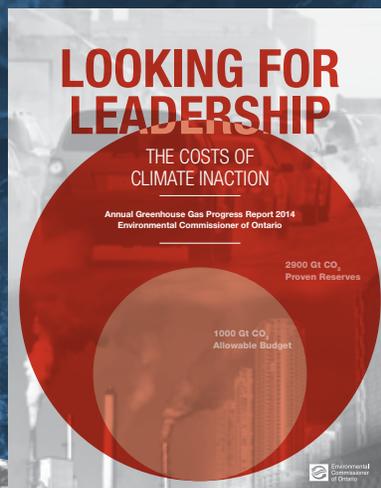


SINK, SWIM OR TREAD WATER?

ADAPTING INFRASTRUCTURE
TO EXTREME WEATHER EVENTS



(AN EXCERPT FROM THE ECO 2014 ANNUAL GREENHOUSE GAS PROGRESS REPORT)



Environmental
Commissioner
of Ontario



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Ontarians are learning that in a changing climate one of the few things they can expect is the unexpected. Destructive weather and associated flooding are becoming the new normal, and are challenging traditional approaches to stormwater management. Multiple levels of government have responsibilities for stormwater management in Ontario. While municipalities are finding themselves exposed on the front lines, the province also has a responsibility to provide oversight and meet its regulatory role in stormwater planning and management. This booklet examines the extent to which the provincial government is fulfilling its responsibility to provide leadership to municipalities in a changing and uncertain climate.

A New Normal: Extreme Storms in Ontario

Ontario has always experienced storms; however, the province has recently faced more intense and frequent extreme weather, as well as unprecedented damage costs.

During a storm in July 2013, parts of Toronto were inundated with up to 126 millimetres (mm) of rain in approximately two hours. This was almost *twice* the average monthly precipitation for July and more than the previous daily rainfall record of 121.4 mm set during Hurricane Hazel in 1954. Insured property damage from this event is estimated at \$940 million, while the City of Toronto faces uninsured costs of approximately \$60 million, making it the most expensive natural disaster in Ontario's history. During a similarly destructive Toronto storm in 2005, areas north of the city received up to 175 mm





of rain over several hours, exceeding the criteria for a 1-in-100 year storm (i.e., a storm with a 1 per cent chance of happening in any year). As a result, a major roadway was washed out at a cost of \$600 million in insurance payments alone. Other municipalities, ranging from Sault Ste. Marie to Peterborough to Thunder Bay have also experienced multiple 100-year storms over the past 15 years.

Flooding from extreme weather has also hit small, northern communities. Many of these towns are surrounded by provincial Crown land and, therefore, do not benefit from the safeguards provided by conservation authorities (conservation authorities are watershed-based government agencies that, among other things, administer flood management programs). For example, in October 2012, the small town of Wawa was stranded when a catastrophic storm washed away parts of the Trans-Canada Highway, as well as roads, houses and businesses; this resulted in damages that could total \$20 million.

Flooding also causes serious environmental damage. For example, the 2013 Toronto flood overwhelmed wastewater treatment plants and stormwater systems; up to a billion litres of sewage, as well as garbage and debris, were washed into Toronto's rivers and Lake Ontario. Municipal wastewater carries bacteria, nutrients, chemicals and other contaminants; this contributes to eutrophication, increases toxic loadings to the aquatic food web and presents risks to human health. Violent stormwater flows also cause shoreline and riverbank erosion.

Built-up urban areas are especially prone to flooding; highly developed watersheds lose most of their capacity to absorb precipitation and runoff before it reaches stormwater systems and flows into rivers. Trees and other vegetation slow rain as it falls and flows over the landscape, allowing water to permeate into the ground. In contrast, impermeable urban land cover, such as pavement and buildings, increases the volume and speed of runoff.

Experts predict that insurance rates will go up, that some types of liabilities, such as wet basements, will not be covered and that, in some locations, homes may not be insurable at all.



Industry and Municipal Responses to Changing Flood Patterns

The growing incidence of extreme and unstable weather events has been a wake-up call for a variety of players, both in the private and public sectors.

