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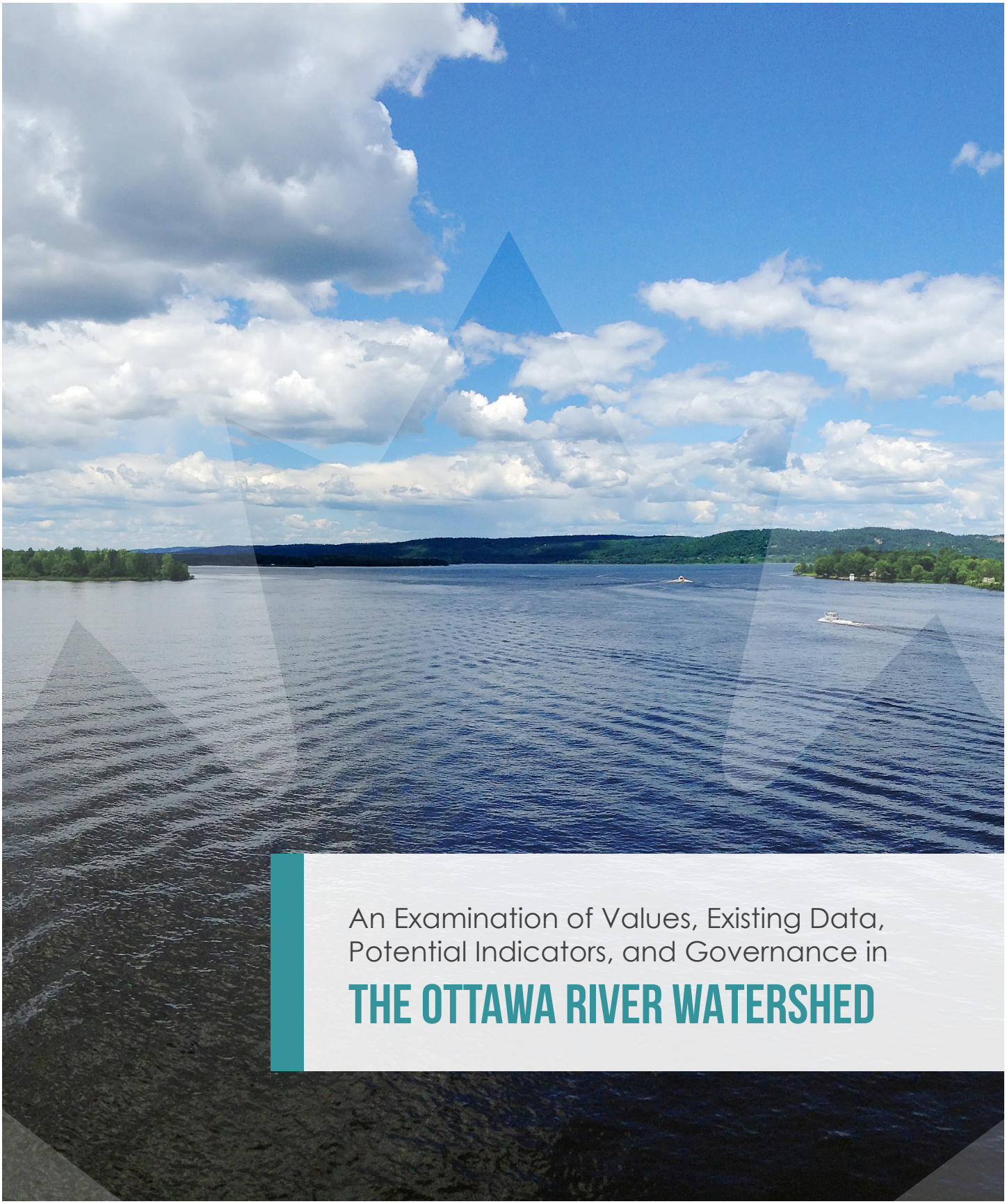

An Examination of Values, Existing Data, Potential Indicators, and Governance in

THE OTTAWA RIVER WATERSHED

Disclaimer: Input within this report is currently being reviewed by Indigenous groups. It should be noted that the report summarizes "what we heard" from Indigenous groups, the public and stakeholder engagement process. The opinions expressed were not validated based on data analyses. The Government of Québec has provided comments of a factual nature on the draft report and does not condone nor is it bound by the findings in this report.

EXECUTIVE SUMMARY

The Ottawa River watershed, home to over two million people, has long been cherished for its natural, economic, cultural, and heritage values. However, much like other watersheds across Canada and around the world, those values are subject to a number of stressors, including pressures arising from population growth, industrial production, and climate change.

The Ottawa River watershed has been home to Indigenous peoples for countless generations, the boundaries of which represent the traditional territory of the Algonquin nation. The River also acted as an important historical travel and trade route for transporting resources, such as timber, to major trading posts. In 2016, the heritage significance of the Ottawa River was celebrated through recognition of the Ontario portion of the river as a Canadian Heritage River, followed by recognition of the Québec portion of the river as a historical site by the Government of Québec in 2017. Considerable efforts have been made over the years to make these heritage designations a reality, to improve understanding about the Ottawa River watershed, and to raise awareness about concerns about the watershed.

Recognizing that protecting the Ottawa River watershed requires collaboration amongst many organizations and individuals that span two provinces, the Government of Canada adopted Private Member's Motion M-104 in May 2017. M-104 directed the Government to undertake a study on the Ottawa River watershed. Consistent with the Motion, the purpose of this study was to: (1) examine the economic, cultural, heritage and natural values associated with the Ottawa River watershed, including possible threats to those values; (2) explore existing and potential indicators for assessing the health of the Ottawa River watershed; and (3) identify barriers to effective management of the Ottawa River watershed, as well as opportunities to enhance watershed collaboration moving forward.

Under the leadership of Environment and Climate Change Canada (ECCC), the Ottawa River Watershed Study (ORWS) was initiated. This involved a broad engagement process that included, among other activities, Indigenous consultations, an online engagement platform, Town Hall events, workshops, webinars, and the soliciting of submissions by email and mail. Input was provided by many, including, but not limited to, Indigenous communities, the provinces of Québec and Ontario, federal departments and agencies, municipalities, Conservation Authorities (CAs), Organismes de bassins versants (OBVs), non-governmental organizations, businesses, stakeholder associations, youth, and individual citizens. To complement this process, ECCC reviewed existing literature pertaining to the watershed and best practices for watershed management across Canada and internationally.

The management of the Ottawa River watershed involves diverse identity groups, including groups whose primary interests in the watershed don't necessarily align. The watershed is valued by many, and the natural, economic, cultural, and heritage values associated with the watershed are highly interconnected. The safeguarding of these values is largely dependent on the health of the watershed, to enable the delivery of ecosystem services. Those ecosystem services include clean drinking water, food, timber and medicinal plants; climate change mitigation and adaptation, through carbon storage and erosion control; as well as cultural services, such as recreation, tourism and spiritual enrichment.

There are many varying economic activities throughout the Ottawa River watershed, including industries such as forestry, agriculture, hydroelectric power generation, mining, and tourism. Through the ORWS, it was found that social and cultural considerations shape the way individual's perceive the watershed, which influences conservation and stewardship activities. Overall, it is clear the Ottawa River watershed provides a number of benefits that contribute to a high quality of life and a sense of identity for those that live within the area. There was also recognition throughout the ORWS engagement process about the importance of natural values associated with the watershed, such as the importance of water quality and quantity to ecosystem health, as well as species diversity and habitat.

European settlement and the establishment of Canada led to a sharp decline in the extent to which Indigenous peoples could enjoy the natural, economic, cultural, heritage and spiritual values provided by the Ottawa River watershed. According to Indigenous groups that provided formal input for the ORWS—the Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, and Métis Nation of Ontario—industrial development led to reduced water quality, biodiversity loss, changes in water levels, and an overall decline in the health of the aquatic ecosystem. Relative to pre-colonization, Indigenous peoples have reduced access to the Ottawa River watershed, and are confined to harvesting limited resources in specific locations. Through the broader public engagement process, concerns regarding water quality featured prominently in feedback received. Respondents generally pointed to nuclear waste disposal, industrial effluent, and raw sewage disposal as major threats to the Ottawa River watershed.

ECCC also explored existing and potential indicators for assessing the health of the Ottawa River watershed, including those related to water quality, biodiversity and shoreline integrity. A number of potential indicators were identified under those three themes, including the examination of habitat cover, physical-chemical conditions of surface water, as well as changes to water flow regimes over time. In addition to the preliminary identification of indicators, surveys of existing monitoring and data collection activities, and of past assessments of watershed health were completed. Existing data collection programs and past assessments of watershed health are being undertaken by various groups, including governments, non-governmental groups, and citizen scientists. In addition, while commonalities exist amongst monitoring activities and health assessments, the general public and stakeholders indicated that methods are not all standardized, and a number of datasets are incomplete and/or out of date. Indigenous

groups consulted for the ORWS also emphasized that current efforts to understand the watershed do not sufficiently incorporate traditional knowledge.

With regard to watershed management, global approaches vary considerably, and there is general consensus that approaches must be tailored to local conditions. There are, however, commonalities in the challenges faced, and groups around the world have worked towards the development of guiding principles for watershed management. Today, the concepts of Integrated Water Resources Management (IWRM) and Integrated Watershed Management (IWM) are generally considered to be the ideal approaches to watershed management. At the national scale, the federal-provincial-territorial Canadian Council of Ministers of the Environment has identified eleven Principles of IWM to encourage its adoption.

Through the ORWS process, a number of existing approaches to watershed management, both domestic and international, were explored, with the objective of informing collaboration in the Ottawa River watershed. A number of models and best practices were also identified by Indigenous groups, including aspects of the holistic, relationship-based management system applied by the Algonquin nation. In describing gaps in current governance, most Indigenous groups emphasized that consultation processes undertaken by governments and the private sector do not sufficiently account for Indigenous rights and related interests.

Views regarding governance in the Ottawa River watershed were gathered throughout the ORWS engagement process. While the range of views expressed varied considerably, it was found that the majority of respondents were in favour of the creation of a new collaborative body, as long as that body was mandated and structured in a way that it remained politically neutral and did not infringe on the existing authorities of its members. In addition, many respondents agreed that if a new collaborative body were to be established, its activities should focus on: improving trust, coordination and information sharing amongst its members; identifying priority issues in the watershed; and supporting local watershed stewardship initiatives. Several respondents strongly cautioned against adding any new layers of bureaucracy or regulation. While Indigenous communities also expressed the need for greater collaboration in the Ottawa River watershed, and generally supported the creation of a new collaborative body, most felt that its membership, structure, and mandate must be established in a way that strongly reflects Indigenous rights and interests, as well as Government commitments towards a renewed nation-to-nation relationship with Indigenous peoples.

Gaps and opportunities were raised by the participants during the ORWS engagement process and are presented throughout this report. Notably, respondents expressed an opportunity to enhance collaboration and communication among governments, Indigenous peoples, stakeholders and other knowledge holders within the watershed. Of importance were the positions expressed by the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Algonquins of Ontario, Métis Nation of Ontario, and the Mohawk Councils of Kahnawá:ke and Kanesatake regarding the need to improve collaboration with Indigenous peoples in the Ottawa River watershed, such as through inclusion in decision making, monitoring and stewardship activities. In addition, some Indigenous peoples and stakeholders recognized the opportunity to develop a strategic

plan and common vision for management of the Ottawa River watershed, with the support of guiding principles and an operational framework. Additionally, respondents engaged through the ORWS identified opportunities to build on existing Indigenous, scientific and socio-economic knowledge in the watershed, through comprehensive baseline assessments, improved information sharing and accessibility, and standardized monitoring and data collection efforts.

By examining emerging trends and signals of change through a process called Foresight Analysis, ECCC also identified potential future challenges and opportunities that could impact the Ottawa River watershed. Examples of these changes include the emergence of disruptive technologies, such as artificial intelligence and blockchain technology, as well as shifts in thinking, such as the growing recognition of the value of ecosystem services.

A central objective of this report is for anyone to use the information to inform their work or interests, rather than ECCC outlining recommendations about how the findings should be used. By considering both present and possible future challenges and opportunities, and by building on past and current initiatives in the Ottawa River watershed, ECCC hopes that this report will contribute to the dialogue about how to support the long-term sustainability of the watershed.

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AAFC	Agriculture and Agri-food Canada
ABRINORD	Organisme de bassin versant de la rivière du Nord
ABV 7	Agence de bassin versant des 7
AI	Artificial Intelligence
CA	Conservation Authority
CABIN	Canadian Aquatic Biomonitoring Network
CCME	Canadian Council of Ministers of the Environment
CEPI	Bras d'Or Collaborative Environmental Planning Initiative
CESI	Canadian Environmental Sustainability Indicators
CHRS	Canadian Heritage River Status
CIPA	Country Policy and Institutional Assessment
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
COBALI	Comité du bassin versant de la rivière du Lièvre
COBAMIL	Conseil des bassins versants des Milles-Îles
COBAVER-VS	Conseil du bassin versant de la région de Vaudreuil-Soulanges
CREDDO	Conseil régional de l'environnement et du développement durable
DFAA	Disaster Financial Assistance Arrangements
ECCC	Environment and Climate Change Canada
EU	European Union
eDNA	Environmental DNA
GBA+	Gender-based Analysis Plus
GHG	Greenhouse gas
GWP	Global Water Partnership
IJC	International Joint Commission
IPCC	Intergovernmental Panel on Climate Change
IWM	Integrated Watershed Management
IWRM	Integrated Water Resources Management
MDDELCC	Ministère du Développement durable, Environnement et Lutte contre les changements climatiques
MNRF	Ministry of Natural Resources and Forestry
MOECP	Ministry of Environment, Conservation and Parks
MP	Member of Parliament
MRBB	Mackenzie River Basin Board

MRC	Municipalité régionale de comté
MVCA	Mississippi Valley Conservation Authority
NBMCA	North Bay-Mattawa Conservation Authority
NCC	National Capital Commission
NGO	Non-governmental organization
NPRI	National Pollutant Release Inventory
NRCan	Natural Resources Canada
OBV	Organisme de bassin versant
OBV RPNS	Organisme de bassins versants des rivières Rouge, Petite Nation et Saumon
OBVT	Organisme de bassin versant du Témiscamingue
OECD	Organisation for Economic Co-operation and Development
ORHDC	Ottawa River Heritage Designation Committee
ORRPB	Ottawa River Regulation Planning Board
ORWS	Ottawa River Watershed Study
POGG	Peace, Order and Good Government
PSPC	Public Services and Procurement Canada
ROBVQ	Regroupement des organismes de bassins versants
RRCA	Raisin Region Conservation Authority
RRT	Regional Round Table
RVCA	Rideau Valley Conservation Authority
SDG	Sustainable Development Goal
SLAP	St. Lawrence Action Plan
SNCA	South Nation Conservation Authority
UN	United Nations
UNCED	United Nations Conference on Environment and Development
U.S.	United States
WEF	World Economic Forum
WWF	World Wildlife Fund
WWF-Canada	World Wildlife Fund Canada

1 INTRODUCTION & CONTEXT

The intent of the Ottawa River Watershed Study (ORWS) has been, above all, to examine the significance of the Ottawa River watershed to the diverse groups who rely on it, as well as to explore opportunities to enhance collaboration. The purpose of this report is to summarize what we heard from the ORWS engagement processes, as well as from research undertaken by ECCC. Recommendations have not been included in this report as the objective is for people to use the information as they see fit. It is hoped that the Government of Canada's ORWS process, and the resulting report, will add to the knowledge base about the Ottawa River watershed, and inform further discussions and initiatives within the watershed.

