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Climate Change in the North Bay-Algonquin Park Region: Adaptation

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"Climate has most effect on the natural systems of the landscape. No engineering can shield a forest or cover a watershed. Adapting to change in our terms has largely to do with how we manage our use of natural resources as they react to changing conditions – to temperature and rainfall, fire and insect pests, drought and flooding. Designing and redesigning with nature with as good an eye to the future as uncertain projections will allow, is the only sustainable approach. Adaptive management in the light of ongoing risk assessments means, first and foremost, understanding ecological and hydrological systems as best we can."

Pearson and Burton (2009)

Introduction

There is now broad international scientific agreement that human activities are primarily responsible for recently documented climate change (e.g., IPCC 2007a). This has largely been attributed to the release of greenhouse gases (GHGs) into the atmosphere, which have caused warming temperatures, and have changed precipitation regimes and increased extreme weather events. Since the Intergovernmental Panel on Climate Change (IPCC) released its first report in 1990, average global temperature increases of about 0.2°C per decade have been observed, contributing to an average global temperature increase of 0.74°C during the period 1906-2005 (IPCC 2007a).

Long-term changes to temperature and precipitation are expected because of climate change. Under low GHG emissions scenarios, the IPCC (2007a) predicts a likely global temperature increase of 1.1°C to 2.9°C by 2100. In their worst case GHG emissions scenarios, however, the IPCC (2007a) predicts that average global temperatures could increase as much as 6.4°C by 2100. Increases in temperature and the amount of precipitation are most likely to occur in high latitude regions (IPCC 2007a). Furthermore, it is almost assured that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. Importantly, scientific observations are increasingly showing that many impacts of climate change are occurring faster and sooner than projected (Pearson and Burton 2009). In this sense, some current projections of climate change likely represent conservative estimates.

While these trends are expected to continue well into the future, the extent of climate change will largely depend on the level of GHG emissions mitigation around the world. Failure to reduce international GHG emissions will lead to more significant changes and increased risk of impacts. However, even if GHGs were dramatically reduced today, anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks. For example, the IPCC (2007a) has predicted that even with concentrations of all GHGs and aerosols kept at year 2000 levels, a further warming of about 0.1°C per decade is expected. These predictions point to the need for adaptation to climate change as well as for reducing sources of GHG emissions.

The objective of this report is to address adaptation to climate change in the North Bay-Algonquin (NBA) Region of Ontario (Figure 1). It is based on the results of other studies many of which have focussed on the Great Lakes Basin. Roughly half of the NBA Region falls within the eastern portion of the Great Lakes Basin. This report was adapted from Prno and Quinby (2010) and builds on Quinby (2010).

Adaptation versus Mitigation

Considering the potential for significant and potentially destructive climate change-related impacts in the NBA Region, opportunities for future climate change adaptation will need to be considered. Adaptation to climate change is any activity that reduces the negative impacts of climate change and/or takes advantage of new opportunities that may be presented. Adaptation is needed to address the challenges of climate change, and it represents a necessary complement to mitigation (Warren and Egginton 2008). The focus in this report is on adaptation related to water resources.

Figure 1 – Core Area of the North Bay-Algonquin Park Region (adapted from Near North Ontario 2017)

However, mitigation efforts (e.g., the reduction of GHGs) are also of fundamental importance to the climate change issue. While a full discussion on mitigation is beyond the scope of this report, it is important to note that a variety of options for reducing GHGs exist and have been successfully employed in countless other jurisdictions. Mitigation activities may include the use of renewable energy, development of energy efficiency and reduction programs, fuel-switching, use of low-emissions vehicles, and purchasing of GHG offset credits, amongst many other examples. Governments in Canada have also increasingly acknowledged the significance of mitigation in their efforts to curb the impacts of climate change, and new legislation on mitigation has been proposed or enacted in many instances. This issue will continue to evolve and require further attention by all parties.

Adaptation in Water Resources Management

While the concept of adaptation is simple, the process of adaptation within human systems is complex. Adaptation actions can be diverse and may involve behavioural changes; operational modifications; technological interventions; and revised planning and investment practices, regulations, and legislation (Lemmen and Warren 2008). Adaptation is often undertaken to reduce the vulnerability of a system. In the climate change literature, vulnerability refers to the degree to which a system is susceptible to and unable to cope with the adverse effects of climate change (IPCC 2007b).

Adaptation in the water sector requires understanding not only of the expected impacts of climate change on water resources, but also knowledge of unique local conditions and capacities to respond to change. As an example, Natural Resources Canada (NRCan 2008) has prepared a list of potential adaptations to climate change that may be taken in the water sector (Table 1). Potential adaptations pertaining to flooding, drought, changes to lakes, changes to stream flows, and changes to groundwater are described. These adaptations range from policy responses, modifications to infrastructure and infrastructure design criteria, the development of water management and conservation strategies, to enhancing forecasting capabilities. While by no means exhaustive (or necessarily relevant to the NBA Region), the list does provide insight into the breadth of adaptation responses that are possible.

Opportunities for Adaptation in the NBA Region

Adaptations specific to the NBA Region will need to be developed if the impacts of climate change are to be reasonably managed in the future. Opportunities for adaptation in the water sector already exist and have been employed in other jurisdictions; however, the design and implementation of adaptations specific to the NBA Region will require planning at the local level. Three opportunities for adaptation are described below.

