change impacts and vulnerabilities, and develop adaptation plans.

With the assistance of funding through the CCAC, Elkford obtained historical and projected climate information from the Pacific Climate Impacts Consortium, and used this information to gather further scientific information about how Elkford and region could be affected by climate changes. The next step was to develop “impact pathways” showing the chain of impacts that could result from climate change and how Elkford could be affected. These impact pathways helped to illustrate how many different departments and service areas within Elkford would be affected, and that they all needed to be involved in evaluating impacts and developing responses. Results were presented to the community, and three priority areas were identified: wildfire, flooding/stormwater management, and water supply. This was followed by a vulnerability and risk assessment, and then action planning to develop an adaptation strategy.

The consultation undertaken by Elkford was significantly more extensive than what would have been considered typical for the development of an OCP. It was felt that this was important for building understanding and acceptance in the community and on council for integration of climate change adaptation into the OCP. Some of the outreach activities included displays at the mall that included a quick survey, a paper and web-based survey, facilitated kitchen table meetings, and an open house that was attended by members of the community as well as a number of current and local council candidates running for election.

The Elkford OCP explicitly references the integration of the climate change adaptation strategy for the community into that document, and notes that the OCP “...guides development for at least the next 10-20 years and effectively addresses sound science regarding future changes in local weather patterns and climatic variables in the District.”²

The Elkford OCP defines climate change adaptation and integrates adaptation goals and objectives throughout the plan, across nearly all areas of policy and decision-making. Some examples include:

1 See *Official Community Plan, District of Elkford, 2010* www.elkford.ca/official_community_plan; Karen Gorecki, Megan Walsh, Jeff Zukiwsky, *District of Elkford: Climate Change Adaptation Strategy* www.cbt.org/uploads/pdf/Elkford_CACCI_Phase_1_Adaptation_Report.pdf

2 *Official Community Plan, District of Elkford, 2010, s.1.2* www.elkford.ca/official_community_plan

- The OCP indicates that council may refer to climate change projections prepared by the Pacific Climate Impacts Consortium and others in decision-making, and that bids, tenders and contracts for planning and development in the District shall make reference to climate change and the Elkford Climate Change Adaptation Strategy;
- Establishing a District Growth Boundary that will have multiple community benefits, including avoiding additional wildfire risks by limiting further development in wilderness areas;
- Updating the flood plain designation to reflect current science;
- Developing a Parks and Trails Master Plan to implement climate change adaptation strategies;
- Placing new roads and sidewalks in locations where they can act as fire breaks and access routes;
- Requiring that stormwater be retained on site in new subdivisions; and
- Restricting development in areas subject to natural hazards, including flooding, steep slopes and wildfire, through DPAs and other measures.

The Elkford OCP also lists bylaws and other District plans and processes that need to be updated and harmonized with the OCP, as well as proposing a number of new actions and studies that would assist in implementing the OCP and achieving climate change adaptation goals.

Specific monitoring and evaluation of climate change adaptation in the District is also identified as necessary.

LAND USE SCENARIO 2: INCORPORATING CLIMATE SCIENCE ABOUT NATURAL HAZARDS INTO LAND USE PLANNING

Local governments have important responsibilities to their communities with respect to public safety, and the protection of people and property in the face of natural hazards.

Some of the projected climate change impacts for BC, which vary by region, that may be relevant for local governments to consider in relation to natural hazards include:³

- Increased risk of wildfires;
- Increased risk of flooding;
- Increased risk of landslides on steep slopes;
- Sea level rise;
- Increased incidence of invasive species; and
- Increased incidence of extreme storm events.

To prepare for natural hazards in the context of climate change, local governments need to obtain the climate information relevant for their region, quantify risk and assess their vulnerabilities, and then determine appropriate responses. Local governments can obtain information about projected climate impacts for their regions from Plan2Adapt, by contracting specifically with the Pacific Climate Impacts Consortium, by working with BC universities, through reviewing scientific literature, by enhancing staff capacity through training and collaboration, by hiring technical consultants, and other sources.

Applying the information about local risks and vulnerabilities to land use planning is in some ways very similar to conventional planning for natural hazards by local governments: land use needs to be determined so that the risks faced by different geographic areas within the community are acceptable in terms of the type of development and permitted uses in that area. Where risks are inevitable, planning needs to ensure that emergency responses can be carried out as effectively as possible and that key infrastructure functioning is maintained.

What is different about preparing for climate change is that assessments of risk and vulnerability based on historical events will not be good predictors of the risks faced in future, unless they factor in climate change projections. As well, risks and vulnerabilities should be periodically reassessed to incorporate evolving and updated information about climate change impacts.

3 The risks related to natural hazards associated with climate change will be different for every region, and each local government should assess its own risks and vulnerabilities, incorporating climate information from sources such as Plan2Adapt <http://pacificclimate.org/tools-and-data/plan2adapt>

Example: City of Prince George

Prince George is a northern BC community that faces significant impacts associated with a changing climate. It is located at the confluence of the Nechako and Fraser, with significant development within the floodplain. It is also surrounded by forests that have been severely affected by mountain pine beetle. The Nechako River has historically been subject to ice jams that can cause flooding in Prince George. In the winter of 2007/2008 there was a 35 km long ice jam that caused extensive flooding.⁴ Prince George is also in a region affected by the mountain pine beetle epidemic, and both surrounding forested lands and trees within municipal boundaries have been damaged.

Faced with questions and potential challenges related to climate change, Prince George has been working with the Pacific Climate Impacts Consortium and researchers from the University of Northern BC⁵ to assess the climate change impacts faced by the City, and to develop adaptation priorities.

Over the next 50 years, annual temperatures in Prince George are projected to increase by 1.6°C to 2.5°C, and precipitation is projected to increase by 3% to 10%. The changes are expected to be more dramatic in winter, and more precipitation is expected to fall as rain. The result is likely to be more flooding and more extreme events such as wildfires, windstorms and extreme precipitation events.⁶ Based on these projections Prince George has been taking action to explore and address flooding and wildfire risks.

In 2009 Prince George hired technical consultants to prepare a flood risk evaluation that included climate change projections. While a number of flood control options were identified for Prince George, including enlarging existing side channels, building dikes and flood-proofing buildings, changing land use in flood prone areas was found to be a potentially cost-effective solution in certain circumstances. Public consultation about flood control options demonstrated that there was public support for proactive measures, largely because of the extensive damage that Prince George had experienced in past flood events. In 2011 Prince George adopted a new Flood Plain Regulation Bylaw

Downstream view of the Nechako River during winter 2007/08 showing the ice-related flooding of the industrial area (dashed line) on the floodplain; damage to infrastructure and property. Source: CEBC 2011 Award for Engineering Excellence: Managing Prince George's Rising Flood Waters, NHC Consultants and City of Prince George.