While undertaking this Study, it has been important to acknowledge and build upon past and current efforts within the Ottawa River watershed. Of particular note, the provinces of Québec and Ontario, and the watershed authorities within each province, have prioritized watershed management and have made significant contributions to knowledge about the Ottawa River watershed. In addition, there are a number of non-governmental organizations that are active within the watershed. For example, in 2015, under the leadership of Ottawa Riverkeeper, representatives of various sectors of society co-created and signed the Gatineau Declaration (see Appendix A), which among other important considerations and recommendations, highlighted that the protection of the Ottawa River watershed is a shared responsibility. In the years that followed, there has been continued momentum to recognize the importance of the Ottawa River watershed, which culminated in attribution of official heritage status to the Ottawa River by the governments of Canada and Québec. There have also been continued efforts to build on the Gatineau Declaration, led by Ottawa Riverkeeper.

Throughout this report, input received from Indigenous, stakeholder and public engagement has been included as applicable. The following sections of the report provide context on: how and why the ORWS was initiated by the Government of Canada; the roles and responsibilities of diverse groups working within the watershed; and the importance of studying trends at the watershed scale. The report also contains a description of important economic, cultural, heritage, and natural values attributed to the Ottawa River watershed, as well as an overview of existing monitoring and data collection activities, and existing assessments of the health of the watershed. Finally, based on the input received through the ORWS, a literature review, and consideration of experiences of existing watershed management bodies in Canada and abroad, the report will outline opportunities to enhance collaboration in the Ottawa River watershed now and into the future.

1.1. MOTION M-104 AND THE OTTAWA RIVER WATERSHED STUDY

This section will describe Private Member's Motion M-104 and how the Ottawa River Watershed Study (ORWS) originated.

1.1.1. ORIGINS OF THE MOTION

The decision to conduct a study on the Ottawa River watershed was initiated by David McGuinty, Liberal Member of Parliament (MP) for Ottawa South, who introduced Private Member's Motion M-104 in the House of Commons on December 2, 2016. During his speech, David McGuinty emphasized the significance of the Ottawa River, which he described as "the jewel in the crown of the national capital region". He also explained that the Motion represents an opportunity to identify management gaps in the Ottawa River watershed, and improve current management practices. McGuinty identified Integrated Watershed Management (IWM) as anapproach that could improve how watersheds are managed across Canada.

When describing the purpose of the Motion, McGuinty described how the Ottawa River defines much of the border between Ontario and Québec, making it an interjurisdictional waterway. According to McGuinty, a comprehensive study could help ensure that multiple levels of governments, Indigenous peoples, and all stakeholders work together to coordinate their activities and decisions, to better support the protection of the Ottawa River watershed into the future (House of Commons, 2017a).

1.1.2. MOTION M-104 DEBATED IN THE HOUSE OF COMMONS

Motion M-104 was debated twice, on February 23, 2017, and on April 6, 2017[1]. The original text of Motion M-104 instructed the Standing Committee on Environment and Sustainable Development to undertake a study on the Ottawa River watershed, and to share its recommendations in a report to Parliament by December 2017. During the first debate, William Amos (MP, Pontiac, Liberal) proposed an amendment which would instruct the Government of Canada to conduct the Study, rather than the Standing Committee on Environment and Sustainable Development, as well as remove the requirement to table a report in Parliament by December 2017. The amendment was accepted by MP David McGuinty (House of Commons, 2017a). On May 3, 2017, the House voted in favour of the amended Motion (House of Commons, 2017b). Motion M-104 reads as follows:

"That, in the opinion of the House, the government should undertake a detailed study with regard to the creation of an Ottawa River Watershed Council, which would bring a comprehensive, inclusive, co-management approach to the Ottawa River Watershed, in order to foster ecological integrity, sustainable economic opportunities, and quality of life; in its study, the government should examine (i) the council membership, which would include, but would not be limited to, federal, provincial, regional, and municipal governments, First Nations, industry groups, non-governmental organizations, and academic institutions, (ii) important indicators such as water quality, biodiversity, and shoreline integrity, in order to assist with the creation of a co-management plan and

[1] The full transcripts of the debates can be found at the following websites: https://www.ourcommons.ca/DocumentViewer/en/42-1/house/sitting-146/hansard and https://www.ourcommons.ca/DocumentViewer/en/42-1/house/sitting-161/hansard

conservation strategy, (iii) the economic, cultural, heritage, and natural values within the Ottawa River Watershed."

1.1.3. PURPOSE OF THE STUDY

The ORWS was led by Environment and Climate Change Canada (ECCC), on behalf of the Government of Canada. To respond to Motion M-104, the purpose of the Study was to (1) examine the natural, cultural, heritage and economic values associated with the Ottawa River watershed, including possible threats to those values; (2) explore existing and potential indicators for assessing the health of the Ottawa River watershed; and (3) identify barriers to effective management of the Ottawa River watershed, as well as opportunities to enhance collaboration within the watershed.

1.1.4. PUBLIC STATEMENTS

On May 31, 2017, the Minister of Environment and Climate Change, Catherine McKenna, delivered a speech at the 4th Annual Ottawa Riverkeeper Gala, describing the launch of the ORWS. A public statement was subsequently posted, in July 2017 on ECCC's website, specifying the Government of Canada's Response to Private Member's Motion M-104 (ECCC, 2017e). On January 25, 2018, a news release announced the launch of public consultations on the ORWS, which occurred from January 25, 2018 to April 27, 2018 (Government of Canada, 2018b; Water Canada, 2018).

1.1.5. ENVIRONMENT AND CLIMATE CHANGE CANADA'S PRIORITIES

Conducting a study of this nature aligns with ECCC's mandate, and with the Minister of Environment and Climate Change's mandate letter priorities to (1) treat freshwater as a precious resource that deserves protection and careful stewardship; and (2) renew Canada's commitment to protect the Great Lakes and the St. Lawrence River basin (Government of Canada, 2017a).. Notably, the Ottawa River watershed is a sub-watershed within the St. Lawrence Basin and is the largest tributary to the St. Lawrence River. Additionally the watershed neighbours the Great Lakes basin, and is hydrologically linked to the basin through the Rideau Canal (ECCC, 2017e).

The ORWS is also in line with government-wide commitments related to reconciliation and a renewed nation-to-nation relationship with Indigenous peoples, the integration of Gender-Based Analysis Plus (GBA+) in decision-making, and the implementation of the Federal Sustainable Development Strategy.

1.1.6. GEOGRAPHIC SCOPE

For the purposes of this Study, the Ottawa River watershed includes the Ottawa River from its headwaters in Québec's Laurentian Mountains, to its junction with the St. Lawrence River at the Lake of Two Mountains, as well as streams, rivers and lakes that are connected to the Ottawa River (ECCC, 2017e). The Ottawa River is connected to a number of rivers along its length, such as the Gatineau, du Lièvre, Madawaska, Coulonge, Petawawa, Rouge, South Nation, Bonnechere, and Dumoine Rivers (Ottawa River Institute, n.d.). As the Ottawa River flows into,

and mixes with, the waters of the St. Lawrence River, groups and communities located downstream of Lake of Two Mountains were also engaged. Figure 1.1-1 is a map of the Ottawa River watershed, and associated population centres.

FIGURE 1.1-1. Map of the Ottawa River watershed and associated population centres (ECCC, 2018g).

1.2. DESCRIPTION OF THE OTTAWA RIVER WATERSHED

1.2.1. DEFINITION OF A WATERSHED

Wang et al. (2016) defines a watershed as “a topographically delineated area that is drained by a stream system—it is the total area above some point on a stream or river that drains past that point”. In other words, a watershed, also referred to as a catchment or drainage basin, is an area of land where all surface water and precipitation (e.g., rain or snow) drain into the same place – be it a creek, a stream, a river, or an ocean. There are two types of watersheds, open and closed. An open watershed is one that, ultimately, drains into an ocean, while a closed watershed is one in which water only leaves through evaporation, withdrawal and use, or seepage into groundwater aquifers. An aquifer is a geological formation of permeable rock or material, such as sand or gravel, capable of holding significant quantities of water (Statistics Canada, 2017c). By this definition, the Ottawa River watershed is an open watershed as it drains into the St. Lawrence watershed and, eventually, into the Atlantic Ocean.

Statistics Canada groups 974 sub-sub-drainage areas representing all Canadian land and interior freshwater bodies into 25 drainage regions (see Figure 1.2-1).

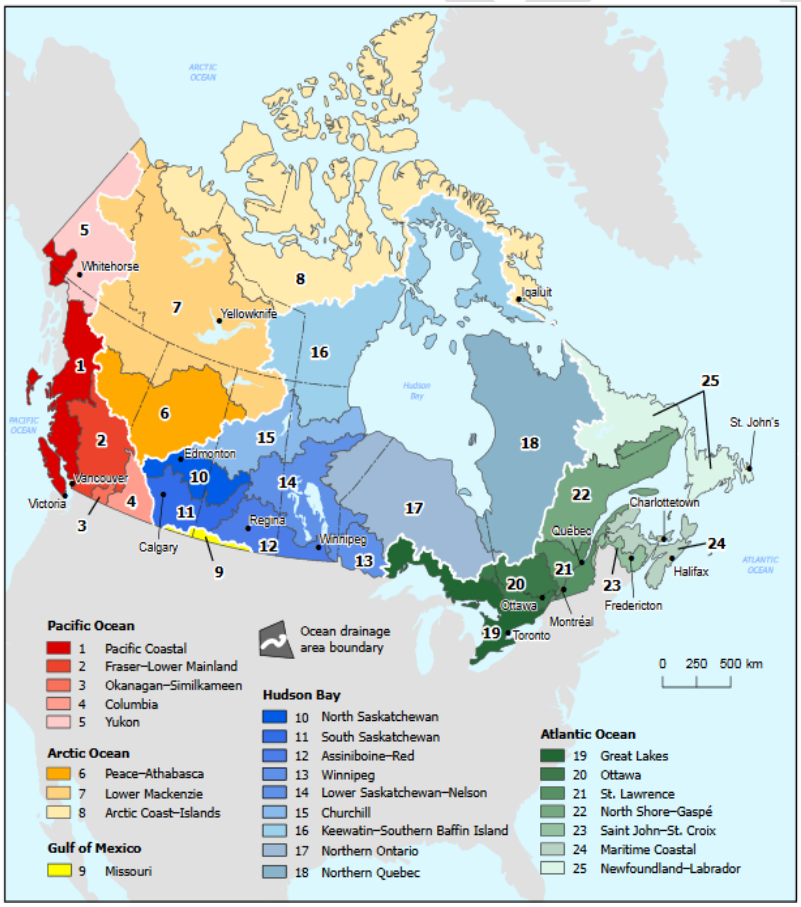


FIGURE 1.2-1. Drainage regions of Canada (Statistics Canada, 2017c).

1.2.2. PHYSICAL DESCRIPTION OF THE WATERSHED

The Ottawa River watershed covers over 140,000 square kilometers; 65% of which is located within Québec, and the other 35% in Ontario (MDDELCC, 2015a). The stem of the Ottawa River has a length of more than 1,130 kilometers, and makes up the majority of the Québec-Ontario border (Ottawa River Institute, n.d.). According to the Ottawa River Heritage Designation Committee (ORHDC), the Ottawa River is Canada's 12th longest river, and ranks 8th in the country in terms of discharge volume (ORHDC, 2005).

The Ottawa River watershed contains more than 90,000 lakes, and 30 reservoirs (MDDELCC, 2015a). Its flow is considered to be highly regulated due to the presence of hydroelectric dams and reservoirs in the watershed. However, because 50% of the storage capacity is within the upper reaches of the watershed, it can be challenging to manage water levels downstream (MDDELCC, 2015a).

Within the watershed, the majority of the land is dominated by forests (approximately 73% forest cover on the Québec side). In the middle to southern regions of the watershed, forest cover is a combination of mixed and deciduous forests, representing 85% of all the forest cover. The remaining 15% is boreal forest, and primarily located in the northern portion of the watershed (MDDELCC, 2015a).

The watershed is located within the Canadian Shield, a landform region that contains some of the oldest rocks in North America: more than 2.5 billion years old (ORHDC, 2005). The landscape of the watershed is largely a result of glacial activity from the last ice age (Pleistocene epoch, 2.6 Million years ago – 11.7 thousand years ago) (ORHDC, 2005). The Ottawa River is also the only Canadian River to cross four major geological subdivisions of the Canadian Shield, all of which have unique physical and geologic features: the Superior Province, Cobalt Plate, Grenville Province, and St. Lawrence Lowlands (ORHDC, 2005).

1.2.3. HISTORY AND PRESENT DEMOGRAPHICS

The Ottawa River watershed has a rich history. Through archaeological findings there is evidence that hunter gatherer communities occupied the area between 8,000 and 10,000 years ago. Evidence of humans from about 6,000 years ago is far more common and while historians are apprehensive about speculating on the ethnic lineage, recorded practices and oral history suggest that they share numerous similarities with Algonquins.

The Algonquin worldview is that the Kitchissippi, or "big river", in Algonquian, has been the lifeblood of the Algonquin people since time immemorial, and that for countless generations prior to European contact, Algonquins were the stewards, managers and guardians of the Kitchissippi watershed. Distinct Algonquin groups lived throughout the Ottawa River watershed over time. There is substantial archaeological evidence that Indigenous peoples have travelled, traded and settled, in and around the Ottawa River watershed for thousands of years. The waterways forming the Ottawa River watershed were typically used by Indigenous communities to determine the boundaries of different family, band and tribal territories, and that those rivers and lakes linked communities together into a larger Algonquin confederacy (Morrison, 2005). Those communities are believed to have included the Ouaouechkarini (or Weskarini), along the Lievre, Petite Nation, and Rouge Rivers; the Kichesipirini on Morisson Island and Allumette

Island; the Kotakoutouemi along the Coulogne and Dumoine Rivers; the Kinouchepirini (or Quenongebin) between the Petawawa and Bonnechere Rivers; the Matouachkarini (or Matouweskarini) along Madawaska River; and the Ountchatarounounga (or Onontchataronon) along the Mississippi, Rideau, and South Nation Rivers (Lawrence, 2013).

Algonquin communities have experienced over four hundred years of colonialism in the Ottawa River watershed—including contact with missionaries, explorers, fur traders, lumbermen, settlers, miners, as well as energy developers—and the nature of their presence within the watershed has changed drastically (Morrison, 2005). Algonquin communities were considerably affected by European diseases, notably smallpox, as well as by ongoing conflict with the Haudenosaunee Confederacy. At present, there are ten Algonquin communities located within the watershed that are federally recognized as "bands" (First Nations) under the Indian Act. As of 2005, the ten communities had a total estimated population size of 8,000 to 10,000 people. Nine of the communities are located in Québec and one is in Ontario. The nine communities located in Québec are the Abitibiwinni (Pikogan), Timiskaming, Kebaowek (Eagle Village), Wolf Lake, Winneway, Kitcisakik, Lac-Simon, Barriere Lake (Rapid Lake) and Kitigan Zibi First Nations. Algonquins of Pikwakanagan is the only Algonquin First Nation in the Ontario portion of the watershed with federal recognition under the Indian Act. Three other First Nation communities in Ontario, Wahgoshig, Matachewan and Temagami, are known to at least be of partial Algonquin descent, though they are located outside of the Ottawa River watershed (Morrison, 2005).

Regarded as a key component of the nation's history, the Ottawa River was a vital route in early European exploration. During the 17th century, the French established a thriving community, called New France. French missionaries were sent throughout the region in order to convert Indigenous populations to the Catholic Church, influencing Indigenous customs, traditions and language (MacGregor, 2017; ORHDC, 2005). While Indigenous communities had already established an extensive trade network throughout the region, the 17th century saw the beginning of a widespread European fur trade. For the next several years, France's booming fur trade was largely uninterrupted by other Europeans until 1670, when the Britain's Hudson's Bay Company was established. Shortly after, the British founded the North West Company, spurring an increase in British exploration. By the late 18th century, fur traders began forming permanent settlements along the Ottawa River. In the early 1800s, timber demand from North America skyrocketed, with an estimated 80 million logs taken from the Ottawa River valley. This demand created jobs, and spurred emigration; Irish, Scottish and French Canadians began travelling to the area in hopes of earning wages in forestry, farming and other pursuits (ORHDC, 2005).

