

Where Resilience Meets Policy:

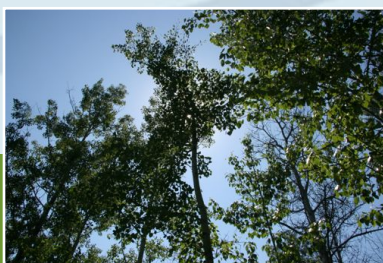
A Review of Southern Alberta Municipal Policies for Climate Change Adaptation (CCA) Strategy Insertion Points

June 2013

Prepared by Guy Greenaway



MIISTAKIS
INSTITUTE



Prepared for:

The Biodiversity Management and Climate Change Adaptation Project

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Executive Summary

Climate change adaptation is an inherently local activity, and few decision-making entities will see as much need to adapt to a changing climate over the coming years as a local government. Fortunately, local governments do have a range of opportunities to address climate change adaptation, building sustainable and resilient communities in the process.

As part of the ABMI-led *Biodiversity Management and Climate Change Adaptation* project, Miistakis is developing a community decision support toolkit that will help communities identify climate change adaptation strategies that satisfy their goals while maintaining the benefits of biodiversity-related ecosystem services. A key need is to connect climate change adaptation (CCA) strategies to existing policies in southern Alberta rural municipalities. This report supports this goal by providing a high-level sense of how resilience-based climate change adaptation strategies might fit into existing municipal plans and policies.

This review involved five steps: identify target municipalities, identify and describe target policies, plans and strategies, review climate change adaptation action plans for emerging issues, and assess the target policies based on their ability to support local CCA.

The target municipalities for this policy review included 16 rural municipalities in the grasslands natural region of southern Alberta. A review of the Climate Change Adaptation Action Planning processes identified in the first stage of this project provided a provisional list of CCA issues local governments are facing, including air quality, agriculture viability, emergency response, health and recreation, planning and development, roads, storm water management, tourism, waste management, water quantity, water quality.

An non-exhaustive catalogue was created of policies in the southern Alberta grasslands municipalities that have the potential to incorporate climate change adaptation strategies, divided into four categories: Policies and plans (Municipal Development Plans, Land Use Bylaws, Area Structure/Redevelopment Plans, Conceptual and Outline Plans), Strategies (Sustainability Plans, Codes of the West, Growth Management Strategies), Municipal programs (Agricultural Service Boards, Emergency Services, Regional Service Commissions), and Support programs (Alberta Municipal Infrastructure Program, Alberta Municipal Water/Wastewater Partnership, Federal Gas Tax Fund).

Although created knowing the research is necessarily incomplete, based on the need for the clear articulation of the impacts of climate change on the local communities coming later in the project, there is enough information to draw several solid, but interim conclusions:

1. There are numerous potential insertion points for climate change adaptation strategies;
2. No one 'ideal' municipality with the 'right' policies best supports CCA Action Planning; different municipalities better suit different climate change adaptation strategies;

3. Non-statutory plans are a strong option for supporting climate change adaptation strategies;
4. Agricultural Fieldmen represent a vital link to CCA implementation;
5. Planning and development policies and strategies represent cost-effective option for climate change adaptation strategies;
6. Availability of provincial funding may dictate most viable policy routes for insertion of CCA strategies;
7. Extreme storm events will be a priority for municipalities and a likely catalyst for inclusion of CCA strategies; and
8. Regional service commissions represent opportunity for efficiency, but a challenge for diffuse impact.

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INTRODUCTION

Climate change adaptation is an inherently local activity, and few decision-making entities will see as much need to adapt to a changing climate over the coming years as a local government. The impacts of climate change will be strongly felt by local communities in southern Alberta in particular, as the frequency and severity of floods, droughts, and extreme storms increases; local governments will increasingly be called upon to play a leadership role in adapting to those changes.

The good news is that local governments also have a range of opportunities to address climate change adaptation, building sustainable and resilient communities in the process. In the 'Local Adaptations' sub-project, Miistakis is developing a community decision support toolkit that will help communities identify climate change adaptation strategies that satisfy their goals while maintaining the benefits of biodiversity-related ecosystem services (see Project Background, below).

This report, *A Review of Southern Alberta Municipal Policies for Climate Change Adaptation Strategy Insertion Points*, supports this goal by providing a high-level sense of how resilience-based climate change adaptation strategies might fit into existing municipal plans and policies, one which can inform the development of generalized but plausible and inspiring examples.

Goal

A key operational intent of the *Local Adaptations* sub-project is to connect climate change adaptation (CCA) strategies to existing policies in southern Alberta rural municipalities (i.e., the decisions that are already being made). The operating premise here is that: 1) climate change adaptation is pervasive and not specific to one municipal function/agency; 2) "new" strategies are viewed as a drain on stretched resources; 3) many effective CCA strategies are already in place in support of other goals; and 4) a separate CCA strategy will be viewed as 'another department's responsibility.'

The goal, then, of this report and its underlying research is to identify the strategies and policies of southern Alberta rural municipalities in the grasslands region (our project focal area) which logically could be an 'insertion point' for a climate change adaptation strategies associated with a CCA Action Plan.

Sub-project context

The review contained in this report is intended to support the two primary research pieces of the *Local Adaptations* sub-project.

The first of these tasks is to relate local environmental changes due to climate change to the impacts they have on local ecosystem services and biodiversity. The will involve illustrating the environmental changes likely to occur due to climate change in the grasslands natural region, then illustrate the impact those changes have on the ecosystem services which a rural community depends on.

The second task is to relate maintenance of ecosystem services and biodiversity management to resiliency-based local climate change adaptation action plan strategies. The process will involve showing how stewardship of local ecosystem services and biodiversity can underpin resiliency-based CCA Action Planning strategies applicable in the Alberta context.

The review of southern Alberta rural municipal policies will identify specific policies, plans and strategies which may accommodate these climate change adaptation Action Planning strategies., identifying the emerging CCA issues they may address, and providing a basis for more detailed development of strategies.

This report should be considered provisional, in that the information contained within will be refined as these primary research tasks are undertaken. Because these other two tasks have not been completed, it creates a 'chicken-and-egg' dilemma – without the identification of specific environmental impacts, it is difficult to be sure if the identified policies could in fact address those issues; however, without the municipal policies first identified, it is difficult to be sure how local governments could actually address the issues.

Methods

This review involved five distinct, but interrelated steps

IDENTIFY TARGET MUNICIPALITIES

- Seventeen rural municipalities in southern Alberta were identified based purely on their location (southern Alberta, and at least some portion in the grasslands natural region); policies and strategies were collected from their web sites (or in the case of ten of them, from the web site of the Oldman River Regional Services Commission (ORRSC.com 2013) who provide municipal planning services across the region)

IDENTIFY AND DESCRIBE TARGET POLICIES, PLANS AND STRATEGIES

- The web sites of the target municipalities, the Oldman River Regional Services Commission, Alberta Municipal Affairs, Alberta Infrastructure, as well our own municipal document libraries were scanned to gather all policies, plans, and strategies deemed potentially relevant to this research.
- After reviewing the policies, plans and strategies associated with each municipality, a summary list was created representing the range of applicable 'types' of municipal policies which had potentially applicability to CCA at the local level.