The insurance industry is introducing policy changes in response to the costs of extreme weather. While fire was once the leading cause of property insurance claims in Canada, the Insurance Bureau of Canada reports that in recent years, water and wind damage caused by severe weather has become the top concern. As a result, insurance companies and experts predict that insurance rates will go up, that some types of liabilities, such as wet basements, will not be covered and that, in some locations, homes may not be insurable at all.

Some larger municipalities are attempting to implement best management practices, such as green infrastructure, to better manage increased stormwater flow. They are also experimenting with innovative financial tools to fund stormwater infrastructure (see Box 1, Municipal Best Practices for Stormwater Management).

However, smaller municipalities often lack the capacity to independently design, test and implement new engineering or financing approaches. Both large and small communities are already struggling with the costs of replacing aging infrastructure. Most municipal water infrastructure in Ontario was built between the 1950s and 1970s and is now nearing the normal end of its life. As a result, Ontario municipalities face a deficit of \$6.8 billion for the repair and replacement of stormwater infrastructure alone.

When municipalities do undertake the costly process of replacing aged stormwater infrastructure, they will require guidance about future climate projections and best management practices. Without this direction, communities run the risk of installing new – but ultimately inadequate – systems that cannot handle projected water flows.

Box 1: Municipal Best Practices for Stormwater Management

Conventional stormwater infrastructure typically involves conveyance and end-of-pipe tools, such as pipes, ditches and retention ponds. However, it is beyond the financial capacity of municipalities to install conventional stormwater systems that can handle 1-in-100 year storms. Therefore, some communities are looking to alternative means of managing stormwater.

Certain municipalities have used financial tools to create a more reliable funding base for the costs of maintaining and updating stormwater infrastructure. The cities of Kitchener and Waterloo collaboratively implemented a stormwater rate system to fund their stormwater management program. Land owners pay rates based on the amount of runoff expected from a property, using criteria such as property size and the amount of area covered by impervious surfaces. As a result of this user-pay approach, Kitchener and Waterloo are better able to recover stormwater management costs.

Some municipalities are also introducing green infrastructure – such as green roofs, permeable pavement and rain gardens – which use vegetation and ecological processes to retain and treat stormwater on-site.

Green infrastructure and stormwater financial tools can also be combined. For example, Kitchener and Waterloo home owners and businesses can apply for a credit to their stormwater rate if they implement source control measures that reduce runoff or improve water quality, such as rain barrels or green roofs. Similarly, the City of Mississauga is planning to implement a stormwater user rate system that will be complemented by low-impact development undertaken by the municipality. Mississauga has been recognized for its partnership with the Credit Valley Conservation Authority in using permeable surfaces and vegetation to retain and treat runoff on municipal properties, such as school yards and road allowances. By using multiple retention tools that include green infrastructure, existing stormwater systems are better able to manage stormwater – and hence, protect property – during extreme weather.

Recent unprecedented weather events have already disrupted the status quo. The insurance industry is responding to control its losses. Municipalities are realizing that some types of flood damage may no longer be insurable. Some large municipalities may be experimenting with new approaches, but most are simply overwhelmed. According to a feature article on infrastructure resiliency in a recent issue of *Water Canada*, “many municipalities feel they are in limbo when it comes to predicting what a changing climate demands of system design and capacity.” Clearly there is a need for higher level co-ordination, guidance and leadership.

The Expert Panel stressed that there was no time to waste and “urged prompt and vigorous action...”

Ontario’s Responsibility for Stormwater Management

The provincial government has a vital leadership and regulatory role to play in the design, management and delivery of municipal stormwater infrastructure. However, the involvement of multiple ministries (see Box 2, Responsibilities of Provincial Ministries Related to Stormwater Management) – as well as municipalities and conservation authorities – each with overlapping mandates and accountabilities, complicates the planning and implementation of stormwater infrastructure that can accommodate the stresses imposed by a changing climate. Moreover, there is no clear lead ministry responsible for addressing urban flooding.