Both farming and forestry vastly changed the landscape of the region, displacing Algonquin peoples and stimulating regional development for Europeans. Contributing to the changing landscape, as well as the availability of jobs, was the construction of the Rideau Canal, a navigable waterway between Lake Ontario and the Ottawa River. From 1826 to 1832, thousands worked on the 202 km long canal. Once completed, the canal was a valuable trading route, and contributed to the establishment and growth of Bytown. In 1855, Bytown was renamed Ottawa (Rideau Info, 2018). In 1857, Ottawa was declared the capital of the United Province of Canada and with the title driving further migration to the area. Influxes of educated people moved from Toronto, Kingston, Montreal and Québec City, joining large numbers of Irish, Scottish and French, along with smaller numbers of Belgians, Swiss, Italians, Germans, and Poles. The majority of immigrants were Irish, who brought distinct food, songs, stories and dance to the region. During the 1880s, an Ottawa Valley culture began to emerge, created by a melding of Irish, French Canadian and other settler cultures.

Over the next century, industries began to diversify, with mining operations, forest products processing, hydroelectric power and nuclear energy research becoming prominent (ORHDC, 2005; MacGregor, 2017). Remnants of the Ottawa River watershed's post-colonial history is still abundant today, with decades old hydroelectric dams still in operation and the Rideau Canal weaving its way through the capital region's historic homes.

Today, the Ottawa River watershed is home to more than 2 million people; however the population of the watershed is not evenly distributed. The highest concentration of population is along the main stem of the Ottawa River, and within the National Capital Region of Ottawa-Gatineau (MDDELCC, 2015a). See ECCC's map in section 1.1 (Figure 1.1-1), which depicts the population centers in and around the Ottawa River watershed.

The average age of the population in the Ottawa River watershed is 41.5 years old, and the average household size is 2.4 people. Over 150 languages are spoken in homes across the watershed. However, in terms of languages spoken most at home, approximately 53% of the population speak English, 37% speak French, and 6% speak non-official languages. Approximately 4% of the population speak more than one language at home.

The following infographic (Figure 1.2-2), presents a summary of the additional demographic information for the Ottawa River watershed from Statistics Canada's 2016 Census (Statistics Canada, 2017d)[2]. The full analysis of the census data can be found in Appendix B.

[2] The demographics presented in this section are adapted from Statistics Canada, Semi-custom Profile, Census 2016. This does not constitute an endorsement by Statistics Canada of this product (Statistics Canada, 2017d). Demographics come from both the long-form and short-form census. It should be noted that in semi-custom profiles, Statistics Canada will use area suppression, as needed, in order to remove all characteristic data for geographic areas whose population size is below a certain threshold. This is done to ensure confidentiality.

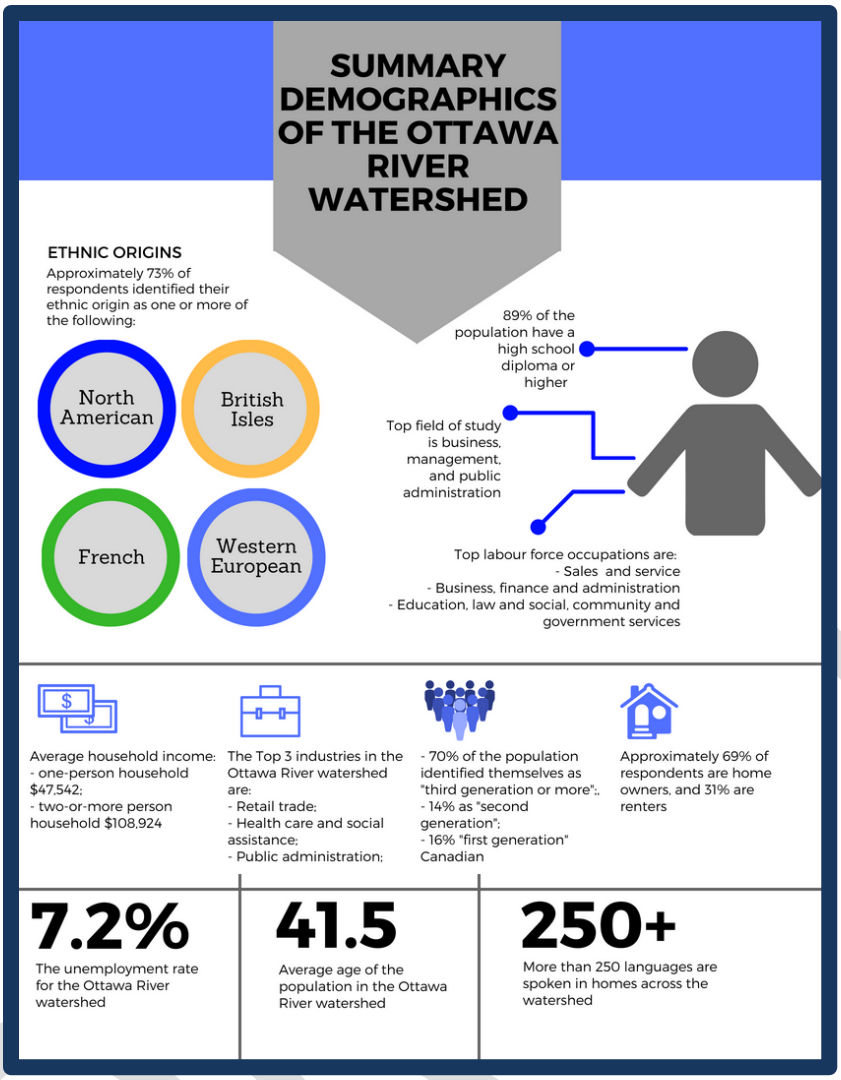


FIGURE 1.2-2. Summary of the demographics in the Ottawa River watershed.

1.3. ROLES AND RESPONSIBILITIES IN THE WATERSHED

Many groups have important roles and responsibilities within the Ottawa River watershed, including the governments of Québec and Ontario, the federal government, municipalities, Indigenous peoples, local watershed management organizations, industry, and others, such as non-governmental organizations, academia, and the general public (Government of Canada, 2017b).

Responsibilities, within the context of watersheds, can be defined as the statutory requirements of an authority to take all necessary measures to protect and conserve water resources. Roles, on the other hand, may be defined as the functions that are expected of an authority or a stakeholder. Roles may not necessarily be driven by legal requirements, but rather by the desire to meet an objective, which would be aligned with that stakeholder's mission. This section

provides an overview of those roles and responsibilities within the context of the Ottawa River watershed.

1.3.1. GOVERNMENTAL RESPONSIBILITIES

There are three main levels of government that share responsibilities in the Ottawa River watershed: the governments of Québec and Ontario, the federal government and municipalities. Water-related jurisdiction for the federal government and the provinces are largely determined by sections 91, 92 and 109 of the *Constitution Act*, *1867*. Specifically, section 91 applies to federal oversight of freshwater, and sections 92 and 109 allocate provinces legislative powers regarding the management and ownership of Crown lands, including water. However, unlike responsibilities for resources such as timber and fisheries, heads of power regarding water resources or overall water management are not specifically described. This section clarifies the responsibilities of the different authorities in the Ottawa River watershed. It should not be interpreted as reflecting the official position of governments on this matter.

PROVINCIAL JURISDICTION

Provincial governments are responsible for water resources within their boundaries. The governments of Québec and Ontario have considerable responsibilities and play a crucial role in management and monitoring of the Ottawa River watershed. Provinces are responsible for the management of provincial crown land, which includes the protection of freshwater resources, monitoring and pollution control, agriculture, health, municipal affairs and land planning, natural resources management and environmental protection (Government of Canada, 2017b).

The governments of Ontario and Québec have passed legislation and policies on water. Within Québec, applicable legislation and policies include the *Québec Water Policy* (2002), the *Act to Affirm the Collective Nature of Water Resources and to Promote Better Governance of Water and Associated Environments* (*Québec Water Act, 2009*), the Environment Quality Act (2018) and the *Québec Water Strategy* (2018). Within the province of Ontario, key water-related legislation and policies include the *Conservation Authorities Act*, *Nutrient Management Act, 2002*, and the *Clean Water Act, 2006*. Additionally, the provinces are responsible for the issuance of water use permits. Ontario and Québec also have important roles in supporting organizations that facilitate collaboration at the sub-watershed level, such as the Conservation Authorities (CAs) and the *Organismes de bassin versant* (OBVs), which are discussed further in section 1.3.3 *Roles of Local Watershed Management Agencies*.

THE GOVERNMENT OF QUÉBEC

Québec's *Water Policy* and the *Québec Water Act* affirm water as an important part of the province's collective heritage, with a goal to protect its quality and its ecosystems (MDDEP, 2009). The province implements a watershed-based management strategy using a sustainable development approach (MDDEP, 2009). This approach has been reinforced with the Québec Water Strategy in 2018. In the province, the management of watersheds is partly delegated to watershed management organizations (OBVs). The term "watershed management" is discussed in section 5.1 *Defining Watershed Management.*

Under Québec's *Environment Quality Act* and *Wetland Conservation Act*, the government of Québec is responsible for the protection of aquatic habitats (lakes, watercourses, banks, shorelines and floodplains), including plants and animal species. The Environment Quality Act also enabled the government to create new regulation regarding drinking water, municipal wastewater treatment systems, water withdrawals and transfers of water out of the St. Lawrence River Basin. The *Wetland Conservation Act* provides a regime for conserving and restoring wetlands as well as their waters (MDDELCC, 2018b). The *Watercourses Act* monitors and regulates the usage of watercourses in terms of development and construction works. Additionally, the *Pesticides Act* requires the government to supervise and control pesticide use on agricultural lands that could have an adverse effect on aquatic environments (Government of Québec, 2018).

THE GOVERNMENT OF ONTARIO

The province of Ontario has also promoted the importance of freshwater protection through the implementation of legislation, such as the *Nutrient Management Act, 2002*, which is designed to manage nutrients derived from farmlands ensuring sustainable agriculture practices and the protection of the environment. The *Fish and Wildlife Conservation Act, 1997* and the *Clean Water Act, 2006,* mandate the protection of plant and animal species and all sources of drinking water, within the province. Both pieces of legislation work in tandem with the *Conservation Authorities Act*, which mandates the government to establish a network of organizations to deliver programs and services that further the conservation, restoration, development and management of natural resources within local watersheds (Government of Ontario, 2017a).

Under the *Water Resources Act*, the province of Ontario provides for the conservation and protection of water resources; licensing and issuing of water permits to users and suppliers, and the efficient management and sustainable use of Ontario's water resources for the promotion of a long-term environmental, social and economic well-being (Government of Ontario, 2016b). Through the *Pesticides Act*, the province also has the responsibility to monitor and control pesticide release that can be detrimental to water resources. Moreover, the *Lakes and Rivers Improvement Act,* the *Forestry Act* and the *Municipal Act*, require the Ontario government to protect and secure shorelines from erosion and flooding.

FEDERAL JURISDICTION

The main federal responsibilities with implications on the Ottawa River watershed include the regulation of fisheries, shipping, navigation, and the management of federal lands. Section 91 of the *Constitution Act, 1867* also grants the federal Parliament broad legislative powers for "Peace, Order and Good Government" and "Criminal Law" (POGG), which can be exercised for matters of national importance, such as protecting freshwater, even if that matter is normally under provincial jurisdiction. The Government of Canada also undertakes water quantity and quality monitoring in collaboration with provinces, and administers programs that provide funding to provinces towards water and wastewater infrastructure. Federal legislation, such as the *Canada Water Act*, *Canadian Environmental Protection Act, 1999*, *International Boundary Waters Treaty Act*, and the *Fisheries Act*, provide for the management and protection of freshwater resources and the activities that depend upon it as it relates to areas of federal jurisdiction, such as fisheries and fish habitat, navigation, bulk water exports, nuclear safety, federal lands and transboundary waters.

The main federal statutes that enable the Government of Canada to manage water, or participate in watershed management, include:

- *Canada Water Act*;
- *Fisheries Act* (currently under review);
- *Canadian Environmental Protection Act, 1999;*
- *Canadian Environmental Assessment Act, 2012* (currently under review);
- *Arctic Waters Pollution Prevention Act;*
- *Canada Shipping Act, 2001;*
- *Dominion Water Power Act;*
- *Nuclear Safety and Control Act;*
- *International Boundary Waters Treaty Act;*
- *International River Improvements Act;*
- *Navigation Protection Act* (currently under review);
- *Northwest Territories Act*;
- *Nunavut Waters and Nunavut Surface Rights Tribunal Act*;
- *Migratory Birds Convention Act, 1994*

The *Department of the Environment Act* identifies ECCC as the lead department on water issues within the federal government, in areas not under the responsibility of other federal departments. ECCC also has mandated responsibilities under specific pieces of legislation, such as pollution prevention and enforcement of general prohibitions on pollution and quality standards for effluents (e.g., under the *Migratory Birds Convention Act, 1994*, and the *Fisheries Act*). ECCC also undertakes monitoring of freshwater quality and quantity, pursuant to agreements with the provinces enabled under the *Canada Water Act*.

Over 20 other federal departments and agencies are involved in addressing water issues in some respect in the Ottawa River watershed. Key departments include:

- Fisheries and Oceans Canada (DFO) (e.g., aquatic science research, fish habitat protection);
- Canadian Coast Guard, a special Operating Agency under DFO (e.g., aids in ensuring safe and accessible waterways);
- Agriculture and Agri-Food Canada (AAFC) (e.g., sustainable on-farm water management practices, drought monitoring);
- Indigenous Services Canada and Crown-Indigenous Relations and Northern Affairs (e.g., First Nations drinking water and wastewater capacity);
- Health Canada (e.g., Drinking Water Quality Guidelines, water quality and health research);

- Natural Resources Canada (NRCan) (e.g., groundwater aquifer assessment and characterization, National Hydrographic Network, remote sensing and mapping to respond to floods);
- Transport Canada (e.g., navigable waters);
- Infrastructure Canada (e.g., funding support for water and wastewater systems);
- Canadian Nuclear Safety Commission (CNSC), an independent federal government agency, which regulates nuclear activities within the watershed including activities of the Canadian Nuclear Laboratories in Chalk River;
- Public Safety Canada (e.g., emergency management for flooding, disaster mitigation);
- Public Services and Procurement Canada (PSPC) (e.g., operates water control dams on the Ottawa River); and
- National Capital Commission (NCC) (federal Crown Corporation; planning, and partnering in the development, conservation and improvement of federal lands in Canada's National Capital Region).

The *Canada Water Act* provides an enabling framework for collaboration among the federal, provincial and territorial governments in matters relating to watershed management. The Act enables the Minister of Environment and Climate Change to enter into agreements and joint programs with the provinces respecting regulation, apportionment, monitoring or surveying of water resources, as well as planning and implementation of watershed protection. The *Canada Water Act* requires the Minister to prepare an annual report to Parliament on operations under the Act, which outlines activities undertaken in support of joint agreements and programs. ECCC has entered into such agreements with the two provincial governments in the Ottawa River watershed, the Governments of Ontario and Québec (e.g., to establish the Ottawa River Regulation Planning Board). Additionally, given the presence of the Rideau Canal within the watershed, the *Department of Transport Act* is also leveraged to manage water regulations within the canal.