- Each policy, plan or strategy type was described, making reference to the overarching law, responsible provincial ministry, provincial agency, funding dynamic, and local examples.
- This task was done in parallel with the review of CCA Action Plan documents which was undertaken to develop a list of emerging municipal CCA issues

REVIEW CLIMATE CHANGE ADAPTATION ACTION PLANS FOR EMERGING ISSUES

- The published material relating to climate change adaptation action planning that was reviewed for the first year of the 'Local Adaptations' sub-project (see Miistakis Institute 2012, 2013) was reviewed again, this time with reference to the local climate change adaptation issues they identified in each of the cases.
- Two key resources are summarized in Appendices 2 and 3.
- A provisional list of emerging issues was created to guide and respond to the evolving list of relevant municipal policy types.

ASSESS THE TARGET POLICIES BASED ON THEIR ABILITY TO SUPPORT LOCAL CCA

- Each policy, plan or strategy type was assessed based on its potential to play a role in addressing CCA at the local level.

PROJECT BACKGROUND

'Biodiversity and Climate Change Adaptation' project overview

The Biodiversity and Climate Change Adaptation Project was conceived by the Alberta Biodiversity Monitoring Institute (ABMI) in response to the need to define the scope of change required to effectively manage biodiversity under a changing climatic regime, and to support Alberta's biodiversity management system with essential knowledge and tools for successful adaptation to a changing future climate.

The rationale for this initiative rests on the importance of biodiversity to Albertans, and the complex relationship between climate and biodiversity. Biodiversity, which includes species and their ecosystems, supports the delivery of numerous ecosystem services. These include provisioning services (e.g., food, fibre, fuel, water), regulating services (e.g. water and air filtration, flood regulation), cultural services (e.g., nature recreation, wildlife viewing) and supporting services such as soil formation and wildlife habitat. Because these biodiversity related services are impacted by a changing climate, and because the relationship between climate and biodiversity is uncertain, knowledge gaps constrain effective adaptation. Proactive investments in the knowledge and tools for effective biodiversity management under a changing climate regime will deliver significant benefits to people and avoid crisis-driven interventions that are by their nature reactive, costly and often ineffective.

The goal of the *Biodiversity Management and Climate Change Adaptation* project is to develop essential knowledge and tools to support the management of Alberta's biodiversity and promote successful adaptation to a changing climate. The project is comprised of four objectives:

1. Predicting the impacts of climate change on Alberta's native species and ecosystems
2. Predicting invasive species responses to climate change
3. Assessing strategies to support climate sensitive species-at-risk
4. Developing and evaluating adaptation policy and tools to manage biodiversity in a changing climate

The *Local adaptations for biodiversity-related ecosystem services* sub-project (concisely, the *Local Adaptations* sub-project) lead by the Miistakis Institute directly supports objective 4.

'Local Adaptations' sub-project overview

As the climate changes, Alberta's communities will be required to make decisions that encourage adaptation to the new climate conditions. To make appropriate decisions, communities will need to understand how the ecosystem services on which they rely might be affected by climate change, and what are their potential adaptation strategies. Alberta currently lacks a framework for local governments to address climate change; filling this gap will enable communities to plot a path forward.

The first step in enabling local community adaptation to climate change is the development of community-based Climate Change Adaptation (CCA) Action Plans. To this end, Miistakis is developing a community decision support toolkit that will help communities identify climate change adaptation strategies that satisfy their goals while maintaining the benefits of biodiversity-related ecosystem services. This toolkit is envisioned to support Alberta-based climate change adaptation (CCA) action planning processes with spatially-explicit tools which allow local managers to visualize the impact a changing climate has on their community's economy, infrastructure, and natural systems.

The central challenge of this sub-project is to connect the vast realm of biodiversity and climate change data to the everyday world of a local community decision-maker. The approach is intended to be pragmatic, seeking a rigorous method while recognizing limits in relevant data and the needs of affected communities, thus ensuring that databases and information are accessible to local decision makers.

Several key concepts will determine the ultimate form and content of this decision-support toolkit:

- The specific needs (i.e., gaps) in Alberta with regard to embracing climate change adaptation (CCA) action plans;
- The identity of the partner community(ies) and their decision-making needs, realizing that the ultimate product will be somewhat specific to the community(ies) chosen (i.e., a proof-of-concept approach);
- The knowledge base (data) required; ecosystem services may be the best way to connect biodiversity and local decision making, but no ecosystem services-specific spatial data currently exist in Alberta;
- The interface between the climate change adaptation (CCA) action plan and the supporting visualization tools (GIS-reliant or otherwise); and
- The value of web delivering tools and products to the greatest degree possible.

TARGET MUNICIPALITIES

The “Local Adaptations’ sub-project has been scoped to focus on rural municipalities in the grasslands natural region of southern Alberta. As such, the target municipalities for this policy review are:

- Cardston County
- County of Forty Mile
- County of Lethbridge
- County of Newell
- County of Warner
- Cypress County
- MD of Acadia
- MD of Bighorn
- MD of Foothills
- MD of Pincher Creek
- MD of Ranchland
- MD of Taber
- MD of Willow Creek
- Rocky View County
- Vulcan County
- Wheatland County

EMERGING MUNICIPAL CLIMATE CHANGE ADAPTATION ISSUES

In the first year of the ‘Local Adaptations’ sub-project, the Miistakis Institute reviewed several climate change adaptation Action Planning processes (Miistakis Institute 2012, 2013), including those developed by the Columbia Basin Trust, ClimateWise, and ICLEI (Local Governments for Sustainability). Although each process was distinct, and each example of the process focused on

different locales, collectively they paint a picture of the climate change adaptation issues local governments are facing.

This review yielded the follow climate change adaptation issues, and associated examples. It is very important to note that this is a provisional list, and one that was developed from the perspective of connecting with municipal policies. The main research tasks of this phase of the *Local Adaptations* sub-project (see *Sub-project context*, above) will involve a much more comprehensive review of this same realm. As well, there are specific examples associated with each issue which are NOT included in the list below only because they were not raised in the documents reviewed.

This list should, therefore, not be taken as a final list, but rather as a provisional list intended to support the task of identifying municipal policies with the potential to support climate change adaptation strategies.