4 Environment Canada. *Canada's Top Weather Stories for 2008, Regional Weather Highlights 2008, British Columbia*. www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=ACC549AF-1

5 With funding from Natural Resources Canada and assistance from the Fraser Basin Council.

6 See City of Prince George. *Prince George Community Climate Change Adaptation* <http://princegeorge.ca/environment/climatechange/adaptation/pages/default.aspx>, and also http://princegeorge.ca/environment/climatechange/adaptation/Documents/2012_PGRAC_CaseStudy_Volume3_Forests.pdf

that updated flood plain mapping and which regulates all new development in the designated flood plain. In a report to council regarding the amendments City staff noted that the mapping would likely need to be periodically reviewed and updated.⁷

As a result of the mountain pine beetle epidemic, Prince George has been working to adapt to the impacts of climate change in its forest management and operations for more than a decade. Since 2006 it has had a Community Forest Agreement with the provincial government, which has allowed it to manage areas of forested Crown land within City limits. The City has engaged in fuel treatment activities including salvage harvesting and thinning operations to reduce wildfire hazards, and has funded these activities through grants from NRCAN and UBCM. Prince George has also developed a Community Wildfire Protection Plan that includes measures such as guidelines for new developments, identifying fire hazard areas and public education.⁸

While it has been an early leader in climate change adaptation at the local government level, Prince George is continuing to develop and implement strategies to address the changing climate.

7 *Ibid.* A short video about Prince George's climate adaptation actions with respect to flooding is found here: www.youtube.com/watch?v=ObMuDOVHHQo&list=PLC9CCE982F121480C&index=1&feature=plpp_video

8 *Implementing Climate Change Adaptation in Prince George, BC, Volume 3: Forests* http://princegeorge.ca/environment/climatechange/adaptation/Documents/2012_PGRAC_CaseStudy_Volume3_Forests.pdf

LAND USE SCENARIO 3: USING INNOVATIVE TOOLS TO ENGAGE THE COMMUNITY IN UNDERSTANDING AND RESPONDING TO CLIMATE CHANGE

Robust community engagement in developing and implementing climate change adaptation strategies is important, because some of the responses will require significant investment of tax dollars and local government resources. Citizens and elected officials will need to have a basic understanding of the climate change projections and impacts in their communities so that they can make informed decisions. There may also be cases where priorities with respect to land uses are at issue. In areas subject to increased risks with respect to natural hazards as a result of climate change, for example, a community might need to weigh the costs and benefits of protection versus relocation. However, the implications of climate change at the local level can be complex, and challenging for communities to understand.

The Collaborative for Advanced Landscape Planning at the University of British Columbia⁹ has developed an innovative visioning tool that has proven effective in helping communities to understand the impacts of climate change in their region, to appreciate the urgency in certain cases, and to prioritize actions. The tool brings together climate data with visual representations of local geography and neighbourhoods, and allows community members to see vivid representations of potential climate impacts. Some of the impacts modeled to date include snow pack reductions on the North Shore mountains (District of North Vancouver); sea level rise and flood adaptation (City of Delta) and wildfire events (City of Kimberley). The tool has been used in interactive public settings in a number of BC communities, and has received very positive feedback from community members.

There is a guidance manual for the tool for BC local governments that is available free of charge. The tool can be used with existing planning resources including Google Earth, GIS and CommunityViz capabilities.¹⁰ Three additional training modules for the use of the tool are being developed.

Example: City of Kimberley

The City of Kimberley in southeastern BC is a small community that relies on tourism and outdoor recreation. It faces potential climate change impacts that include flooding, wildfire, water supply issues, and others.

As part of the Kimberley Climate Adaptation Project supported by the Columbia Basin Trust, Kimberley worked with CALP to pilot a climate change visioning process, that “use[d] tools such as GIS mapping and 3D visualizations to localize, spatialize and visualize climate change impacts and solutions.”¹¹ In particular, the visualizations gave community members the opportunity to ask “what if” questions and see the outcomes modeled before them.

9 With support from the Ministry of Community, Sport and Cultural Development.

10 www.calp.forestry.ubc.ca/news/viz-guidance-manual/

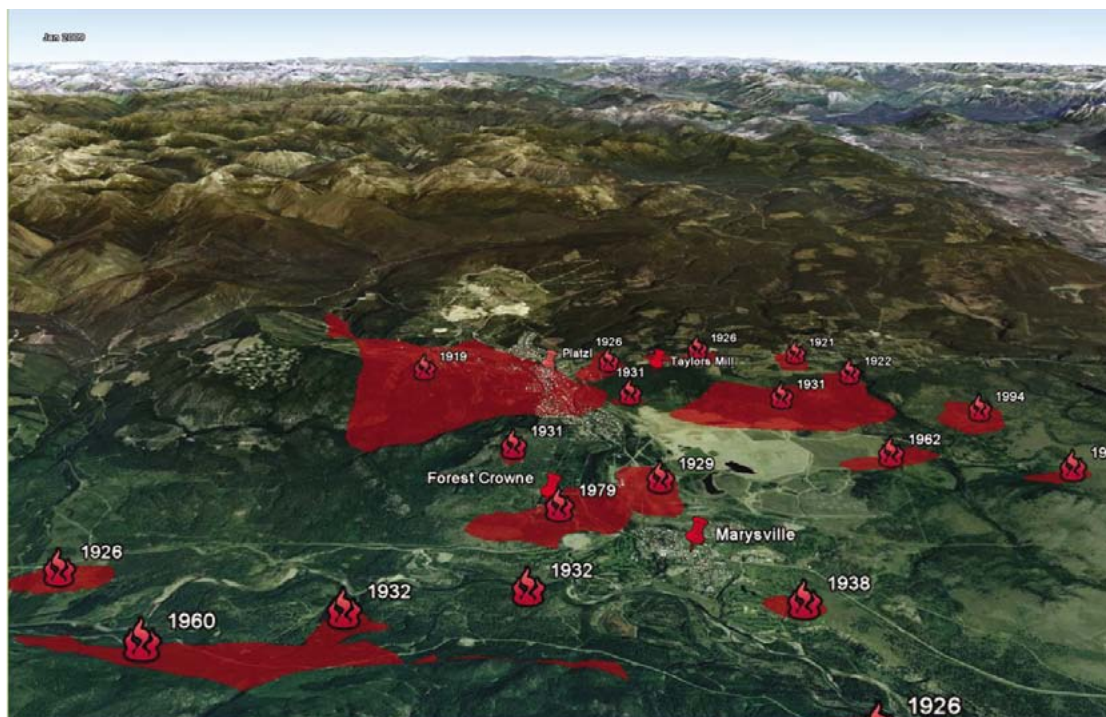
11 CALP Visioning and Visualizations: Kimberley Climate Adaptation Project, Final Project Report to the Real Estate Foundation Communities in Transition Program <http://cfubc.ehosting.ca/wp-content/uploads/2010/02/REF-CALP-Kimberley-Report2.pdf>

The mapping and visualizations that were produced included vulnerabilities to wildfire and flooding. Options for reducing vulnerabilities or adapting to changes were also provided. A summary of the visualizations was presented to an open house in Kimberley.

