A1226 Pryce: Government Roles in Climate Change Adaptations for Urban Infrastructure

Executive Summary

Climate change has been recognized by the international scientific community as an event in which human activities are contributing to the cause (IPCC). Though mitigation measures are likely to assist with the rate and degree of change, it is more than likely that the impacts of climate change, whether influenced by humans or not, will be unavoidable. It will therefore be important to look at ways in which we plan our communities and supporting infrastructure to adapt to these impacts. This will be an important component in working towards achieving sustainable communities.

Adaptation methods assume that climate change will occur, and aim to find ways to adjust to these changes. Adaptation involves not only examining the ways that climate change will negatively impact a community, but also looking at ways communities can gain from climate change. Government plays an important role in creating a framework to enable adaptation; offering climate change expertise and financial resources to implement adaptation techniques.

This study aims to examine the roles and responsibility of government in considering the role of climate change adaptation as it relates to the development of urban infrastructure. The analysis identifies potential impacts that may result from climate change impacts, and a review of legislation, policy and regulations to establish if decision-makers have the ability to consider climate change adaptation approaches. For the purposes of this study, we have restricted our analysis to City infrastructure, namely waterways and greenways, stormwater, utilities, roadways, sanitary sewer, solid waste disposal, and emergency preparedness systems.

In undertaking the analysis, the study focuses on the infrastructure related to the City of Fredericton, New Brunswick. The City has similar locational and infrastructure challenges that are faced by many Cities located across Canada. Based on consultation with Environment Canada and current modeling trends on the potential impacts of climate change, the following projections for the Fredericton Area for 2050 were identified:

Climate Change Elements	Projections for the Fredericton Area for 2050
Temperature Changes • Increase • More Extremes • More Variability	Higher annual mean temperatures
	Higher mean winter, summer, and autumn temperatures
	More temperature variability causing freeze/thaw cycles
	More severe heat waves with longer duration
Precipitation Changes • Increase • More Extremes • More Variability • Pattern Change	More annual precipitation
	A greater percentage of the annual precipitation falling in spring
	More extreme precipitation events more frequently
	More extreme drought events more frequently
	More winter precipitation as rain, rather than snow
Overall Weather Patterns • More extremes	Potential for more intense storms
	Greater overall climate variability

Source: Gary Lines, Environment Canada

The above projections have been used in identifying the vulnerability and potential impacts over the next fifty years on the infrastructure reviewed in this report.

Legislation Review and Summary

In 2006, an Organization for Economic Co-operation and Development (OECD) report investigated how countries were proceeding with implementing climate change adaptation. It identified Canada as being advanced on impacts assessment but slow on development of policy responses. In reviewing the legislation relating to infrastructure at different levels of government, there was no direct linkage to climate at any specific level. There were a number of supporting documents relating to assessment criteria that has required climate change impacts to be a considering factor.

At the Federal level, the Environmental Assessment Act provides guidance to incorporate the management of climate change impacts. The guidance provides an effective risk analysis approach to evaluate the vulnerability of the project to climate change. This allows the proponent to undertake appropriate measures to adapt the infrastructure accordingly. A climate change assessment criterion is also included for international and designated interprovincial power lines.

At the Provincial level, the Clean Environment Act has the greatest opportunity to consider climate change impacts because it applies to a wide range of infrastructure projects that are not necessarily government related. However, the requirement to consider climate change appears to be in the hands of a review committee in deciding what needs to be considered in the assessment and it is not clear whether climate change would be a consideration.

Other legislation indirectly provides tools for Municipalities that could be used as a climate change technique. An example of this is the ability for a Municipality to acquire 10% of lands for public purposes. These lands could focus on areas that are sensitive to flooding impacts from climate change, while also using the area for recreational purposes. This is a form of adaptation utilizing existing legislative provisions.

The City of Fredericton is moving towards recognizing the importance of the impacts of climate change. This is reflected in their draft Municipal Plan (2006) where they are proposing specific policy requiring the Municipality to monitor the impacts of climate change, and look at ways to introduce new standards and operational approaches to reduce potential climate change impacts. These could be both mitigation and adaptation techniques that, once the plan is adopted, should lead to the review of existing bylaws.