The identified issues (in alphabetical order) were:

- Air quality
 - Fire effects
- Agriculture viability
 - Drought and crops
 - Drought and stocking rates
 - Crop damage due to hail and extreme rainfall
 - Impact of increased invasives
- Emergency response
 - Increased wildfire
 - Wildland urban interface (WUI)
 - Flood disaster response
- Health and recreation
 - Impact of heat on citizens (dehydration, heat stroke, respiratory ailments, mortality)
 - Impacts on recreation species (hunting limits, birdwatching)
 - Increase in infectious diseases (e.g., mosquito-borne diseases like West Nile and Lyme)
- Planning and development
 - Accommodating greater irrigation infrastructure
 - Accommodating greater electrical infrastructure (for A/C and cooling)
 - Industrial requirements to return cool water to streams
 - Development in growing floodplains (100 year floods every 10 years)
 - Accommodate alternative energy (climate change mitigation infrastructure)
- Roads
 - Impacts from extreme storm run-off
 - Oiling dry roads
 - Accommodating decreasing flood intervals

- Increased erosion due to increased heavy rainfall and drought
- Storm water management
 - Accommodating increased run-off (ditches)
 - Maximizing capacity of wetland complexes
- Tourism
 - Effects of wildfire
 - Effects of wildlife losses
- Waste management
 - Dispersal of pollutants, in air, soil and water may be modified
 - Location of facilities such as waste disposal sites (contaminated land or other “brownfield” sites may need to be reassessed for the potential future remobilization of pollutants)
- Water quantity
 - Increased erosion complicates water storage strategies
 - Decreased surface water increases competition for groundwater
- Water quality
 - Algal blooms in lakes
 - Stormwater runoff mixing with sewage systems
 - Increased erosion (flood, wildfire, wind) leading to lower water quality for humans and other species

TARGET POLICIES, PLANS AND STRATEGIES

Especially at this early stage of this project, it would be impossible to exhaustively list all municipal policies, plans and strategies in southern Alberta that have the potential to incorporate climate change adaptation strategies. However, a start can be made.

The policies (used now to refer to policies, bylaws, strategies, resolutions, and similar devices at play within a municipality that guide human activity) listed in this section are each described, then assessed in brief qualitative terms with regard to their potential to accommodate CCA strategies at the local government level.

There is no attempt to exhaustively catalogue every policy in the southern Alberta grasslands municipalities. However, examples are given of the municipalities that have used those policies, and conversely, no policy type is listed if an example of its use was not found in the target municipalities.

This section is divided into four categories:

- Policies and plans
 - Statutory and other plans required or described by the Municipal Government Act
- Strategies

- Guiding strategies and resolutions formally adopted by council, but which may not have the authority of law
- Municipal programs
 - Municipally-initiated or led programs, boards and commissions
- Support programs
 - Programs and organizations which directly support municipal services or activities, in many cases providing tied funding

Policies and Plans

MUNICIPAL DEVELOPMENT PLANS

The *Municipal Development Plan* (MDP) is the overarching vision document for land use in an Alberta municipality. Despite its name, it references all aspects of development, conservation, and community well-being associated with land use planning at the municipal level (in other jurisdictions, this same plan is called a Community Plan, a Comprehensive Plan, etc.).

Alberta municipalities with a population of 3500 or more are required to create an MDP, and those with lesser populations are encouraged to do so. They are reviewed and revised on an infrequent basis, with some over a decade old. The revision process is usually extensive, involving significant community engagement.

There is no pre-determined template, though each one generally includes such categories as transportation, economy/commercial, environment/environmental significant areas, residential, etc. Some are more specific about particular industrial or land use activities (forestry, urban fringe, etc.), and all refer to subdivision, servicing, and other municipal responsibilities.

Regardless of the form, there are a series of requirements prescribed under the *Municipal Government Act* (MGA), namely that the MDP must address:

- the future land use within the municipality,
- the manner of and the proposals for future development in the municipality,
- the co-ordination of land use, future growth patterns and other infrastructure with adjacent municipalities if there is no intermunicipal development plan with respect to those matters in those municipalities,
- the provision of the required transportation systems either generally or specifically within the municipality and in relation to adjacent municipalities, and
- the provision of municipal services and facilities either generally or specifically,

The MGA allows that the MDP “may” also address:

- proposals for the financing and programming of municipal infrastructure,
- the co-ordination of municipal programs relating to the physical, social and economic development of the municipality,
- environmental matters within the municipality,
- the financial resources of the municipality,

- the economic development of the municipality, and
- any other matter relating to the physical, social or economic development of the municipality,

It is notable that the MGA also dictates that MDPs “must contain policies respecting the protection of agricultural operations.”

Since the 2009 enactment of the *Alberta Land Stewardship Act*, municipalities must now align their plans with the applicable Regional Plan, though there are no directions on what that must entail.

Related to the MDP is the *Intermunicipal Development Plan*. Two or more municipalities may adopt an such a plan in respect of land where a consensus on use and development is desired. Such a plan typically relates to the fringe area of urban and rural municipalities or to shared natural features such as lakes. (AB Municipal Affairs 2012)

Potential to Support Climate Change Adaptation Strategies

Because the Municipal Development Plan is the highest-level, cross-municipal planning document, virtually every potential climate change adaptation strategy could be referenced and affected by the Municipal Development Plan. MDPs speak in broad, vision-level terms to agricultural viability, emergency response, recreation, planning and development, roads, water services and infrastructure – all areas in need of focus for climate change adaptation.

The greatest challenge with MDPs is their general lack of integration. Visions for the expansion of local economies, promotion of agricultural, and protection of environmental significant areas all sit in adjacent silos with little reference to integration or trade-offs. Having said that, the MDP likely has the greatest potential for integration of higher-level CCA strategies as each ‘silo’ still takes its direction from the MDP.

Every target municipality has a Municipal Development Plan.

LAND USE BYLAW

The Land Use Bylaw identifies categories of land use, and slots every parcel in the municipality into one of those districts or zones (e.g., R-1 Residential, Light Industrial, Agricultural Conservation). The LUB then identifies the land and building use activities that are or may be permitted in each district, and sets out a permitting process. All municipalities are required under the Municipal Government Act to adopt a Land Use Bylaw.

The permitted and discretionary uses for a district can prescribe at a high level (i.e., across any parcel with that land use zone) several land use factors including building standards, landscaping, access, excavation/filling, and population density. As well, a LUB district can be

designated as public land (with specific requirements for municipal acquisition). The LUB also provides for a paradoxically named 'Direct Control District,' which on the surface facilitates the municipal council's ability to dictate control of land and building use and development in the affected zone with, but in practice can be an unplanned free-for-all, with various individual stakeholders lobbying council to create exclusive guidelines outside of a public process.

Potential to Support Climate Change Adaptation Strategies

Similar to the Municipal Development Plan, the Land Use Bylaw has great potential to support climate change adaptation strategies because of the cross-municipal focus. Like MDPs, Land Use Bylaws speak to agricultural viability, emergency response, recreation, planning and development, roads, water services and infrastructure (all areas in need of focus for climate change adaptation), but do so at a level one step closer to on-the-ground implementation.

The additional opportunity that Land Use Bylaws provide beyond Municipal Development Plans is that direction can be made at a land use category level. There is potential to zone districts as "Storm Water Management" areas or "Agricultural Preservation Zones" and then craft permitted and discretionary uses to support those goals. This allows for a characterization of land use, building, and development activities in outcome-oriented terms, leaving room for innovation in the choice of actual activities.

AREA STRUCTURE PLANS / AREA REDEVELOPMENT PLANS

Area Structure Plans (ASPs) and Area Redevelopment Plans (ARPs) are two related statutory plans enabled under the Municipal Government Act. Both are specific to a given sub-region of the municipality that is facing defined development pressures and opportunities, but neither provides the parcel-specific mapping that may occur later in the development approval process (e.g., a subdivision plan).

Municipalities may adopt Area Structure Plans to establish the general land use, transportation, and servicing framework for specific areas undergoing substantial new development, and Area Redevelopment Plans to outline proposals for addressing planning issues when rejuvenating existing developed areas (Alberta Municipal Affairs 2012).