1.3.2. INDIGENOUS PEOPLES

A number of other Algonquin organizations were formed in order to represent the collective voices of multiple Algonquin communities. Algonquin Anishinabeg Nation is comprised of six First Nations in Québec – Kitigan Zibi, Kebaowek (Eagle Village), Winneway, Lac-Simon, Kitcisakik, and Abitibiwinni (Pikogan) First Nations – as well as one First Nation in Ontario, Wahgoshig First Nation. Similarly, the Algonquin Nation Secretariat is comprised of three other Algonquin communities in Québec; Timiskaming, Wolf Lake, and Barriere Lake First Nations. The Native Alliance of Québec represents around 18 non-status and non-reserve Algonquin communities. In the Ontario portion of the watershed, Algonquins of Ontario is comprised of Pikwakanagan First Nation, as well as nine Algonquin collectivities throughout communities in eastern Ontario without federal recognition as "status" First Nations under the Indian Act. Those nine communities are the Antoine, Bonnechere, Greater Golden Lake, Kijicho Manito Madaouskarini (Bancroft), Mattawa/North Bay, Ottawa, Shabot Obaadjiwan (Sharbot Lake), Snimikobi, as well as Whitney and Area Algonquin collectivities.

At the regional level, the Assembly of First Nations Québec-Labrador and the Chiefs of Ontario play a secretariat and political forum role for collective decision-making, action and advocacy for First Nations communities in Québec and Ontario, respectively. Métis peoples and communities located in Ontario are represented by the Métis Nation of Ontario. At the national level, the Assembly of First Nations is an advocacy organization representing First Nations with federal recognition under the Indian Act, which includes over 900,000 people living in 634 First Nation communities, as well as cities and towns across the country. The Congress of Aboriginal Peoples represents off-reserve status and non-status Indigenous peoples at the national level.

The Algonquins of Golden Lake (now the Algonquins of Pikwakanagan) began negotiating a comprehensive land claim with Ontario in 1991; Canada joined the negotiations in 1992. However, due to actions from other Algonquin groups seeking involvement at the negotiation table, it became apparent that the Algonquins of Pikwakanagan did not represent all Algonquins in Ontario. In 2005, negotiations expanded to include nine Algonquin collectivities that make up Algonquins of Ontario. There are a number of other Algonquin communities located within the watershed, which do not have federal recognition as "bands" (First Nations) under the Indian Act, and are not participating in the Algonquins of Ontario land claim negotiation process, despite attempts by negotiators for Canada and Ontario to include them in the process. Scholars have found that the majority of Algonquin peoples in Ontario do not currently have federal recognition, largely because they were not assigned reserves during the colonization process, or lost federal recognition as a result of marriage to "non-status" persons (Indian Act was amended in 1985 so that the loss of status through marriage to "non-status" persons could be prevented and reversed). This is inconsistent with national Census data, which states 81% of First Nations peoples have federal recognition under the Indian Act and 19% do not (Hedican, 2017). Networks of "non-status" Algonquin families are located in places such as Ardoch, Baptiste Lake, Mattawa, Sharbot Lake, Whitney, Allumette Island, and Pembroke (Lawrence, 2013).

Throughout the course of this Study, it became apparent that there were disputes and divisions within and between Algonquin communities as a result of colonial history and the Crown's policies. Some Algonquin groups are opposed to the Algonquins of Ontario land claim negotiation process, and expressed the view that Algonquins of Ontario is not sufficiently representative of all Algonquins (Munson, 2016). In addition to the land claim negotiation process, division and tension has been exacerbated by the fact that some Algonquin communities are recognized as bands under the Indian Act while others are not. Ardoch Algonquin First Nation and Allies, for example, is an Algonquin community located along the Madawaska, Mississippi and Rideau Rivers, which does not have federal recognition under the Indian Act and is opposed to the Algonquins of Ontario land claim negotiation process. Algonquin First Nations located in Québec, with federal recognition under the Indian Act, have also expressed opposition to the Algonquins of Ontario land claim negotiation process, asserting that they continue to have Aboriginal rights and title to land in Ontario, as the provincial border separating Ontario and Québec did not exist prior to colonization by Europeans (Melnitzer, 2017). Over the years, Québec Algonquin communities have also submitted a number of land claim assertions and declarations to the Government of Canada. Most of these assertions have included territory on both the Ontario and Québec sides of the Ottawa River watershed. The Native Alliance of Québec was not a party to any submissions by Algonquins in Québec.

The Mohawks of Kanesatake and Kahnawá:ke are located downstream of the Ottawa River, near its junction with the St. Lawrence River. Kanesatake and Kahnawá:ke First Nation

communities also share jurisdiction over the uninhabited or, occasionally, sparsely inhabited reserve of Doncaster 17, which is located within and near the northeastern border of the Ottawa River watershed. Doncaster 17 primarily serves as hunting and fishing territory for both First Nations. The Mohawks of Kanesatake and Kahnawá:ke are members of the Haudenosaunee Confederacy.

1.3.3. MUNICIPAL JURISDICTION

There are about 200 municipalities in the Ottawa River watershed - the most populous of which include the cities of Ottawa, Gatineau, Petawawa, Pembroke, and Rigaud. Municipal governments are generally responsible for drinking water and wastewater treatment services. Municipalities also undertake watershed protection initiatives within their respective areas of jurisdiction. In 2003, the municipalities of Ottawa and Gatineau partnered with the NCC to release the Ottawa River Integrated Development Plan, including recommended projects to be implemented over the long term. One such recommendation was that an Ottawa River Summit be held. An Implementation Guide for the Ottawa River Integrated Development Plan was released in 2009, and Ottawa Riverkeeper led the first Ottawa River Summit, in 2010, with the support of the NCC, the City of Ottawa, and the City of Gatineau (NCC, n.d.-b). Also in 2010, the City of Ottawa released an Ottawa River Action Plan, a collection of 17 planned projects to improve the health of the watershed. Ottawa's Combined Sewage Storage Tunnel project, for example, is a $232.3 million investment to reduce combined sewer overflows to the Ottawa River, with funding support from the governments of Canada and Ontario. The project is expected to be operational by 2020 (City of Ottawa, n.d.).

Local regional governments, such as counties, may also be responsible for wetland conservation, waste management, and the protection of shorelines and floodplains from encroaching development within their regional boundaries (Government of Canada, 2017b). In both the provinces Ontario and Québec, the municipalities and regional government authorities have been delegated some managerial functions in terms of watershed protection. For example, in Ontario, under the *Environmental Protection Act*, the *Ontario Water Resources Act* and the *Planning Act*, the province of Ontario has the responsibility in partnership with the municipality to protect potable water sources, construct, operate and manage water supply and sewage services, as well as provide adequate remedial measures in situations of infrastructure default (Government of Ontario, 2016b). In Quebec, the *Conservation of wetlands and bodies of water Act* reaffirms the government's partnership with the municipal sector, in particular by specifying the role of regional county municipalities in urban planning, wetland mapping and the management of restoration programs (MDDELCC, 2018).

1.3.4. OTHER COLLABORATIVE INITIATIVES

Due to shared jurisdiction related to water resources, water management is often undertaken collaboratively by multiple levels of government. Examples of joint initiatives undertaken in the Ottawa River watershed include the Ottawa River Regulation Planning Board (ORRPB) and the Joint Directors Committee on Water Management.

OTTAWA RIVER REGULATION PLANNING BOARD

The ORRPB was created by the governments of Canada, Québec, and Ontario in 1983 to ensure integrated management of the principal reservoirs of the Ottawa River watershed. This integrated management of flow aims to minimize flood and drought damage along the Ottawa River, with particular attention to the Montreal region, while maintaining beneficial water uses such as hydro-electric power production and preserving statutory or environmental levels and discharges in respect of other interests (ORRPB, 2017). In the 1983 context, the term "integrated management" meant integrating the decision making processes of respective dam operators into one common process that provides a common information and decision-support system. The Board is composed of seven members who represent the federal government (3 members), the governments of Québec (2 members) and Ontario (2 members), as well as Hydro-Québec and Ontario Power Generation. Without legal authority over the decisions of the operators of the reservoirs, the Board members work together to establish and implement general principles, priorities and overall regulation policies for integrated management of the reservoirs. The authority of the Board is defined by an Agreement Respecting Ottawa River Basin Regulation. The ORRPB also ensures that relevant information, for example forecasts of river flows and levels along the Ottawa River, is made available to the public and government organizations, especially provincial agencies given that the preparation and issuance of flood messages along the Ottawa River are a provincial responsibility (ORRPB, 2017).

QUÉBEC-ONTARIO WATER MANAGEMENT JOINT DIRECTORS COMMITTEE

The interprovincial Québec - Ontario Water Management Joint Directors Committee was created in 2015 and was then reaffirmed under the 2016 Environmental Cooperation Agreement between Ontario and Québec. Through this Agreement, the governments of Ontario and Québec committed to the strengthening of existing bilateral cooperation, information exchange on shared watersheds and ecosystems, to work mutually to address environmental issues, and to prevent and mitigate adverse transboundary impacts (Government of Ontario, 2015; Government of Ontario, 2016a). The joint committee provides a platform for Québec and Ontario to discuss water management issues, including management of the Ottawa River watershed.

CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT

The Government of Canada has a long history of collaborating with provinces and territories through the Canadian Council of Ministers of the Environment (CCME). CCME works cross-jurisdictionally to provide guidance and Canada-wide tools for water management (e.g., Canadian water quality guidelines development, advice to inform surface and groundwater decision-making). The federal government also collaborates with non-governmental organizations, to address gaps in water knowledge (e.g., with Ducks Unlimited Canada for wetland mapping and conservation).

EASTERN HABITAT JOINT VENTURE

Since 1989, the provincial and federal governments and NGOs, such as Ducks Unlimited Canada and the Nature Conservancy of Canada, have been working together to create the Eastern Habitat Joint Venture. These partners have been delivering wetland-habitat conservation projects in Eastern Canada, as part of the continental North American Waterfowl

Management Plan – an international partnership with Canada, the United States and Mexico, to conserve wetland and associated upland habitats for the benefit of waterfowl and other migratory birds. Eastern Habitat Joint Venture partners in both Ontario and Quebec work together to undertake habitat conservation and restoration projects for wetlands within the areas of the Ottawa River watershed that have been identified as priority areas for conservation work (Eastern Habitat Joint Venture, 2018).

1.3.5. ROLES OF LOCAL WATERSHED MANAGEMENT AGENCIES

This section provides a brief description of local watershed management agencies that are active in the Ottawa River watershed. More information on their contributions to monitoring activities, data collection and research can be found in Chapter 4: *Data, Monitoring, and Potential Indicators – Views on the health of the Ottawa River Watershed*.

ORGANISMES DE BASSINS VERSANTS

With the adoption of the *Québec Water Policy* in 2002, a network of 33 local watershed management agencies, called *Organismes de bassins versants* (OBVs), were established to improve water management in Québec. In 2009, the distribution of OBVs was modified to ensure full coverage of the province, which led to an increase in the total number of OBVs to 40 (COBAMIL, 2010). OBV membership differs, depending on local contexts, but typically includes representatives from municipalities, regional county governments (*municipalités régionales de comté* or MRC), local non-governmental organizations (NGOs), the general public, and industry. All OBVs are convened and supported by the non-profit umbrella coalition called *Regroupement des organismes de bassins versants du Québec* (ROBVQ) (MDDELCC, 2018b, ROBVQ, 2018). Each OBV is required to develop a watershed master plan (*Plan directeur de l'eau*), and subsequently promote, coordinate and monitor its implementation based on a set of designated priorities that align with a detailed vision and a diagnostique of regional issues (MDDELCC, 2015a).

The Québec portion of the Ottawa River watershed was subdivided into seven integrated water management zones (see Figure 1.3-1). Within these zones, consultations and water management initiatives are carried out by seven OBVs (ROBVQ, 2018): Conseil du bassin versant de la région de Vaudreuil-Soulanges (COBAVER-VS); Conseil des bassins versants des Mille-Îles (COBAMIL); Comité du bassin versant de la rivière du Lièvre (COBALI); Organisme de bassin versant du Témiscamingue (OBVT); Organisme de bassins versants des rivières Rouge, Petite Nation et Saumon (OBV RPNS); Organisme de bassin versant de la rivière du Nord (ABRINORD); and Agence de bassin versant des 7 (ABV 7).

REGIONAL ROUND TABLES AND ZIP COMMITTEES IN QUEBEC

Integrated management of the St. Lawrence River is implemented through Regional Round Tables (RRTs). There are 12 RRTs being implemented, of which 6 are already active. RRTs are independent, permanent, multi-stakeholder entities responsible for individual geographical areas covering the length of the St. Lawrence River. The primary purpose of RRTs is to promote collaboration amongst stakeholders in their respective sections of the St. Lawrence River basin, and harmonize their actions in order to ensure integrated management of the basin (SLAP 2011-2026, 2012). Regional integrated management plan are developed to assist RRTs in

accomplishing their mission. IWM has long been a priority for the St. Lawrence River basin. Additional committees exist in Areas of Prime Concern, known as ZIP committees, and represent important partners, among others, in supporting the work of RRTs. ZIP Committees were established previously, in 1993, in a joint initiative led by the governments of Québec and Canada. There are now 12 ZIP Committees in total, including in areas without RRTs, which are responsible for coordinating the development of Regional Integrated Management Plans.

FIGURE 1.3-1. Map of the watershed management agencies in the Ottawa River watershed.

CONSERVATION AUTHORITIES

Established in 1946 under the *Conservation Authorities Act*, the Ontario Conservation Authority is a non-profit association representing a network of 36 CAs throughout the province of Ontario. The mandate of CAs is to oversee at the watershed level the conservation, restoration and responsible management of aquatic habitats, lands and natural resources, while balancing environmental, economic and human needs (Conservation Ontario, 2018b). Five CAs operate within the Ottawa River watershed (see Figure 1.3-1). They are the: Mississippi Valley Conservation Authority (MVCA); Rideau Valley Conservation Authority (RVCA); South Nation Conservation Authority (SNCA); Raisin Region Conservation Authority (RRCA); and North Bay-Mattawa Conservation Authority (NBMCA). Watershed programs and services managed by CAs include (Government of Ontario, 2017a):

- Watershed planning and management, and the protection of watercourses, wetlands and hazardous lands subjected to flooding and erosion;
- Monitoring and advice on fish habitat protection, watercourse condition and sub- watershed ecosystem health;
- Advice to municipalities on land use planning and development of wetlands, river and stream valleys, woodlands, fish habitat, hazard lands, and hydrogeology;
- Provide emergency planning and response, including flood forecasting and warnings, and low water responses;
- Evaluate climate change impacts, develop mitigation and adaptation resilience strategies;
- Engage landowners and residents on waterway clean-ups, tree planting, shoreline protection, erosion control and water quality protection through education; and
- Develop measures to reduce water pollution, mitigate or prevent natural hazards (flood, drought, erosion), protect or restore wildlife habitat and restore shorelines.

1.3.6. ROLES OF KEY STAKEHOLDERS

When examining the wide array of responsibilities and initiatives highlighted in this section, it becomes clear that the protection of the Ottawa River watershed involves a number of important players, some of which do not have direct responsibilities within the watershed. Ensuring the success of policies and programs at the watershed level requires the participation and commitment of key stakeholders, who are often well placed to address watershed issues at the local scale (Cook, 2011).

PRIVATE SECTOR AND INDUSTRY

As users of the watershed, the private sector has an important role to play, not only with regard to their socio-economic value, but also in fostering innovation, developing corporate social responsibility plans, and by ensuring their activities and practices are sustainable (e.g., they ensure that their activities do not directly or indirectly affect the environment by adhering to environmental regulations and industry standards). Domtar Corporation and Cascade Inc. are both major paper and pulp producers operating within the watershed. Other significant

industries in the watershed include the Canadian Nuclear Laboratories, Hydro-Québec and Ontario Power Generation. More information on industry in the Ottawa River watershed can be found in section 3.2.2 *Economic Values*.

