An Overview of the Risk Management Approach to Adaptation to Climate Change in Canada

Prepared for:

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March 2005

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I. OVERVIEW OF THE REPORT

This report provides an introduction to risk-based approaches to climate change adaptation decision-making. It examines several risk management approaches that have been used in Canada and internationally, for managing climate-related and other types of risk, and recommends that risk management information and tools be further developed and disseminated in Canada to support adaptation decision-making. It also identifies functional areas where government departments at all levels could initiate risk management activities for the purpose of adapting to climate change.

The report includes two appendices. Appendix I presents some of the observed and projected climate changes in Canada, and Appendix II profiles examples of early efforts to manage climate-related risks.

II. INTRODUCTION

Governments at all levels, industry, NGOs and other decision-makers from across Canadian society must manage, often in the face of many risks. Historically, they have managed financial, political, social, engineering and other types of risk. Risks related to climate change are a new type of risk that is an increasing concern for governments and citizens around the world.

Climate change poses many risks, such as those related to increasingly frequent and extreme weather events, changes in water availability and quality, and changes in performance of infrastructure systems. Many of the observed and projected climate changes for Canada, and their associated risk issues, are presented in Appendix I. Impacts are already being felt. Decision makers, are well-advised to initiate action sooner rather than later

Canadians have long successfully adapted to Canada's highly variable climate. Individuals, governments and corporations have, for example, installed insulation to reduce winter heating costs and developed new seed varieties to optimize agricultural production in regions with various climatic stresses. The strategies and decision frameworks underpinning adaptations – in these examples, cost-benefit analysis and research and development – are clearly productive and have yielded significant benefits to Canadians.

Adaptation to climate change, however, is a challenge that is complex and involves increasing risk. Efforts to manage these risks can involve many decision-makers, conflicting values, competing objectives and methodologies, multiple options, uncertain outcomes and debatable probabilities. Adaptation occurs at multiple levels in a complex decision environment, and is generally evaluated as better-worse, not right-wrong, based on multiple criteria. Identifying the best adaptation response is difficult, and as a result, people may deny, delay or defer important actions.

Risk management techniques help to overcome these problems. Risk management offers a decision-making framework that assists in the selection of optimal, or the most cost-effective, strategies using a systematic, broadly accepted public process. In the context of adapting to climate change, the risk management process offers a framework for identifying, assessing and prioritizing climate-related risks, and developing appropriate adaptation responses.

As a vehicle for guiding adaptation to climate change, risk management approaches have demonstrated considerable benefits.

- Vulnerability assessment is an intrinsic element of risk management. Vulnerability refers to "the degree to which a system is susceptible to, or unable to cope with, adverse effects of

climate change, including climate variability and extremes" (Intergovernmental Panel on Climate Change 2001). Vulnerability assessment is increasingly useful for guiding adaptation, since it helps reveal local- and larger-scale system vulnerabilities for which adaptation measures may be necessary to prevent serious adverse consequences as the climate continues to change over the coming decades. Future climate scenarios, based on the outputs of Global Circulation Models, will continue to provide valuable information, but the vulnerability-based approach is critical for helping identify specific risks and potential impacts that reflect the interests and values of people affected.

- Unlike "adapting", the concept "managing risks" seems, from many perspectives, much more palpable. Risk management is a familiar concept, especially in disaster management, whereas the notion of "adapting" remains poorly understood by many.
- Risk management provides a means for addressing uncertainties explicitly. Uncertainties exist in respect to uncertain future climate conditions and other aspects of climate change adaptation decision-making. Absent a risk management paradigm, decision-makers often seem paralyzed by uncertain responses to their question "what are we adapting to?"
- Risk management is very practicable in Canada. Many Canadian organizations have developed and accepted generic risk management procedures, and gained first-hand experiences in using risk management techniques. Increasingly, these are being applied to manage climate-related risks. Canadian organizations continue to learn about and experience their vulnerabilities to climate change, and advances in climate science now permit more confident future climate projections. Organizations from across all sectors can draw from these experiences to develop practicable and effective strategies for managing climate-related risks.

The risk management procedures described in this document can be considered "Stakeholder analysis tools" or "Decision-support tools" in the terminology of the United Nations Framework Convention on Climate Change's Subsidiary Body for Scientific and Technological Advice (FCCC/BSTA/2004/INF.13, 10 Nov. 2004).

What are we adapting to?

As indicated above, uncertainties exist in respect to various aspects of adaptation to climate change. Often, the focus is on uncertain climate change science and future climate conditions. However, over the last 35-40 years, we have observed many climatic changes and trends that are a foretaste of the types of changes that we might anticipate for the future. Despite the uncertainties, it is valuable to consider both recent historical trends and future climate projections to assess likely changes for which adaptations may be required. Many of the observed and projected climate changes and impacts for Canada are presented in Appendix I.

III. THE RISK MANAGEMENT APPROACH

Risk management is a "process for dealing with uncertainty within a public policy environment"[1]. It comprises a "systematic approach to setting the best course of action under uncertainty by identifying, understanding, acting on and communicating risk issues"[2] and by managing the risk in such a way that it is reduced to acceptable levels or accommodated by other actions.

Before the 1980s, risk management was an analysis tool used almost exclusively by financial institutions and the insurance industry. Since then, its use across the engineering, health science, environmental science and other disciplines has become increasingly common. When complex decision-making involved real or perceived impacts on human health, property or the environment, scientists and technical professionals turned to a science-based, risk management methodology to arrive at optimal decisions. As they gained experience with the approach, risk management practitioners from across the disciplines learned of its immense value as a decision-making tool, in part because many of the factors that bear on a risk situation are qualitative in nature and subject to the perceptions of the individuals or groups affected.

Risk management has also become an important component of government policy analysis.

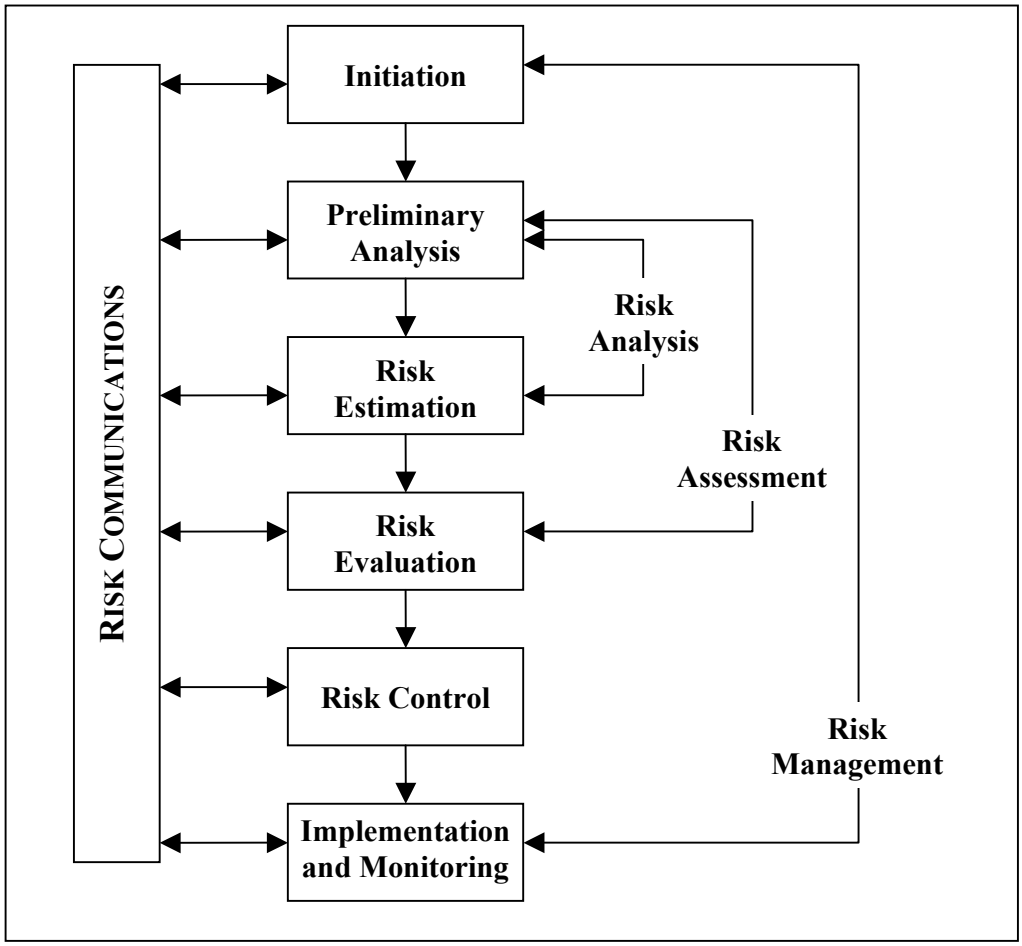
Canada's National Risk Management Guideline