The Municipal Government Act requires ASPs to describe: the sequence of development proposed for the area; the land uses proposed for the area, either generally or with respect to specific parts of the area; the density of population proposed for the area either generally or with respect to specific parts of the area; and the general location of major transportation routes and public utilities. Area Redevelopment Plans are for the purpose of: preserving or improving land and buildings in the area; rehabilitating buildings in the area; removing buildings from the area; constructing or replacing buildings in the area; establishing, improving or relocating roads, public

utilities or other services in the area; facilitating any other development in the area. (Municipal Government Act).

Potential to Support Climate Change Adaptation Strategies

Unlike the Municipal Development Plan and the Land Use Bylaw, Area Structure Plans and Area Redevelopment Plans are not cross-municipal, which creates both limitations and expanded opportunities for supporting climate change adaptation strategies.

ASPs and ARPs are created only for certain areas and only when desired by the municipality, meaning they have limitations for promoting cross-municipal strategies. However, they are speak much more specifically to the kinds of activity that will go on in those regions, and therefore have greater applicability to the target issues of planning and development, roads, storm water management, waste management, and water quality.

Almost all target municipalities have at least one Area Structure Plan, but as each one is constructed in a completely different fashion, they do not represent a 'common' opportunity. As well, the MGA states that adoption of an ASP does not commit a municipality to approving any of the projects contained within it (s.637), so it can retain a theoretical state if the municipality so chooses.

CONCEPTUAL AND OUTLINE PLANS

There are a variety of plans used by local governments that are not enabled under the Municipal Government Act, and are not statutory plans. However, these plans are formally adopted by council resolution and/or as bylaws. Four examples are described below:

- Area Concept Plans
- Conceptual Schemes
- Outline Plans

"The purpose of an *Area Concept Plan* (ACP) is to present a comprehensive planning policy framework and a generalized future land use concept which will be used by the County to:

- Guide the preparation of detailed Area Structure Plans undertaken by developers;
- Promote orderly development within the area encompassed by the plan boundaries; and
- Provide guidance to Administration and Council in reviewing future zoning, subdivision and development proposals" (Strathcona.ca 2013a)

"The purpose of the *Conceptual Scheme* is to provide a non-statutory framework, pursuant to the Municipal Government Act (MGA) and the Subdivision & Development Regulations to:

- Provide a framework for the subsequent subdivision and/or development of land within the Country Residential Policy Area and the Agricultural/Large Rural Residential Policy Area of the Municipal Development Plan;

- Establish a potential plan of future subdivision or development that applies to a specific parcel of land;
- Ensure that the redistricting and/or subdivision under review does not prohibit the ability of remnant parcels, or adjacent parcels, to be further subdivided in the future. This can be achieved through improved subdivision design” (Strathcona.ca 2013b)

“*Outline Plans and Area Concept Plans* are non-statutory plans that are used as a guideline for the subsequent redesignation, subdivision and development of an area of land. These plans are conceptual schemes that provide a much greater level of detail than an Area Structure Plan or Development Concept Plan in terms of the actual subdivision design, site specific technical analysis and details how the proposal is in keeping with the overall municipal goals for development.” (Mdfoothills.com 2013)

Potential to Support Climate Change Adaptation Strategies

Although these non-statutory conceptual plans have limited ability to direct specific activities and strategies, they – as the name imply – have the ability to shape land use conceptually. Many of the climate change adaptation strategies need to apply at this level, at least to begin with.

Like Municipal Development Plans and Land Use Bylaws, these conceptual plans cover emergency planning, recreation, planning and development, roads, storm water, water management, water quality, and other climate change adaptation-related issues.

However, because they are not required, they tend to be less likely to try and capture all issues, and instead focus on specific place-based issues. This makes them perhaps ideally suited to support climate change adaptation strategy development.

Strategies

SUSTAINABILITY PLANS

There are a number of types of municipal sustainability plans, many of which have been developed and implemented in Alberta (AAMDC 2013, AUMA 2006, Infrastructure Canada 2005, Lahit 2004).

Of particular importance in the Alberta context is the 2005 New Deal for Cities and Communities (NDCC) between Canada and Alberta, which became the Federal Gas Tax Fund (see below). That program provides financial assistance to municipalities to support the sustainability of capital municipal infrastructure, in order to “maintain or enhance economic, social and cultural opportunities and well being, while protecting and improving the quality of the environment” (AAMDC 2013).

As part of the agreement, municipalities are required to develop an Integrated Community Sustainability Plan (ICSP), focused on the four dimensions referenced above (environmental, cultural, social and economic), developed through public consultation, and providing direction to their Multi-Year Capital Infrastructure Plan (AAMDC 2013).

Potential to Support Climate Change Adaptation Strategies

This funding-leveraged requirement to create sustainability plans creates a policy-based opportunity to insert climate change adaptation strategies into municipal visioning and planning, as the plans' focus on sustainability is grounded in environmental values but expansive.

Several communities in southern Alberta have created sustainability plans (see for example County of Lethbridge 2009), and the Oldman River Regional Services commission has experience creating such plans.

The challenge is that, as with any "funder-required" plan, commitment may be tepid, and the degree to which it plays a significant role in the municipality's day-to-day thinking/operations will vary.

CODE OF THE WEST

The "Code of the West" is as soft a policy document as you can find, but may have significant impact for that reason. The colloquial nature and wording resonate with people in southern Alberta rural communities, and may guide actions to a degree well beyond its official authority.

Based on the 1934 Zane Grey novel of the same name, the Code of the West arose as first an unwritten code, and then gradually various entities made efforts to capture it in writing. It has become increasingly adopted in the rural municipal/county policy realm largely because it makes pointed, plain-language statements about the implications of living in a non-urban, agriculturally-based community – something statutory documents are not structured to provide.

'Code of the West' policies have become increasingly popular in rural communities that are seeing an influx of semi-urban residents, and who are seeing an increasing conflict between "new" and "old" residents and ways of life. It is a deceptively simple policy document, (e.g., Section 1.5 of the MD Willow Creek code says, "Animals and their manure can cause objectionable odors. What else can we say?"), that cuts to the pragmatics of rural living.

The MD of Willow Creek, MD of Pincher Creek, and Rocky View County have all adopted Code of the West policies, and Lethbridge County and Vulcan County make passing reference to such codes in their Municipal Development Plans.

Potential to Support Climate Change Adaptation Strategies

Willingness to adopt climate change adaptation strategies in rural communities will not be as the result of reams of climate change data and complex graphs. It will be as the result of plain-spoken, locally-applicable options and directives. The Code of the West policies provide an opportunity to link climate change adaptation strategies to these place-based aphorisms, such as this one from the MD of Pincher Creek *Code of the West*:

- *"A flash flood may occur, especially during summer months and turn a dry gully into a river. It is wise to take this possibility into consideration when building. You need to ask if your property is in a flood zone. Development (construction) in a 1:100 year flood plain, as determined by Alberta Environment, is prohibited in the M.D."* (MD of Pincher Creek 2012)

GROWTH MANAGEMENT STRATEGIES

Growth Management Strategies are non-statutory, high-level planning documents intended to characterize and direct municipal growth over an extended period into the future. There are only a handful of municipalities in Alberta with these strategies, very few rural communities, mostly "rurban" communities who are experiencing significant growth pressures from adjacent fast-growing municipalities. Goals of these strategies can be to "provide a framework to direct where and how development would be most desirable for the good of the community" (Rocky View County 2010), and "enable us to protect and preserve those aspects of the MD that our residents value, and to capitalize on opportunities for growth and development where it makes the most sense" (MD of Foothills 2013).

