

Workshop on the Integration of Climate Change Impacts and Adaptation into Municipal Policy and Programs: A Focus on Water Management

**November 3, 2005
Black Creek Pioneer Village, Toronto**

**Draft Meeting Notes
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Background

There is strong scientific evidence that climate change is already taking place and having environmental, social and economic impacts. Global warming is a reality: average global temperature has increased by around 0.4°C since the 1970s, and now exceeds the upper limit of natural variability. What the exact impact of climate change will be at the regional and local levels, however, is not well understood. Nevertheless, it is widely accepted that even after significant reductions in the emissions of greenhouse gases – for example, meeting the reduction targets in the Kyoto Accord – additional global warming is inevitable.

Regionally, climate change may manifest itself as a shift in mean conditions (such as average precipitation rates) and/or as changes in the intensity and frequency of extreme events (such as flooding and drought). While there remain many uncertainties with respect to the regional impacts of climate change, there is growing confidence in the ability of climate simulation models to provide natural resource managers with useful projections of future climate scenarios to support planning and management activities across a range of space and time scales.

There are two broad policy responses to climate change. The first is to try to mitigate global warming by reducing the emissions of greenhouse gases. The second response, which is compatible with the first, is to develop strategies to adapt to climate change. Such adaptation strategies are designed to moderate the potential impacts of climate change or benefit from the opportunities associated with it.

To explore the integration of climate change adaptation into municipal policy and programs, a workshop was held on November 3, 2005 at Black Creek Pioneer Village in Toronto. The Workshop was organized by the Ontario Canadian Climate Impacts and Adaptation Research Network – Ontario (C-CIARN) and Toronto and Region Conservation and was aimed at municipal managers, conservation authorities, agencies, consultants and non-governmental organizations with an interest in the climate change issue. Over 100 *[check number]* participants attended the all-day meeting. The purpose of the Workshop was to:

- share information on climate change as it relates to water management;
- develop a better understanding of municipal needs and gaps related to climate change adaptation and risk management;
- familiarize participants with a vulnerability assessment approach to understanding and managing climate-related risks from a municipal perspective; and
- identify key areas of further research to inform strategies and tools for climate change adaptation.

This Meeting Report is intended to convey the key presentations and discussion that took place at the Workshop. The Agenda from the Workshop is included in Appendix A, and the Workbook is included as Appendix B. *[Please confirm and add files]*

Presentations

Climate Change and New Science

Don MacIver from Environment Canada set the stage for the workshop with his presentation on “Climate Change and New Science: Creeping Environmental Impacts.” He began by noting that there was widespread knowledge of the impacts of Hurricane Katrina, which he dubbed a “celebrity storm”, but little understanding of the subtle climate change effects that are already at play around us. He noted that we have transformed the landscape of southern Ontario dramatically in the last 200 years, and that we are experiencing the interrelated impacts of climate change and a changed landscape.

MacIver noted many climate trends that are recognizable. Across the country, we are experiencing less intense cold, which has an impact on the number of frost days and demand for heating. Overall, Canada is becoming wetter and Ontario is getting warmer and wetter. We are seeing examples of “high impact weather” with events such as the Ice Storm of 1998 and the Saguenay flooding of 1996, along with droughts, forest fires, floods, windstorms and waves. He noted that the January 1998 Ice Storm, which left one million households without power, was Canada’s most costly weather disaster ever. Ontario’s Dufferin County has experienced increasing number of windstorms and tornados since 1971, with most of the damage being caused by lower speed F0 and F1 storms.

MacIver noted that there is an increasing “adaptation deficit” which he defined as the difference between insured losses and economic losses due to climate impacts. He suggested that it is good public policy to invest in disaster resilience. He cautioned against using Hurricane Hazel as a design standard and noted that there have been four storms in the last decade in which rainfall exceeded that experienced during Hurricane Hazel.

MacIver repeatedly stressed the sub-regional nature of climate impacts in his presentation, and the need to tailor adaptation strategies to regional climatic patterns. He finished by noting that adaptation to climate change has to be carried out in partnership with communities.