In 1997, with the support of the Canadian Standards Association (CSA), a diverse group of risk management practitioners and stakeholders from across Canada, which included several federal government departments and the Treasury Board Secretariat, developed the CSA Guideline CAN/CSA-Q850-97, *Risk Management: Guideline for Decision-Makers.* The guideline evolved out of a number of existing risk models[3] and established, for the first time, a common methodology and terminology for undertaking risk management. The common methodology and terminology are critically important to effective risk management in an interdisciplinary and complex environment. This was an important achievement: only two other countries have produced a standard on the risk management process – Australia (in partnership with New Zealand) and Norway.

The CSA Guideline, illustrated in Figure 1, lays out the general steps of the risk management process for the identification, analysis, evaluation and control of risks and potential risks, including risks to health and safety. It offers a pragmatic and evolutionary approach to guide the development of strategies to avoid, reduce, control or otherwise manage real and perceived risks. It also assists in setting priorities and balancing the effectiveness and costs of complex risk control strategies. Importantly, the process is iterative and allows for the inclusion of new information when it becomes available.

Communications with and among stakeholders is emphasized throughout the process. The CSA approach, in contrast to others, focuses a significant effort on the identification of stakeholders, even marginal ones, and the development of a comprehensive understanding of their needs through all issues and stages. This ensures that stakeholders' concerns are included, and engages stakeholders in the final decision-making process. Having an iterative and continual communications process that is highly credible and inclusive and is tightly linked to the more technical risk assessment and risk control components is a unique aspect of Canada's risk management framework. This makes the process particularly appropriate where the general public's concerns are high. Finally, the CSA approach requires full documentation of each of the major components of the risk management process to ensure consistency during implementation, accountability and transparency, and to provide records for future reference applications.

Figure 1: The Canadian Standards Association risk management approach



The Government of Canada's Integrated Risk Management Framework

In 2001, the Treasury Board Secretariat developed an Integrated Risk Management Framework[4] to assist the public service in risk management decision-making and to improve strategic risk management across government departments. The Framework applies at the organizational level and covers all types of risks (e.g., policy, operational, human resources, financial, legal, health and safety, environment, reputational). Its specific objectives are to:

- Provide guidance to advance the use of a more corporate and systematic approach to risk management;
- Contribute to building a risk-smart workforce and environment that allows for innovation and responsible risk-taking while ensuring legitimate precautions are taken to protect the public interest, maintain public trust, and ensure due diligence; and
- Propose a set of risk management practices that departments can adopt, or adapt, to their specific circumstances and mandate.

The government anticipated that practising integrated risk management would promote a cultural shift to a risk-smart workforce and environment. Specifically, it was anticipated that the Framework would:

- Support the government's governance responsibilities by ensuring that significant risk areas associated with policies, plans, programs and operations are identified and assessed, and that appropriate measures are in place to address unfavourable impacts and to benefit from opportunities;
- Improve results through more informed decision-making, by ensuring that values, competencies, tools and a supportive environment form the foundation for innovation and responsible risk-taking, and by encouraging learning from experience while respecting parliamentary controls;
- Strengthen accountability by demonstrating that levels of risk associated with policies, plans, programs and operations are explicitly understood, and that investment in risk management measures and stakeholder interests are optimally balanced; and
- Enhance stewardship by strengthening public service capacity to safeguard people, government property and interests.

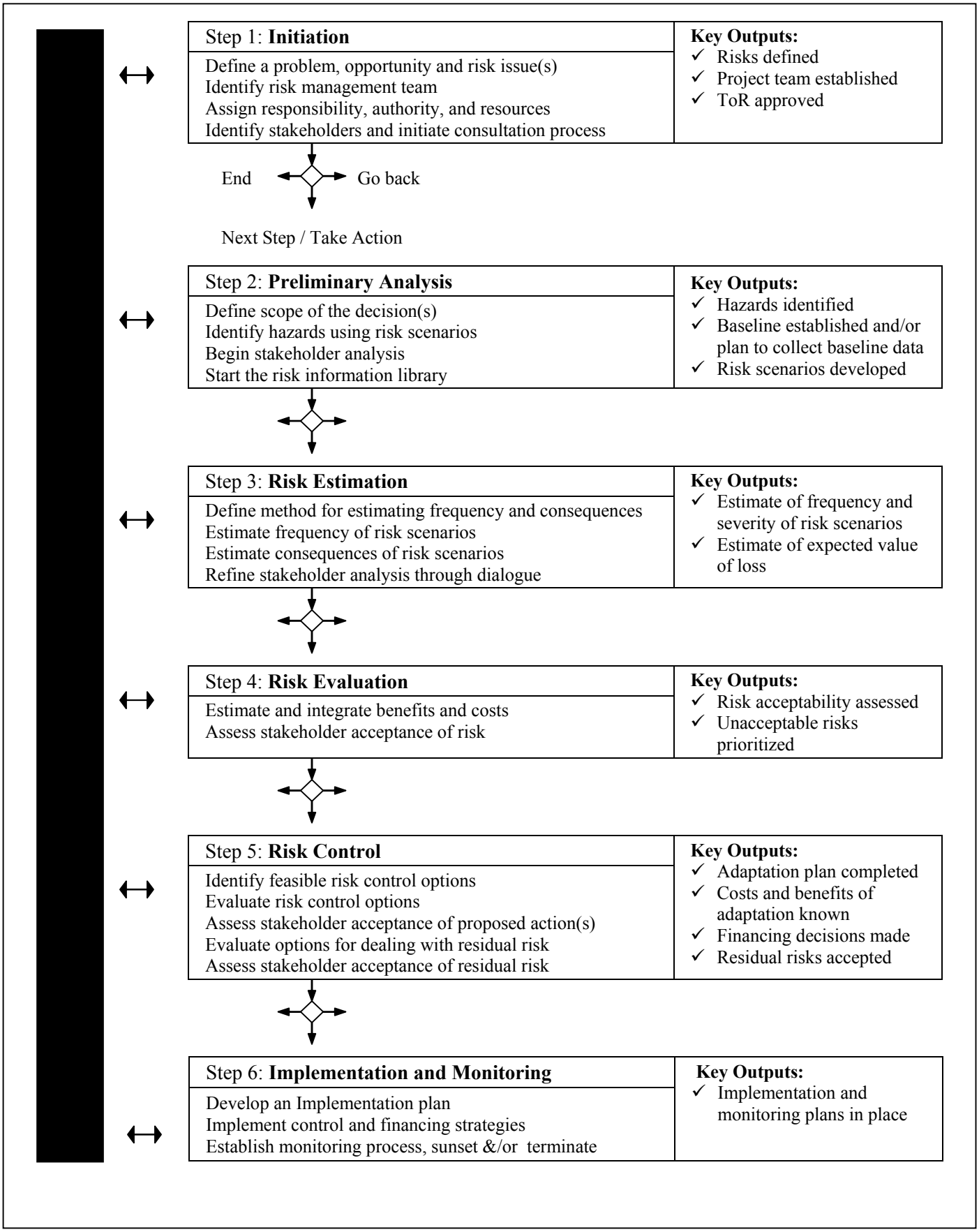
The Framework flowed from the recommendations contained in the *Report of the Independent Review Panel on Modernization of Comptrollership in the Government of Canada* (1997) and incorporated elements from CAN/CSA-Q850-97, *Risk Management: Guideline for Decision-*Makers. It builds on existing risk management practices, reflects current thinking, best practices and the value of approach described in the Privy Council Office (2000) report—*Risk Management for Canada and Canadians: Report of the ADM Working Group on Risk Management*. The Framework is linked with other federal risk management initiatives, including recent efforts to strengthen internal audit and increase focus on monitoring. Collectively, these initiatives are helping to strengthen risk management across the federal government in line with modern comptrollership and improve practices in managing risk from a whole-of-government perspective.