NON-GOVERNMENTAL ORGANIZATIONS

There are many environmental NGOs currently active within the Ottawa River watershed. Some of them are presented below.

OTTAWA RIVERKEEPER

Ottawa Riverkeeper is a charity organization whose mandate is to protect the river and its watershed. They have assumed an important role by conducting non-profit research, facilitating stakeholder collaboration through conferences and events, conducting water monitoring and encouraging environmental stewardship in the region (Ottawa Riverkeeper, 2015). Ottawa Riverkeeper advocates for the responsible and sustainable use of the Ottawa River in the context of several issues of interest to the public, including the storage of nuclear waste and sewage overflows by municipalities. They also lead various public education and awareness programs, such as the Riverwatcher network and the River Patrol.

As previously mentioned, in 2015, Ottawa Riverkeeper spearheaded the Gatineau Declaration, which highlighted the shared responsibility to preserve biodiversity, water quality and the well-being of communities in the Ottawa River watershed, and outlined shared actions to be taken by signatories moving forward. Following the release of the Gatineau Declaration, Ottawa Riverkeeper initiated a Watershed Health Committee and has been promoting the creation of an Ottawa River Watershed Council. Ottawa Riverkeeper released a discussion paper on Ottawa River Watershed Governance in May 2017, including a proposed structure for the Steering Committee of an Ottawa River Watershed Council (Ottawa Riverkeeper, 2017).

DE GASPÉ BEAUBIEN FOUNDATION

The De Gaspé Beaubien Foundation is a family run charity that organizes meetings and mobilizes champions in addressing community challenges, such as water conservation. They held a summit (AquaHacking) with a focus on the Ottawa River watershed in 2015, where the event brought together experts, decision-makers and passionate individuals to find innovative and technological solutions to promote the sustainable use and conservation of Canada's freshwaters (Aquahacking, 2015a). During the summit, which was organized in partnership with Ottawa Riverkeeper and Blue Legacy, the River Mission project was created with the goal to raise community awareness on preservation of the Ottawa River (Aquahacking, 2015b).

WATER RANGERS

Water Rangers is a non-profit charity that was founded out of the Aquahacking summit held in 2015. The organization is composed of citizens, web designers and developers who use their skills to help protect water resources. They cooperate with municipalities, schools, Indigenous communities, CAs and other NGOs to raise awareness and find solutions to water related issues (Water Rangers, 2018a). More specifically, their mission is to create the tools needed by citizens and scientists to record and analyze water-related data in order to understand the issues, share their discoveries and engage with their neighbours. In alignment to their mission,

they have designed test kits adapted to experienced or inexperienced individuals who want to monitor water quality. Water Rangers also host a free platform for citizen scientists who wish to record their observations on water. Their interactive map is available online or through a smart phone application (Water Rangers, 2018a).

DUCKS UNLIMITED CANADA

Ducks Unlimited Canada is a non-governmental organization and registered charity. Established in 1938, their mission is to "conserve, restore and manage wetlands and associated habitats for North America's waterfowl" (Ducks Unlimited Canada, 2018a). As a leader in Canadian habitat conservation, Ducks Unlimited Canada has completed more than 9,720 projects across Canada working in areas such as wetlands, grasslands, water, waterfowl, wildlife and Canada's Boreal ecosystem. As part of their mandate, they conduct scientific research, work with all levels of government to help shape policy, and provide education programs to inspire, empower and deliver real-world results (Ducks Unlimited Canada, 2017). Ducks Unlimited Canada has a large presence in the Ottawa River watershed. They are working with many different organizations and levels of government, to focus conservation efforts on priority wetlands, such as mapping areas along the Ottawa River (Ducks Unlimited Canada, 2017).

NATURE CONSERVANCY OF CANADA

Nature Conservancy of Canada is an NGO that specializes in land conservation. Through donation, purchase, conservation agreement and the relinquishment of other legal interests in land, they secure properties and manage them for the long term (Nature Conservancy of Canada, 2018a). The Ottawa Valley is one of the Priority Natural Areas for the organization, where there have been numerous successful land acquisition projects, such as the Gervais Caves property, a 75-acre shoreline parcel (Nature Conservancy of Canada, 2018b).

WORLD WILDLIFE FUND CANADA

WWF-Canada is actively engaged in the protection of Canada's freshwater, as well as the protection of species at risk, including those found in the Ottawa River watershed. Its main focus, across Canada, is centered on building resilient communities, promoting the use of scientific data in decision-making, and creating water conservation awareness and stewardship by working with all levels of government, Indigenous communities, researchers and civil society (WWF-Canada, n.d).

CONSEIL RÉGIONAL DE L'ENVIRONNEMENT ET DU DÉVELOPPEMENT DURABLE DE L'OUTAOUAIS

Created in 1990, the Conseil régional de l'environnement et du développement durable de l'Outaouais (CREDDO) is one of 16 regional environmental councils throughout Québec. These councils are non-profit organizations run by a board of directors elected from among their members. CREDDO's membership includes businesses, individuals and local government representatives interested in the environment and sustainable development of the Outaouais region. CREDDO sits on multiple committees and also participates in consultations led by different groups, such as municipalities and Hydro-Québec (CREDDO, 2018).

ACADEMICS AND RESEARCH INSTITUTES

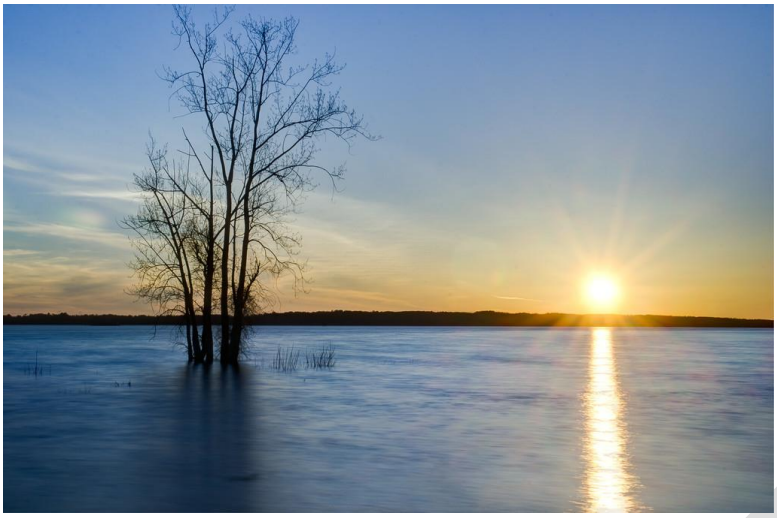
Academics and scientists play a crucial role in understanding the Ottawa River watershed. Academic institutions, research institutes and governmental science-based departments are all home to renowned scientists and experts. They provide peer-reviewed scientific knowledge and technical data, develop innovative theory and practices, and support informed decision-making (MDDELCC, 2018b).

Within the Ottawa River watershed, academic institutions have been active in promoting research geared toward improving the health of the Ottawa River. Carleton University, for example, spearheaded the Watts Creek restoration project through the Great Lakes Guardian Community Fund to protect water quality and promote community involvement (Carleton University, 2013). Moreover, the University of Ottawa conducts research within the watershed, such as modelling of agricultural best management practices and research focused on assessing contaminant loading in the river (Parker, 2004).

GENERAL PUBLIC

The general public plays an important role in the management of the watershed by: actively participating in organizations that promote the wellbeing of the watershed, like environmental NGOs; participating in community outreach and research programs hosted by OBVs and CAs; voicing public opinion at municipal hearings; as well as through communication with federal departments and provincial ministries. The general public has the potential to influence decision-making, which ultimately impacts watershed management. More information on public values and the sense of purpose the public derives from participating in watershed-scale efforts is included in section 3.2.4 Social dimensions.

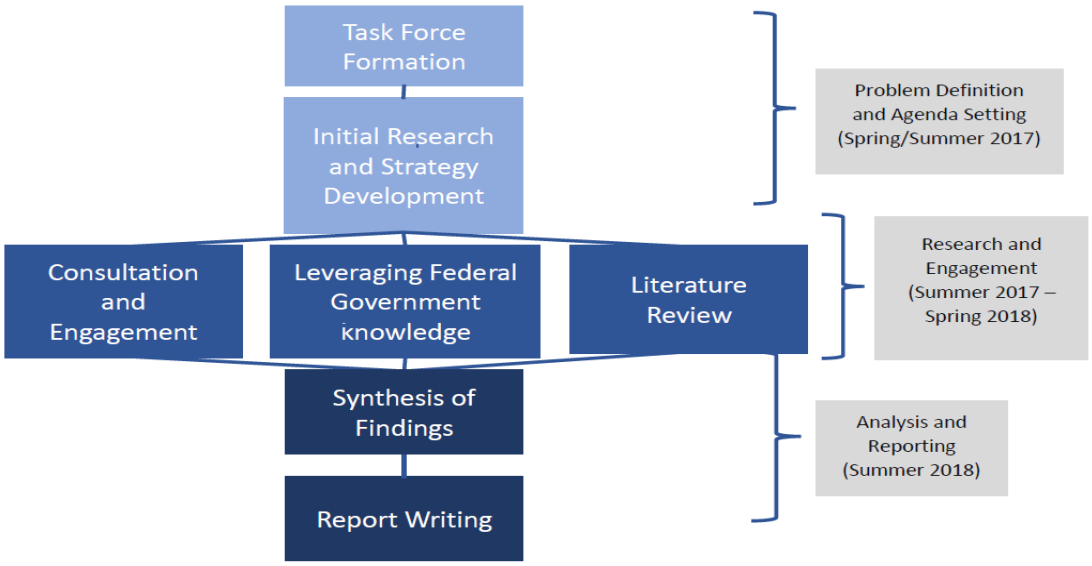
Specific features of the watershed are also of importance to the general public. For example, Réseau ZECs (controlled harvesting zones), provincial parks, such as Plaisance National Park, and Outfitter Associations within the watershed are popular ways to access nature in order to pursue different activities, such as camping, hunting, and fishing (Québec Outfitters, 2018). As users of the Ottawa River watershed, the collective interests of the public play a significant role in the sustainable use and protection of the watershed.



2 STUDY METHODOLOGY

The Ottawa River watershed has an engaged public, multiple government bodies and diverse ecosystems found within its boundaries. In order to effectively engage the diverse groups who live and/or have an interest in protection of the Ottawa River watershed, ECCC sought to undertake a broad, comprehensive and multi-pronged engagement process. In addition, the region, the watershed, and the Ottawa River have been the focus of past publications and reports, which were analyzed as part of the ORWS.

In May 2017, an ECCC task force was established, bringing together experts from across the department. Task force sub-groups were also formed to allow collaboration between ECCC staff with expertise on specific components of the Study. Task Force and sub-group members shared knowledge, compiled and assessed resources, and created and implemented the engagement approach. Overall, the Study methodology involved the steps outlined in Figure below.



2.1. ENGAGEMENT

ECCC strived to ensure that the engagement approach reached a broad range of groups and was comprehensive, transparent and meaningful. Engagement included:

- informal initial meetings with Indigenous groups and support for Indigenous communities to run their own consultations and reporting processes;
- meetings and written submissions from all levels of government;
- development of a list of potential stakeholder groups and email outreach over a three month period;
- public open-door meetings;
- submissions and questions to dedicated ECCC Study email account;
- workshops, presentations and webinars with specific stakeholders; and
- the use of an online public engagement platform called PlaceSpeak.

Figure 2.1-1 below summarizes the various groups that were proactively engaged throughout the course of the Study (see Appendix C for list of organizations that participated in the engagement process):

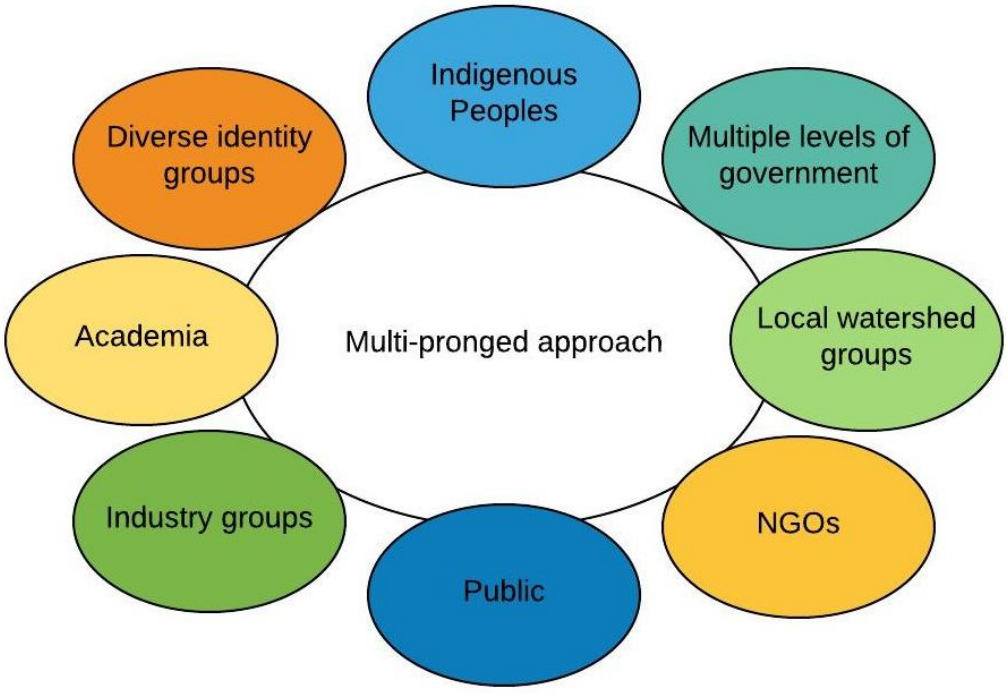


FIGURE 2.1-1. ORWS multi-pronged engagement approach.

2.1.1. CONSULTATION WITH INDIGENOUS COMMUNITIES

ECCC committed, at the outset of the ORWS, to meaningfully consult Indigenous communities. A study about the Ottawa River watershed could not be successful if the rights and related interests of Indigenous peoples in the region were not duly considered. This commitment is in line with the ten *Principles respecting the Government of Canada's Relationship with Indigenous Peoples*, released in February 2018. The Principles guide the federal government's commitment to a renewed, nation-to-nation, government-to-government relationship based on recognition of rights, respect, co-operation, and partnership. The Principles are rooted in section 35 of the *Constitution Act, 1982*, and are guided by the United Nations (UN) Declaration on the Rights of Indigenous Peoples. They are also informed by the Report of the Royal Commission on Aboriginal Peoples and the Truth and Reconciliation Commission's Calls to Action (Department of Justice, 2018).

The Government of Canada follows the Principles as a starting point to support efforts to end the denial of Indigenous rights, which led to disempowerment and assimilationist policies and practices. They seek to advance fundamental change whereby Indigenous peoples increasingly live in strong and healthy communities with thriving cultures. To achieve this change, it is recognized that Indigenous nations are self-determining, self-governing, increasingly self-sufficient, and rightfully aspire to no longer be marginalized, regulated, and administered under the *Indian Act* and similar instruments. It should be noted, however, that the understandings and applications of these Principles in relationships with First Nations, Métis, and Inuit are diverse, and their use is contextual.

ENGAGEMENT WITH GOVERNMENT BY THE NUMBERS

34	Attendees at two workshops with federal representatives
60	Federal officials that received engagement guides
2	Trilateral, executive-level meetings with ON and QC
2	Provinces received engagement guides for distribution to relevant ministries
1	Presentation to Ottawa River Regulation Planning Board and tailored engagement guide
91	Municipal councils and municipalities within the watershed received engagement guides
3	Municipalities downstream of watershed engaged
14	Engaged Conservation Authorities and Organismes de bassins versants received engagement guides

In the early planning stages of the ORWS, ECCC developed an overarching Indigenous Consultation Strategy to guide its approach throughout the duration of the study (see Appendix D). The Strategy was updated over time to adapt to new information as it became available.