Infrastructure and Water Management – A Municipal Perspective

Michael D’Andrea from the City of Toronto gave a presentation on “Climate Change Impacts on Infrastructure and Water Management”. He began by reviewing climate change impacts. He noted that in the future, evidence suggests that we will see an increase in the intensity of rainfall events, which will lead to increased risk of flooding and increased stream erosion. Evidence also suggests that we will see substantial changes in seasonal distribution of flows including high and low flow conditions, greater winter runoff and reduced summer flows.

D’Andrea then posed the question “Are we seeing the effects of climate change now in Toronto?” He noted that there have been seven extreme rainfall events in last 20 years in Toronto. They have caused severe surface and basement flooding. In response, the City has changed designs to address the issue several times, but the designs have been overwhelmed by the next large event. In the August 19, 2005 storm, which exceeded the 1 in 100 year storm in the north part of the city, one rain gauge recorded 153 millilitres of rain in a three-hour period. The

storm caused flash floods of creeks, rivers and ravines, overflowing stream banks, substantial bank erosion, damage to public and private property and infrastructure, and sewer backups. The City received over 3,000 complaints about basement flooding. Over 140 stream erosion sites were investigated to prioritize repairs and a section of a major arterial road collapsed.

D'Andrea stressed that municipalities must adopt adaptive management approaches. Standard design practices based on historical climate records need to be reviewed based on projected new norms. D'Andrea wrapped up by concluding that climate change is already being observed in Southern Ontario. Municipal infrastructure and delivery of services are already being affected by more frequent extreme events. To address the issue, more collaboration must take place among affected agencies. We need to establish new service delivery targets and corresponding design standards and modify existing infrastructure rather than building new. With respect to cost, D'Andrea noted that we need to compare the costs of adapting to the losses that can be expected if we do not adapt.

Source Protection

Rob de Loë from the University of Guelph focussed his remarks on “Ontario’s Drinking Water Source Protection Initiative and Climate Change”. He began by suggesting that Drinking Water Source Protection planning in Ontario may be the best opportunity we have to mainstream climate change planning at the municipal level. He described the White Paper being developed by Pollution Probe and the Canadian Water Resources Association, which will examine how climate change can be incorporated in Drinking Water Source Protection Plans. The document is aimed at all those involved in Source Protection planning, but it may most useful to smaller communities in Ontario.

De Loë began by arguing that climate change in Southern Ontario will likely lead to declining lake levels, reduced runoff, reduced groundwater levels and groundwater recharge, and increased temperature of surface waters. He described the watershed-based approach to Source Protection planning and suggested that there will be opportunities to address climate change in four parts of the process:

- the development of water budgets;
- vulnerability analyses;
- identification of threats and issues; and
- responses.

This means that climate change would be considered in activities such as the delineation of Wellhead Protection Areas and Areas of Significant Recharge, land use planning, water supply and wastewater master planning and decisions on Permits to Take Water. De Loë wrapped up his presentation by reiterating that we must address climate change in the Source Protection planning process; if not, we will undermine the entire process. He suggested that the political and social challenges of doing so outweigh the technical challenges.

Financial Implications and Insurance Liability

Alan Pang from CGI Insurance Business Services gave a presentation on “Risk Management of Sewer Backup Exposures”. He began by introducing CGI and describing their approach to risk management. He then moved on to describe the poor state of public infrastructure. In 2002, the Canadian Society for Civil Engineers reported that 30% of public infrastructure is more than 80 years old, and that if repairs are neglected, replacement will cost 125 times more than the expense of good maintenance. Various bodies have estimated the municipal infrastructure deficit at between \$50 and \$125 billion and growing.

The results of this infrastructure deficit can be seen in the extent and costs of sewer back ups. In 2004, eight serious sewer back up events took place across the country in PEI, New Brunswick, Quebec, Ontario, Manitoba and Alberta. Pang described some of the impacts in terms of insurance claims for storms such as:

- the June 9-10, 2002 event in Peterborough;
- the June 27, 2002 event in Ottawa;
- the June 16-19, 2005 event in High River Alberta; and
- the August 19, 2005 storm in Toronto.