The Caribbean Risk Management Guideline

In its first known application to climate change adaptation decision-making, Canada's risk management guideline was adapted for use in the Caribbean nations. Climate change and its accompanying sea level rise are major challenges for the Caribbean nations, as they are for all Small Island Developing States, and numerous Caribbean governments have committed to adapting. In a Canadian International Development Agency- funded project, Global Change Strategies International worked with many local partners to develop a guidebook to assist CARICOM[5] countries in the selection and implementation of feasible adaptation options. The guidebook was based largely on the CSA standard, since this was deemed a suitable approach for addressing and incorporating the various uncertainties associated with climate variability and change. The guidebook also drew from the *"Comprehensive Hazard and Risk Management"* (CHARM) process (which was based on the Australian and New Zealand risk management standard) developed and utilized by the South Pacific Island countries for improving and mainstreaming risk reduction activities in the region.

The Caribbean risk management guideline is illustrated in Figure 2. It is modified from the CSA approach to reflect the process, actions and expected outputs in the context of adaptation to climate change.

Figure 2: The Caribbean risk management guideline for adaptation decision-making



Each of the steps in the process is described in Box 1.

Box 1: Description of steps in the risk management process, applied to adaptation to climate change

1. **Initiation:** The potential climate change impact and the risks associated with it are defined. The stakeholders, organisations or groups that should be involved in the process are identified. Responsibilities, resources, timeframes and authorities are assigned. Other concerned stakeholders and interested parties are identified, information needs are assessed and the consultative process is initiated.
2. **Preliminary Analysis:** The scope of the issue and the decisions that will be needed are decided. The hazards and the risks are defined using risk scenarios and those who could be affected identified. The analysis of stakeholders who could be affected and/or interested is started. The consultation process is implemented and the risk information "library" started.
3. **Risk Estimation:** The methodology for estimating or quantifying the frequency and severity associated with the hazards is selected. Estimations are made of the frequency of risk scenarios. The consequences or potential results of the risk scenarios are estimated. Through ongoing consultation with stakeholders, the stakeholder analysis is refined.
4. **Risk Evaluation:** The costs of negative outcomes and benefits are estimated, based on the stakeholders' values. The consultation process and stakeholder analysis continue. The acceptability of various risks to stakeholders is assessed.
5. **Risk Control:** Feasible risk control options and opportunities are identified. Risk control options are analyzed and evaluated in terms of cost, benefits, effectiveness, acceptability with stakeholders, residual risks and other factors. Through ongoing consultation with stakeholders, the risk control options are decided.
6. **Action and Monitoring:** An implementation plan is developed. Selected risk control measures are implemented. Financing and communications strategies are developed and implemented. The effectiveness of risk management process is evaluated. A monitoring process and "sunset" timeframes (if applicable) are established. Dialogue with stakeholders is continued. The entire process is repeated with updated information and experience, as appropriate.
7. **Risk Communications:** Risk communications comprise a continual and meaningful dialogue among stakeholders at all stages in the process, including the final decision-making process. It is important to include all stakeholders, including parties who *think* they are stakeholders. Ineffective risk communications may lead to irreplaceable loss of management credibility, unnecessary and costly conflicts with government, difficult and expensive approval processes and bitter and protracted debates with stakeholders, diversion of management attention from important problems, non-supportive and critical employees, and unnecessary human suffering due to high levels of anxiety and fear.

Other Risk Management Approaches

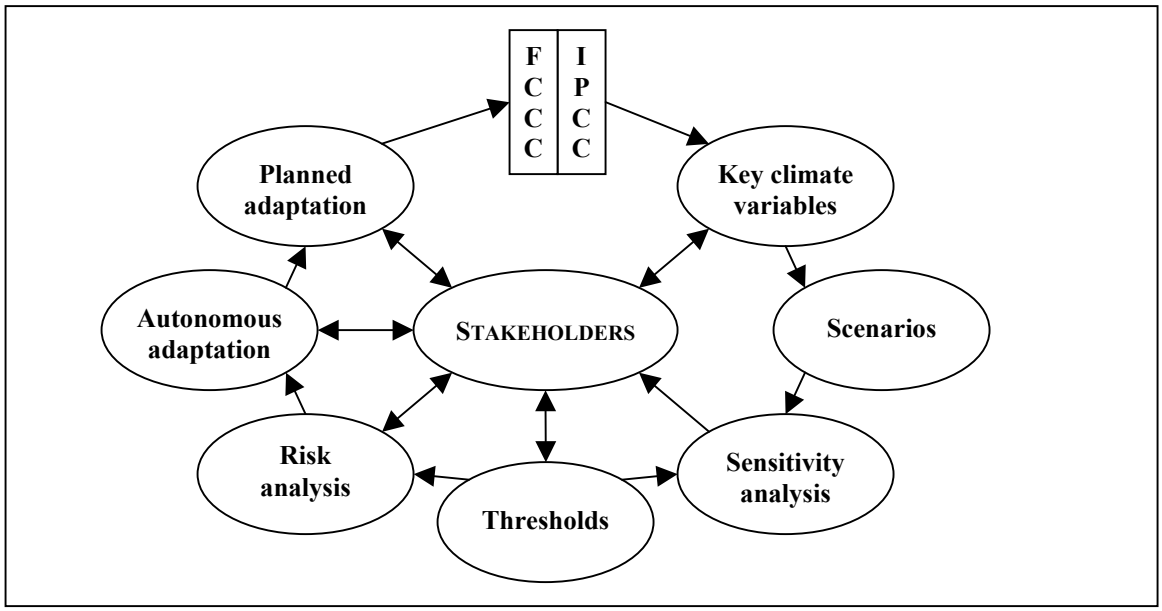
Other risk management frameworks are being used in a number of areas to assist practitioners to make the most cost-effective decisions related to adapting to climate change and increased climate variability.

- In a policy-level paper prepared for the World Bank, Burton and van Aalst (2004) recommend that adaptation to climate change be mainstreamed into the bank's development work "through the routine incorporation of climate risk management into Bank work at the country level and in the project cycle". They did not recommend a specific process, but illustrated the merits of using a risk management framework for the country project-cycle to ensure that decisions account for potential changes in climate.[6]

- Jones (2001) proposes an environmental risk assessment and risk management framework for assessing the impacts of climate change on individual exposure units identified as potentially

vulnerable to climate change. The framework, illustrated in Figure 3, is designed specifically to manage the systematic uncertainties associated with biophysical and socioeconomic climate impacts derived from climate change scenarios. This process is generally similar to the CSA approach, particularly in the analytical sequence and cyclical nature of the process. It is, however, very technical and may not be easily understood or applied by non-specialists.[7]