Potential to Support Climate Change Adaptation Strategies

Growth Management Strategies are a relatively new player on the municipal policy landscape, and as noted above, tend to occur mostly in areas of significant growth pressure. The feature of GMSs that makes them well suited to supporting climate change adaptation strategies is that they assume growth, and therefore development and more intensive land use, will occur, and they seek to explicitly – and proactively – identify where that will / should occur. For a climate change adaptation approach that assumes strategies will "piggyback" on existing actions and decisions, this type of forward-moving policy may be ideal. For example, a policy to increase wetland retention and creation is perhaps more likely to succeed when created at the same time as a policy that is seeking to understand where future at-flood-risk development may occur, and how it may be mitigated.

Municipal Programs

AGRICULTURAL SERVICES BOARDS

Agricultural Service Boards (ASB's) were first established by Alberta Agriculture in 1945 to provide local authority over weed infestation and soil erosion from wind & water. The *Agricultural Service Board Act* allowed rural jurisdictions to set up these local boards, with the Agricultural Fieldmen hired to carry out the programs. The boards became advisory to the local municipal council and the Minister of Agriculture (Aaaf.ab.ca 2013a).

ASB programs vary considerably across Alberta due (see *Aaaf.ab.ca 2013b* for a description of ASB programs in the southern region). In general, they include “invasive plant species control programs, soil and water conservation programming, facilitation of Agriculture Canada's Shelterbelt Tree Program, encouragement of Alberta's crop seed cleaning & treating plants including annual certification inspections, pesticide container recycling programs, sustainable livestock management education/awareness, specialized agricultural equipment rentals, agricultural pest programs, coordination of selected provincial agricultural program initiatives” (Aaaf.ab.ca 2013a).

ASBs and the Agricultural Fieldmen continue to focus on weed control, soil & water resource conservation, & pest management, but have broadened to include advocating for local agriculture. Agricultural Fieldmen are also now seen as key contacts for ecological resource sustainability (Aaaf.ab.ca 2013a).

Potential to Support Climate Change Adaptation Strategies

Any climate change adaptation strategy related to agriculture will obviously pass through the hands of the Agricultural Services Board (ASB) and the local Agricultural Fieldman. More importantly, any impacts on the local agricultural community and economy will be keenly apparent to these people. In rural municipalities, there are direct connections between the ASB and the municipal council, always overlap in membership, and some cases where the ASB has been folded with their duties passing directly to council.

However, it is also not an exaggeration to say that any new environmental program is likely to land on the desk of the Agricultural Fieldman. A review of the ASB programs in southern Alberta (Aaaf.ab.ca 2013b) shows conservation programs, ecological monitoring, living with wildlife programs, etc. There is increasing intermixing of agricultural and environmental programming, with the provincial ASB grant to municipalities having been merged with the Alberta Environmental Sustainable Agriculture funding in 2010 (Aaaf.ab.ca 2013a).

The ASB work also has explicit links to the *Municipal Development Plan*, as the MDP is required by the *Municipal Government Act* to include provisions for the protection of agricultural operations.

Collectively, this indicates that the Agricultural Services Board and the Agricultural Fieldmen have the potential to accommodate – and even champion – climate change adaptation strategies

related to agricultural viability, planning and development, storm water management, water quality/quantity, and biodiversity in general.

EMERGENCY SERVICES

The *Emergency Management Act* requires municipalities to establish certain structures and to maintain certain responsibilities for managing emergencies and disasters. The *Act* requires municipalities to “at all times, be responsible for the direction and control of the local authority’s emergency response ...” Every municipality is required to establish an emergency management agency, and to prepare emergency plans and programs.

There are a variety of emergency services in a municipality. Emergency medical services (ambulance, paramedic) are now provided by the province, but the municipality is still responsible for the ‘public safety answering point’ (PSAP), which takes the 911 call and directs the emergency service. Municipalities set up their own fire services, through a branch or department of the municipality or through a regional services commission. Municipalities are also responsible for several aspects of fire permitting and management, and pass bylaws with respect to these matters.

There are a number of granting programs that support these services, but the disaster and emergency-related programs (e.g., Municipal Wildlife Assistance Program, Disaster Recovery Programs) tend to provide funding for after-the-fact fighting actions such as fighting fires and flood recovery – not prevention.

Potential to Support Climate Change Adaptation Strategies

Extreme storm events, flooding, and wildfires are identified, above, as significant climate change adaptation issues for municipalities.

As this report was being finalized, the Calgary region experienced flooding representing the worst natural disaster in our province’s history, with 100,000 people under mandatory evacuation order and early damage estimates of \$3-5 billion. This 2013 flood is reported to be more than twice the volume of the hitherto record 2005 flood, which was matched by the 1995 flood. Emergency Services Agencies are realizing that planning for 100-year floods is a thing of the past.

Municipal policies and strategies related to such climate change-influenced occurrences as floods and wildfires, are logical places for the insertion of climate change adaptation strategies. Perhaps the most significant challenge will be finding homes and funding for the prevention-based strategies that focus on resilience.

REGIONAL SERVICES COMMISSIONS

Although regional planning was wiped out in the mid-90's in Alberta, some regional service provision was maintained. In the transition, some of the old regional planning commissions, which were tasked with creating binding regional plans under the old *Planning Act*, carried forward and became service providers, continuing to provide planning services to multiple-municipality regions.

Today, two or more municipalities may set up a regional services commissions that provide services on a regional basis to member clients. The commissions are established through regulation under Part 15.1 of the *Municipal Government Act* (Alberta Municipal Affairs 2013).

Regional services commissions have their own distinct legal status with natural person powers, separate from municipalities, meaning they can hire staff, administer their own payrolls, own property in their own name, and raise capital. This structure allows municipalities in Alberta to work collaboratively with other municipalities to deliver services to the their communities (Alberta Municipal Affairs 2013).

Though most regional services commissions focus on water and wastewater, there are a range of a range of municipal services that can be delivered using a regional governance model, including:

- Administrative services
- Airport services
- Assessment services
- Economic development services
- Emergency services
- Family and Community Support Services
- Geographic Information Systems (GIS)
- Housing
- Parks management services
- Planning services
- Recreation services
- Solid waste management services
- Transit services
- Water services
- Wastewater services (Alberta Municipal Affairs 2013)

Potential to Support Climate Change Adaptation Strategies

Regional services commissions oversee several water and waste water systems in southern Alberta (see *Appendix 1: Regional Services Commissions in Southern Alberta*), making them the logical operational body to consider for an climate change adaptation strategies related to water management, water storage, water quantity, and water quality.

As well, the Oldman Regional Services Commission provides planning services to at least eight of the target municipalities in the grasslands region. These services include drafting Municipal Development Plans, Land Use Bylaws, other bylaws, Integrated Sustainability Plans, and additional provide direction and advice on integration with the Regional Planning process.