The strongest audience response came from the virtual fire tour which situated the projected forest fire season extension under climate change within a localized “fire story”. First, a 3D historical fire map showed the last 100 years of fires around Kimberley. Further mapping displayed in the virtual globe illustrated that the forest ecosystems around Kimberley are both fire-dependent, and heavily fuel-loaded due to fire suppression. Then, fire modeling results for a simulated current forest fire that starts southwest of the City were shown: each hour of the fire was layered on the virtual landscape in a time sequence, showing the fire cutting off the Highway access in three hours and reaching the City of Kimberley in four hours. The audience visibly responded by sitting up and there was an audible intake of breath in the room. The virtual tour then illustrated how the fire season could extend under climate change: currently starting in May, it could be starting as early as mid-March by the 2040s, and mid-February by the 2080s. Again, the time slider in Google Earth was used to show the possible future shift, and again the audience visibly and audibly reacted as they absorbed the information.¹²

Surveys conducted among attendees following the Open House indicated that the visualizations had been useful in helping people to understand the link between climate change and land use decisions. Reduction of wildfire risk and a fuel treatment program were among the recommended actions in the report prepared for the City.¹³

Historic fire map: Google Earth image of previous forest fires around Kimberley
(data source: Bob Gray). Source: Collaborative for Advanced Landscape Planning, UBC.



¹² Ibid.

¹³ *Adapting to Climate Change in Kimberley, BC, Report and Recommendations June 2009* (Prepared by Ingrid Liepa)
www.cbt.org/uploads/pdf/Kimberley_CACCI_Phase_1_Adaptation_Report.pdf

Developing Climate Change Adaptation Strategies: Checklist for Local Governments

The purpose of this checklist is to assist local governments in exploring the entry points for integrating climate change adaptation into policy and operations, as well as the scope of responsibilities that may be affected. It is meant to trigger further investigation and discussion about adaptation options and strategies. Occasional references to further resources are included. Because adaptation is an ongoing process, many of these questions will ideally be revisited over time. This checklist is meant to be a practical supplement to the information provided in Part 1 of this guide, and to help local governments move to the stage where they are ready to implement climate change adaptation strategies as discussed in Part 2.

As described in Part 2, the Official Community Plan (OCP) will be one of the main tools used to implement adaptation strategies, together with a number of local government bylaw powers and other activities that can be used to make communities more resilient to a changing climate. However, prior to updating an OCP it is important to start assessing potential climate change impacts, as well as options for addressing impacts based on community vulnerability, resources, capacity, local context and other factors. Even where local governments have limited resources available for climate change adaptation, there are ways to begin preparing, as described in *Appendix D — Considerations for Local Governments with Limited Resources*.

While efforts have been made to include as many useful questions as possible, the checklist is not exhaustive. Extra space has been provided so that users can add their own questions.

There will be overlap among the topic areas set out below. A good way to start a review of the checklist is to establish an inter-departmental committee, have a meeting, and go through the questions together in order to explore different viewpoints and start to understand the linkages. It is also useful to review the questions for each of the different types of impacts and to ask “what if...” questions.

MAKING THE MOST OF THE CHECKLIST: UNDERSTANDING CLIMATE CHANGE AND ADAPTATION

Making the most effective use of this checklist will require a basic understanding of climate change and adaptation, local impacts, and how to assess risks and vulnerabilities. In particular, the following background would be considered helpful:

- a. Climate change adaptation—an understanding of the difference between climate change mitigation and adaptation is necessary. See, for example, the diagram and discussion on pages 10-12 of this guide.
- b. Climate change projections (how will the global climate change?)—basic knowledge might be acquired, for example, through a review of resources such as:
 - The Columbia Basin Trust Climate Basics (video) www.youtube.com/watch?v=ECJtF7CfYcA
 - PICS Climate 101 series (videos) <http://pics.uvic.ca/education/climate-insights-101>
- c. Climate change projections at the regional level (how will the climate change in BC communities?)—climate change information for BC regions is available from the Plan2Adapt tool <http://pacificclimate.org/tools-and-data/plan2adapt> including:
 - climate projections;
 - related impacts; and
 - management considerations for each impact.
- d. Risks and vulnerability—Adaptation is place-based. Each community will need to review its particular situation, identify what the local government controls, and how planning and operations might be affected by climate change. The questions below are aimed at helping local governments begin to work through this process, and explore some of the options for adapting. It is important to plan for multiple events, e.g. unusually high temperatures and power outages. See *Appendix A: Further resources* for help with assessing risks and vulnerability.

Note: Understanding that the past will no longer be a good predictor of the future is a key part of adapting to climate change. Local government staff and elected representatives will need to be aware of the “new normal”: the climate of the future will be different than the climate of the past. For example, extreme weather events such as heat waves, drought and storms may become more frequent and more severe. Flooding and wildfires may be more frequent or extensive, or both, than previously experienced. As a consequence, it is important to recognize that what worked in the past to address these types of challenges will not necessarily work for the future.

Getting started on climate change adaptation

- ☐ Has the Pacific Climate Impacts Consortium (PCIC) Plan2Adapt modeling (<http://pacificclimate.org/tools-and-data/plan2adapt>) for the region been accessed to gain an understanding of the projected climate scenarios and impacts?
- ☐ Has a review of climate change impacts and management considerations (for the local government) been completed?
- ☐ If appropriate, has locally relevant, downscaled climate modeling been obtained?
- ☐ Is council/board well-briefed on climate change impacts in the community and the rationale for action?
- ☐ Has the community engaged in a climate change assessment process that has identified vulnerabilities, quantified risk, and decided on priority areas for action?
- ☐ Has local knowledge about climate change and its impacts been included in the assessment process?
- ☐ If a climate change assessment process has not yet been undertaken, could this process be linked to OCP review and updating?
- ☐ Has a list of key stakeholders for consultation and possible partners for implementation of adaptation strategies been identified (noting that this list needs to include climate scientists, emergency personnel, and others who might not typically be consulted)?
- ☐ Have any important information gaps related to climate change impacts and adaptation been identified, and a course of action determined?
- ☐ Has a scan of programs, policies and bylaws that could be affected by, or could include climate change adaptation, been carried out?
- ☐ What actions are already in place that can be considered adaptation?
- ☐ Given the projected climate change impacts in the community, what level of resources is it appropriate to commit for staff, and/or consultants?
- ☐ Which staff representatives (area/level) should be on an interdepartmental climate change adaptation committee — finance/ asset management, engineering/operations and works, planning, parks and recreation, emergency preparedness, communications, etc.?
- ☐ Should a select, standing or advisory committee be established?
- ☐ Are there currently in-stream applications or proposed developments or civic projects that should be re-evaluated in light of climate change impacts?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Regional and provincial context