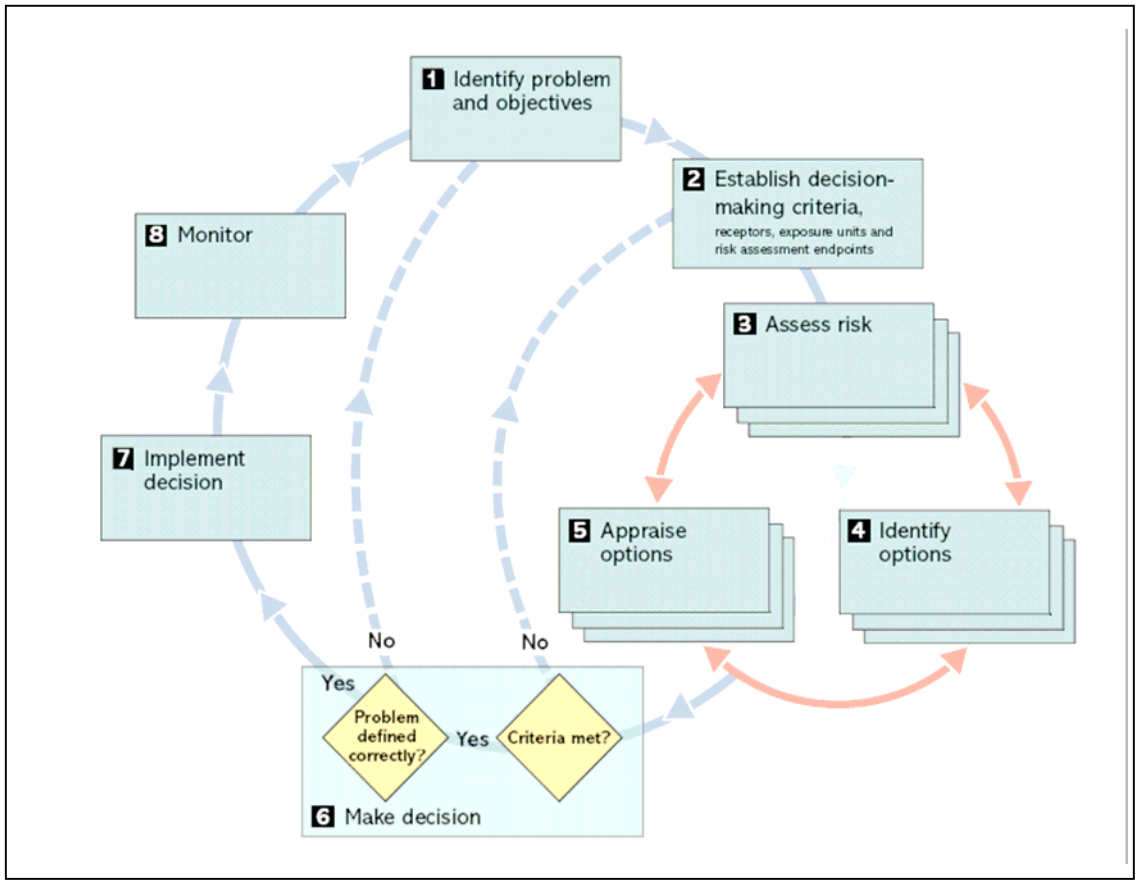
Figure 3: Risk management framework for assessing climate change impacts (Jones, 2001)



- The United Kingdom Climate Impacts Program (UKCIP) recommends a risk-based framework, illustrated in Figure 4, to guide adaptation decision-making.[8] This approach is also generally consistent with the Canadian approach. However, the UK framework is not supported by a national standard, and as a result, various disciplines are likely to use different terminologies, particularly through the risk assessment and risk analysis stages of the process. Experience shows that inconsistent uses of terms by various disciplines can seriously delay and hinder consensus-building, which is an integral part of the process. The iterative aspects of the process are valuable, especially where information is incomplete or suspect. Various steps can be repeated as new information becomes available or as the risk management team becomes more skilled in its use. The UK process, like many others, places less emphasis on stakeholder communications and documentation than does the Canadian approach. These have proven to be very important considerations in Canadian and Caribbean contexts.

- In 2001, the UK Department for Environment, Food and Rural Affairs (DEFRA) undertook a study to explore the implications of climate change across the whole range of policy and operational responsibilities for DEFRA and its agencies, and to advise on how to proceed toward a national adaptation policy. The study involved interviews with representatives from every DEFRA Directorate likely to be affected by climate change, and with a selection of experts from a variety of sectors outside DEFRA. The study recommended that:
  - DEFRAs Global Atmosphere (GA) Division issue guidance to policy-makers and key audiences outside Government via a toolkit which would include guidance on risk assessment and risk management;

Figure 4: The UKCIP risk management framework for adaptation decision-making



- GA Division articulate an overall vision for risk management in relation to climate change, setting out the overall approach to assessing risks, determining priorities and making decisions, as well as the respective roles of the various players within and outside Government. Within this overall framework, each DEFRA Directorate should be responsible for its own strategy for incorporation of climate issues, but could draw from the toolkit described above; and
- GA Division work with UKCIP to identify and target those outside DEFRA who should be building climate assumptions into existing risk management systems, for example within the insurance, engineering and transport sectors.

The report suggested that the overall risk management framework include clear statements of roles and responsibilities, particularly on the extent of DEFRA's responsibility in relation to external organizations. It also suggested that the framework highlight the need to give priority to those responsibilities where a proactive and precautionary approach is required.

Building on the 2001 report and recommendations, the UK Government has recently initiated and is now in the midst of a comprehensive interdepartmental process to consider the implications of climate change across the full range of its policy and operational responsibilities.

DEFRA is currently developing the risk management framework and toolkit.

- In 2002, a UNDP Expert Group acknowledged that despite the "coincidence of a good part of the subject matter and concerns related to both (disaster) risk management and adaptation to climate change, this has not yet been reflected in wide scale collaboration, consensus and integration of the scientific and practitioner communities that espouse them." The Group suggested that there is a substantial and unproductive divergence between current approaches toward managing disaster risk and climate adaptation. The first focuses predominantly on response to disaster events and fails to address the configuration and trends of hazards, vulnerabilities and risks, while the latter focuses on the risk of future climate change impacts without making a strong connection with current responses to climate-related extreme events. They concluded that the approaches are divorced "in concept and in terms of the institutional arrangements and programming mechanisms at the national and international level", but that clearly, "the two concepts are essentially linked and represent a continuum where risk, human security and sustainable development are at the centre of analysis and concern."

  The Group recommended that an integrated approach to climate risk management should be promoted, building on successful approaches piloted by the disaster risk management community but mainstreamed into national climate strategies and programs.[9]

IV. KNOWLEDGE & EXPERIENCE OF THE PLANNING COMMUNITY

Canadian agencies are responding to a changing risk environment related primarily to:

- Increasingly frequent and severe weather-related hazards and health emergencies, many of which may be partly attributed to climate change;
- An increasing and more mobile population;
- Increasing concerns about safety and security including threats of terrorism, and
- Aging infrastructure

The Changing Risk Environment

It is certainly evident that climate-related risks have increased. In addition, governments have had to respond to other risks, some of which may have been exaggerated by media coverage and public misperceptions.

As a result, municipalities, for example, have increased their resource allocations to emergency management, fire and police services, and to planning activities and initiatives to increase the resilience of vulnerable infrastructure. The cost of emergency and police services has increased relatively more than other municipal budget items. In the six large western Canadian cities, for example, Emergency Management & Fire Services increased by 26% between 1990 to 2002, representing 25–50% of municipal expenditure growth[10]. Calgary and Edmonton receive a portion of the provincial gas taxes allowing total budget increases incorporating these emergency related costs. The four other western cities, and cities in other provinces where municipal revenues are based on property-taxes and are practically fixed, have devoted an increasing proportion of their overall budget to emergency services and have reduced other services and social benefits. For example, total per capita spending in Winnipeg decreased by 14% between 1990 and 2003. In the same period, fire and emergency services (including medical) spending rose by 9% and police service by 18%[11]. Expenditures on police services have increased in virtually all communities. It is not clear what proportion of these increases is for response to real and perceived emergency risks, compared to crime concerns. And although most crime has declined, public perceptions suggest otherwise.

Vulnerabilities of Response Mechanisms

Perhaps due in part to budget constraints, examples of preventive actions to reduce other risks, especially those related to natural hazards, are few. Even though municipalities are the first line of defence against most disasters, many municipal officials consider disaster risk reduction a provincial or federal jurisdiction. If significant programs of disaster loss prevention are to be achieved, a broad range of municipal departments (e.g. planning, finance, utilities) need to be more engaged than they are presently.