Support Programs

ALBERTA MUNICIPAL INFRASTRUCTURE PROGRAM

The Alberta Municipal Infrastructure Program provides financial assistance for “developing capital municipal infrastructure to maintain or enhance economic, social and cultural opportunity and well being, while protecting and improving the quality of our environment upon which people and economies Alberta depend” (Alberta Ministry of Transportation 2005).

Funding can be used for “core capital infrastructure” projects, including municipal roads, bridges, public transit vehicles and facilities, water and wastewater systems and facilities, storm drainage systems and facilities, emergency service vehicles and facilities and infrastructure management system software; this includes design and engineering services, construction and rehabilitation, vehicle purchase, and land acquisition (Alberta Ministry of Transportation 2005).

If core capital infrastructure needs have been addressed, funds may also be used for cultural and recreational facilities, community environmental and energy systems and facilities, solid waste management systems and facilities, municipal buildings and other municipal physical infrastructure (Alberta Ministry of Transportation 2005).

Potential to Support Climate Change Adaptation Strategies

The broad interpretation of infrastructure indicates that this program could support municipal climate change adaptation strategies related to emergency response, recreation, roads, storm water management, waste management, water quality and others.

ALBERTA MUNICIPAL WATER/WASTEWATER PARTNERSHIP (AMWWP)

“The Alberta Municipal Water/Wastewater Partnership provides cost-shared funding to eligible municipalities to assist in the construction of municipal water supply and treatment and wastewater treatment and disposal facilities” (Alberta Ministry of Transportation 2013a). Activities and items funded under this program include treatment plants, water supply lines, feasibility studies, water management master plans, water supply studies, pipeline and pumphouse upgrades, water corridor studies, lagoon upgrades, main replacements, and others.

Potential to Support Climate Change Adaptation Strategies

This program has the potential to support municipal climate change adaptation strategies related to water management, water quality, storm water management. However the shoehorning of economic development goals that requires all municipalities receiving these funds to use the private sector for all work undertaken will hamstring local efforts to a degree.

FEDERAL GAS TAX FUND (FGTF)

The Federal Gas Tax Fund grant program (begun in 2005 as the New Deal for Cities and Communities) assists municipalities in addressing their sustainable municipal capital infrastructure needs. The program allocates a portion of the federal gasoline tax to Alberta Municipalities “in support of sustainable capital municipal infrastructure to maintain or enhance economic, social and cultural opportunity and well being, while protecting and improving the quality of our environment upon which people and economies of Alberta depend” (Alberta Ministry of Transportation 2013b).

“Funding under this program supports the development of public transit systems, and water and wastewater systems, solid waste management, community energy systems, and community capacity building. For communities with less than 500,000 population, the funding may also be used for rehabilitation of municipal roads and bridges that enhance sustainability outcomes” (Alberta Ministry of Transportation 2013b).

As a requirement of receiving these grant monies, municipalities are required to develop and implement a sustainability plan (Alberta Ministry of Transportation 2013b).

Potential to Support Climate Change Adaptation Strategies

As well as catalyzing the creation of the sustainability plans described above, this program has the potential to fund municipal climate change adaptation strategies based on their contribution to sustainability.

CONCLUSIONS

As noted in the introduction, this report was created with the full knowledge that the research is incomplete. However, the information that this report is waiting on (the clear articulation of the impacts of climate change on the local communities, and the associated climate change adaptation strategies), is also waiting on this report to inform it.

As well, while policies, bylaws, strategies and plans were reviewed in all the target municipalities, it would be disingenuous to suggest that “all” of them were found and reviewed. It is fully anticipated that others will be found, and will be reviewed as they are.

Nevertheless, there is enough information now available to draw several solid, but interim conclusions.

1. There are numerous potential insertion points for climate change adaptation strategies indicated by the municipal policy review;

2. The review of policies did not indicate any one 'ideal' municipality with the 'right' policy makeup to best support climate change adaptation Action Planning; rather, different municipalities will likely have different interests (and needs) with regard to different climate change adaptation strategies, and thus respond to different CCA messaging;
3. Non-statutory plans formally adopted by council are an increasingly viable places to look for support and direction regarding climate change adaptation strategies (e.g., area concept plans, growth management strategies, codes of the west, etc.)
4. Agricultural Fieldmen (and the Agricultural Service Boards they support) represent a vital link into CCA strategies both with regard to agricultural viability and environmental sustainability;
5. Planning and development policies and strategies (area structure plans land use bylaws, etc.) may represent the most cost-effective location for climate change adaptation strategies, as they have pervasive influence, and for small investments in 'tweaks' can yield large dividends in activities that support climate resilience;
6. The most viable policy routes for insertion of climate change adaptation strategies may be dictated by the availability of provincial funding, requiring specific attention to where the money is coming from, and which policies have "tied" grant funding that require demonstrated sustainability practices;
7. Extreme storm events will be a priority for municipal planning, infrastructure, agricultural, urban/rural interface for some time, and may represent the most likely catalyst for inclusion of climate change adaptation strategies; and
8. Regional service commissions represent a huge opportunity and a significant challenge in that they represent several municipalities making for great efficiencies in policy changes, but have no authority to direct policy and may have only a diffuse impact.

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¹ ICSP = Integrated Community Sustainability Plan

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APPENDICES

Appendix 1: Regional Services Commissions in Southern Alberta (municipalities listed in bold are those within the focus area of this project)

Foothills Regional Emergency Services Commission

Members

- Town of Okotoks;
- Town of Black Diamond;
- Town of Turner Valley;
- Town of High River;
- Village of Longview;
- **Municipal District of Foothills No. 31;**
- Town of Nanton;
- Kananaskis Improvement District;
- **Vulcan County;**
- Town of Vulcan;
- Village of Milo;
- Village of Arrowwood;
- Village of Carmangay;
- Village of Champion;
- Village of Lomond.

Services

- The Commission is authorized to provide emergency medical services and an emergency services communication system.

Foothills Regional Service Commission

Members

- **Municipal District of Foothills No. 31;**
- Town of Okotoks;
- Town of High River;
- Town of Black Diamond;
- Town of Turner Valley;
- Town of Nanton.

Services

- 1) The Commission shall supply sewage transmission and treatment services and waste management services
 - (a) to the municipalities, and
 - (b) to any additional persons to whom the board of directors of the Commission from time to time decides to supply sewage transmission and treatment services or waste management services.

- (2) Sewage transmission and treatment services and waste management services shall be supplied to all customers on an as- required basis.

Highway 3 Regional Water Services Commission Regulation

Members

- **Municipal District of Taber;**
- **The County of Forty Mile No. 8;**
- Town of Bow Island.

Services

- The Commission is authorized to provide water treatment and transmission services.

Lethbridge Regional Water Services Commission

Members

- **County of Lethbridge;**
- Town of Coaldale.

Services

- The Commission is authorized to provide water services.

Magrath and District Regional Water Services Commission

Members

- **Cardston County;**
- Town of Magrath.

Services

- The Commission is authorized to provide wholesale potable water to its members.