- ☐ Are there any existing or proposed provincial guidelines that require consideration of climate change impacts relevant to the community? (For example, Ministry of the Environment, *Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use*. www.env.gov.bc.ca/wsd/public_safety/flood/structural.html)
- ☐ Have adaptation strategies of other local governments in the region been considered? Is the regional board advocating action? Are municipal councils within the region identifying issues or already taking action? What can be learned from them? Are there opportunities to work collaboratively?
- ☐ Have opportunities to work with universities and colleges, non-governmental organizations, businesses and/or others to develop climate change adaptation strategies been explored and pursued?
- ☐ Have roles and responsibilities of local, provincial and federal levels of government with respect to assessing and responding to climate change impacts been determined, and areas of cooperation identified?
- ☐ Has the relationship of local adaptation action to regional adaptation action been considered, and roles and areas of potential cooperation identified? Have opportunities to work with First Nations been explored? (See Regional Climate Adaptation Planning Alliance, *Report on Climate Change and Planning Frameworks for the Intermountain West*. www.parkcitygreen.org/Files/USDN-Inter-Mountain-West-Report_Final-Aug-2011.aspx)
- ☐ Is there potential to create regional partnerships to obtain climate impacts information or seek guidance on developing adaptation plans (e.g, from ICLEI www.iclei.org/index.php?id=611, Columbia Basin Trust www.cbt.org/Initiatives/Climate_Change/?Adapting_to_Climate_Change) or other external services)?
- ☐ _____
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Official Community Plan (OCP)

- ☐ Is there an opportunity to mainstream climate change adaptation into the OCP through a revision? (See pages 30-34 of the Guide, and note that some local governments have chosen to develop stand-alone climate change adaptation plans).
- ☐ Have all existing policy areas within the OCP been reviewed through the lens of climate change impacts in the community/region, both long and short term, and appropriate revisions considered?
- ☐ Where an OCP includes a Sustainability Checklist for reviewing applications for OCP amendments, zoning changes, new developments, etc., has it been reviewed and revised in light of climate change adaptation priorities (both vulnerabilities and opportunities) for the community? (See Halifax Regional Municipality, *Developers Guide to Risk Management* www.halifax.ca/climate/documents/DevelopersGuidetoRiskManagement.pdf)
- ☐ Have any new policies and objectives identified for the OCP with respect to climate change adaptation been considered in conjunction with the financial plan?
- ☐ Has council/board met its statutory requirements for consultation with respect to any changes to the OCP that it intends to make related to climate change adaptation?
- ☐ Does the current OCP indicate the need to act to address climate change impacts within the current time-frame, even though impacts may not be significant until later iterations of these planning documents?
- ☐ Have projected climate change impacts such as changes in water supply, run-off (e.g. reduced snowpack volume/earlier spring snowmelt), and temperature; increased intensity and frequency of extreme weather events and forest fires; increased occurrence of invasive species; and others been taken into account in developing new OCP policies?
- ☐ Have low-impact development and the use of the Water Balance Model to support community resilience in the face of climate change been explored? (See City of Courtenay OCP, www.courtenay.ca/planning/official-community-plan.aspx)
- ☐ Has mapping of specific climate change impacts and related hazards been carried out, and can this be incorporated into the OCP along with appropriate policy direction? Note: This may be a big topic that requires separate discussion. For example, What sort of mapping is most appropriate? Risk and/or vulnerability mapping? Overlaying hazard and vulnerability? What sort of accuracy/ precision is appropriate? Would visualization techniques be useful? (See page 34 of the Guide)
- ☐ If mapping has been carried out, has a timeframe been identified for review and updating?
- ☐ Have existing Development Permit Areas related to natural hazards been reviewed, and updated with current and projected climate information relevant to the region?
- ☐ Does the OCP address community safety and social planning issues related to climate change?
- ☐ Has the need for further outreach and public education related to new policies and objectives related to climate change adaptation been considered? Have business and industry been included?

- ☐ Have processes for monitoring and assessing the adaptation strategy outlined in the OCP been put in place?
- ☐ How and when will progress on climate change adaptation be measured and reported?
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- ☐ _____
- ☐ _____
- ☐ _____

Land use and zoning

- ☐ Has the community engaged in a climate change assessment process that has decided community priorities for action? If not, could this process be linked to OCP updates, zoning bylaw updates, applications and other land use activities?
- ☐ Where are the high, medium and low risk areas in relation to a changing climate (e.g. valley bottoms, steep slopes, areas near rivers, coastlines subject to sea level rise, areas near dams, high hazard fire risk areas, etc.)?
- ☐ In areas where wildfire risks currently exist, have risks been re-evaluated to account for climate change impacts (such as, potentially, reduced precipitation and a longer dry season)? See UBCM's Strategic Wildfire Prevention Initiative for funding opportunities: www.ubcm.ca/EN/main/funding/community-safety/strategic-wildfire-prevention.html¹⁴
- ☐ Are there specific types of land uses that may be at risk? (e.g. areas subject to hazardous conditions that may become more severe or widespread as a result of climate change, environmentally sensitive areas, etc.)
- ☐ Are there risks based on socio-economic factors, income levels, density and specific location (e.g. sea level rise planning areas)?
- ☐ How will land uses change over time (e.g. increased use of parks during hotter periods and more demand for shade)?
- ☐ How will building uses change over time (e.g. increased need for cooling centres at recreational facilities or community halls)?
- ☐ Are there locations with equipment, tools or facilities that will be helpful or essential during an emergency event (e.g. public works yards and equipment, trucking/car rentals, refueling stations, private businesses, schools, churches, community centres, provincial /federal facilities, etc.)?

