



**Geoffrey F. Bruce Fellowship
in Canadian Freshwater Policy**

Assessment of Water Resilience Principles in Water Policies and Plans in the Niagara Region

POLICY BRIEF

By

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Acknowledgement

I am very grateful to the Geoffrey F. Bruce Fellowship in Canadian Freshwater Policy which generously provided financial support for my major research paper (MRP) as a Masters of Sustainability student at Brock University. The funding provided through this fellowship allowed me to put more time towards my MRP to help advance research in water governance, water resilience, and water policy. The purpose of this research was to provide a better understanding of the application of water resilience principles in water policies and plans in the Niagara Region. As a result, I hope these findings can help inform present and future policymakers to include and strengthen water resilience principles in water policies and plans to create sustainable freshwater systems.

Introduction

In Canada, freshwater may seem abundant as the country has the third largest renewable freshwater supply in the world (Statistics Canada, 2018). This is often perceived due to Canada's abundance of lakes, rivers and streams formally known as surface water. However, there is also another supply of freshwater that is less visible but plays a valuable role in contributing to a quarter of all Canadians' daily water needs – this is formally known as groundwater (Environment and Climate Change Canada, n.d.a). Together, surface water and groundwater provide us with freshwater supporting living organisms and allowing landscapes to provide ecosystem services that sustain ecological habitats and support plant growth (Rockström et al., 2014). This makes freshwater the core of our life support system contributing to human health while also providing food and energy (Falkenmark, 2020; Rockström et al., 2014). Despite these life-sustaining benefits, human activities are influencing changes in environmental processes which is affecting the sustainability of freshwater (Falkenmark, 2020).

Urban growth, climate disasters, economic development, pollution, and shifting consumption patterns are contributing to water scarcity and shifting freshwater ecosystems from stable environmental conditions (Falkenmark, 2020; Saikia et al., 2022; United Nations, 2021). Additionally, to one where there is an increased demand for water, higher water withdrawals, a decline in the quality and quantity of freshwater, and increased pressures on water management (van Leeuwen, 2013). These factors have direct consequences on water security. Therefore, the sustainability of freshwater is in a global crisis that requires novel ideas to ensure freshwater systems are resilient to the many shocks and stressors it faces now and in the future. This can begin with policymakers and water professionals working together to build a better understanding of how to improve water resilience from a policy perspective and translating it into practice.

Consequently, this case study examined five water policies and plans produced by the Regional Municipality of Niagara and the Niagara Peninsula Conservation Authority (NPCA). First, this research identified what types of water sources are included in each water policy and plan to better understand the effectiveness of managing and governing water sustainably in the Niagara Region. Second, this research examined to what extent the resilience principles from the water governance literature are evident in water policies and plans to increase our understanding of how resilience principles are being operationalized and contributing to a more resilient and sustainable water system (see Table 1). Finally, based on the results of these two objectives, key findings and recommendations were made to help incorporate groundwater and the resilience principles into water policies and plans in the Niagara Region.

Table 1: List of seven resilience principles for building resilience in social-ecological systems (Biggs et al., 2012).

Principle 1. *Maintain diversity and redundancy*

Principle 2. *Manage connectivity*

Principle 3. *Manage slow variables and feedbacks*

Principle 4. *Foster an understanding of social ecological systems as complex adaptive systems*

Principle 5. *Encourage learning and experimentation*

Principle 6. *Broaden participation*

Principle 7. *Promote polycentric governance systems*

Policy and Governance Problem

Water governance is comprised of a variety of formal and informal institutions that regulate the development and management of water resources (Farhad & Baird, 2022; Pahl-Wostl, 2015). Thus, water governance contributes to how water is managed and controlled while also connecting political, social, economic, and administrative systems that develop and manage water systems as well as allocate water services to different societal groups (Bayu et al., 2020). However, in Canada a fragmented water governance structure impedes the ability to properly manage water resources and overlapping jurisdictions from both a vertical and horizontal scale adds further complexity (Bakker & Cook, 2011; Caniglia et al., 2016). For example, in Ontario, water is vertically managed at the federal, provincial, and municipal government levels along with conservation authorities and Indigenous peoples. This is further complicated at the horizontal scale when multiple actors could be operating across the same level. For instance, in Ontario there are two responsible ministries for the governance of water including the Ministry of the Environment and the Ministry of Natural Resources (Environment and Climate Change Canada, n.d.b). Consequently, having multiple actors at different scales can limit the efficiency of water policies and plans as well as water governance leading to the unsustainable use and conservation of water (Caniglia et al., 2016).

Water resilience is the ability of a system to absorb a disturbance, persist, adapt, transform, and evolve with change to sustain human well-being and support ecosystems (Folke, 2016). Therefore, resilience has become a significant policy interest as anthropogenic changes are altering the world's ecosystems and potentially causing irreversible changes (Biggs et al., 2012). Currently, water systems are presently faced with cumulative pressures on global water resources which will impact water-related decision-making and planning (Rodina, 2018). Including water resilience within water policies and plans presents an opportunity to limit these pressures and other stressors on water systems. However, building water resilience within a system is limited if water resources and services are not being managed and governed appropriately. Consequently, water resilience has been increasingly associated with water governance (Rodina, 2018). Thus, how formal and informal institutions manage and govern water resources and services will determine whether the resilience of the system increases or decreases.