Many public systems are interrelated. Often, they are interdependent, meaning that the performance of one system hinges on the performance of others. For example, the Montréal Public Health Department describes this event:

> *On August 12, 2002, a water distribution main in Montréal bursts, floods the neighbourhood and remains broken for nine days. Boil water advisories are issued to approximately 50,000 people. Social services, infectious disease specialists and hospitals mobilize to prevent, monitor and treat gastrointestinal illnesses. Public works modifies the water distribution network to optimize the*

system for the whole city, thereby reducing the supply pressures for many, but cutting access from another 22,000 people. The City assesses flood damages to 250 homes, 40 of which are declared uninhabitable, opens an emergency shelter for 41 people, and assists 1300 families left without electricity or gas. Another problem arises: heat warnings are issued between August 12 and August 15. Vulnerable populations are advised to drink plenty of water, exacerbating the pressures on the water supply. The City launches an appeal to residents to reduce water consumption to maintain pressure in the drinking water distribution system and thus serve as many people as possible.[12]

Many other examples from recent memory, such as the heavy rains and other factors that contributed to the Walkerton, ON tragedy and the SARS outbreak that crippled Toronto's hospitality and tourism industries, demonstrate similar levels of interrelatedness across public jurisdictions.

These and other examples described in Appendix II illustrate the range of impact and adaptation issues on Canadians. Clearly, climate and climate change can have direct effects on various government functions, and through the interdependency and complexity of municipal systems, can also have indirect effects that are less visible, but no less important. Table 1 identifies some of the functions that may be affected, and for which governments may need to implement strategic, tactical or operational responses. While municipalities are often on the front line, provinces and federal departments have important roles to play in sustaining such functions in a changing climate.

Table 1: Some functions impacted by climate change

- Infrastructure planning, renewal and management
- Public infrastructure engineering and building codes
- Water and energy supply and distribution systems
- Wastewater management systems
- Public works operations and management
- Transportation systems design and management
- Land-use, subdivision and neighbourhood planning
- Parks and Recreation planning and operation
- Local economic development
- Public and emergency health management and health care services
- Public safety, and emergency preparedness and management

Several municipalities and senior level government departments have undertaken risk analyses to support their emergency planning, but these have been done mostly on an informal and ad hoc basis. Except in a few cases, these analyses have not factored in climate change and have not followed a systematic risk management approach. Those that have used a systematic approach have found it to be very beneficial. Unfortunately, there remains a divergence between emergency management and adaptation to climate change across all levels of government in Canada. They are sometimes viewed as very separate issues, but clearly should be considered together.

A risk-based process can be applied to assess climate-related risks within and across the systems listed in Table 1 above. More specifically, the approach could be used to guide adaptation decision-making related to the following planning activities which are either now underway or under consideration.

INFRASTRUCTURE RENEWAL AND DEVELOPMENT

Climate change poses substantial risk to the performance of various infrastructure systems, and needs to be considered in the earliest stages of project planning and design. Since much of Canada's public infrastructure is aging and deteriorating, and the federal government has committed to assisting municipal infrastructure renewal, this will certainly be an important area for climate risk management in the very near-term.

EMERGENCY PLANNING AND MANAGEMENT

The Ontario Emergency Readiness Act of 2003 requires all Ontario municipalities to undertake a risk assessment by the end of 2005. A systematic risk management approach would assist these and other Canadian municipalities undertaking similar analyses related to emergency preparedness and adaptation to climate change.

WATER PLANNING

A number of communities, especially in southern Alberta, B.C. and Ontario, are concerned about future water availability, and need to explore options for meeting future demand.

LONG-TERM PLANNING AND GROWTH MANAGEMENT

Urban growth will increase the demand for numerous municipal infrastructure systems and services. Climate change may affect many of these systems, either directly or indirectly, and should thus be considered a variable in long-term growth and land use management planning. This is especially true in designated growth areas, such as in Ontario's Golden Horseshoe. Moreover, many planning and growth management activities, if implemented in accordance with the principles of Smart Growth, are *de facto* adaptive actions that will reduce communities' vulnerability to climate change. In many cases, the keys and barriers to successful growth management are similar to the keys and barriers to successful adaptation.

Some Experiences

Early experiences with risk-based approaches to adaptation decision-making in the Caribbean, and in various simulation exercises delivered through workshops of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN), have demonstrated their utility and user-friendliness. Participants have used a risk-based approach to identify and assess risks across a wide range of communities, both real and fictional (but plausible), and to recommend practicable and effective risk control options. Table 2 offers examples of potential risk modification options identified through these experiences.

Table 2: Examples of adaptation responses identified using a risk-based approach

- Better manure management to reduce risks to water quality in rural areas due to heavier rains
- Economic diversification and improved evacuation planning and management to reduce economic and health impacts of forest fires in forest-dependent communities
- Public education and outreach activities related to anti-idling and urban forestry to reduce health impacts associated with smog events
- Promote rainwater capture and greywater recycling (for appropriate uses) to reduce water shortage risks to the tourism industry in the Caribbean
- Building recreational docks in sections to accommodate fluctuating lake water levels and to limit losses from damaged docks

More detailed examples of municipalities' efforts to redress climate risks are presented in Appendix II below.

V. SUGGESTED FUTURE ACTIONS

Risk-based approaches are becoming the preferred paradigm for climate change adaptation decision-making, both when considered independently or in combination with other social and environmental developments. Early experiences have proven very useful and have improved the quality and public acceptance of many of the resulting decisions. In industry, risk management has been generally accepted, but has been rarely invoked for climate change. Senior levels of government have rarely used the technique.

Many risk management frameworks have been developed internationally to support adaptation decision-making. Most advocate a similar and generic approach, with slight variations and differing emphases. The Canadian Standards Association's *Risk Management: Guideline for Decision-Makers* offers a pragmatic, evolutionary and user-friendly approach developing of strategies to avoid, reduce and control real and perceived risks. The CSA Guideline emphasizes stakeholder engagement, risk communications and thorough documentation throughout the risk management process. These foci have proven important in responding to climate change in the Canadian and Caribbean contexts. For adaptation to climate change, where the public's interests are at stake and where uncertainties are significant, these aspects will be important considerations for achieving sustained commitments to adapt.

In order to have risk management methodologies used in climate change related decision-making, more widespread awareness of climate change risks and the importance of planning to address these risks is required. The development of decision-making tools, followed by training and experience in applying the procedures, is needed. This is required across relevant departments in all levels of government, and particularly for officials concerned with planning, design and construction, and disaster loss reduction.

Since much of the scientific knowledge of climate change impacts and implications rests within governments, while physical planning and construction approval takes place at the municipal level, a concentrated effort is needed to ensure strong communication between these groups. Training programs and guidebooks aimed at decision-makers could be useful tools. Somewhat different guides may be needed by planners in different levels of government, but these would contain many common elements. There are several benefits of taking a coordinated approach to training. One is that planners in all levels of government would become familiar with the methods and value in addressing adaptation to climate change and related social and environmental changes. A guidebook, targeted to local municipal actions, could also be useful at more senior levels of government and the private sector and facilitate a constructive intergovernmental dialogue.

To be an effective element of a training program, a guidebook must simultaneously meet the needs of organizations and individual users:

- At the **organizational level**, it should offer a risk-based process that is applicable within users' organizational capabilities. It should build on, and not exceed, existing capacities. It should also build on and connect to priority issues and processes, rather than offer an entirely separate process that would be undertaken independently of other processes. It should be systemic and integrative, designed to fit within and strengthen existing decision-making structures and processes, across the full range of affected jurisdictions.
- At the **individual level**, a guidebook would need to deliver a learning benefit to departmental and private sector staff. As such, it should be designed as a learning tool that adheres to the principles of adult learning and is tailored to the characteristics of adult learners. It should:

- ✓ be **learner-centred**, **practical** and **problem-oriented**, with relevant overviews, summaries, examples and stories that link theory to practice
- ✓ **build on** and **augment experiences** and **knowledge base**
- ✓ **guide practice** so that the methods can be applied and mastered incrementally in order to maximize users' success with the approach

It should build on past experiences with risk management methods, in general, and on experiences in managing climate-related risks, and it should engage users in simulated and real-world pilot applications of the risk management process. The development process should allow for participants to assess which aspects of the risk management approach are operable for them and which are not, and to refine the approach so that it fits better within the institutional context.

Now is an opportune time to begin developing training materials and tools for decision-makers, such as a climate change risk management planning guidebook. Governments and industry are increasingly aware of the need to manage risks associated with climate variability and change. There is also a need to include consideration of climate change in long-term initiatives such as municipal infrastructure renewal. There is both need and opportunity to integrate climate risk management into the development of comprehensive risk-based emergency management programs, as well as into the long-term sustainability plans, growth plans, water supply plans, and strategic plans of various jurisdictions. Integrating climate risk analysis into these long-term planning processes and frameworks would be prudent to enhance their sustainability.