Pang noted that as of October, 2005 there were over 17,000 claims received from the recent Toronto storm. These were for damage to automobiles, personal property (wind and hail related), personal property (sewer backup) and commercial property. Losses totalled more than \$360 million, with about 70% of this attributable to damage to personal property from sewer backups.

Pang finished his presentation by stressing the importance of funding infrastructure maintenance and renewal. He noted that in 1995, the Prime Minister spoke of eliminating the budget deficit “come hell or high water”. The budget deficit has been eliminated, noted Pang, but the water is still rising.

Climate Change and Atmospheric Hazards – A Risk Management Approach

Joan Klassen from Environment Canada gave a presentation on “Climate Change and Atmospheric Hazards: A Risk Management Approach”. She began by showing the increasing costs (both economic and insured) of natural disaster losses between 1980 and 2000. She noted that community vulnerability to high impact weather is increasing because of increasing populations, more affluence and property and increasing urbanization, coupled with aging, deteriorating infrastructure, decreased spending on new infrastructure, and increasing dependence on electricity, electronics and communications.

Klassen noted that in the spring and summer of 2000, there were several high impact rainfall events in southern Ontario, some of which exceeded the 100-year frequency of occurrence. One of these storms was linked to the Walkerton tragedy. She described the magnitude and impacts of some of these “celebrity storms” including the northwestern Ontario flood of June 8-11, 2002, the Peterborough flood of July 14-15, 2004, and the Toronto flood of August 19, 2005. Klassen also reviewed other climate-related events such as the Ice Storm of 1998, the Toronto snowstorms of January 1999, tornadoes in 2004 and 2005, and periodic droughts since 1997.

Klassen then went on to examine some projected changes in extreme precipitation, extreme temperatures (minimum and maximum) and increased vulnerability to ice storms for southern Ontario. As part of Ontario's *Emergency Management Act* (Bill 148), municipalities are required to develop risk-based emergency management programs. The first phase of the assessment is a hazard risk assessment. Klassen stressed that this should include assessing the atmospheric such as: fog, lightning, heavy rain, heavy snow, hurricanes, wind storms, tornadoes, extreme heat and cold, ice storms, drought and extreme air quality events. As a tool to help municipalities in hazard assessment, Environment Canada in partnership with Emergency Management Ontario has developed a report (Atmospheric Hazards in Ontario) and a related website (www.hazards.ca). The aim of the website is to help the Canadian public reduce the threat to life and property from high impact weather. At the website, Emergency Management Coordinators and others can access maps, data and information on atmospheric hazards such as the frequency of tornadoes or extreme rainfall events across the province.

TRCA Climate Change Initiatives

Don Haley from TRCA finished off the formal presentations at the workshop with his talk on "Integration of Climate Change Impacts and Adaptation into Municipal Policy and Programs: A Focus on Water Management". He noted that in the mid-1990s TRCA had identified climate change as an important issue that related to its watershed management mandate. At the time it was noted that existing changes in urbanization had already modified surface and sub-surface components of the hydrologic cycle, and the additional changes in the rainfall regime because of a changing climate would create significant challenges for managing watersheds in the future.

To address the issue, TRCA with the assistance of Environment Canada and the MOE hosted a symposium on Climate Change and Watershed Management. One of the key findings of the symposium was that Watershed Planning could provide a unique platform to integrate both climate change mitigation and adaptation into water resources management. Since then, TRCA has begun to develop the baseline data and watershed analysis tools that are needed to integrate climate change into watershed planning. This includes development of:

- a comprehensive groundwater model;
- base flow mapping and an inventory of water users;
- water budgets in each watershed; and
- continuous simulation hydrologic models.

In the current Update of the Rouge River Watershed Plan, Haley noted that two climate change scenarios were selected to represent future conditions that are either wetter and warmer or drier and warmer. Modelling will predict the effects of these scenarios on factors such as water budget. The potential climate change impacts will be integrated into the policies and management programs for the Rouge Watershed.