In 2009, Ontario’s Expert Panel on Climate Change Adaptation (the “Expert Panel”), released a report that emphasized the province’s responsibility to provide leadership on climate change adaptation. The very first recommendation called for Ontario to “enhance provincial government capacity to take leadership” in managing climate change risks, as well as highlighting the province’s responsibility to “increase efforts by communities to improve climate change resilience ...”. The Expert Panel stressed that there was no time to waste and “urged prompt and vigorous action” to develop and implement a strategic plan.

Municipalities have also called for provincial direction. In January 2014, 19 mayors and three municipal chairs of the Greater Toronto Area not only requested disaster relief funding after the December 2013 ice storm, but also unanimously asked that the province show leadership with new and stronger programs to help municipalities adapt to climate change. Similarly, conservation authorities have requested the provincial government provide policy and funding support for green infrastructure, updated floodplain maps, emergency planning and infrastructure asset management.

The ECO has urged ministries – as far back as 2007 – to update the rules, policies and guidelines dealing with stormwater and flood prevention in light of climate change.

Box 2: Responsibilities of Provincial Ministries Related to Stormwater Management

Ministry of the Environment

- Developed the Stormwater Management Planning and Design Manual to provide guidance for planning, designing, operating and maintaining stormwater management infrastructure
- Issues Environmental Compliance Approvals for stormwater infrastructure

Ministry of Municipal Affairs and Housing

- Administers the Provincial Policy Statement, which provides direction to municipalities on land use planning, including restricting development from lands subject to flooding or erosion hazards
- Operates the Ontario Disaster Relief Assistance Program, which provides some compensation for property damaged or destroyed due to natural disasters

Ministry of Natural Resources

- Ministry assigned provincial lead for water-related natural hazards including flood hazards
- Monitors weather, rainfall and stream flows, provides advisories to conservation authorities and MNR district offices on flood potential
- Shares aspects of public safety and natural hazard prevention with municipalities
- Administers *Conservation Authorities Act*, delegating flood management responsibilities to conservation authorities where they have been established in the province
- Provides, through Emergency Management Ontario, support to municipalities during flooding when municipal resources are overwhelmed

Ministry of Transportation

- Provides design standards for provincial culverts, bridges and highway drainage systems

Ministry of Infrastructure

- Is responsible for administering infrastructure investment and managing sustainable growth



The Provincial Response So Far

The province itself has promised leadership on climate change adaptation, including guidance for stormwater management and planning. Commitments made in the province's Climate Ready Adaptation Strategy and Action Plan ("Climate Ready"), released in 2011 and covering the 2011 – 2014 period, were shared across several ministries, including MOE, the Ministry of Infrastructure (MOI), MNR and MMAH.

Minimal Guidance from the Ministry of Infrastructure

Climate Ready made two explicit commitments related to public infrastructure. First, it promised to build climate change adaptation into Ontario's 10-year infrastructure plan. Second, it committed to undertake vulnerability assessments of infrastructure.

On the first front, MOI did acknowledge in its 2011 infrastructure plan, *Building Together*, that "climate change will have a significant impact on stormwater systems...". The plan promised a roll-out of new requirements for performance measures and reporting for municipal water systems, including stormwater, under the *Water Opportunities Act, 2010*, but offered few details and no timelines. The ECO has not observed any roll-out of performance measures for municipal stormwater systems to provide such design guidance.

On the second front – climate change vulnerability assessments – MOI's progress has been even more tentative. Indeed, the ministry has missed a golden opportunity to make vulnerability assessments a core element of asset management planning at the municipal level. Over the years, the ministry has been emphasizing the need for asset management plans, after observing that fewer than 40 per cent of municipalities had these tools in place. In 2012, the ministry made asset management plans a pre-condition for municipalities to receive infrastructure funding support, and also published a 40-page how-to guide, setting out minimum expectations.



Unfortunately, MOI's guide does not make vulnerability assessments a mandatory component; nor does it explain the concept. The guide includes useful advice on financial planning, data collection and public engagement, but the looming issue of vulnerability to climate change is relegated to a single illustrative bullet point in a back page. MOI's guide leaves municipalities to puzzle through the linkages between infrastructure planning and climate change adaptation for themselves.