APPENDIX I – CLIMATE CHANGES AND IMPACTS

Climate is naturally variable due to many factors, including changes in solar energy, volcanic emissions, and naturally occurring greenhouse gases (GHGs). In its Third Assessment Report, the Intergovernmental Panel on Climate Change cites studies that indicate that before the mid 1960s, the global mean temperature was influenced significantly by both natural and human-caused factors. But since the late 1960s, the Earth's rapid warming is forced almost entirely by the accelerating rise in GHG concentrations, particularly carbon dioxide (CO_2), that are largely attributable to human activities.

Atmospheric CO_2 concentrations have risen from a pre-industrial level of 280 parts per million by volume (ppmv) or less to a 2004 level of 379 ppmv. Atmospheric methane and water vapour concentrations have also increased significantly. Given the current concentrations and persistence of GHGs and the likelihood that the growing global energy demand will be supplied mainly by fossil fuels in the next few decades, it seems certain the climate will continue to change as a result of atmospheric GHG concentrations. International efforts to reduce GHGs, such as the Kyoto Protocol, will only slow the rate of change.

Over the last 35-40 years, we have observed many climatic changes and trends that are a foretaste of the types of changes that we might anticipate for the future. It is instructive to compare recent climate trends and those projected by climate models to help verify whether modeled projections can reliably inform adaptation decision-making. Table 1 presents trends and projections for key climate parameters affecting Canada, while Tables 2 to 9 present trends and projections for Canada's regions, and some observed or expected impacts.

It should be noted that observed and projected average changes over large areas (such as Canada) can obscure very significant differences in changes at smaller scales. For instance, Canada's mean temperature increased by over 1°C in the 20th century. Yet, the east coasts of Newfoundland and Labrador have cooled and are expected to continue to cool due to changes in ocean circulation, while Canada's Northwest has already experienced rapid warming by several degrees, especially in the winter and spring months. Other regions have experienced changes between these extremes. It should also be noted that higher surface temperatures are accompanied by changes in other climate related parameters, such as rain and snow amounts, increased intensities of rain, more frequent severe storms in winter, changes in water availability and quality.

Table 1: Observed and projected climate changes, Canada 1900-2100

	Observed to Date (2000)	**Projected**
Global mean temperature (IPCC 2001)	▪ 0.6+ or –0.2^{0}C (20^{th} Century)	▪ 1.4 to 5.8^{0}C (1990-2100)
Canadian mean temperature	▪ 1^{0}C (20^{th} century)	▪ 2 to 4^{0}C (by 2040-60, CGCM)
Total Precipitation (2040-2060)	▪ ++ at high altitudes, + at mid latitudes ▪ less in southern Prairies in summer	▪ 0 to 20% more in North, slightly less in mid continent in summer (HadCM3)
Streamflow (or soil moisture) Mid Continent	▪ -10% (Southern Prairies, 1967-1996)	▪ -30% by 2050 (by 2050, CGCM 2xCO_2)
Date of Spring Breakup	▪ Earlier 82% of basins (1967-96)	▪ Earlier
Extreme Rainfall	▪ Up to 16% increase in intensity of heavy one-hour rainfalls	▪ 100% increase in frequency of heavy rain events

	(Ontario, 1970-2000)	(CGCM 2xCO_2)
Water Vapour in Troposphere (lower atmosphere)	▪ Statistically significant increase over N. America, except for NE Canada	▪ Increase
Mean Sea Level Rise	▪ 10 – 20 cm (1900-1999)	▪ 40 - 50 cm (mean IPCC projections, 1990-2100)
Arctic Sea Ice extent	▪ -14% year round ice	▪ -30% by 2050 (CGCM)
Snow Cover extent Dec. Jan. Feb	▪ -10% (Northern Hemisphere)	▪ -15% (N. America, by 2050, CGCM)
Late season snow pack – Rockies – Apr. 1	▪ 30% less (Fraser River basin, since 1976)	▪ Less due to increased melting in winter
Glacier retreat south of 60^0N e.g. Glacier National Park	▪ 2/3 reduction in numbers (from 150 to 50, 1850–1990s)	▪ None left (by 2030)
Severe winter storms Frequency and intensity	▪ Increased frequency and intensity (N of 60^0N, 1959-1997) ▪ Increased intensity (S of 60^0N, 1959-1997)	▪ 15% to 20% (CGCM 2x CO_2)

Note: HadCM3 – Hadley Centre (UK) Climate Model version 3
CGCM – Canadian Global Climate Model (Environment Canada, University of Victoria)
2 x CO_2 – Doubled pre-industrial level of CO_2 equivalent (by latter half of 21st century)

Regional Changes and Impacts

The following subsections and tables summarize some of the observed and projected regional changes in climate and some of their effects across Canada.

1) THE NORTH:

- In the western Arctic and sub-Arctic, average annual temperatures have increased 1.5–2ºC to date, and are projected to warm by 5–7ºC in the 21st century. Increases in precipitation have already been observed, and this trend is expected to continue.
- There has been little temperature change in the eastern Arctic, particularly in the Labrador Sea region and in coastal Labrador. Climate models suggest that cooling may occur in this region in a changing climate due to changes in ocean currents and ice transport.

Table 2: Projected climate change impacts in Canada's western Arctic and inland eastern Arctic

Climatic changes	**Potential impacts**
Permafrost thawing, land slumps	Instabilities in building infrastructure, road
Loss of sea and river ice, movement of wildlife	Wildlife and hunting disrupted
Sea level rise, storminess, less ice	Shore erosion in northwest (Beaufort Sea shore)
Higher temperatures and evaporation	Forest fire increase
Thawing roads, lower minimum flows	Winter road and barge transportation reduced
"Grasshopper effect"* in south accelerated transporting toxics north more rapidly	Increased toxic contaminants
Reduced flooding of fresh water deltas	River ecosystem productivity reduced
Loss of sea ice	Greater commercial ship transportation and resource exploitation – Arctic sea and channel

Sources: Bruce et al., 2000. Cohen, S.J., 1997, Natural Resources Canada, 2000

2) BRITISH COLUMBIA AND SOUTHERN YUKON

- Average annual temperatures have increased by about 1.5ºC in central, northern and eastern regions, and by about 1ºC in coastal areas. Projections are for increases of double these amounts over the next 50 years.
- North of 60ºN, precipitation has increased and is expected to continue to increase, with enough winter snowfall to maintain glaciers.
- South of 60ºN, more rain, often heavy, and less snow is projected, with little change in total precipitation and this pattern has already been observed. Glaciers will continue retreating south of 60ºN.

Table 3: Projected climate change impacts in British Columbia and southern Yukon

Climatic changes	Potential impacts
Lower mean annual flows	Decline in hydropower
Lower flows, seasonal changes in flow	More intense conflicts between water users and between Canada and U.S.A.
Sea level rise, storminess	Potential for south coastal flooding
Milder winters, warmer summers, more lightning	Forest fire insect and disease increases
Warming ocean and rivers	Fishery changes, e.g. reduction in cold water species
Heavier rains	Flash flood and landslide increases
More winter rain, less snow	Shorter ski season
More and longer hot spells	Longer smog episodes, lower mainland
Permafrost thawing	Building, infrastructure instabilities

Sources: Beamish et al., 1997. Bruce et al., 2000. Moore, 1996. Rory et al., 1998. Shaw et al., 1998.

3) THE PRAIRIE PROVINCES

- Average annual temperatures have increased by 1–2ºC to date, more in the west than in the east. Temperatures are projected to increase by an additional 2–4ºC over the next 50 years.
- Impacts are expected to be quite different in the boreal region, generally north of 55ºN, than in the agricultural, more populated south.
- Reductions in glacier areas are already resulting in declining low season streamflow in rivers rising on the East Slopes of the Rockies.