The next step was to identify and contact over 20 communities and organizations, both within and outside of the watershed, with potential ties to it. These communities included: Algonquins of Ontario, Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, as well as Métis Nation of Ontario, and the Mohawk Councils of Kanesatake and Kahnawá:ke. In keeping with the spirit of the Indigenous Consultation Strategy, ECCC's initial contact letters introduced the study, expressed ECCC's interest in consultation, and asked communities to

indicate whether and how they would like to be involved moving forward. Informative letters were also sent to other organizations to welcome their involvement and to notify them about the ORWS, including the Assembly of First Nations and the Congress of Aboriginal Peoples.

A number of initial meetings with Indigenous groups and representatives were held. Following these interactions, a number of proposals were submitted and discussed with ECCC. Six separate contracts were negotiated and signed with the Algonquins of Ontario, Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Métis Nation of Ontario, and the Mohawk Councils of Kanesatake and Kahnawá:ke, to allow these groups to gather, reflect and formulate their input for the ORWS. ECCC also attended a portion of some of the consultations to give a presentation about the ORWS and to answer questions.

2.1.2. ENGAGEMENT WITH GOVERNMENT BODIES

ECCC engaged all levels of government with authorities or responsibilities relating to the management of the Ottawa River watershed (see section 1.3 for a description of the roles and responsibilities).

Two federal workshops were held in August 2017, the first within ECCC, and the second with other pertinent federal departments and agencies. The goal of the workshops was to engage federal departments and agencies on the Study early in the process. ECCC then designed an engagement guide, which was sent to these departments and agencies, to facilitate gathering their input.

Engagement with provincial governments was initiated by a letter from the Deputy Minister of ECCC to counterparts in Ontario and Québec's environmental ministries, followed by a Deputy Minister level meeting to discuss the ORWS. This meeting was followed by regular discussions among officials at the working level, including a presentation by ECCC to the Québec-Ontario Water Management Joint Directors Committee. A customized engagement guide was sent to both provinces, to gather information from the different provincial ministries about initiatives that implicate the Ottawa River watershed.

Following initial discussions with executives at the provincial level, ECCC developed a plan to engage directly with municipalities and with CAs in Ontario and OBVs in Québec. Customized engagement guides were sent to each of those groups.

In addition, ECCC gave a formal presentation about the Study to the ORRPB, which was also sent a custom engagement guide to help them structure their input. Of note, all engagement guides were tailored based on the roles and responsibilities of respective groups.

2.1.3. STAKEHOLDER ENGAGEMENT AND GENDER-BASED ANALYSIS PLUS

ECCC designed the public and stakeholder engagement process based on broad and meaningful engagement.

PUBLIC AND STAKEHOLDER ENGAGEMENT PLANNING BY THE NUMBERS

3 Bilingual maps created

1 Socio-economic analysis commissioned (Stats Can)

1 Online citizen engagement site created and managed

2 Bilingual webpages about the Study created on Canada.ca

1 Study email inbox created and managed

ECCC developed a GBA+ strategy to frame the research and engagement process of the ORWS. The strategy was used to help understand how diverse groups of people experience the Ottawa River watershed, how they might be potentially impacted by governance mechanisms, and how to mitigate or eliminate any differential impacts. To encourage input from a broad diversity of voices, ECCC developed a large stakeholder outreach list encompassing about 300 groups. These groups represented: industry and business, NGOs, researchers and academics, community-based organizations, cultural, ethnic and faith-based organizations, persons with disabilities, and youth. For more information on the GBA+ approach, the strategy can be found in Appendix E.

STAKEHOLDER ENGAGEMENT

Identified stakeholder organizations received initial emails introducing them to the study and alerting them that they would receive occasional emails throughout the engagement process. Five subsequent email updates were sent to this stakeholder list while the online engagement site was live, encouraging

APPLYING A GENDER-BASED ANALYSIS PLUS LENS

The Study and its associated engagement process are in line with government-wide commitments such as the integration of Gender-Based Analysis Plus (GBA+). GBA+ is an analytical tool used to assess how diverse groups of people may experience policies, programs and initiatives, while also considering identity factors, such as gender, race, ethnicity, religion, age, and mental or physical disability. The approach is undertaken to mitigate potential adverse impacts on different segments of the population.

STAKEHOLDER ENGAGEMENT BY THE NUMBERS

300+ Stakeholders identified and informed about Study

5 Email updates sent to stakeholders during online public engagement

42 Attendees at joint, multi-stakeholder workshop co-created with Ottawa Riverkeeper with support from ISED Innovation Lab

60 Business and industry representatives sent custom engagement guides

2 Webinars with water-related networks

2 E-articles in water-related e-publications

1 Guest lecture to a university class

3 Sessions with middle school and high school youth

participation and asking for help in promoting the study. Each email gave recipients the ability to opt-out from further updates. ECCC also informed stakeholders that submissions could be sent to the ORWS e-mail account or to ECCC by mail.

In addition to the email updates, customized engagement guides were sent to key industry and business associations. The purpose of the guides was to provide an opportunity for stakeholders to describe their industry's presence within the watershed, contributions to the natural, social and economic well-being of the region, to identify monitoring programs and available data on indicators relating to the health of the watershed, and to get their perspective on watershed governance. Academics and research institutes were also contacted related to indicators and data collection, specifically to post information about their research on the online public engagement site.

As indicated in section 1.3, Ottawa Riverkeeper has been active in the Ottawa River watershed for many years. Ottawa Riverkeeper initiated its own process to create an Ottawa River Watershed Council. Early on in the ORWS process, ECCC approached Ottawa Riverkeeper regarding planning a workshop to gather further information about their process to establish an Ottawa River Watershed Council. A workshop was co-created by ECCC and Ottawa Riverkeeper with support from the Innovation, Science and Economic Development Canada (ISED) Innovation Lab, and was held in November 2017. When the online public engagement began, Ottawa Riverkeeper helped promote the study among its network and through social media outreach. A custom engagement guide was also prepared and sent to Ottawa Riverkeeper.

In addition, ECCC actively sought input from youth, as they have unique perspectives and insights. ECCC facilitated lessons and activities with youth at the middle school and high school level (Blue Sky School and St. Lawrence Academy in Ottawa), presented at a science communication class at Carleton University, and actively reached out to other colleges and universities. In addition, ECCC promoted the ORWS through: submitting an online article to the Partnership for Water Sustainability in

ONLINE ENGAGEMENT ON PLACESPEAK BY THE NUMBERS

97	Days to provide input through the online public engagement site
71	Distinct documents, images, links posted as Resources
7	Distinct postings on Overview page
8	Distinct discussion questions posted
2	Distinct poll questions fielded
2	Distinct calls to action on Place-it map
4	Emails sent to connected participants
41K	Page views during the online engagement period
387	Citizens registered
46	Comments on Noticeboard
333	Votes cast in two separate snapshot polls
27	Postings on Place-it map

British Columbia; writing an online article for Water Canada magazine; and delivering a webinar to water professionals through the Canadian Water Network's Student and Young Professionals Committee.

2.1.4. ONLINE PUBLIC ENGAGEMENT – PLACESPEAK

PlaceSpeak was selected to host public engagement for the ORWS. Of note, ECCC was the first federal department to use this platform. Governments and local watershed management agencies in British Columbia had shown that PlaceSpeak was an effective approach to gathering public input. ECCC benefited greatly from their past experiences, best practices and lessons learned when planning the online public engagement.

PlaceSpeak is designed for how Canadians behave in a digital age. Individuals are in the driver's seat, deciding how they want to participate, on what topics, and how often they wish to be notified about opportunities to provide input. It was felt that PlaceSpeak was well suited to host the online public engagement for the Ottawa River watershed due to a few unique features that met the needs of the Study. By linking digital identity to geo-location, ECCC was able to know whether participants in the online engagement lived within the watershed or not. By sub-dividing the watershed by census areas, ECCC was able to track and analyze whether comments differed across the watershed.

PUBLIC ENGAGEMENT - BY THE NUMBERS

1,063	Visits to Study webpages on Canada.ca
3,800+	Views of video of Minister promoting the Study
13	Social Media postings about the study by other organizations
141,193	Social media account holders reached with "ads"
160,776	Distinct views of video used in public information notice "ad"
15,239	Click-throughs from social media ads to Study's online engagement site PlaceSpeak

By registering on this platform, participants were able to connect with each other, with participants able to stay connected after the public engagement closed for the Study. The PlaceSpeak platform allowed ECCC to share a variety of resources and gather input in a number of formats. ECCC posted information on the "Resources" page, such as maps, external reports and studies, as well as storyboards and "what we heard" summaries. ECCC posted eight different discussion questions to the "Discussion Board" and fielded two different questions to the "Snapshot Poll". Individuals could also post documents, videos and photos on the "Noticeboard". Another unique feature used on the PlaceSpeak site was "PlaceIt", where citizens could pinpoint an area on a map of the watershed and post a comment on issues or concerns in the watershed. The "PlaceIt" feature was also used for citizens to indicate where they collect data within the watershed.

These PlaceSpeak features gave ECCC the ability to adapt and change the engagement conversation as the Study evolved. For example, two discussion questions were posted to start the conversation about the Study, asking people

how they are connected to the watershed and the issues of concern to them. ECCC then added new content related to watershed collaboration – a new snapshot poll, and three discussion questions. Questions were then added about indicators of watershed health, and citizen science. Finally, before the online engagement closed, ECCC posted summary storyboards that reflected on what was heard from participants on PlaceSpeak, so that any gaps could be addressed. These storyboards were then posted in the Resources section as the "what we heard" summaries for the public engagement portion of the Study. It should be noted that this report details "what we heard" from the ORWS engagement process. The opinions expressed were not validated based on data analyses.

2.1.5. COMMUNICATIONS AND OUTREACH

ECCC developed a number of communications products to support online public engagement and to ensure broad awareness throughout the Ottawa River watershed about the Study.

Two public meetings in the National Capital Region (one in Ottawa, the other in Gatineau) were hosted to provide people with the opportunity to engage with ECCC, to consult maps and other resources about the Ottawa River watershed, and to learn more about the Study and the online public engagement.

As the watershed is quite large, special attention was focused on reaching rural communities. ECCC developed a social media public notice campaign specifically for the rural communities through Facebook and Instagram. It significantly boosted page views on PlaceSpeak. The list of cities and towns targeted includes:

- Hawkesbury, ON
- Embrun, ON
- Kirkland Lake, ON
- Petawawa, ON
- Pembroke, ON
- Renfrew, ON
- Arnprior, ON
- Smiths Falls, ON
- Perth, ON
- Barry's Bay, ON
- Bancroft, ON

ONLINE ENGAGEMENT ON PLACESPEAK BY THE NUMBERS

2	Bilingual videos produced, one featuring the Minister
1	News release to launch the public engagement process
6	Bilingual storyboards produced
5	Bilingual infobytes produced for social media platforms
27	Bilingual tweets from ECCC or Minister's Twitter accounts
7	Bilingual posts on Environment and Natural Resources in Canada Facebook page
2	Open-door public meetings
63	Days of public information notices on social media sites
2	Media interviews
2	Bilingual videos produced, one featuring the Minister

- Sainte-Agathe-des-Monts, QC
- Mont Laurier, QC
- Maniwaki, QC
- Rouyn-Noranda, QC
- Shawville, QC

That success led ECCC to expand the public notice campaign to include residents of Ottawa and Gatineau. These notices continued until the end of April 2018, and greatly expanded the reach of the engagement process.Other Engagement Activities

To support research regarding watershed governance, watershed management bodies and experts from across Canada were engaged. Summaries of watershed management bodies were produced and provided for feedback to respective organizations. This was followed by a webinar hosted by ECCC with the intent to gather information on experiences, best practices and feedback on the eleven CCME Integrated Watershed Management (IWM) principles. As a follow-up to the webinar, a customized engagement document was distributed to 24 interested water management bodies (see Appendixes J and K for governance body summary tables).

2.2. LEVERAGING GOVERNMENT OF CANADA EXPERTISE

ECCC collaborated with other Government of Canada departments, in addition to the ISED Innovation Lab. These departments included Policy Horizons and Statistics Canada.

ECCC worked with Policy Horizons Canada to develop a Foresight workshop used to develop and write the Foresight Analysis section.

ECCC also collaborated with Statistics Canada to better understand natural, economic and demographic features of the Ottawa River watershed. For example, information was drawn from Census 2016 data, as well as Statistics Canada's 2016 Human Activity and the Environment publication.

2.2.1. LITERATURE REVIEW

Significant background research was necessary to develop foundational knowledge and provide context to various components of the Study. Research was required to discern characteristics of effective watershed governance and to identify various methods and council structures used elsewhere in Canada and internationally. In addition, ECCC gathered information on the existing governance framework within the Ottawa River watershed. Regarding watershed health, literature was relied upon to develop an understanding of the variety of biological, geological and aquatic systems found throughout the watershed. Reports and datasets were also examined to understand existing information relevant to watershed health, along with an assessment of potential gaps in scientific data and monitoring efforts throughout the watershed. Lastly, ECCC researched and analysed the historical, economic, cultural and natural context of

the watershed, through the use of historical summaries, academic literature and reports produced by various institutions.

2.2.2. ANALYSIS AND REPORTING

ECCC received input from multiple sources and in a variety of formats, depending on the target group. Submissions were analyzed, with individual comments tagged by keyword and entered into a database. Based on keywords, comments were qualitatively analyzed and grouped into broad themes.

It should be noted that this Study does not provide Government of Canada recommendations. However, it does outline gaps and opportunities, which will inform further discussions about next steps.

2.2.3. FORESIGHT ANALYSIS

Foresight Analysis is the practice of identifying potential policy problems on an approximately 15 year time horizon, by researching and identifying indicators of change (weak signals) that may disrupt existing policies should they become more mainstream in the future. Foresight has helped ECCC understand what influences the Ottawa River watershed, how it may evolve, and what challenges or opportunities may arise in the future. The forward-thinking nature of foresight provides a powerful context to develop more resilient and adaptable policy in the face of change (Policy Horizons Canada, 2016).

To identify emerging policy challenges and opportunities, ECCC followed the Policy Horizons Canada Foresight Method (Horizons method) (Policy Horizons Canada, 2016). ECCC began the foresight analysis by framing the problems at hand, and identifying commonly held assumptions that were either, embedded in Motion M-104, or currently influencing policy makers. To help frame the problem, and understand the interactions of various system elements, ECCC created a system map based on fundamental elements that rely on, or influence the Ottawa River watershed, including governance, natural values, economic values, and social/cultural/heritage values (see Appendix F for System Map).

The Horizons method cites insightful scanning for weak signals as the foundation for effective foresight analysis (Policy Horizons Canada, 2016). ECCC identified weak signals by scanning domestic and international media, industry reports, and academic journals amongst other sources of information. Workshops were held to identify how these emerging signals may affect the Ottawa River watershed system should they become more prevalent in the future, and those that notably disrupted at least one of the system elements were selected as change drivers.

At this point in the Horizons method, scenarios could be built to explore plausible futures for the system of study. The foresight analysis conducted by ECCC did not include an extensive scenario-building component. Instead, ECCC drew insights from the change drivers to develop plausible future circumstances for the watershed, which were then used to brainstorm first-, second-, and third-order impacts that may be caused by the realization of each circumstance.

The final step in the Horizons method was to test the strength and validity of the previously defined assumptions against the defined change drivers, to help and identify potential policy challenges or opportunities. The results of the foresight analysis are provided in section 7.1.