Overall, the analysis identified an ad hoc rather than a cohesive approach to the inclusion of climate change into the planning, design and maintenance of infrastructure projects at the different levels of government. This results in a large number of infrastructure projects having no requirement for including climate change impacts in the planning, design and maintenance process potentially placing these systems at a greater risk of being impacted. Part of this relates to different areas of jurisdiction and/or no action on changing the status quo to keep abreast of the issue.

The second issue identified was no clear understanding on exactly how climate change was considered in the assessment, or the weight decision-makers are giving to the subject matter in the process. One of the challenges in undertaking this type of assessment will be standardizing the models to be used, to ensure consistency across the country, and the availability of information at the local level to fully understand the identified impacts. This information will assist in assessing the vulnerability and appropriate actions that could be undertaken to build in adaptation techniques.

Waterways & Greenways

The City of Fredericton is dominated by the geographical feature of the Saint John River. The river plays an important part in the City's infrastructure in providing recreation and stormwater runoff from surrounding watersheds. Its functions also include: conduits for sanitary sewer discharge, accommodating hydropower facilities, a source of Municipal well-water recharge and water-based transportation. The infrastructure that is dependent on the river system and the surrounding land uses are vulnerable to the impacts climate change may have on the watershed and river system. Effectively, the impacts on this system flow through to impacts on the other infrastructure covered in this report.

Flooding is an existing challenge and based on the local modeling, the frequency of this could increase. The modeling suggests that there is likely to be more extreme weather events and greater percentage of precipitation that is likely to increase the vulnerability of the waterway system to flooding. The flooding that may occur more often is likely to be around small-scale tributaries of the Saint John River and local stormwater management areas.

There are a range of adaptation techniques outlined in the report that involve all levels of government. One of the first recommendations in our case study area is the need to update the existing flood risk areas that are currently 20 years out of date. Part of this process needs to not only rely on historical data, but also be cognitive of the climate change modeling at the local level. This process may identify other areas that are at risk from the impacts of climate change. An ongoing monitoring program needs to be established to gauge whether climate change is having any effect on these areas. This exercise should occur on at least a five-year basis to take account for climate change and reflecting improved modeling. Policies and regulations will also need to be reviewed to reflect the changing environment, however, these will need to be balanced with the impacts they may have on private landowners and businesses.

Stormwater

Stormwater management has similar impacts to the waterways review, the greatest being flooding; however, the focus is more on the community scale rather than on the regional scale. There are a number of innovative techniques being utilized by a number of Municipalities across the country in controlling stormwater, with a focus on maintaining pre-development flows for a 1 in 5 or 1 in 100 year storm event. Stormwater management best practices are needed to guide developers in what is required in controlling stormwater from a site during extreme weather events. Components of this require careful consideration of catchbasin sizing and cleanout, to incorporating peak flow reduction techniques, such as roof or underground storage systems. The challenge with these systems is their maintenance that is often neglected, resulting in the techniques becoming redundant over time. A lack of willingness to monitor and/or undertake enforcement action by regulatory bodies has often contributed to private systems becoming ineffective.

Utilities

Energy, telecommunications and radiocommunication services are critical in connecting our communities, maintaining our day-to-day living standards and operating other key infrastructure services we depend upon, such as sanitary sewer system, drinking water and the road network. This infrastructure is also very vulnerable to the natural weather elements as the majority of the infrastructure is delivered by above ground services. These systems are also administered by a complex matrix of government and private companies because the service is provided at different levels - locally, provincial, nationally and internationally.

The vulnerability of the infrastructure from climate change impacts is not only the predicted increase in extreme weather events on the physical infrastructure, but also the demand placed on

the system's operational capacity from the consumers as the energy demand increases with economic growth. For example, on August 14, 2003, 10 million Canadian customers were left without power and an additional 40 million in the United States during a blackout. One of the factors contributing to this was the high demand from air conditioners. Experiences such as these have resulted in people looking at alternative energy sources to avoid being dependent on one system where they have no direct control. This is an adaptation technique that is likely to grow as people seek alternative sustainable methods for reducing their costs and controlling their own energy consumption.

There are a range of adaptation techniques that can be developed from the local through to the international level. It is likely there will be an increase in more local based initiatives such as buildings being designed with back up systems (e.g. generators/gas), and moves to reduce the growing energy demands on the system (e.g. using fluorescent vs incandescent light bulbs).