¹⁴ In Kimberley historical fire strikes were plotted on a computer visualization (a map) based on local knowledge and historical records. This was combined with the climate projections from Plan2Adapt, expertise from CALP and local knowledge about fire behaviour to estimate future risks. See www.planningforclimatechange.ca/wwwroot/Docs/Presentations/SE06%20-%20Ellen%20Pond.pdf

- ☐ How may climate change affect the community given its particular geography and historical development patterns (e.g. heritage buildings, transportation systems, industrial areas, topography, geology, hydrology, windward/leeward location, community plan vision and goals)?
- ☐ What is the community context within the region (e.g. economic drivers, community values, regional services, relations with First Nations) and how will this be taken into account when planning for climate change?
- ☐ Where are vulnerable populations and associated services (e.g. hospitals, medical clinics, pharmacies, seniors homes, transition houses, group homes, homeless shelters, schools, universities, correctional facilities)?
- ☐ What developed areas are likely to be subject to increased risks over time (e.g. due to sea level rise, steep slopes or increased flood or wildfire hazards)?
- ☐ What undeveloped areas are likely to be subject to increased risks over time?
- ☐ Where does the OCP indicate new development will be located and should it be re-evaluated in light of projected climate impacts?
- ☐ Are there potential implications for new or existing development from climate change impacts on aquifers (e.g. lower rates of re-charge, salt-water intrusion)?
- ☐ Will an increasing urban heat island effect be a problem?
- ☐ Is there a Tree Management Inventory, Plan or Bylaw? Does there need to be a balance between increasing the number of trees for shade and/or removing or pruning trees to reduce the risk of wildfire?
- ☐ Are there ecosystems that will require additional protection as a result of climate change? Will protected areas and corridors need to be expanded or shifted?
- ☐ Do wetlands need to be protected and expanded (in light of sea level rise and increased storm surge)?
- ☐ Are there opportunities to support agriculture and improve food security in the community through changes to zoning and other bylaws to protect farmland, promote local food production, processing and sales (such as community food gardens, farmers markets, agri-tourism, etc.)?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Community infrastructure

- ☐ Has the frequency and intensity of climate change impacts (e.g. severe storms) been reviewed and updated?
- ☐ Has community infrastructure been assessed in light of climate change?
- ☐ Is climate change factored into the development of all new facilities and systems? Is it considered in procurement processes?
- ☐ Does the community's application for federal or provincial funding for infrastructure require consideration of climate change impacts?
- ☐ Are projected climate change impacts being taken into account in decisions to replace or upgrade infrastructure?
- ☐ Have agricultural and other industries that rely on community infrastructure, such as drainage and transportation infrastructure, been consulted about the impacts of climate-related disruptions and failures on their operations?
- ☐ Have water or sewage treatment plants been assessed for vulnerability to climate impacts (e.g. more intense storm events; increased risks related to flooding, water shortages; disruption of power supply associated with natural hazards, etc.?) Are backup generators needed?
- ☐ Is community infrastructure at risk from increased landslide activity (e.g. water quality impacts as measured by TSS — total suspended solids)?
- ☐ If higher storm surge, scour or sea level rise are projected impacts of climate change, then:
 - ☐ Are intakes and outfalls or linear infrastructure at risk?
 - ☐ Are bridges, roads, railways, or airports at risk?
- ☐ Are wells and septic systems at risk from increased precipitation or water shortages resulting from climate change?
- ☐ How will warmer water affect water quality (e.g. algae blooms)?
- ☐ How will available water supply be affected by more severe droughts? Can consumption be reduced through demand management and leak detection programs? Is there storage capacity available?
- ☐ Is there a watering restriction bylaw in place?
- ☐ Will a universal water metering program help manage water resources more effectively in the future?
- ☐ In regions where the frequency and intensity of extreme precipitation events are projected to increase:
 - ☐ Is the capacity of drainage infrastructure adequate? Are board/council and the public willing to accept a reduced level of flood protection or should upgrades be considered?

- ☐ Are there initiatives to reduce the volume and rate of surface water entering the drainage system (e.g. source controls, bylaws and policies that minimize the creation of impervious areas)?
- ☐ Have incentives for disconnecting downspouts been explored, and is this practice viable (i.e. does the soil have adequate capacity to absorb water) and have other mitigative measures like topsoil requirements and rain gardens been evaluated?
- ☐ Have design criteria been adjusted to address climate change (e.g. updated Intensity-Duration-Frequency Curves)?
- ☐ If there is a combined stormwater sewer system, how will climate change affect overflows? Is there increased risk to the environment or public health? Will upgrades such as sewer overflow tanks or a sewer separation program be considered?
- ☐ In areas vulnerable to increased flooding as a result of climate change:
 - ☐ Would measures to promote the installation of backflow valves by residents and businesses be appropriate?
 - ☐ Is there a flood plain management bylaw and should it be updated to reflect changing precipitation patterns?
 - ☐ Are issues related to increased debris and sediment accumulation being considered?
 - ☐ Will waterlogged soils need to be addressed?
- ☐ Are tools such as the Water Balance Model's climate change module being used to assist in adaptation planning? <http://bc.waterbalance.ca/>
- ☐ If alternate water supply sources are being planned for, will there be adequate energy available for increased pumping demands?
- ☐ Will street lighting and public waste and recycling receptacles be vulnerable to climate change (e.g. increased wind and more severe storms)?
- ☐ Are homeowners and businesses aware of the actions they can take in light of climate change impacts affecting water supply? (See *Okanagan Homeowner's Guide to Using Rain as a Resource* www.okwaterwise.ca/pdf/HomeDrainageGuide_Okanagan.pdf)
- ☐ Are urban trees at increased risk from wildfire, invasive species, water shortages, extreme weather events, etc.? Should other species that are more heat/drought/moisture tolerant be considered for future plantings? Is a greater diversity of tree species needed to assure resilience to pests and invasive species that might be associated with climate change? (See *Urban Forests: A Climate Adaptation Guide* www.retooling.ca/_Library/docs/Urban_Forests_Guide.pdf)
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

*Transportation systems and connectivity
(Roads, trails, railways, airports, marine transportation, communications, utilities, etc.)*

- ☐ Has the community engaged in a climate change assessment process that has identified vulnerabilities, quantified risk, and decided on priority areas for action with respect to transportation systems and connectivity?
- ☐ Is the local road network vulnerable to climate-related emergencies (e.g. increased risk of flooding or wildfire) or longer-term gradual impacts (e.g. sea level rise)?
- ☐ Are there specific assets such as bridges and culverts that are particularly vulnerable to climate change impacts?
- ☐ Are there pipes or conduits located under or alongside bridges that need to be relocated?
- ☐ Is consultation and coordination required with other authorities and operators (e.g. Ministry of Transportation and Infrastructure, railway companies, port authorities)?
- ☐ Will more freeze-thaw cycles or increased summer temperatures result in higher maintenance demands for roads and sidewalks?
- ☐ In the event of a climate-related emergency (e.g. flooding) will there be impacts on the transportation network?
 - ☐ Are there secure emergency access and evacuation routes?
 - ☐ Will there be missing transportation links, gaps or dead end roads?
 - ☐ Are any emergency facilities likely to be cut off during a climate-related emergency (e.g. fire, emergency, ambulance, police/RCMP, helicopter pads, public works yard, coast guard station)? If so, do they need to move over the long term or is there an alternative access (i.e. right of way)?
 - ☐ Would the transportation system function well if there was more than one extreme event happening at the same time (e.g. windstorm and flooding)? Will the transport of food and supplies, as well as business continuity (e.g. transport of industrial and commercial goods, employee travel to and from work) be affected?
 - ☐ Are gas, diesel and electrical vehicle fueling stations and distribution facilities at risk?
- ☐ Are there back-up options/plans for hydro, gas and telecommunications in the event of disruptions (e.g. generators or solar facilities for running and recharging communications devices such as cell phones and radios)?
- ☐ Is there an up-to-date emergency plan in place for transportation (with contacts, phone numbers and protocols)?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Asset management