North Forty Mile Regional Waste Management Services Commission

Members

- **County of Forty Mile No. 8;**
- Town of Bow Island;
- Village of Burdett.

Services

- (1) The Commission shall supply waste management services
- (a) to all customers who are, on the effective date of acquisition of the facilities under section 5, receiving waste management services from the North Forty Mile Regional Waste Management Authority, and
 - (b) to any additional persons to whom the board of directors of the Commission decides to supply waste management services.
- (2) Waste management services shall be supplied to all customers on an as required basis.

Oldman River Regional Services Commission

Members

- **Municipal District of Pincher Creek No. 9;**
- **Municipal District of Ranchland No. 66;**
- **Municipal District of Taber;**
- **Municipal District of Willow Creek No. 26;**
- **Cardston County;**
- **County of Lethbridge;**
- **Vulcan County;**
- **County of Warner No. 5;**
- Town of Cardston;
- Town of Claresholm;
- Town of Coaldale;
- Town of Coalhurst;
- Municipality of Crowsnest Pass;
- Town of Fort Macleod;
- Town of Granum;
- Town of Magrath;
- Town of Milk River;
- Town of Nanton;
- Town of Picture Butte;
- Town of Pincher Creek;
- Town of Stavely;
- Town of Vauxhall;
- Town of Vulcan;
- Village of Arrowwood;
- Village of Barnwell;
- Village of Barons;
- Village of Carmangay;
- Village of Champion;
- Village of Coutts;
- Village of Cowley;
- Village of Lomond;
- Village of Milo;
- Village of Nobleford;
- Village of Warner.

Services

- The Commission is authorized to provide services related to municipal planning.

South Forty Waste Services Commission

Members

- **County of Forty Mile No. 8;**
- Village of Foremost.

Services

- The Commission is authorized to provide solid waste management services.

Twin Valley Regional Water Services Commission

Members

- **Vulcan County;**
- Town of Vulcan;
- Village of Champion;
- Village of Carmangay.

Services

- The Commission is authorized to provide water treatment and transmission services.

Vauxhall and District Regional Water Services Commission

Members

- **Municipal District of Taber;**
- Town of Vauxhall.

Services

- The Commission is authorized to provide water treatment and transmission services.

Appendix 2: Excerpts from “Canadian Communities’ Guidebook for Adaptation to Climate Change”

(adapted from Bizikova et al 2008)

<p>changes in temperature, runoff and other climatic conditions; will lead to significant changes in species ranges, ecosystem structure and function</p>	<ul style="list-style-type: none"> • Surface and bottom water temperatures of lakes, reservoirs, rivers and estuaries in North America will likely increase (projection of 2 to 7oC under doubling of CO2) • Increased vegetation growth in certain areas, and an earlier onset of spring “greenness” • Increased river scouring and turbulence due to changes in runoff timing could have negative effects on aquatic ecosystems
<p>changes to water quantity, temperature and salinity, will stress fish, fisheries and the food chain</p>	<ul style="list-style-type: none"> • Declines in salmon populations have cascading effects for terrestrial species and ecosystems that depend fundamentally on the salmon as a food and nutrient source. • Changes in water temperatures and river flows will create opportunities for exotic species to invade. • Fisheries will be negatively affected by salinity and temperature changes in rivers • Profound changes to fish health, migration and spawning success • Warming of the rivers is likely to have negative effects on some fish species, but positive effects on species tolerant of warmer water
<p>changes to precipitation type, timing, intensity and frequency; together with temperature changes will impact the availability and quality of the water supply</p>	<ul style="list-style-type: none"> • Water demand is increasing due to population growth and development. • Shrinking glaciers, earlier snowmelts and a decreasing snowpack will mean that less water is available in the summer and fall when there is high demand • Increased demand for surface water will in turn place pressure on limited groundwater supplies that are also at risk of salinization • Increasing water temperature, water-borne diseases, forest fires and landslides are a growing concern and can impact water quality. • An increasing proportion of precipitation falls as rain rather than snow • Earlier melting and a significantly decreasing snowpack contribute to increases in winter and early spring flows while summer flows may decrease substantially

	<ul style="list-style-type: none"> • In the short term, melting glaciers may add to streamflow in spring; in the long term, this will probably mean less runoff, especially in summer • Increased water stress regionally and greater competition between agricultural, industrial and ecological uses • More frequent landslides, forest fire contaminants as well as warmer temperatures could impact water quality • Surface and bottom water temperatures of lakes, reservoirs, rivers and estuaries in North America will likely increase (projection of 2 to 7oC under doubling of CO2) • Water quality impacts could occur due to a longer erosion season and enhanced erosion in agricultural areas
<p>changes in amount and timing of precipitation, and extreme weather; will stress water, storm and sewer infrastructure</p>	<ul style="list-style-type: none"> • The amount and timing of precipitation poses clear challenges for the capacity and functioning of stormwater infrastructure and the sewer system • Issues will be greater in areas with low permeability (e.g. paved surfaces). • Flooding could raise the water table and result in the floating of sewers and foundations if they are not designed to deal with this. • Potential issues with reservoir capacity and operations, water supply, storm and sanitary sewer size, sewer flow during periods of summer drought and sewer outfall during periods of high precipitation, flood • Rise in water table may also cause floating of sewers, foundations, etc that were not designed for those conditions
<p>impacts of water supply shortages, temperature changes, changes in the number of growing days and in the frequency of natural disturbances; will have both positive and negative implications for agriculture and food security</p>	<ul style="list-style-type: none"> • Projected changes in the local climate are generally expected to have positive impacts for agriculture in terms of the number of growing days, length of the growing season and potential to grow higher-value crops. This will be constrained, however, by soil suitability, moisture and erosion. • More frequent and severe pest infestations as their range extends northward • Impacts of more frequent extreme weather events • Vulnerability of agriculture to climate change is complex: it is dependant upon direct and indirect climate effects, economic factors and technological and adaptation changes • The increase in number of growing days, decrease in frost-frequency in spring and fall, extension of the frost-free period and trend towards an earlier spring could have a positive impact on the agricultural growing season in Canada.

	<ul style="list-style-type: none"> • Moderate climate change will likely increase yields of rain-fed agriculture in North America by 5 to 20% over the first decades of the century (high confidence). However, potentially positive impacts on agriculture are dependent on appropriate soil types, soil moisture, water availability and erosion. Potential for more spring flooding as well as summer drought conditions (lower soil moisture and streamflow) • Changes in temperature can improve or impair production of different crops; crops currently near thresholds will be negatively impacted (medium confidence) • Heavy rainfalls can impact agricultural crops • Possible introduction of new agricultural pests and diseases
<p>impacts of a reduction in snowfall, will pose challenges for winter sport industries, while beaches and natural parks will be faced with both challenges and opportunities in a changing climate</p>	<ul style="list-style-type: none"> • As winters become milder and less precipitation falls as snow, winter sport industries, notably the ski industry, will be negatively impacted • Winter recreation could be negatively impacted, but snowmaking could offset some of the reduction to the ski season • A longer warm weather tourist season could increase visits to Canada’s natural parks, bringing economic benefits, but more pressure on ecological systems
<p>impacts of sea level rise, climate variability and extremes, will challenge energy production, transportation and associated infrastructure and economic activity</p>	<ul style="list-style-type: none"> • Changes in water availability could be positive in the winter as supply increases but negative in the summer when a reduced water supply coincides with increases in energy demand for residential cooling and other competing uses • On the other hand, demand for heating in the winter has decreased in Western Canada. • Hydropower production is sensitive to total runoff, the timing of runoff, and to reservoir levels • Under projected temperature increases, hydroelectric supply will improve in winter, but face challenges in summer due to conflict with instream flow targets and aquatic restoration goals • In western Canada, there has been a significant decrease in the number of days requiring space heating and an increase in the number of days requiring space cooling, with resultant implications on total energy demand • Warmer and less snowy winters may reduce delays, improve ground and air transportation reliability and reduce road