Group Exercise on Risk Management Adaptation Strategies

Al Douglas from C-CAIRN set the stage for the Group Exercise on Risk Management Adaptation Strategies, by explaining that it was designed to provide insight into the Risk Assessment process and the kinds of issues that might be addressed in a Climate Change Vulnerability Assessment. To provide a context for the exercise, the organizers had created a fictitious community of Wetbury, which was described in the Workshop materials. For the exercise, participants should assume that climate variability can damage communities and that climate change may exacerbate vulnerabilities and risks.

Douglas assigned four climate-related scenarios to be used as the basis for the Group Exercise. These were:

- increase in drought (Red Group with facilitator, Joanna Kidd);
- increase in heavy rainfall in the urban area (Green Group with facilitator, Don Haley);
- increase in heavy rainfall in the rural area (Yellow Group with facilitator, David Pearson); and
- increase in winter ice storms (Blue Group with facilitator, Al Douglas).

The results of the Group Exercise are presented in the following pages.

Red Group: Increase in Drought

Description of scenario: The group defined the scenario to be warmer and drier conditions for three months in the summer with a likelihood of being repeated in future years.

Identified Impacts:

- Reduction in groundwater levels*
- Reduction in surface water levels
- Increase in water usage
- Reduction in surface water quality (including algal blooms, botulism)*
- Warmer surface water
- Reduction in baseflow to rivers
- Shortage of potable groundwater
- Taste and odour problems with drinking water from surface water sources
- Water allocation conflicts among users*
- Degradation of riparian/shoreline habitat*
- Fisheries affected by water quality
- Stress on urban forest
- Human health impacts from heat*
- Increase in energy use (air conditioning)
- Reduction in aesthetics of lake

The group selected a range of important impacts (marked with asterisks) for further assessment.

Prioritized Vulnerability/Risk for Increase in Drought

		Selected Impacts				
		Reduced Groundwater Levels	Reduced Surface Water Quality	Water Use/ Allocation Conflicts	Health Impacts of Heat	Degraded Shoreline Habitat
Severity of Impact	Economic	H	M	H	H	L
	Environmental	H	H	L?	M	H
	Social	M	M	M	H	L
Probability of Occurrence		H	H	L	H	H
Prioritized Vulnerability/Risk		3	2	5	1	4

After discussion, it was agreed that the highest vulnerability/risk was associated with the human health impacts of heat.

Adaptation Strategies for Health Impacts of Heat:

Short-Term

- Institute a Heat Alert Response System
- Conduct public education on heat coping (such as hats, clothing)
- Set up cooling centres
- Increase resources for emergency services

Long-Term

- Reduce urban heat island effect through green roofs, etc.
- Improve building standards and design
- Plant more trees

Green Group: Increase in Heavy Rainfall (Urban)

Description of scenario: The group defined the scenario as an increase in heavy rainfall that exceeds infrastructure design standards.

Identified Impacts:

- Flooding of basements*
- Flooding of streets (such that emergency vehicles cannot move freely)*
- Washouts of roads
- Overflows of sanitary sewers into watercourses
- Contamination of surface water (source of drinking water)*
- Increased contaminated runoff from industries
- Utility disruption (hydro, telephone, and radio)*
- Economic losses for local businesses
- Closure of airport*
- Contamination of groundwater

The group selected a range of important impacts (marked with asterisks) for further assessment.

Prioritized Vulnerability/Risk for Increase in Heavy Rainfall (Urban)

		Selected Impacts				
		Basement Flooding	Contamination of Surface Water	Utility Disruption	Street Flooding	Airport Closure
Severity of Impact	Economic	H	L	H	L	H
	Environmental	M	H	L	M	L
	Social	H	H	H	M	M
Probability of Occurrence		H	L	M	H	L
Prioritized Vulnerability/Risk		1	3	2	3/4	5

After discussion the group identified basement flooding as the highest vulnerability/risk.