3 SIGNIFICANCE OF THE WATERSHED

Watersheds are complex socio-ecological systems that involve various dimensions, including the environment, the economy, and society (Krievens, 2015). Such systems provide abundant services to humans that range from supplying raw goods, such as drinking water, to meeting more intangible needs, such as spiritual connections. In addition to providing value to humans, watershed ecosystems also hold intrinsic value by, for example, supporting rich biodiversity and unique habitats. Healthy watersheds represent an important part of Canada's historical fabric, as Indigenous peoples and, subsequently, settler populations have long relied on watersheds for their livelihoods, including for travel, food and drinking water (CCME 2016). Under Motion M-104, one of the three components of the study specifies the examination of the economic, cultural, heritage and natural values associated with the Ottawa River watershed.

3.1. VALUES OF INDIGENOUS PEOPLES

Indigenous peoples have long relied on the Ottawa River watershed as a source of natural, economic, cultural and heritage values. Indigenous representatives of Algonquin origin, including the Algonquins of Ontario, the Algonquin Anishinabeg Nation, and the Algonquin Nation Secretariat, described that the Algonquin nation was the primary steward and manager of the Ottawa River watershed for countless generations. Indigenous peoples have relied on the watershed for their livelihoods—including for food, drinking water, ceremonial purpose, trade, transportation, recreation, and observing nature. The values expressed by those groups—be they natural, economic, societal values or a combination of the three—generally related to the four themes below.

FISH AND ANIMAL HEALTH

Multiple groups noted that they valued a diversity of consumable fish in large quantities, such as sturgeon, rainbow trout, pickerel, whitefish, and speckled trout. A member of the Algonquin Nation Secretariat stated that they valued the subsistence that the watershed provides to their family. The Mohawk Council of Kanesatake largely valued "fishing for consumption of the fish" and ice fishing, notably because the water quality is "best in the winter season and the fish caught harbored less parasites." The Métis Nation of Ontario valued the diversity of fish in the region, as well as the economic contributions of a "commercial caviar fishing [that] took place at La Page during the 1970s." However, the same group expressed various concerns regarding fish species, notably the "significant decline in the quantity and size of fish over the years. Some [Métis Nation of Ontario members] stated that they "used to see sturgeon in the past that were

40-50 pounds larger than they are today." The Algonquin Anishinabeg Nation expressed their concern for fish and wildlife species, and stated that "as living creatures, they deserve to live in an environment not only to survive but to thrive."

CLEAN WATER FOR DRINKING AND SWIMMING

Many respondents were focused on the importance of clean water. A respondent from the Algonquin Nation Secretariat said "I'm happy that we have water. Water is life", while another community member from the same group noted that everything grows from water, and that "we grow from it". The ability to drink from, and swim in a watershed that is free of contaminants was desired by many Indigenous groups. Notably respondents from the Métis Nation of Ontario expressed their enjoyment of swimming in the river. Indigenous youth engaged by the Algonquin Nation Secretariat stressed that having access to clean waterways is important for the purpose of strengthening or reinvigorating their ancestral way of life, and ensuring the intergenerational transfer of culture (Kitchisibi Ikidowin Anishinabe, 2018)

TRADITIONS, SACRED SITES AND BELIEFS

Memories, stories and sacred sites that have been passed down or used by multiple generations were highly regarded. Respondents from the Algonquin Nation Secretariat conveyed that good memories came from stories told by elders and parents. Other groups valued the capability to congregate at sacred sites located across the Ottawa River watershed. A respondent reiterated that water is a sacred element, and that honouring the sacred is an important cultural value of the Anishinaabeg (Gehl, 2018). The respondent then explained how beliefs have a significant influence in shaping one's behaviour, which can ultimately impact society globally. It was noted that "human beings need to value that what is sacred is more than living in close view of a river, it is more than having fun swimming in a river, it is more than having fun boating on a river. By trivializing and denying the cultural value of honouring the sacred, human beings are destroying and polluting the river" (Gehl, 2018).

TRAVEL AND TRANSPORTATION

The ability to travel freely along the many waterways that make up the watershed was appreciated by many groups. As noted in Chapter 1 of this report, prior to, and following the arrival of Europeans, the Ottawa River was an important component of travel and trade networks, linking the St. Lawrence River, the Hudson Bay, the Ungava Bay, as well as the Great Lakes. As stated by the Algonquin Nation Secretariat, the birchbark canoe, or wigwas ciman, illustrates the important role historically played by Algonquin communities in travel and trade, as it was perfected by Algonquin communities, and traded with others, in order to allow for travel across the Ottawa River watershed's powerful currents (Kitchisibi Ikidowin Anishinabe, 2018). Similarly, the Mohawks of Kahnawá:ke also stressed the importance of the Ottawa River watershed as a trade and travel route for Mohawk Nation (Mohawk Council of Kahnawá:ke, 2018). To this day, the Ottawa River watershed provides recreational and transportation value to the Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, Métis Nation of Ontario, and non-status communities. For example, members of the Métis Nation of Ontario stated that they enjoyed whitewater rafting and canoeing.

ADDITIONAL VALUES

The Ottawa River watershed is of unique spiritual value to the Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, the Métis Nation of Ontario, as well as non-status communities. The Algonquin Anishinabeg Nation noted that there is a tendency to place too much focus on technical and political elements of water, while spiritual considerations are often ignored. Specifically they commented that "there has always been a spiritual connection with NIBÌ (water)." They went on to state that water is "the lifeblood for all living things on the planet. The lakes and rivers were used by ancestors and therefore there is a spiritual connection to the water" (Algonquin Anishinabeg Nation Tribal Council, 2018). As explained by the Algonquin Nation Secretariat, Algonquin creation stories support the assertion that their time on this land reaches far into the past. The story of the giant beaver, for example, involves a species believed to have lived in North America during the Pleistocene epoch over 11,000 years ago (Kitchisibi Ikidowin Anishinabe, 2018). Another story of importance to Algonquin peoples, raised by the Algonquins of Ontario, is the Seven Fires prophecy, which concerns eight prophets who appeared to Algonquin peoples, on seven occasions, before crucial periods in their history. The prophet of the Sixth Fire, for example, warned that colonialism would reduce the Algonquin nation to the lowest point in their history, while the prophet of the Seventh Fire spoke of an opportunity for Algonquin peoples and Rainbow People—all other people who share the land—to determine if the environment, and people who depend on it, will survive or perish (Richardson, 2018). The Algonquin Nation Secretariat stressed that such stories, or dibaajimowinan, are "not simply "folk tales" or for entertainment purposes, nor are they to be dismissed as knowledge that is primitive or irrelevant to the modern day." Rather, they should be treated as living records from which to draw life teachings and reverence (Kitchisibi Ikidowin Anishinabe, 2018).

3.2. ECONOMIC, SOCIAL AND NATURAL VALUES

Economic, cultural, heritage and natural values associated with the Ottawa River watershed were identified throughout the ORWS, largely through feedback received during the public engagement process. A combination of public and stakeholder input, academic literature, and reports released by various institutional bodies were used to examine the diversity of values in the watershed. Figure 3.2-1, depicts the overall breakdown of values associated with the Ottawa River watershed.

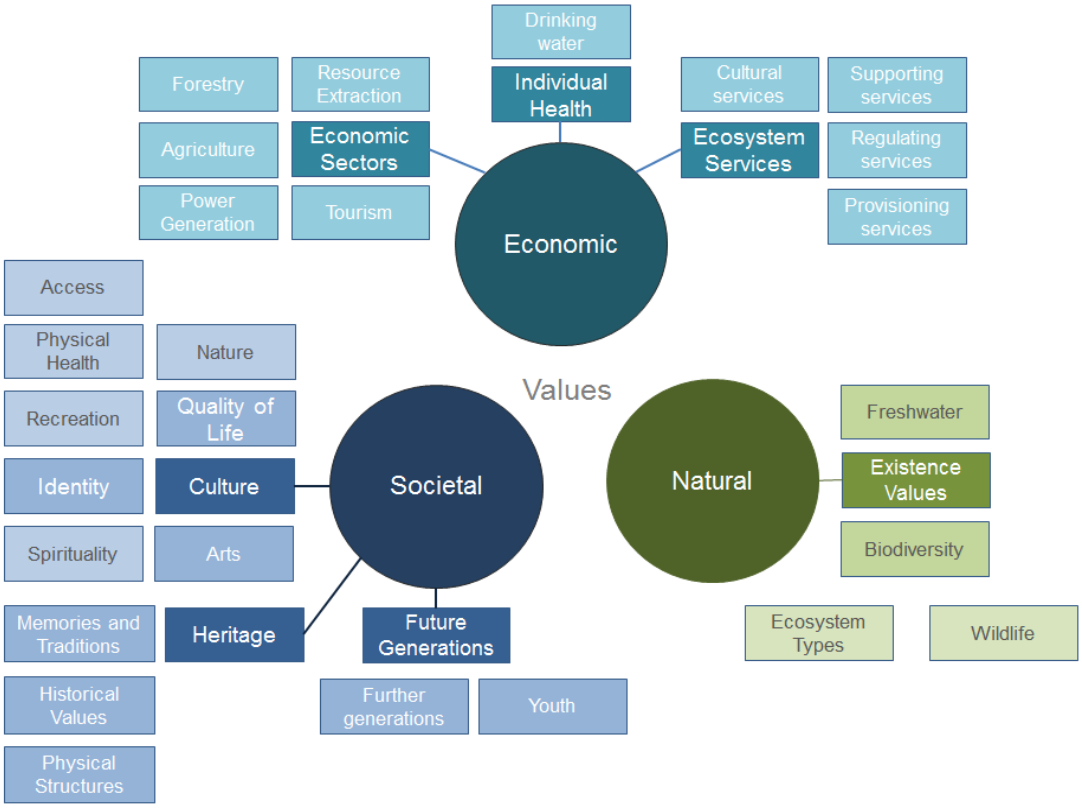


FIGURE 3.2-1. Breakdown of values associated with the Ottawa River watershed.

3.2.1. NATURAL CAPITAL AND ECOSYSTEM SERVICES

A healthy watershed is integral to human health, economic development and habitat conservation. While watersheds contribute directly to various economic sectors through the provision of freshwater and other services, the monetary value of these services can often be difficult to quantify through commercial markets. By not assigning economic value to nature, there is concern that services and resources will be perceived as worthless or limitless, and not be efficiently allocated or managed. Recognition of the services ecosystems provide is integral to ensuring that the most effective decisions are made, now and into the future (Kennedy & Wilson, 2009). To address this issue, there has been a move towards quantifying the goods and services nature provides.

Ecosystem services are the benefits that humans derive from ecosystems, and in the case of this study, watersheds. Valuation of ecosystem services can assist in providing comparisons of natural capital to physical capital to compare contributions to human welfare. These services can be broken down into four categories (Castro et al, 2018; Parkes et al., 2010):

- Provisioning services, which include goods directly obtained from the ecosystem;
- Regulating services, which include processes that maintain the environment;
- Cultural services, which are non-material benefits that humans obtain from ecosystems; and
- Supporting services, which refer to services not directly useful to humans, but integral to other supporting services.

PROVISIONING SERVICES

Drinking water from both surface and ground sources is one of the most common services that healthy watersheds provide. This service was recognized throughout public engagement on the ORWS as being extremely valuable (Public and Stakeholder consultations, 2018). Both forests and wetlands are integral to a clean water supply, as soil and small organisms filter pollutants out of the water. Food sources and timber are other examples of a provisioning service found in the watershed, with fishing, hunting, agriculture and foraging practiced in order to obtain food sources, and forests are harvested for timber and fiber (Molnar et al., 2012). In a study undertaken by the NCC in 2016, it was found that urban forests, rural forests, and wetlands all contribute to the provisioning of freshwater, providing a value of over $1,200 per hectare per year. The same study also valued the contribution of ecosystem services to agricultural production at over $1,000 per hectare per year (Dupras, J., L'Ecuyer-Sauvageau, C., Auclair, J & He, J. 2016).Regulating Services

Most of the services provided by watersheds are less visible than the consistent supply of quality drinking water; however, regulating services; systems that help to maintain regular ecosystem functions, are vastly important and plentiful. Services include carbon storage and sequestration, filtration of water resources, erosion control, air quality control, flood and storm protection, pollination and seed dispersal and climate regulation. Natural systems, notably forests and wetlands, act like a sponge, providing water regulation services that are costly and challenging to replicate using manmade infrastructure.

Wetlands are especially good at regulating water supplies, storing water when there are excess amounts, and providing valuable reserves during dry periods (Molnar et al., 2012). In the Rideau watershed, a sub-watershed within the Ottawa River watershed, the RVCA estimates that flood damage would be 10% higher without wetlands (RVCA, 2015). Wetlands are also key systems for filtering waste produced by humans. Physical, chemical and biological functions in wetland areas are especially efficient at removing phosphorus and nitrogen, thus providing free waste filtration, a service that is typically costly in urban settings. It is estimated that wetlands are capable of filtering 60% of metals, and 90% of sediment out of freshwater, while high forest cover is correlated to lower water treatment costs. A study focused on the contribution of watershed ecosystem services in the Toronto area, found that if forests and wetlands declined from 30% to 10%, water treatment costs would rise from $0.60 per cubic meter, to $0.94 per cubic meter (Molnar et al., 2012). A separate study on ecosystem services in Ontario's Credit River watershed found that the services wetlands provide, including flood reduction, water storage, waste treatment and carbon sequestration are valued at $247 per person, annually, the highest value of any land cover type (Kennedy, 2009). Wetlands cover roughly 8% of the Québec portion of the watershed, while in the Ottawa region roughly 20% of land cover is represented by wetlands (MDDELCC, 2015a; City of Ottawa, 2011).

Trees and forests contribute additional regulating services to the Ottawa River watershed, and were recognized through the ORWS engagement process for this ability. Among other services, trees and forest ecosystems assist in ensuring a consistent quantity of water. A recent study found that forest restoration increased the amount of water being stored in soil, reduced flood intensity and frequency, and had a positive impact on water availability during the dry season (Filoso et. al, 2017). A case study focused on Kenauk property within the Ottawa River watershed, found that the 4,000 hectare forest stores half a million tons of carbon, and captures an additional 10,000 tons annually. The property also provides a vital wildlife corridor for wide ranging mammals, habitat for threatened species, and water filtration for the nearby town of

Montebello. Given these services, the forest was valued at $20,000 per hectare annually (Becker et al., 2017). Dominated by, eastern white pine, eastern hemlock, red oak, red pine, sugar maple and yellow birch, the Ottawa River watershed forests provide services such as carbon sequestration, wildlife habitat, and nutrient cycling. In 2009, a study commissioned by Ontario's Ministry of Natural Resources and Forestry (MNRF) estimated that rural forests provide services valued at $4,442 per hectare, annually (Troy & Bagstad, 2009).

CULTURAL SERVICES

Cultural services include non-material benefits and services, such as spiritual enrichment, cognitive development, aesthetics, recreation and education. These services are often integral to an individual's sense of identity, wellbeing, and motivation; people may treasure family trips to a lakeside cottage, canoe adventures with loved ones, or simply taking the time to sit in nature to reflect. However, the value of these experiences is often difficult to quantify or assign meaningful value. Recreation is a major way in which the population connects and values the Ottawa River watershed.