In Niagara, water plays an important role in its economy, ecosystems, society, and supporting human health and wellbeing (Niagara Region & Brock University Environmental Sustainability Research Centre, 2013). For example, the Niagara Region encompasses a large agricultural industry from grape and tender fruit growers to cannabis, dairy, poultry, and livestock that generates \$1.41 billion in GDP (Niagara Region, 2021; Weatherson et al., 2021). This is largely due to its geographic location being surrounded by Lake Ontario and Lake Erie and sheltered by the Niagara River (Niagara Region, 2022). However, climate change, urban growth/sprawl, among other compounding issues are exacerbating issues related to water security and availability on Niagara's regional water system (Penney, 2012). Therefore, there is a critical need to conduct research and enhance the sustainability of water in freshwater policies and plans to ensure these water services can be provided for future generations.

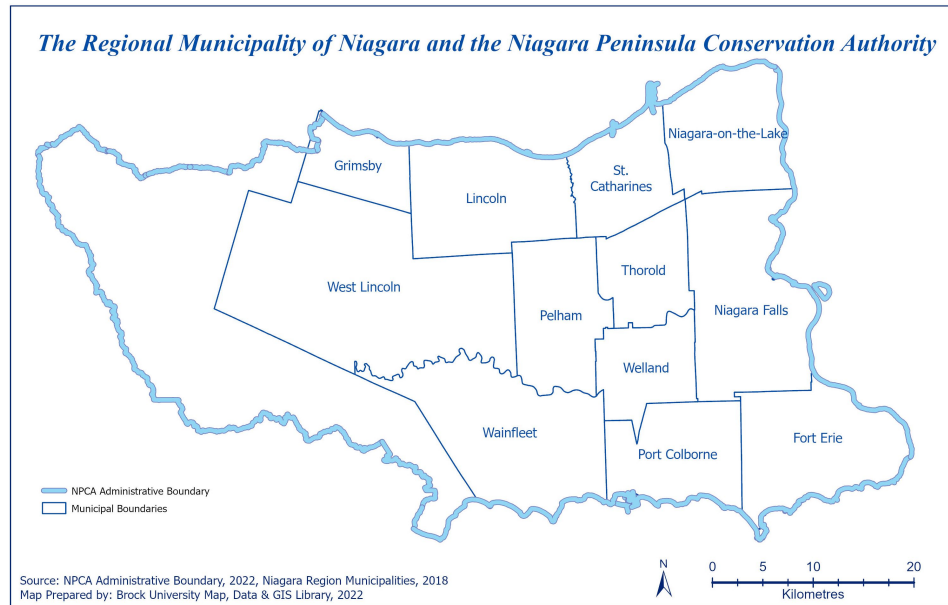


Figure 1. A map of the Regional Municipality of Niagara and the Niagara Peninsula Conservation Authority (Brock University Map, Data & GIS Library, 2022).

Policy Recommendations

This research finds that there was limited reference to groundwater in the five water policies and plans. This suggests there is a failure to acknowledge groundwater as a source of water which can limit the effectiveness of managing and governing water sustainably in the Niagara Region.

Recommendation #1 is to develop a Niagara groundwater study/policy document while using existing information from the Ontario Geological Survey and the Geological Survey of Canada. In addition, it is recommended when developing this groundwater document, collaboration takes place with local institutions and environmental consulting firms who have experts in hydrogeology, hydrology, engineering, municipal planning, agriculture, etc. Furthermore, it is recommended this document includes strategies and action plans that will protect the region's groundwater resources in the long-term. Together, these recommendations can help protect the region's aquifers and further support the sustainable use of groundwater.

Recommendation # 2: to help incorporate groundwater into water policies and plans is to strengthen communication and collaboration. Two-way flow of communication between scientists and policymakers, where information is being received and distributed, needs to be strengthened (Maguire, 2007). This can help close gaps in the policy decision-making process and lead to stronger water policies and plans.

Recommendation #3: collaboration in the form of developing councils/committees; facilitating long-term relationships/partnerships; and providing opportunities for early-career researchers through fellowships, co-ops, or other programs that allow for direct interactions with legislators and policymakers would ensure scientific research is effectively integrated into public policies. Strengthening policy collaborations also provides scientists with a better understanding of how

the science-policy process works (Gaieck et al., 2020; Maguire, 2007). Consequently, this could strengthen future water policy, groundwater governance and the sustainable management of freshwater.

Related to Research Objective 2, this study found areas in need of improvement to address issues related to water governance and water resilience. The five water policies and plans showed lack of communication between academic institutions and public agencies.

Recommended # 4: the NPCA and the regional municipality continuously work to share and receive information with local institutions such as Brock University and Niagara College. As mentioned above this could be in the form of a community of practice, a committee, or having graduate students share their research with the municipality and NPCA. Open communication channels with two-way flow of information presents an opportunity to strengthen water policies and plans now and in the future.

Recommendation #5: increase policymakers' knowledge, awareness and understanding of the seven resilience principles. This begins with knowing when, how, and where to apply the principles as well as understanding their differences and similarities. The seven resilience principles should then act as a guide to build water resilience and reinforce water governance concepts within the water policies and plans. The next recommendation is to monitor the water policies and plans over the long-term, or the next time they are revised, to identify where and what resilience principles are enhancing the resilience of the water system. This may involve reviewing and updating the documents every few years to ensure they reflect the Official Plan and current research on water governance. Furthermore, the impact of the water policies should be monitored to ensure the desired outcomes are being achieved. This can be accomplished through developing measurable targets for the region and the NPCA to evaluate whether they are being met or need to be updated or changed.

Recommendation #6: the NPCA and Niagara Region adopt a City Water Resilience Framework (CWRF) tool that can help incorporate water resilience in water policies and plans. This tool allows cities to identify existing resilience gaps and future actions that build water resilience (Saikia et al., 2022). However, this tool may require the NPCA and the region to refine the indicators and add different indicators to achieve their respective goals with respect to water resilience.

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