	<p>maintenance demands. However, more storms could increase risks</p> <ul style="list-style-type: none">• Higher potential flood levels and more frequent flooding at levels rarely experienced today is projected with very high confidence. More frequent flooding and landslides would impact transportation• Heat spells could cause increasing damage to railroad tracks and roads, with implications for future road design, construction and management• An increase in extreme storm events has implications for ports, airports, railways, roads, highways, and inland navigation• Higher ground water levels in low lying areas may reduce bearing capacity or roads requiring rebuild or increased load restrictions
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Appendix 3: Excerpts from “A Guide for Incorporating Adaptation to Climate Change into Land-Use Planning”

(adapted from Collins et al 2005)

Natural Environment	
Potential Impacts	Examples of Adaptation Responses
Higher risk of flooding/erosion of susceptible developments in floodplains or coastal margins	Ensure planning takes account of future trends in flooding and coastal erosion. Consider range of options for flood and coastal management, including promoting appropriate and sustainable defenses and locating new development away from areas of highest risk. Accelerate investment in existing rolling programs of coastal and river flood defenses to protect existing development in flood prone areas against increased risks from climate change. Undertake planning on a watershed basis with requisite inter-agency cooperation.
Increased risk of subsidence as soils shrink in hotter drier summers	Plan for preventative and remedial maintenance of existing housing stock and infrastructure
Temperature increases affect living space environment	Use thermal properties of materials to improve cooling and retrofit energy efficient air conditioning
Change in ecosystem stability resulting in loss or change of habitat or species	Improve protection and management of existing designated areas and engage voluntary organizations for help. Reduce non-climatic stresses
Loss of ability to attenuate existing or future impacts	Ensure policy builds on the natural dynamics of ecosystems and incorporates buffer zones in designated areas and incorporate opportunities to ... facilitated colonization in agri-environment schemes, flood protection schemes and coastal planning.
Infrastructure	
Potential Impacts	Examples of Adaptation Responses
Increased risk of disruption due to flooding, high winds, heavier snowfalls or other extreme weather events	Plan to flood-proof or re-site infrastructure and plan routes to minimize disruption. Assess overhead versus underground systems including comparative risk analysis of factors such as damage from wind and subsidence. Zone landscape around these facilities to minimize flood risks on the infrastructure and the adverse impacts from, for example, run-off. Reduce expected economic lifetimes

Increased temperature causing service disruption and heat stress to traveling public	Avoid exposed places and provide shade or cooled waiting areas
Renewable sources of energy are likely to play an increasing role in future energy provision.	Leave space for these to be developed
Health and Safety	
Potential Impacts	Examples of Adaptation Responses
Higher risk of skin cancer / sun burn due to hotter summers and increased outdoor recreation	Consider ways to increase awareness of dangers of exposure. Provide more shade in public recreational areas
Heat stress to the old, poor and vulnerable communities and people likely to increase	Ensure adequate shade and cooling available. Provide areas of refuge. Improve the preparedness and awareness of society.
Loss of power in high rises has implications for seniors relying on infrastructure, such as elevators for movement to upper floor homes and refrigeration for food storage. They will not be able to escape heat nor will they be able to walk up and down from the upper floors every day to get food.	Consider height restrictions, provide areas of refuge.
EMO facilities could be cut off from areas of need during a natural disaster	Carefully locate new EMO facilities away from medium and high-risk flood areas but without affecting response times. Institute a program of relocation for poorly located existing facilities. Where high-risk areas cannot be avoided facilities need to be designed and constructed to ensure emergency services can be operational in all circumstances. Development of improved contingency responses would also assist in reducing risk.
Dispersal of pollutants, in air, soil and water may be modified	Carefully locate facilities such as waste disposal sites. Re-assess contaminated land or other "brownfield" sites may need to be reassessed for the potential future remobilization of pollutants

Guidelines

- Don't link adaptation and mitigation before thoroughly evaluating the pros and cons in your climate change response.
- As you begin the process of incorporating climate change considerations into your land use plans, you should undertake the following activities:
 - Identify any climate change related problems that have occurred to date;
 - Identify perceptions regarding the risks of climate change within your organization;
 - Discuss resources for analysis of climate change data within your municipality and with climatologists at Environment Canada;
 - Review issues with emergency response coordinators to ensure they are aware of what you are doing, and
 - Identify key vulnerabilities if the information is available.
- Check the foundations that support your community to ensure the vision is reasonable given the reality of climate change.
- Make sure those most vulnerable to climate change or the costs incurred from climate change are appropriately consulted.
- Vulnerability of goals and objectives should be evaluated using realistic scenarios to identify unacceptable risks to extreme events.
- Try to anticipate rather than respond. Begin developing appropriate climate change policy now to improve ability and capacity to deal with future climate change scenarios.
- Integrate climate change policies with other policies that support similar planning goals and objectives.
- Be aware of enacting short-term policies that may constrain future response options. There are numerous examples of climate change policies that support adaptive planning strategies. These include:
 - no new development within xx metres of shorelines;
 - no new development with the xx year floodplains;
 - no new development that would increase water demand over the current planned capacity;
 - no new development on steep slopes over xx%, and
 - no new development in areas prone to coastal surges without an approved emergency evacuation plan.

- Consider climate change policy in terms of short, medium, and long- term framework supporting the municipal planning vision
- Conduct a risk and vulnerability assessment to determine priorities and focus policy goals and objectives.
- Develop policy options that can respond to variable scenarios
- Consider the potential impact of extreme events and possible longer term changes in environmental conditions as one of the bases upon which the land use plan is created.
- In additional to changes within your municipal unit, look beyond your boundaries for potential impacts that could affect the plans you create.
- Keep on top of data related to climate change in your area, for example, sea level rise, hydrographic and flooding data, etc., and be prepared to make changes to your generalized future land use maps based on the incorporation of that information during your plan reviews.
- Determine required amendments to zoning plans and by-laws to reflect climate change impacts. Determine budgeting and human resource allocations required to implement the required amendments.
- Determine if additional information on the consideration of climate change adaptation is required from developers as part of the application process, for example, improved stormwater management plans that consider extreme events.
- Liaise with other municipal units and jurisdictions to be aware of what impact their efforts may have on your municipality and to coordinate efforts to manage both incoming and outgoing impacts.
- Periodic reviews of climate change projections for your area should be incorporated into the plan review process to ensure plan adapts to changing environment.
- Both short term and long term communication strategies will be required to sell adaptation planning.