Climate Change Impacts and Adaptation in Ontario: **Infrastructure Risk Management**

Introduction

Infrastructure, such as schools, hospitals, roads, bridges and water systems, are essential for providing services, growing the economy, and ensuring a high quality of life for all Ontarians. Disruptions to Ontario's infrastructure as a result of climate change have already occurred in all parts of the province[2] and risks to the integrity of Ontario's infrastructure systems are expected to rise as the climate continues to change. At the same time, Ontario's population is expected to grow by roughly 30 percent by the year 2041[1]. This will drive the need to invest in infrastructure that can withstand the impacts of climate change while accommodating the demand of a growing population.

The replacement value of Ontario's public infrastructure is valued at close to $550 billion[1].

To ensure a well-functioning society and future economic prosperity, the Ontario government is investing $160 billion over 12 years starting in 2014-15 – this is considered the largest infrastructure program in Ontario's history. This investment also provides an important opportunity to integrate climate change considerations into infrastructure maintenance and expansion. The Moving Ontario Forward infrastructure plan will align unprecedented infrastructure investments Ontario's Climate Change Strategy. The integration of the climate strategy can help ensure that new infrastructure investments support provincial efforts to reduce emissions, and will ensure that investments are resilient in a changing climate[3].

Climate Change Risks

The impacts of a changing climate on Ontario's infrastructure are widespread. Beyond direct physical impacts and damages sustained by assets, consequences will also be felt by individuals, communities and businesses who rely on that infrastructure.

Climate change impacts can appear through both gradual changes in climate and from increasing variability and extremes. Increased average temperatures will lead to greater

exposure to freeze-thaw cycles and increased damage to roads. Likewise, rising average temperatures leading to increased frequency, severity and extent of forest fires also increases the likelihood that homes, buildings and people are at risk[2]. High intensity precipitation events and severe droughts increase the likelihood that flooding and erosion leads to damage to transportation, buildings, and stormwater infrastructure.

To better understand risks and consequences, it is important to recognize infrastructure systems do not exist in isolation and are often interdependent. Consequently, a failure in one area can lead to a failure in another, ultimately increasing the associated economic costs of various extreme weather events[2]. For example, failure in a hydropower station can disrupt the operation of a water system that relies on the energy being produced. Infrastructure owners and operators may therefore need to respond by understanding the far reaching impacts beyond a single infrastructure asset, and focus on building resilience within and between infrastructure systems[6].

Examples of how climate change is affecting communities across Ontario are prevalent. For communities in the Far North of Ontario, shorter ice road seasons has meant increased reliance on air transportation and, consequently, higher costs for food and other materials. Extreme rainfall events have led to localized flooding, causing damage to roads, buildings and disrupting power lines, disrupting businesses and lives. These recent events provide insight into what continued climatic change might mean for Ontario communities.

Melting permafrost is leading to unreliable ice roads, reducing access to necessary items like food.

Climate Resilient Infrastructure

Infrastructure is designed to provide services over a time period lasting anywhere from 10 to 100 years. Well maintained infrastructure that integrates climate change considerations can reduce climate-related infrastructure failures, and can contribute to increased community resilience.[2]

There are many adaptation tools and resources available to support development of climate resilient infrastructure in Ontario. For example, Engineers Canada has developed a risk and vulnerability assessment protocol to help engineers, designers, infrastructure managers consider climate change risks to infrastructure. The Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol is a formalized process that can be applied to any type of infrastructure to assess engineering vulnerability and risk from current and future climate impacts. As of

The PIEVC Protocol includes a five step process to analyze the engineering vulnerability of an individual infrastructure to current and future climate.

2013, nearly 30 case studies using the protocol have been completed across Ontario and Canada.

Practitioners looking to adapt stormwater infrastructure can consider the use of green infrastructure. For Ontario's combined sewer systems - located in 89 municipalities across the province – green infrastructure can reduce vulnerability to the impacts of climate change.

Bioretention cells and permeable pavers installed in Mississauga, ON provided effective stormwater infrastructure relief during a July 2013 storm event (Image: CVC)

Although a relatively new concept, green infrastructure uses trees, vegetation, and wetlands, or engineered systems that mimic natural landscapes and the natural water cycle. Green infrastructure manages stormwater at the source by capturing and slowing runoff before it can reach the sewer system, thus reducing impacts from climate change by reducing surface water discharges that contribute to flooding[5]. The term 'green infrastructure' includes engineered solutions such as green roofs and green walls, permeable pavement, rain barrels, as well as existing natural features (e.g. wetlands and urban forests). Other benefits to building or enhancing green infrastructure include improved air quality, reducing urban heat-island effect, reduced erosion, energy conservation, and enhanced ground water supply and stream flow.

Climate Change Adaptation Resources

Natural Resource Canada's Adaptation Platform is a unique online resource hub for tools and information that members of the infrastructure sector can use to support their efforts to adapt to a changing climate. Led by the Climate Change Impacts and Adaptation Division (CCIAD), the Adaptation Platform is a national forum that brings together key Working Groups to collaborate on various climate change adaptation priorities and to produce project-level research and activities. The Infrastructure and Buildings Working Group aims to support adaptation of public infrastructure and buildings to climate change.

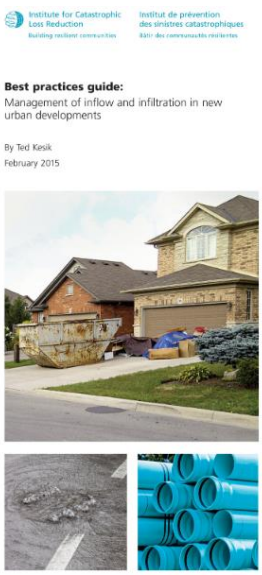
How can the adaptation platform products help?

The following is a sample of resources available on the platform that members of the infrastructure sector can utilize in their efforts to prepare for a changing climate:

Product: **Cities Adapt to Extreme Rainfall**

Description: Cities Adapt to Extreme Rainfall is an online webpage that provides 20 highly accessible best practice case studies of practical measures applied by municipalities across Canada for adapting homes and infrastructure to the impacts of extreme rainfall. Examples from Ontario include: regulations of the construction of new homes to ensure that builders install backwater valves (City of Ottawa); and the development and implementation of incentives for at-risk homeowners to disconnect weeping tiles (City of London).

Product: **Best Practices Guide: Management of Inflow and infiltration in new urban developments**



Description: This best practices guide is aimed at municipalities, and the development and home building industries. The guide outlines approaches that can be applied during the planning and construction phases to limit the occurrence of inflow/infiltration in wastewater systems over the lifespan of wastewater infrastructure servicing new developments at the subdivision scale.

Product: IDF CC Tool: Updating IDF curves to account for climate change impacts

Description: The IDFCC Tool is a publicly accessible, online tool that allows for local water managers and other interested stakeholders to apply Global Climate Models (GMCs) outputs to local Intensity Duration Frequency (IDF) curves to generate updated IDF curves that account for climate change impacts. The Tool provides access to outputs from 22 GCMs, and is pre-loaded with rain monitoring data (e.g., annual maximum precipitation events) from roughly 700 Environment Canada rain monitoring stations. Users can also create and enter data for their own rain monitoring stations.

Footnotes

[1] Ontario Government, 2017a
[2] IISD, 2013
[3] Ontario Government, 2017b
[4] CVC, 2013
[5] Podolsky and MacDonald, 2008
[6] Lloyd`s, 2017

Full References

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