Roadways

Roadways are important corridors for the movement of people and goods, and are critical to the economic success of communities and the country as a whole. When the system fails through events that constrain or prevent the movement of people and goods along these corridors, there are losses to all sectors of the economy. Therefore, it is important we locate, design and maintain our roads to sustain economic activity and accessibility for communities.

Today we already experience the impacts weather can play on roads through flooding, washouts or winter storms that prevent people and goods from moving. Though these are currently rare, local modeling suggests that climate change will increase the variability and extreme nature of storm events that could lead to an increase in the vulnerability of the road network. It may also result in greater vehicular accidents occurring. For these reasons, we need to consider how we adapt our road network, or the way we use it, without significantly impacting the economy and society.

There are a range of adaptation techniques that are not costly and generally easy to implement, such as road weather information systems for improved management techniques through to enabling people to work from home when weather events prevent access to our offices. Other measures can be more costly, but are also important for the sustainability of our road network. These may include floodproofing of roads, avoiding flood-prone areas through to creating a multiple road network that provides more than one option of access to a given location.

Sanitary Sewer

Our sanitary sewer systems provide for the disposal of human waste within a controlled environment to protect the health of our communities. Many urban areas have traditional combined storm/sanitary systems that are recognized as placing a burden on the treatment facilities during extreme weather events because of the inflow and infiltration that occurs. Treatment plants are generally located in low-lying areas adjacent to a watercourse, and therefore are vulnerable to flooding from rising waters. Based on these characteristics, the system is vulnerable to overloading from inflow and infiltration and flooding of the treatment plants.

Sanitary sewer systems have also been designed to accommodate a large number of people, resulting in whole communities and their receiving waters being placed at risk should the system fail. Municipalities have struggled with the financial cost of maintaining their sanitary systems, and in some cases these systems have been neglected by the politicians in favour of putting the resources into more visible assets (such as parks and community centres).

Technology, along with land use practices, has changed and is providing a mechanism for adaptation. An example of this is where new communities are providing their own tertiary level of treatment system (e.g. membrane bioreactor system MBR's) that are being managed by the communities themselves. These systems are becoming financially viable at a small community level (approximately servicing 150 houses). Other smaller initiatives are also occurring to reduce the vulnerability of climate change impacts. An effective technique has been to improve the maintenance of the existing system (e.g. installing rubber sealed manholes) or designing into a new system techniques to reduce the inflow and infiltration rates. One of the challenges with this infrastructure is the capital costs of developing new or fixing existing sanitary sewer systems.

Solid Waste

Landfills play an important function in managing our waste and our infrastructure that needs protection from contaminating our land and waterways. Management of these facilities plays a critical part in reducing the risk of contamination. It will be important that future management of these facilities recognize the potential impacts climate change may have on influencing their design and management techniques. Overall, however, these facilities were identified as being less vulnerable to the impacts of climate change when compared to other infrastructure.

Emergency Services

This chapter focuses more on the responsiveness of emergency services to the potential impacts identified from climate change. The analysis recognized that existing emergency service in the case study area is well structured to respond to emergencies arising from the impacts of climate change. Part of this success is a well-established Comprehensive Emergency Plan, and these plans should form a fabric of all communities.

Conclusion

The study has identified that different levels, legislation, policies, regulation and relationships of government are complex and often compartmentalized. In this area, improvements are needed to create a more cohesive transparent structure. A level-playing field for all developments, whether private or institutional, should be adopted. Accountability to provide efficient and effective delivery of services in meeting clear objectives is required. The existing structure appears ad hoc and out of date with existing climate change events and enabling innovative approaches to adapt to the impacts of climate change recognized by the world scientific community.

The study provides a section with some overall critical recommendations in making steps towards enabling the implementation of effective climate change adaptation techniques. A strong monitoring regime is needed to enable effective and ongoing review of legislation, policies and regulations, to ensure they are relevant to current economic, environmental and social trends.

There is a wide range of challenges; however, they will only be seriously addressed when there is political recognition of the issues supported by financial resources. It is likely the majority of the initiatives on climate change adaptation will be driven from the local level that will need financial and legislative support from both Provincial and Federal Governments. Not investing in adaptation principles is similar to not investing in a retirement fund, and the financial consequences could be severe.