Table 1 - Potential Adaptations to Climate Change in the Water Sector (from NRCan 2008)

Issue	Example Adaptations
Flooding	• enforcing flood-plain policies that restrict development in flood zones and allowing rivers to spill into their natural flood plains • modifying design criteria for water infrastructure to handle larger runoff volumes in urban areas • building or enhancing existing ice-control structures and snowmelt reservoirs to reduce flooding downstream • enhancing flood-forecasting capabilities and emergency-preparedness procedures to react quickly when flooding occurs
Drought	• establishing regional 'drought watch' services to warn communities and industries about the onset and end of drought • creating water-conservation strategies to reduce water consumption in affected regions • finding alternative sources of water • constructing more green spaces in urban areas to allow water to infiltrate into the soil and replenish bodies of water
Changes to Lakes	• implementing nutrient and chemical management control practices near lakes to reduce the use of chemicals • lowering municipal drinking-water intake pipes to pump water from deeper depths • planting trees and shrubs around lakes to create shade and lower water temperatures
Changes to Stream Flows	• constructing water storage facilities to use water from rainfall or snowmelt when needed • ensuring stricter regulations on pollution discharge to safeguard water quality • shifting some freight transportation cargo from water to rail • managing potential water-shortage disputes through agreements based on priority water needs
Changes to Groundwater	• creating more protected groundwater discharge areas to safeguard wetland habitats for wildlife • replacing lost wetlands with constructed wetlands • tapping into both ground and surface water sources to meet water needs

Develop Downscaled Climate Change Projections for the NBA Region

This report highlights several potential issues related to climate change in the NBA Region and represents only a preliminary assessment. In many cases, more research and data are needed to better understand the specific local implications of climate change. The projections of future climate conditions in the NBA Region (Quinby 2010) are based on the results of global climate models, however, the results of these models only provide general details on the nature of expected changes. Locally relevant geographic conditions and climate-influencing factors may not be captured in these models. Downscaling climate data to the local level is one way this issue can be managed. Downscaling is a method that derives local- to regional-scale (10-100 km) information from models or data analyses addressing multi-regional areas (IPCC 2007b). While downscaling is a process that requires technical expertise, the results it produces will likely be very useful for adaptation planning.

For example, if data are required for planning at local or regional scales (e.g., small watersheds), or the study area includes features such as precipitation gradients, heterogeneous land surfaces, mesoscale convective systems, or climate information at a fine temporal scale (such as daily information or information on extreme events), then downscaled information may be required (Mearns et al. 2003). Furthermore, in many global climate models the Great Lakes region is poorly modelled. In cases where fine resolution forces (e.g., rain shadow, lake effects) are important drivers of local climate, a method of regionalization or downscaling of climate data from global climate models has been recommended (de Loe and Berg 2006).

There are many potential uses for downscaling of climate data that can respond to the varied geography of the NBA Region such as the proximity to large lakes, heterogeneous land surfaces, and significant relief changes. In particular, it could be used in water budget and watershed characterization models and in future analyses of water quality trends.

Improve Environmental Monitoring Capabilities

Environmental (including climate) monitoring ensures that local data and trends are recorded, and potential issues that may affect water resources management are flagged. Monitoring data are also important for forecasting purposes and for comparing predicted climate change trends and impacts against actual trends and impacts. However, for climate monitoring data to be useful, they must first be representative of the local geographic area. Thus, a needs assessment

and gap analysis of environmental monitoring capabilities in the NBA Region should be undertaken. Where gaps are identified, a strategy for enhancing these capabilities will need to be developed.

Develop a Climate Change Adaptation Plan for the NBA Region - Regardless of the types and resolution of data to be used, the development of a climate change adaptation plan for the NBA Region should be developed.

Components of a Climate Change Adaptation Plan

Identify Water-related Vulnerabilities

A vulnerability assessment would assist in identifying the specific vulnerabilities to climate change that exist in the NBA Region. One type of vulnerability assessment starts with documenting the actual conditions that are, or have been, problematic (current exposure-sensitivities) and the adaptations that have been employed to manage these (current adaptive strategies). Based on the identification of current vulnerabilities, potential future vulnerabilities are identified through climate forecasts. A primary output of this analysis is the determination of key factors that are expected to enhance or constrain future adaptive capacity (e.g., Smit and Wandel 2006). Vulnerability-type assessments have been used in various locations and contexts around the world to help understand climate change vulnerability and opportunities for adaptation (Turner et al. 2003, Smit and Wandel 2006, IPCC 2007b).

Identify Adaptations

Using the results of the vulnerability assessment, adaptation options for each vulnerability can be evaluated and developed. While some adaptations may be relatively straightforward such as modifying design standards for drainage systems or developing a public education campaign, others may be more complicated. These more complicated adaptations may include challenges such as coordinating policy responses amongst multiple levels of government or with multiple agencies, or contingency planning for extreme climatic events that would require coordination with public agencies as well as private landowners. It is expected that both the identification of vulnerabilities and of adaptations would require significant input from all stakeholders.

Identify Opportunities for Mainstreaming Climate Change into Water Resources Management

Wherever possible, opportunities for mainstreaming climate change into water resources management should be identified. Mainstreaming, in this sense, refers to areas where climate change can be included in everyday management and decision-making processes. Building climate change projections into watershed characterizations and water budgets are two examples where mainstreaming could occur.

Develop an Adaptive Management Plan

Vulnerability is not a static condition – thus, the need for adaptive and ongoing management of climate change impacts is important. A climate change adaptation plan must also include provisions for monitoring and evaluation; identification and incorporation of new climate change data, information, and risks; and flexible processes for modifying existing water resources management approaches.

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