Adaptation Strategies for Basement Flooding:

- Install backflow valves in homes
- Change grading around homes to direct surface water away from foundations
- Develop source control program (such as disconnecting downspouts, installation of porous pavement and use of rain barrels)
- Separate sanitary and storm sewers
- Study and prioritise works

Yellow Group: Increase in Heavy Rainfall (Rural)

Description of scenario: The group defined the scenario to be rainfall that lasted a long time (several days) and which saturated the ground.

Identified Impacts:

- Flash flooding in rivers and streams
- Soil erosion
- Crop damage*
- Contamination in runoff
- Interference in business operations*
- Flooding of basements*
- Washouts of Roads
- Impacts on fish habitat (scouring and siltation of spawning beds)
- Contamination of municipal and private wells*
- Increased risk to personal safety*
- Negative publicity for tourism

Prioritized Vulnerability/Risk for Increase in Heavy Rainfall (Rural)

		Selected Impacts				
		Crop Damage	Business Interference	Basement Flooding	Contamination of Municipal and Private Wells	Increased Risk to Personal Safety
Severity of Impact	Economic	M	M	L	H	
	Environmental	L	L	L	H	
	Social	L	L	H	H	
Probability of Occurrence		H	H	H	H	
Prioritized Vulnerability/Risk		4	2(tie)	2(tie)	1	

After discussion the group identified contamination to municipal and private wells as the highest vulnerability/risk.

Adaptation Strategies for Contamination of Wells:

- Improved training of water system operators with proper regulation and increased oversight
- Develop an emergency response plan for well contamination
- Increase monitoring and testing of municipal wells
- Improve communication with Medical Officer of Health
- Improve communication with public
- Make resources available for quick response
- Develop a prevention/protection plan
- Conduct risk assessment of individual wells (municipal and private)
- Educate farmers on best practices for handling manure, pesticides and fertilizers
- Improve septic system inspection and planning to take into account soils and extreme rainfall events
- Consider converting houses on septic systems to municipal
- Increase awareness of potential threats and build political will to act
- Provide back up/alternative water supply

Blue Group: Ice Storm

The group started out by setting management objectives:

- Ensure the safety of residents
- Keep lines of communication open
- Ensure adequate supply of power
- Keep transportation routes open
- Develop a strategy for how to deal with ice storm
- Educate public in advance of the event
- Ensure that emergency services are functioning
- Develop a team approach involving fire, police, the mayor and health care providers

Identified Impacts:

- Impassable sidewalks
- Flooding of rivers (ice interfering with flow)
- Loss of hydro (blackout)
- Essential services affected include: sewer, drinking water, telephone, waste collection, police, fire service, ploughs, salt trucks
- Rail lines and roads affected; food delivery impaired
- Access issues relating to bridges, roads and hospitals
- Closure of airport (affects travel and essential supplies)
- Personal injury (especially the elderly and homeless)
- Contamination of water systems
- Damaged infrastructure from fallen trees
- Tree damage
- Economic impacts relating to closures and interruption of businesses
- Economic impacts relating to insured and uninsured property damage
- Question of financial assistance from province and federal government
- Social impacts include closure of schools
- Lack of heat leads to burst pipes
- Loss of social order (panic and looting)
- Loss of wildlife
- When ice melts, impacts from massive flow of water

Prioritized Vulnerability/Risk for Increased Ice Storms

		Selected Impacts				
		Loss of Transportation	Contamination of Surface and Groundwater	Impacts on Essential Services	Loss of Communication	Ecosystem Impacts
Severity of Impact	Economic	H	H	H	L	M
	Environmental	L	H	M	L	H
	Social	H	H	H	H	M
Probability of Occurrence		H	L	H	H	H
Prioritized Vulnerability/Risk		2 (tie)	2 (tie)	1	5	2 (tie)

After discussion the group identified the impacts on essential services as being the highest vulnerability/risk.

Adaptation Strategies for Impacts on Essential Services:

- Build in redundancy
- Develop independence from networks
- Develop local generation of power (as backup)
- Maintain infrastructure
- Improve design standards
- Be less dependent (e.g., have ample food in storage)

- Improve weather forecasting
- Develop an emergency plan (adaptive)
- Purchase ice grips and other equipment to allow people to move around
- Develop alternative transportation routes