Table 4: Projected climate change impacts in the Prairies, north of 55°N

Climatic changes	Potential impacts
Permafrost thawing, land slumps	Building, utilities, pipelines instability
Milder winter, warmer summers, more lightning	Increased frequency and intensity of forest fires and forest insect infestations
Warming waters	Cold water lake and river fish species further north

Sources: Natural Resources Canada, 2000. Schindler, 1997.

Table 5: Projected climate change impacts in the Prairies, south of 55°N

Climatic changes	Potential impacts
Higher temperatures and evaporation, glacier retreat	Increased agricultural drought incidence and intensity
Declines in river flows and water levels	Competition for declining water supplies
Lower flows	Reduced hydropower production
Lower minimum flows, higher water temperatures, more high intensity rains	Water quality problems
More and longer heat waves	Increased urban smog episodes

Sources: Brown et al., 1997. Gregory et al., 1997. Wetherald & Manabe, 1995. Wheaton, 1994.

Zhang et al., 2001.

4) NORTHERN ONTARIO AND HUDSON BAY LOWLANDS (N OF 52ºN)

- Average annual temperatures have increased by about 0.5ºC to date. A further increase of 2–3ºC is projected by 2050
- The ice-free period in Hudson Bay is expected to lengthen. Little change in annual precipitation is expected, but more rain and less snow are expected.

Table 5: Projected climate change impacts in northern Ontario

Climatic changes	Potential impacts
Permafrost and peatland thawing	Instability of buildings, utilities and pipelines
Peatland thawing	Increased emissions of greenhouse gases
Higher temperature and evaporation	Increased forest fire hazard indicies in some areas
Lower mean annual flows	Decreased hydropower production

Sources: Natural Resources Canada, 2000. Zhang et al., 2001.

5) GREAT LAKES-UPPER ST. LAWRENCE BASIN, SOUTHERN ONTARIO AND SW QUEBEC

- Average annual temperatures have increased by about 0.6ºC to date. A further increase of 2–3ºC is projected by 2050.
- Little change in total precipitation is expected, but short duration heavy rainfalls have already increased 8–16% and are projected to continue increasing.
- Evaporation from the Great Lakes, especially winter is increasing with higher water temperatures and less ice.

Table 7: Projected climate change impacts in Great Lakes-Upper St. Lawrence basin

Climatic changes	Potential impacts
Lower Great Lakes levels and flows of channels and St. Lawrence	Increased shipping and navigation costs Reduced hydropower production Reduced access for water supply intake and recreational boating Dredging requirements increase, stir up polluted sediments
Shorter Great Lakes ice season	Increased lake effect snows Easier winter navigation
Declining groundwater and low river flows with increasing demand	Reduced water availability and competition for water in tributary basins
Lower minimum flows and levels	Late summer, autumn water quality problems
Heavier short duration rainfalls	Increased flash floods and drainage over-taxing Increased threat of erosion and polluted runoff from agricultural operations
Longer, more intense hot spells	Health effects of increasing smog and heat stress
More winter rain, less snow	Winter snow/ski season shorter, southern Quebec and Ontario – longer golf season
More intense winter snow and ice storms	Paralyzing winter events increasing

Sources: Brown et al., 1997. Bruce et al, 2000. Canada Country Study, Ontario, 1997. Karl et al. 1995. Mortsch et al. 1997. Lambert, 1995. McCabe et al., 2001. Sanderson, 1993.

6) CENTRAL AND EASTERN QUEBEC

- Observed trends are mixed, with eastern coastal areas having cooled and central forested regions warming, 0.5ºC or less. Temperature increases of 2–4ºC are projected for the

central regions, with the highest temperatures kerning near Hudson Bay as ice cover decreases. Little change or slight cooling is expected in the Northeast.

- Precipitation has increased by 2–4 mm per decade, mainly in winter, and this is expected to continue, but be balanced by slight declines in summer rainfall.

Table 8: Projected climate change impacts in Central and Eastern Quebec

Climatic changes	Potential impacts
Higher intensity storms and more frequent rain-on-snow events	Increase in floods and other weather related natural disasters
Sea level rise, increased storminess	Shoreline inundation and erosion in St. Lawrence Estuary and Gulf
Salt water intrusion up the St. Lawrence River with sea level rise	Changes in ecosystems and water supplies Lower St. Lawrence
Increased flows in central areas offset declines in upper St. Lawrence	Little net change in hydropower generation

Sources: Browne et al., 1997. McCabe et al., 2001. Natural Resources Canada, 2001. Whitfield et al., 2000.

7) ATLANTIC CANADA

- Annual temperatures have increased slightly in western parts of the region (e.g. St. John River basin) and have decreased slightly on the eastern coasts of Labrador and Newfoundland. Climate projections to 2050 suggest continued cooling in the northeast and over Labrador Sea, and warming of 1–4ºC in other areas, more towards the west.
- Precipitation has trended toward heavier snow and rain storms and this trend is projected to increase.
- Sea level has risen 10–20 cm in the past century and is projected to rise by an additional 40–50 cm over the next century.

Table 9: Projected climate change impacts in Atlantic Canada

Climatic changes	Potential impacts
Sea level and severe storm increases	Coastal damages, inundation and erosion
Storm surges, more intense winter storms	Potential for major disasters
Heavier short duration rainfalls	Flash floods and overtaxing drainage facilities
More frequent winter breakups	More ice jam floods, New Brunswick, Western Nova Scotia
Continued lack of warming, or cooling	Eastern Newfoundland and Labrador, longer winter ice cover
Salt water intrusion with sea level rise	Ground water quality threatened in coastal areas, e.g. P.E.I.
Increased temperatures and evaporation losses	New Brunswick and Nova Scotia more frequent summer agricultural droughts
Warmer river waters, and coastal water in western part of Gulf	Atlantic salmon threatened and increased shellfish contamination
Continued cooling Labrador Sea	Cod stock, Labrador Sea slow to recover

Sources: Abraham et al., 1997. Arctic Sciences Ltd., 1993. Boer et al, 1998. Bornhold, 1993. Forbes et al, 1997. Hare et al., 1997. McCabe et al, 2001. Stone et al., 2000.

APPENDIX II - CLIMATE RISK MANAGEMENT ACTIVITIES & EXPERIENCES

Managing climate-related risks is not new. Either implicitly or explicitly, many Canadian organizations have identified, assessed and evaluated climate-related risks, and have implemented risk reduction measures. In many instances, these efforts are akin to efforts to manage risks associated with climate change:

MONTREAL'S HEAT ALERT

In its 2003 Annual Report titled "Risk Management and Health: A modern-day safety net", the Montreal Public Health Department (DSP) acknowledged climate as an important, and previously, relatively unappreciated source of risk for the city (the City of Toronto implemented a heat / health alert system in 2001). The report highlights public health risks related to heavy precipitation, ice storms, heat waves and poor air quality.

In response to public health risks from heat waves, DSP initiated a comprehensive risk management program that includes a research program, a public education and communications program, and a mobilization plan to ensure effective interventions to help protect individuals at high-risk.

DSP also reflected on its various experiences with the aim of adopting an effective and integrated health risk management approach. Among its many recommendations, it identified the needs to strengthen capacity to anticipate risks and to harmonize risk communications. It emphasized the importance of collaboration, accounting for the social acceptability of risks, sustained public education and awareness building, and perhaps most importantly, a strategic focus on prevention.

GUELPH'S LOW WATER RESPONSE PLAN

The City of Guelph sought solutions to recurring drought conditions in the late 1990s that threatened water shortages through the summer months. It reviewed infrastructure-based enhancement of water supply and storage, but upon applying the user-pay principle, concluded that the costs were too high. Instead, it developed its Outside Water Use Program (OWUP) to manage peak demand. The program was supported by a comprehensive customer communications strategy, extensive media advertising and branding, a partnership with a community-based organization to promote a residential rain barrel program, and a municipal bylaw that ensured effective enforcement and raised program compliance.

The program cost $32,000 to develop and $55,000 to implement. Between July and October 2002, Guelph received 30 percent less rainfall than normal. These conditions represent a 1 in 50 year occurrence under the relatively stable climate of the past. The OWUP reduced average demand by 13%, saving the city approximately $50,000 in hydro and treatment costs. The sale of time-shift and new lawn watering permits raised an additional $5,000 in revenue.