Nova Scotia, in contrast, has given its municipalities in-depth guidance, with its 2011 Municipal Climate Change Action Plan Guidebook. Nova Scotia's Guidebook walks municipalities through identifying vulnerabilities, hazards and key infrastructure, and helps prioritize actions. The Guidebook is similarly linked to a strong incentive, since municipalities must submit their climate change plans to qualify for funding support.

MOE: Retreating from Commitments?

MOE promised to develop guidance for stormwater management in response to climate change; this was Action 10 in the province's Climate Ready Action Plan. In 2010, the ministry had made similar and even more detailed commitments after a three-year internal review in response to an *EBR* application. The promised guidance is still in preparation, however, and the ECO has been told it will not be available for public comment before the end of 2014. In the face of increasingly severe weather patterns and calls for action stretching back to 2007, this delay is unacceptable.

More troubling still are indications of retreat from reforms MOE had viewed as necessary four years ago in its review of stormwater management. In 2010, the ministry felt that its 2003 Stormwater Management Planning and Design Manual needed to be updated to reflect the need for climate change adaptation. Rather than doing so, however, the ministry is drafting only supplementary and voluntary guidance on low impact development. As such, despite its commitment in 2010 to do so, there is no indication the ministry is working on an "MOE policy framework ... to support resilient municipal stormwater management systems and adaptation to

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climate change". Nor does the ministry appear to be strengthening its "approvals process for municipal stormwater management ... to include source control best practices," despite highlighting this need as a key finding in 2010.

Updated Floodplain Mapping: An Orphaned Responsibility

The big lesson Ontario learned from Hurricane Hazel – not to build on floodplains – has helped enormously to prevent flood damage over the past five decades. In acknowledgment, Climate Ready noted the value of floodplain maps to identify flood-prone areas and to be used as a tool to steer development away from them. But many of Ontario's floodplain maps date from the 1970s and 1980s, and do not reflect the twin realities of rapidly urbanizing landscapes and extreme weather events. As upstream areas of watersheds are paved over, increased runoff can dramatically alter downstream flooding patterns – alterations that old maps fail to capture. Changing precipitation patterns are also not reflected in the old maps.

Ontario's conservation authorities have long been warning that many, if not most, of their floodplain maps are outdated – the estimates range from 50 to 80 per cent. On average, Ontario's floodplain maps are 22 years old, with many only available in hard copy format, rather than digitized. In 2013, Conservation Ontario estimated that the one-time cost to update all these maps to a standard that would be suitable for effective emergency management and planning would be \$24 million.

That Ontario's floodplain maps urgently need updating is not in dispute – the need has been highlighted by the Expert Panel, the insurance industry and the ECO. A dispute does revolve, however, around who should take leadership and who should pay. Both the Expert Panel and the ECO have called on MNR to lead this exercise, in collaboration with conservation authorities. Conservation Ontario recommends sharing the cost among all levels of government, arguing that many municipalities simply do not have the resources to cover this work on their own. The perspective of the insurance industry is that a centralized database at the provincial or even



federal level would have value, and have called for independent, science-based mapping that would be less subject to political influence. The industry's concern is that, in the absence of a clear directive from a senior level of government, municipalities would find it politically challenging to forbid local short-term economic development on lands newly identified as flood prone.

For its part, MNR has resisted leading or funding the update of floodplain maps, and Climate Ready did not contain a commitment to do so. Ministry staff acknowledge there are gaps in mapping but believe that conservation authorities are adequately empowered for the task, that some are in fact producing updated maps, and that municipalities can find ways to fund the work. This position is contrary to concerns raised by conservation authorities and the insurance industry about outdated floodplain maps. MNR's position also fails to address the needs of small municipalities not associated with conservation authorities and who do not have the capacity to undertake updated floodplain mapping on their own.