(For additional resources see: Asset Management BC www.assetmanagementbc.ca/)

- ☐ Have local government assets and property been assessed for vulnerability to climate impacts anticipated during their lifetime?
- ☐ Have the assets and property found to be vulnerable been assessed and ranked in terms of how critical their functions are (e.g. a bridge that also carries water, sewer, gas lines and communication lines will likely be more critical than a bridge that only serves road transportation needs)?
- ☐ Has appropriate action been taken in terms of policy and investment to reduce vulnerability of critical assets?
- ☐ When taking into account the impacts of climate change over the longer term, have life cycle costing methods been used to understand the real costs of improvements or alterations required to infrastructure (i.e. including not only capital investment, but operation and maintenance costs)? Have the life-cycle costs associated with green infrastructure solutions or low-impact development been compared?
- ☐ Have changed levels of service because of climate change impacts been incorporated into planning and communicated to the public?
- ☐ Does the community have a formal asset management program and can future replacement programs be used to adapt to climate change?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Financial plan, strategic plan and budget

- ☐ Has the five-year financial plan been reviewed and revised in light of short to medium term costs associated with climate change assessments and adaptation planning?
- ☐ Does the five-year financial plan include costs associated with implementing adaptation actions to reduce vulnerability to climate change?
- ☐ Have possible effects of climate change impacts on the tax base been considered?
- ☐ Have the longer term financial implications of climate change been explored in the context of maintaining service levels and community quality of life into the future?
- ☐ _____
- ☐ _____
- ☐ _____

Emergency planning

(For additional resources see: Emergency Management in BC: Reference Manual, Emergency Management BC, 06/08/2011. Note that not all emergencies are eligible for emergency funding.)

- ☐ Has the Emergency Response Plan and related planning and policies been reviewed and updated to take into account projected changes in climate?
- ☐ Will effective emergency planning require consultation with other local governments in the region, other government agencies and authorities? (e.g. port authorities, public transportation authorities, utility companies, railway companies, RCMP, Coast Guard, Ministry of Transportation and Infrastructure, meteorological services, etc.)
- ☐ Are there opportunities to partner with neighbouring communities and First Nations with respect to emergency planning and response?
- ☐ Will the central business area and commercial and industrial activities that the community relies on be able to continue functioning during a climate-related emergency?
- ☐ Where are hazardous materials located in the community?
- ☐ Where are the vulnerable populations (i.e. seniors, homeless, street workers, low income areas)? Are they able to evacuate easily? Is there dependence on public transit?
- ☐ Are there specific land uses that may need additional attention in a climate-related emergency (i.e. hospital, care facilities, seniors homes, group homes, transition houses, shelters, schools, pharmacies, emergency gathering centers)?
- ☐ Are there special communications considerations in resorts or major tourist areas where visitors' primary language may not be English?
- ☐ Where are the contamination risks (sewage lagoon, landfill, groundwater, commercial or industrial uses)? What mitigation is needed?
- ☐ What would happen if farm animals needed to be moved? Is there a plan to deal with dead or injured livestock?
- ☐ Do local emergency response teams have the capacity to deal with multiple disasters occurring at the same time, e.g. an extreme precipitation event and a severe windstorm? Note that some areas are also subject to earthquakes and tsunamis.

Please see, also, emergency-related questions under "Transportation, systems and connectivity."

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Insurance

- ☐ Does insurance coverage need to be updated in light of local climate change impacts? What potential climate-related losses will be covered by insurance? What losses would not be covered?
- ☐ Are insurance premiums being affected by exposure to risks associated with climate change? Are there actions that can be taken to address these risks?
- ☐ Are businesses and residents encouraged to minimize their risks associated with climate change impacts?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Staff training

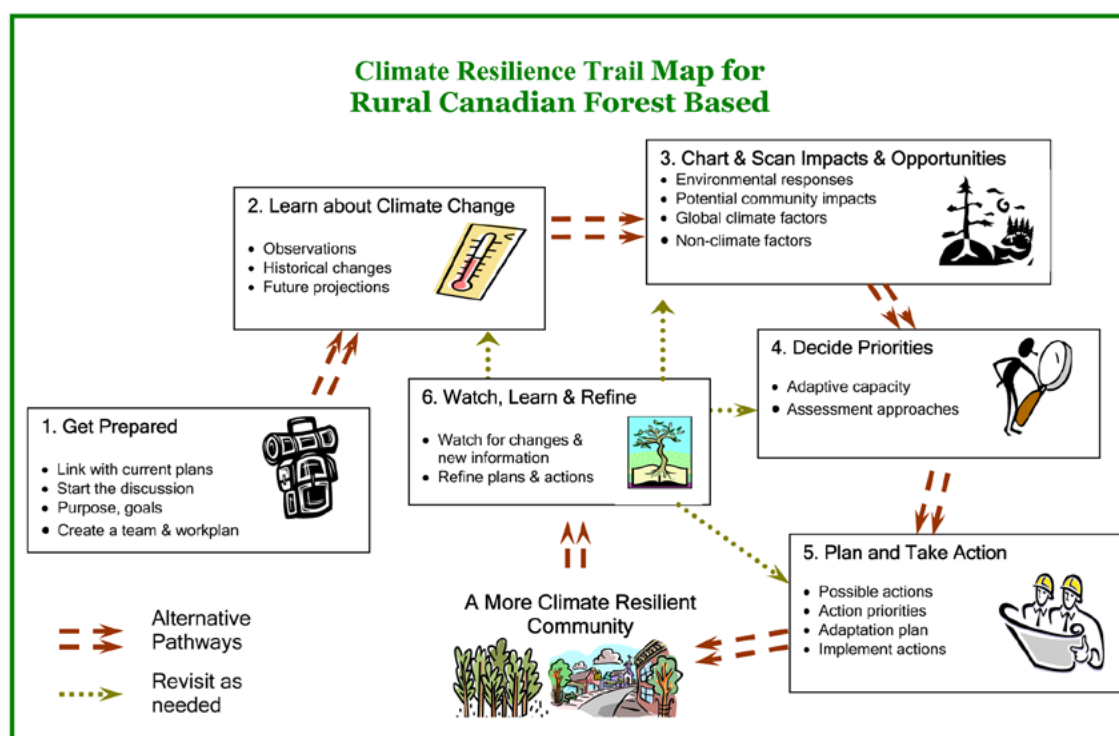
- ☐ Have staff and community training needs with respect to climate change adaptation been evaluated, and steps taken to identify and implement training options?
- ☐ Have partnering or mentoring options been considered?
- ☐ _____
- ☐ _____
- ☐ _____

Considerations for local governments with limited resources

Assessing climate change impacts and prioritizing actions

It is very important for local governments, whether small or large, to start assessing the impacts of climate change in their communities and developing adaptation strategies. BC's climate is changing, and scientists who study the climate are projecting further changes over the next decade. The decisions that are being made today by local governments will critically affect the ability of their communities to manage the impacts of many of these changes in the future.