CLEAN AIR HAMILTON

In 1995, the City of Hamilton undertook the Hamilton Air Quality Initiative (HAQI) to assess local air quality and set new priorities for air quality management, and initiative for which the City later earned the prestigious Dubai International Award for Best Practices to

Improve the Living Environment. Subsequently, the city funded Clean Air Hamilton, a community-based initiative to act on HAQI recommendations. Through Clean Air Hamilton, Hamilton citizens and City staff meet bi-monthly with representatives from local industry, all levels of government, McMaster University and community-based organizations to set action priorities, leverage expert volunteer support and initiate air quality improvement activities.

Hamilton's ten-year air quality trend shows a significant improvement in ambient industrial air pollutants, but little improvement in ambient levels of transportation-related emissions. Clean Air Hamilton continues to work with industry to reduce industrial emissions, and has developed a new focus on transportation-related emission reductions. Importantly, the organization is aiming for continual improvement. It recently undertook a visioning exercise, adjusted its organizational structure, and committed to becoming the authoritative voice on air quality issues in the region.

FLOOD DAMAGE REDUCTION IN THE RED RIVER BASIN

Between 1962 in 1972, the City of Winnipeg installed, with support from the federal and provincial governments, a massive dyke and diversion system to reduce disaster flood risks from the Red River. In addition to this protective structure, the city, province and other organizations maintain a suite of non-structural risk reduction measures to reduce any residual risks – for example, land-use mapping and regulation, flood-proofing, flood forecasting and warning, flood fighting and emergency preparedness, and post-flood recovery. The 1997 Red River flood was the largest flood event on the Red River in 145 years, with damages in Canada exceeding $500 million. Estimates of flood damages in the absence of these risk-reducing measures range from $4.5–$7 billion.

Following the 1997 flood, the Manitoba Water Commission (MWC) was tasked to recommend measures to the Manitoba Government to mitigate future flood event risks. The MWC held extensive stakeholder hearings, analysed potential impacts and risk control measures, and recommended a number of actions. These risk control measures were considered for implementation:

- Individual dykes for individual properties
- Raising certain critical structures
- Abandoning vulnerable sites
- Expanding the floodway around Winnipeg

The precise effect of climate change on flooding in the Red River Basin is unclear, but the timing and frequency of major floods will likely change, and this has raised questions about the nature of flood risks. Climate models project warmer temperatures and more late autumn and early winter precipitation, conditions which would raise the risk of rain-on-snow events and frequency, timing and severity of flood events.

CALGARY'S RISK MANAGEMENT APPROACH TO EMERGENCY MANAGEMENT

The City of Calgary developed a risk management framework for its emergency management department. This framework has been used for analysing hazards, estimating their consequences and ranking them in priority for mitigation efforts and emergency preparedness. City Council recognized the results of the process and allocated additional resources for mitigation and preparedness actions.

PUBLIC COMMUNICATIONS AND NEIGHBOURHOOD PLANNING IN EDMONTON

The City of Edmonton experienced a 1 in 200-year flood event (by past climatic statistics) in summer 2004 that overwhelmed its stormwater drainage system and resulted in $160 million in insured losses. The City acknowledged that the cost of rebuilding the system to accommodate an event of this magnitude is prohibitive, but resolved to reduce the risks associated with this type of event via other means, including such measures as reducing pavement coverage in certain locations, providing emergency pumping facilities in sensitive road subways and accelerating the separation of sanitary and wastewater sewage systems in older sections of the city..

During the event, the water level in several stormwater retention ponds rose substantially, but not to their maximum level. However, numerous Edmonton residents alerted the City's Office of Emergency Preparedness of the rising water levels, in fear of an imminent overflow. The City has since committed to better signage and public communications to raise public awareness to prevent unnecessary anxieties during these events.

The City recently initiated and is now supporting neighbourhood-based approaches to emergency planning and preparedness, recognizing that neighbourhood-level organizations are better able to service certain localized needs and vulnerabilities.

NEW BRUNSWICK COASTAL AREAS PROTECTION POLICY

In 2001, the New Brunswick government undertook to revamp its Coastal Lands policy to reflect the risks associated with sea-level rise and increasingly damaging storm surges resulting from climate change. As a result, the new Coastal Protected Areas Policy includes a provision that the habitable portion of all new or rebuilt structures in the "coastal lands buffer area" be at least two metres above the Higher High Water Large Tide (HHWLT) elevation. The policy adds "as a general rule, all permanent structures should be built at an elevation two metres above HHWLT, to provide a margin of safety from storm surges and flooding".

The Government of New Brunswick projected the current rate of sea-level rise (0.5m per 100 years) forward over a long planning horizon. It employed public education, outreach and communications activities from the beginning of the policy development process, and invoked the precautionary principle to prevent uncertainties from thwarting a policy response. The Government concluded that a two-metre elevation requirement provided an acceptable buffer (approximately 400 years at current rate of sea-level rise) against sea-level rise risk.

ALBERTA'S EMERGENCY PUBLIC WARNING SYSTEM

Following the 1987 tornado in Edmonton that killed 27 people, injured 600 and caused $300 million in damages, municipal, provincial and federal governments partnered with broadcasters to develop a new and improved emergency public warning system (EPWS) to reduce the time needed to warn the public about critical emergency situations, such as extreme weather events and chemical releases. This a unique collaboration between governments and private broadcasters whereby broadcasters actually relinquish some control over their broadcasts.

The EPWS is the only system in North America designed to give local government officials the ability to broadcast an emergency warning quickly and directly to radio, cable and television stations. It currently services 276 municipalities, including First Nation

Reserves, and is expected to service all Alberta municipalities by May 2005. Authorized personnel from each municipality have access codes to activate the system by telephone. Using a touchtone phone, these personnel can activate the system and instantly deliver disaster warnings via all radio, television and cable systems in the service area. With some 300 authorized personnel who can activate the system from remote locations, the system has greatly improved early warning effectiveness.

ADAPTATION TO CLIMATE CHANGE IN THE CARIBBEAN (ACCC)

ACCC was a major CIDA-funded project to enhance the capacity of Caribbean countries to adapt to climate change. As part of the project, participants adapted Canada's Risk Management Guidelines for Decision-Makers to support climate change adaptation decision-making in the Caribbean. One product of this exercise – a guidebook for managing climate-related risks – has proven a useful tool to many municipalities and sectors in the region. The cooperative production of the Guidebook provided for capacity building in a number of economic sectors. The Guide has been used to address water supply issues for Barbados and, more widely, the water for tourism sector, as well as climate related disasters by the insurance industry.

CONSIDERING CLIMATE CHANGE IN ENVIRONMENTAL ASSESSMENTS

The Canadian Environmental Assessment Agency (CEAA) reviewed six projects subject to the environmental assessment (EA) process to explore climate change considerations in project design, planning, operation and decommissioning. The review concluded that the use of historical climate data is widespread, and that future climate projections are too uncertain to meet decision-making needs. (This conclusion failed to recognize the trends of the past 3 decades.) Nonetheless, there is a recognized need for contingency plans, ongoing monitoring and the identification of triggers that should initiate action.

The CEAA subsequently produced a publication, aimed at EA practitioners, on incorporating climate change considerations in EA, and under the ACCC program, the Caribbean Development Bank has adopted a strategy for inclusion of climate change considerations in Environment Assessments.

While all of these examples have employed risk-based techniques, only a few followed a systematic risk management approach that was broadly understood and accepted. By applying a comprehensive and systematic approach that is integrative of all climate-sensitive systems, municipalities can make better-informed and more optimal choices.

Following Canada's risk-based approach, in particular, municipalities will benefit additionally from extensive stakeholder engagement and documentation. Meaningful stakeholder engagement ensures that important groups in the community are well informed about the decision-making process and "buy into" the eventual result. Community support for and understanding of adaptation decisions is important when the implementation costs for some of the adaptation issues are considered in areas such as water supply and treatment, health facilities and changes to building codes. While not readily apparent, the benefit of maintaining a thorough and retrievable document trail can be very high when documenting costs, lessons learned or repeating certain aspects of the process as appropriate.

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