Missed Opportunities in the Review of the Provincial Policy Statement

Climate Ready committed the government to integrating climate change adaptation policies into the Provincial Policy Statement (PPS) – the touchstone document relied on by land use planners for provincial guidance and direction.

Climate change is explicitly acknowledged as an issue in the new PPS released in February 2014 by MMAH. A handful of scattered language changes now advise that planning authorities: "shall consider" impacts from climate change, "shall ... support climate change adaptation," and "should promote" green infrastructure. MMAH also added new direction on planning for stormwater management, but inexplicably omitted any reference to climate change in that section.

In the absence of new standards, targets, training and clearer direction from the Ministry of Municipal Affairs and Housing and other ministries, most communities will stick with familiar, business-as-usual approaches, especially if short-term costs are lower.

Requiring that municipalities “consider” climate change is an important first step. Unfortunately, it will not be nearly sufficient to make climate change adaptation a transcending theme for future land use planning, as was called for by the Expert Panel in 2009. The only other guidance that MMAH provides to municipalities on planning for climate change appears to be a four-page Infosheet produced five years ago. In the absence of new standards, targets, training and clearer direction from MMAH and other ministries, most communities will stick with familiar, business-as-usual approaches, especially if short-term costs are lower.

Stronger climate change direction could and should have been integrated into the 2014 PPS, especially considering that the document’s next review is likely five to ten years in the future. For example, MMAH had the opportunity to:

- Require municipalities to identify infrastructure and lands vulnerable to climate change, just as the PPS 2014 now requires municipalities to identify growth and development areas and natural heritage systems;
- Not permit development in flood-fringe areas, especially in light of the fact that most floodplain maps do not reflect projected changes in precipitation patterns;
- Require that planning for stormwater management reflects changing precipitation patterns as already observed in many Ontario locations and as predicted by climate change models; and
- Roll out more detailed planning tools, guidance, outreach and training on climate change adaptation, as well as relevant performance measures and ongoing review, as the ministry had promised in Climate Ready.

On stormwater management and climate change, Ontario ministries have unfortunately not yet stepped up to their responsibilities.

ECO Comment

Ontarians count on the provincial government to provide leadership and direction when consistent, province-wide vision and regulation is needed, especially when public safety is at risk. Such provincial oversight has been offered – and even imposed – in the past. After Hurricane Hazel in 1954, the province directed conservation authorities to map floodplains and later the province, in conjunction with conservation authorities, developed regulations that could restrict development in these areas. Similarly, the Ontario government has provided direction over the last decade to protect the public and overhaul drinking water safety through the *Safe Drinking Water Act, 2002* and *Clean Water Act, 2006*.

The province's role to lead and set an overarching vision is also well established in land use planning through the *Planning Act* and the Provincial Policy Statement. The result has been more coherent and consistent public policy, and arguably, wiser stewardship of Ontario's public resources than municipalities would have achieved in isolation.

On stormwater management and climate change, Ontario ministries have unfortunately not yet stepped up to their responsibilities. In a number of areas, they have in fact stepped back from their own recent commitments. The ECO urges the province to clarify that strategic leadership and inter-ministerial co-operation is expected on this file. Necessary actions include:

- Ensuring that public infrastructure is assessed for its vulnerability to climate change;
- Updating the policy and approvals framework for municipal stormwater management in light of a changing climate;
- Creating a funding structure and an independent science-based process for updating floodplain maps; and
- Providing municipalities with the necessary tools, guidance and training to respond to a changing climate.



There are very real public safety and environmental implications if the Ontario government fails to act. There are also huge economic implications; without supporting and regulating climate change adaptation at the provincial level, the future costs of responding to extreme weather will be much higher. The province can choose to either support proactive planning now or pay disaster relief again and again. Extreme weather has become an inescapable new normal and provincial leadership is crucial if Ontario and its communities are to adapt. Treading water is no longer an option.



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**Environmental
Commissioner
of Ontario**

1075 Bay Street, Suite 605

Toronto, ON M5S 2B1

Tel: 416-325-3377

Fax: 416-325-3370

1-800-701-6454

www.eco.on.ca

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