Part 1 of this Guide presents some high level information about climate change in BC, and background about adaptation and how communities can obtain scientific information relevant to their communities, assess their vulnerabilities and risks and prioritize actions. These steps are necessary before climate change adaptation strategies can be developed. While some local governments might



Source: *Pathways to Climate Change Resilience: A Guidebook for Forest-based Communities*
www.modelforest.net/pubs/Pathways_to_Climate_Change_Resilience_FINAL_Feb_2011.pdf

be hesitant to begin in light of challenges with resources and capacity, *Appendix C—Developing Adaptation Strategies—Checklist for Local Governments* provides a series of key questions that can help to get started.

As well, a resource developed specifically for smaller BC communities offers helpful guidance about assessing impacts and prioritizing actions. The six step process set out in *Pathways to Climate Change Resilience: A Guidebook for Forest Based Communities*¹⁵ is reproduced on page 103. It is hoped that this material might help some local governments be in a better position to begin implementing the climate change strategies described in Part 2 of this Guide. Further guidance with respect to assessing impacts and prioritizing actions is also provided below, and in *Appendix C*.

Learning about climate change impacts

- A Columbia Basin Trust video (5.41 minutes) provides an introduction to climate change from the perspective of a City Councillor, elementary school student, retired mill worker and gardener, and scientist. www.youtube.com/watch?v=ECJtF7CfYcA
- Pacific Institute for Climate Solutions (PICS) has a series of short videos and lessons on climate change. <http://pics.uvic.ca/education/climate-insights-101> An Introductory Climate Insights Trailer (2.50 minutes), Climate 101 module (about 10 minutes) and a series of four Climate Lessons: 1. Carbon Dioxide and Greenhouse Gasses; 2. Mother Nature's Influence; 3. Observable Changes and 4. An Introduction to Climate Modeling.
- Plan2Adapt is a (free) online tool that offers climate projections by region, and some description of impacts. The tool is from the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria. <http://pacificclimate.org/tools-and-data/plan2adapt> The projections are at a regional scale, however some communities have contracted with PCIC to get information scaled down to a local level, where possible.
- The City of Prince George has prepared a series of short videos about climate change impacts in their region and some of the actions they are taking. www.youtube.com/playlist?list=PLC9CCE982F121480C
- Local observations can be an additional source of information about changing weather patterns in the community. Consider and discuss the ways the climate has changed in the community over the last 30+ years; for example, it is no longer cold enough for an outside skating rink; the wind comes from a different direction and trees have blown down; there is increased and earlier spring flooding/ summer droughts/ heat waves; there is increased risk of wildfire; there are more intense storms/ ice jams/ high water threats to bridges and water pipes/sewage lagoon flooding/dike breaches or overtopping; there are more/different pest outbreaks, or they occur at different times. Newspaper stories and pictures from previous events may be helpful to catalyze discussion.

Note: The information obtained from community observations can be compared with the scientific information obtained about climate change. Both areas of overlap as well as areas where scientific information suggests potential risks not anticipated based on anecdotal information alone should

15 With thanks to Cindy Pearce. See *Pathways to Climate Change Resilience: A Guidebook for Forest-based Communities* www.modelforest.net/pubs/Pathways_to_Climate_Change_Resilience_FINAL_Feb_2011.pdf

be explored. Local governments should be aware that an accurate understanding of the climate impacts in their region will likely require expert assistance, whether from PCIC, through BC universities, or possibly through provincial or federal government departments or agencies.

Some ways to increase local capacity for climate change adaptation

- Engage community stakeholders and experts in consultation (e.g. community leaders, businesses, local scientists, university/college representatives, utilities, non-governmental organizations, recreation groups, and interested stakeholders).
- Check in with neighbouring communities, regional districts and First Nations to see what they have done, and where there may be opportunities for partnership or cooperation.
- Consider creating a citizens advisory committee on climate change adaptation to act as an ongoing resource and sounding board for staff as climate change impacts are assessed, priorities identified, and adaptation strategies are developed and implemented.

Assessing risk and vulnerabilities, and prioritizing actions

- Adaptation is place-based so each community will have to assess its own unique situation.
 - Review the community's local geography, environmental and regional context for climate change impacts. Some of the typical impacts facing BC communities (depending on where they are located in the province) include: increased risk of riparian flooding; sea level rise and erosion in coastal areas; increased wildfire risk; changes in wind patterns and tree blow down; aquifer and water supply issues. Community risk and vulnerability to these impacts are important factors in prioritizing action. For example, if the climate change impact is a high risk of sea level rise of 1 m by 2100, but the local topography is 5-meter rocky bluffs along the shoreline, then the community likely has a low vulnerability to coastal erosion. By contrast, a community with low-elevation coastal areas may be extremely vulnerable if faced with the same risk.
 - Review land use development patterns, locations of key facilities (e.g. hospitals, emergency facilities, works yards etc.), transportation/ emergency routes and check for connectivity and stranding in the case of emergencies arising from natural hazards associated with climate change such as flooding or wildfire, green space and sensitive habitats and check demographics, socio-economic factors, housing (location, age, rental) to identify vulnerable populations, etc. Part 2 of this Guide has further information about climate change adaptation considerations with respect to many of the services and responsibilities of local governments.
 - Use the risk evaluation matrix to help prioritize actions.

Sample Risk Evaluation Matrix which may help in prioritizing actions¹⁶

IMPACT SEVERITY	Extreme					
	Major					
	Moderate					
	Low					
	Very Low					
		Very Unlikely to Happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Certain to Occur
FREQUENCY/PROBABILITY						

 **Extreme risk:** Immediate controls required
  **High risk:** High priority control measures required
  **Moderate risk:** Some controls required to reduce risks to lower levels
  **Low risk:** Controls not likely required
  **Negligible risk:** Scenarios do not require further consideration

Source: Robert A. Black and James P. Bruce, *Adapting to Climate Change: A Risk-based Guide for Local Governments*, Volume 1, October 2010.

- Think about how to address in-stream applications and identify any big projects that may be at very preliminary stages. Consider prioritizing a review of climate change adaptation considerations for these projects.
- Community engagement is very important. Some climate adaptation strategies will require significant investment of tax dollars and local government resources. Citizens and elected officials will need to have a basic understanding of the climate change impacts in their communities so that they can make informed decisions. In areas subject to increased risks with respect to natural hazards as a result of climate change, for example, a community might need to weigh the costs and benefits of protection versus relocation. See Land use scenarios #1 and #3 in Appendix B for further ideas about community engagement.
- In communities where funds are not available for adaptation planning, review the checklist in Appendix C in light of risks and vulnerabilities that have been identified.

¹⁶ Note that time is also an important variable to be considered — when will consequences be felt, and how long does it take to address them or put in place measures to anticipate them?

BC Regional Adaptation Collaborative (RAC) Resources

This Guide was produced with funding from the BC RAC. The list below highlights a number of reports, guidelines, case studies and other documents also produced under the RAC. For a complete listing of all the documents and related links, please go to www.retooling.ca

<i>Okanagan Water Supply & Demand Project Summary Report</i> , Summit Environmental Inc.	<i>Nicola Water Use Management Plan (NWUMP)</i> , NWUMP Multi-Stakeholder Committee
<i>Tutorial video for Okanagan Water Viewer</i> , Okanagan Basin Water Board (OBWB)	<i>Evaluating the Vulnerability of Pacific Salmon in the central interior of BC to the effects of climate change</i> , ESSA Technologies Ltd.
<i>Slow it, Spread it, Sink it! An Okanagan Homeowner's Guide to Rainwater Management</i> , Insight Environmental Ltd.	<i>Groundwater Habitat Interactions for Interior Fraser Coho Salmon</i> , Nicola Tribal Associations
<i>Rain to Resource 2010 Report</i> , Insight Environmental Ltd.	<i>Preliminary Technical Summary: Assessing Effectiveness of Climate Adaptation</i> , Steve Conrad
<i>Agricultural Water Demand Model Reports for Nicola Basin, Similkameen Basin, Kettle Basin, Okanagan Basin</i> , Ted Van der Gulik, BC Ministry of Agriculture	<i>Public Infrastructure Engineering Vulnerability Committee (PIEVC) Workshop Report</i> , OBWB & Jacquie Belzile
<i>Water Balance Model Technical Guide</i> , HB Lanarc	<i>Green Bylaws Workshop</i> , OBWB & Jacquie Belzile
<i>Erosion Assessment</i> , Kerr Wood Leidal Associates Ltd.	<i>Water Balance Model Workshop, Guide to Workshop Process</i> , OBWB & Jacquie Belzile
<i>Theodosia Watershed Climate Adaptation Plan</i> , Patrick Little for BCFF	<i>Advancing Adaptation in the Basin (for Okanagan Basin, Somass Basin, & San Jose Basin)</i> Cindy Pearce, Mountain Labyrinths Inc.
<i>Rethinking Our Water Ways: A Guide to Water and Watershed Planning for BC Communities in the Face of Climate Change and Other Challenges</i> , Fraser Basin Council (FBC) staff	<i>Stream and Riparian Area Checklist for Assessing the Health of Stream Reaches</i> , D. Tripp

Climate Change Adaptation Planning for Northwest Communities — Project Update, Project Team & Brinkman Group

Designating “Temperature Sensitive” Streams in BC, A Discussion Paper, Lars Reese-Hansen BC Ministry of Forests, Lands and Natural Resource Operations, Marc Nelitz, ESSA Technologies Ltd. & Eric Parkinson

Skeena River Water Conservation Project Overview, Cortex Consultants

Climate Change Adaptation Planning for Northwest Skeena Communities, Dirk Brinkman, James Casey, Stewart Cohen et al.

Coastal Floodplain Mapping Guidelines, Kerr Wood Leidal

Campbell River Floodplain Map, Kerr Wood Leidal

Professional Practice Guidelines for Legislated Flood Hazard & Risk Assessments in a Changing Climate in BC, Association of Professional Engineers & Geoscientists of BC (APEGBC)

Sea Dike Coastal Guidelines: Policy Discussion Paper. Sea Dike Coastal Guidelines. Sea Dike Coastal Guidelines: Guidelines for Management of Coastal Flood Hazard Land Use, Ausenco Sandwell

Delta – RAC Sea Level Rise Adaptation Visioning Study, Policy Report, Sea Level Rise Adaptation Visioning Study Technical Report, Dr. Stephen Sheppard, Ellen Pond, David Flanders, Sara Barron, Kristi Tatebe, Glenis Canete, Sara Muir Owen, Jeff Carmichael (University of BC Collaborative for Advanced Landscape Planning – CALP)

Online Training Modules (for Visualizations), CALP

Delta Adaptation Website, CALP

A Primer of Options for Adapting to Climate Change Impacts on Canada’s Southern Coasts, Graham Farstad, Sally Elford, Arlington Group

Cost of Adaptation – Sea Dikes & Alternative Strategies. Technical Memorandum: Recommendations for Developing A Holistic Flood Risk Management Strategy, Delcan

Urban Forests – A Climate Adaptation Guide, Judith Cullington & Associates and Jeremy Gye & Associates Urban Forest Consulting

Preparing for Climate Change: An Implementation Guide for Local Governments in BC, Deborah Carlson, West Coast Environmental Law and Cathy LeBlanc, BC Ministry of Community, Sport & Cultural Development

City of Prince George. *The Effects of Climate Change on Natural Area Ecosystems*, Ecora Resource Group Ltd. & H. Griesbauer. *Precipitation & Freeze-Thaw Assessment*, Kerr Wood Leidal

City of Prince George. *Implementing Climate Change. The myPG Integrated Community Sustainability Plan*, I. Picketts. *The Draft Official Community Plan*, I. Picketts and City staff. *Forests*, C. Coady. *Natural Areas & Ecosystems*, C. Coady. *Transportation & Infrastructure*, I. Picketts. *Precipitation & Freeze-Thaw*, I. Picketts. *Ongoing & Future Initiatives*, I. Picketts. *Flooding*, I. Picketts & D. Dyer. *myPG Integrated Community Sustainability Plan*, HB Lanarc

City of Prince George. *Terrestrial Ecosystem Mapping & Sensitive Ecosystem Mapping*, Bio-Geo Dynamics, Ltd.

Cariboo-Chilcotin Climate Change Adaptation Strategy. Cariboo Regional District Case Study, Mike Simpson, FBC

Climate Change Adaptation Case Study for Xat’sull First Nation (Soda Creek), Donnell Sellars, FBC

Columbia Basin Trust. *Planning for Change. Local Impacts of Climate Change. Video- Climate Change Science 101 for the Columbia Basin. Summary Report- Getting Started with Climate Adaptation Workshops, Learning Network Reflection Webinar, Learning Network Newsletter*, Michelle Laurie & Rachael Roussin

Columbia Basin Trust Case Studies. *Adaptation Action Plans for the City of Rossland, the Regional District of Central Kootenay Area D & the Village of Kaslo, & the City of Castlegar*

Saanich Adaptation Plan, District of Saanich & Stantec



West Coast Environmental Law
200 – 2006 West 10th Avenue,
Vancouver, BC Canada
V6J 2B3

www.wcel.org