In 2016, the NCC categorized aesthetics and recreational activities as cultural services, and found that within the Greenbelt and Gatineau Park, the aesthetics of crops, prairies and freshwater systems provided services valued at over $400 thousand per year. Recreation was assigned a value of over $3.7 million annually, as recreation services are provided by a variety of ecosystem types within the NCR (Dupras et al., 2016). A 2004 study considering tourist spending in Algonquin Provincial Park, within the watershed, found that visitors spent $20 million annually within the park, contributing $1.9 million to Ontario's provincial GDP (Bowman & Eagles, 2004). A separate report, focused on the Credit River watershed, found that recreational pursuits contribute $6.9 million per year in value to the watershed, with $1.2 million being attributed to recreational fisheries (Credit Valley Conservation, 2008; Kennedy, 2009). Notably the Credit River watershed is an area of 94,885 ha and had a population of roughly 800,000 in 2006. The Ottawa River watershed, by comparison, is far larger at 14 million ha (140,000 km2), and has a population of around 2 million. Cultural services independent of economic value will be considered in the following subsection.

SUPPORTING ECOSYSTEM SERVICES

Supporting services include processes that are integral to processes described in the previous section, such as soil formation, photosynthesis, primary production and nutrient cycling. These services are less frequently studied and assigned economic value, however they are integral, as all other services depend on them for regular functioning (see Figure 3.2-2) (MEA, 2005).

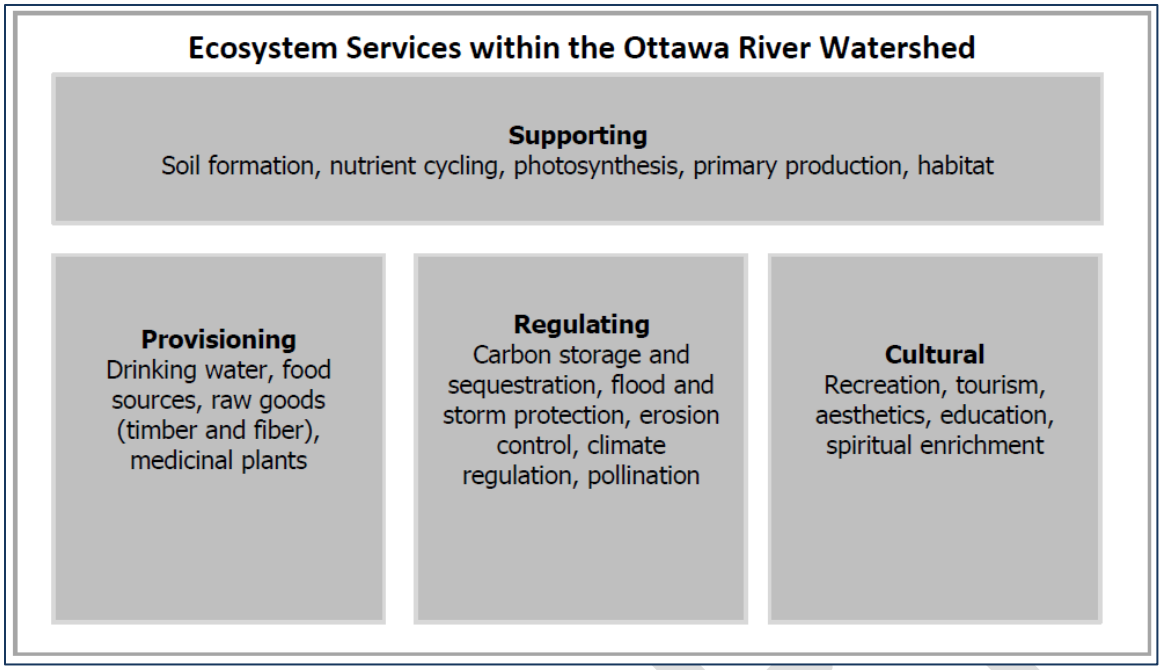


FIGURE 3.2-2 . Types of ecosystem services within the Ottawa River watershed.

3.2.2. ECONOMIC VALUES

The term “economic value” can be interpreted as the economic contribution of goods or services that a watershed provides. Quantifying the value of those goods and services is regarded as beneficial, as it creates an understandable frame of reference for the public. It is a way to evaluate development and management decisions, and it assigns worth to resources that may otherwise be taken for granted or ignored (Costanza et al., 1997; Daily et al., 2009). However, much like valuing ecosystem services, determining the economic value of a watershed and the services it provides is difficult, as watersheds do not follow geo-political and administrative boundaries, making data collection and comprehensive economic valuation a challenge.

3.2.3. FRESHWATER AND THE ECONOMY

A healthy population and environment is needed to promote economic growth and development; accessible and quality freshwater are needed for both. Drinking water is vital to the livelihood and health of those in the watershed, and its price is kept low to ensure that the population can access the necessary resource, and so that other industries are not hindered by costs (Renzetti, 2009). As water utilities maintain low prices for services, and are subsidized, it does not directly contribute to GDP

There are two main ways in which Canadians use water: through instream uses and withdrawal uses. Instream uses are those that allow water to remain in its natural setting, which include activities such as transportation, wildlife habitat and fisheries. Hydroelectric power generation is also often considered an instream use; however, it impacts the quality and quantity of water, through factors such as water flow, erosion and dilution. These uses have relatively little impact

on the quality and quantity of water. Withdrawal uses are those that remove water from its source for an amount of time, eventually returning all or some of it to its original source (e.g., household uses, industries and agriculture) (ECCC, 2013). The quality and health of a watershed is influenced by a variety of conditions, including changing climatic conditions, pollution from industry and agriculture, waste and sewage disposal, erosion and sedimentation, and degradation of wetlands (Henshaw, Bryan & ECCC et al., 2017). In turn, these factors alter physical, chemical, biological and microbiological characteristics of water bodies, such as nutrient levels, pH, turbidity, bacteria and fecal coliform levels (Chapman, 1996; Khan, Husain & Lumb, 2003). Water quality in the Ottawa River watershed will be discussed further in Chapter 4. Throughout public engagement, numerous respondents noted that ensuring healthy ecosystems, clean water and preserving the integrity of natural spaces within the Ottawa River watershed were vital for its economic prosperity, as industries and individuals rely upon its natural resources.

Ontario and Québec are both dominated by service producing industries, with services making up roughly 78% and 73% of their respective economies, while goods producing industries make up the remainder (Statistics Canada, 2017b). Like Ontario and Québec as a whole, the Ottawa River watershed is dominated by service industries, with public administration, health care and social assistance, retail and education making up almost half of the workforce (Statistics Canada, 2017b). The importance of a consistent and safe water supply can be illustrated through an example of when water quality was compromised. The 2000 Walkerton water contamination crisis saw municipal water supply contaminated with *E. Coli.* Within the small community, six people died and over two thousand people suffered illness, leading to severe disruption of the community and its wellbeing, as well as economic costs of $64,527,194, and lost productivity costs totaling over $1.2 million (Livernois, 2002). Overall, people rely on the watershed for a safe, accessible and affordable water supply to support health and productivity.

ECONOMIC SECTORS

Aside from the service sectors described previously, environmental health, water quality and water quantity are linked either directly or indirectly to all industry. Throughout public engagement, respondents noted that economic growth and industries were important to their quality of life, due to jobs, economic stimulation and identity of the region. A handful of industries within the Ottawa River watershed, both in the services and goods realm, noted the importance of water and the watershed to their processes and/or staff. Below, the economic contribution and significance of sectors is outlined. In section 3.3, the impacts each of these sectors has on the watershed will be examined further. For more information on specific sectors, please refer to Appendix G.

FORESTRY AND FOREST PRODUCTS MANUFACTURING

Today, the forestry sector is a key pillar of the Canadian economy, as well as the economy of the Ottawa River watershed. Canada's forests account for about 9% of forested land worldwide (Statistics Canada, 2018a). The Ottawa River watershed is dominated by forests, with approximately 85% of the watershed covered by deciduous or mixed forest cover. In the far north of the watershed, the forest is primarily boreal forest cover (DePratto & Kraus, 2017). Water and rivers are also vital to the forestry industry. Water is used in various levels of timber processing. Today, Canada is the world's fourth largest producer of pulp, paper and paperboard, and in 2016 accessible timber stocks were valued at $215.4 billion, while the

forestry and logging industry employed 205,660 people (Statistics Canada, 2018a). Of these jobs, 31% (approximately 63,755 jobs) were located in Québec and 21% (approximately 43,189 jobs) in Ontario.

In central and eastern Ontario, the local forestry industry generates $573 million every year, while forestry industries in the central and eastern Ontario region employ over 6,000 people. In Québec, forestry and logging contributed $337.6 million to the 2014 GDP, while pulp and paper mills contributed $609.5 million in the same year (Statistics Canada, 2014). On the Québec side of the river, corporations such as Fortress Cellulose run plants in Hull, Mason and Thurso, and mills contribute 12.5% of Québec's total pulp, paper and paperboard production, while the Abitibi-Témiscamingue and Nord-du-Québec regions contribute another 8.9% to the total production (ORHDC, 2005). Currently, nine pulp and paper mills are operating within the watershed (Ottawa Riverkeeper, 2018d). Natural resources are vital to this industry, and access to water is integral to producing paper, as it is used in almost all levels of processing, from cleaning to cooling, as well as for transport of both waste and completed products (Ottawa Riverkeeper, 2006). Pulp and paper processing is intensive; it uses the most water and creates the most effluent of any industry operating in the Outaouais region of the watershed (MDDELCC, 2015a).

POWER GENERATION

Dam construction is credited with dramatically transforming the Ottawa River, enabling hydroelectric power generation and flood control. In turn, this allowed for increased settlement along both the Ontario and Québec shores of the Ottawa River. Today, over 50 dams are dispersed throughout the watershed, 43 of which are used for hydro-electric power generation (ORRPB, 2011; ORHDC, 2005). These dams rely on large reservoirs that supply adequate flow for electricity production (see Table G-1, Appendix G). Ontario Power Generation and Hydro-Québec both operate several large dams within the Ottawa River watershed (see Table G-2, Appendix G). These dams produce reliable and clean electricity to the Canadian public and commercial industries, while supporting economic growth, supplying a variety of local jobs, and reducing risk of flood. The dams developed for power production also provide various ancillary benefits to the Ottawa River. These include control of water flow, which in turn enhances opportunities for navigation, tourism, fisheries and the establishment of recreational properties on reservoirs. The economic and cultural benefits from these ancillary services are not currently quantified (ORRPB, 2017).Statistics Canada reported in 2008 that hydroelectricity represents 96.8% of Québec's electricity use, while in Ontario, hydroelectricity represents 25% of the energy share (Statistics Canada, 2016). Hydro-Québec employs 19,786 people, while Ontario Power Generation employs over 10,000 people. Brookfield Power also operates hydroelectric dams in the region, specifically four hydroelectric stations along the La Lièvre River. Increasingly, energy markets are becoming more diversified; the watershed is also home to solar projects and gas fired electricity (IESO, 2017). In Québec the energy sector represented 3.88% of the provinces GDP in 2017, while in Ontario, energy made up 2% of the provinces GDP in 2017. During public engagement for the ORWS, respondents noted the importance of rivers in the watershed for power generation.

MINING AND RESOURCE EXTRACTION

The mining industry is dependent on water and natural resources for their activities, and uses water to flush out waste. As of 2012, the Québec side of the watershed had 16 active mining projects, eleven of these being in the Abitibi-Témiscamingue region (MERN Québec, 2017).

Northwestern Ontario also has several active mines or mines in development. The Cobalt and Temiskaming region has the majority of mines, with 12 mines in operation and nine others in development, both within the boundary or near the boundary of the watershed (Ontario's Golden North, 2016). Of these mines, 17 extract or plan to extract gold (see Table G-3, Appendix G). Statistics Canada reports that roughly 6,800 people are employed in the mining, quarrying, and oil and gas extraction industry within the watershed (Customized Statistics Canada Data, 2018). There is no watershed specific data available on the mining, quarrying, and oil and gas extraction industry's contribution to GDP; however, in 2014, Statistics Canada reported that the sector contributed $7.9 billion and $4.5 billion to Ontario and Québec, respectively (Statistics Canada, 2014).

RECREATION AND TOURISM

Recreation, cultural pursuits and tourism are significant within the watershed, both economically and for societal well-being. Like previous sectors, there is a lack of data distinguishing the tourism industry's specific contribution to GDP. Thousands of tourists are drawn to both the wild and comparatively subdued rivers within the watershed for rafting and paddling opportunities. The Ottawa River contains a section of whitewater that is renowned as a world-class paddling and rafting destination (Ottawa Tourism, 2018). Other recreational activities, such as hiking, also draw in many tourists. A study conducted by the NCC in 2017 found that tourism in Gatineau park provided over 4,700 full time jobs, and brought direct expenditures of $184 million during a one year period between 2015 and 2016 (Coulson, 2017). Additionally fishing for tourism and recreation is lucrative in the watershed. The total economic value for fishing on the Ottawa River, including expenditures and investments, was estimated at $32.1 million in 2010 (ORHDC, 2005).

A number of provincial parks and wildlife reserves are located within the reaches of the watershed on both sides of the Ontario-Québec border. These parks include Algonquin Provincial Park, which was the first Canadian provincial park established to protect a natural environment. There is also a newly designated National Park, Opémican in Témiscamingue (Ballivy, 2018). Additionally, a few wilderness lodges, camps and retreats are found throughout the watershed. Businesses rely on the natural environment within the Ottawa River watershed, with one wilderness resort owner stating "my livelihood and that of my employees depend on the pristine nature of the watershed" (PlaceSpeak consultations, 2018). Others noted that clientele are often drawn to secluded wilderness lodges for their remoteness, pristine nature and wildlife. In addition to nature focused pursuits, ORWS respondents noted the tourism activities in the City of Ottawa, such as museums, historical sites, and festivals throughout the region, draw in millions of visitors annually (PlaceSpeak consultations, 2018). Winter time activities, such as sugar shacks, ski resorts and cross country skiing also draw tourists to the region. For 2017's Canada 150 celebrations, tourism in the capital increased 8.8%, as over 11 million tourists visited the National Capital Region. Total visitor spending in Ottawa was calculated at $2.3 billion for 2017 (Ottawa Tourism, 2018).

AGRICULTURE

The agriculture industry is highly connected to the watershed, relying on freshwater resources for irrigation and food processing. Agriculture is the largest consumer of water in Canada, consuming 1,600 million cubic meters annually, largely due to the fact that water used for irrigation and other purposes is absorbed into plants or transpired into the atmosphere (ECCC, 2016b). Both Ontario and Québec use little water compared to western provinces, with irrigation

only occurring on 4% and 3% of each provinces farm land, respectively. In the Ottawa drainage basin, irrigation levels are the lowest in the country, with only 1,110 ha irrigated (Statistics Canada, 2010). Roughly 6,000 farms are estimated to be in the Ottawa River watershed region, with large areas of land used for agriculture purposes. For example, over 50% of land in the lower Mississippi, Castor, Ottawa East and Carp sub-watersheds have been allocated for agriculture use. Farm and crop types vary based on region; however, cattle ranching and livestock farming dominate farm types in the region, with large scale farming for vegetables, grains and other products far less common (Statistics Canada, 2016). Nutrient-rich silt and clay soils dominate the lower Ottawa River Valley, allowing for higher productivity where surface water drainage is adequate. In these areas, grain, food for cattle and alfalfa are often grown, and pastureland is common. In the northern and middle portions of the Ottawa River watershed, agriculture is limited, due to poor drainage (ORHDC, 2005).

ADDITIONAL ECONOMIC CONSIDERATIONS

The Ottawa River watershed is connected to multiple other parts of the economy. During public engagement, many respondents noted the importance of economic development, research and commercial interests.

Property Value: Property value and demographics are often influenced by the health of the watershed, and the proximity to scenic waterways and landscapes. Such properties can spur economic and population growth in smaller communities. Numerous responses throughout public engagement noted the connection between watershed health, property value and desire to live in a certain location.

Nuclear Energy Research: Located in Chalk River, the headquarters of Canadian Nuclear Laboratories (CNL) employs 2,800 people including many world-leading experts in a variety of scientific and technical disciplines. Founded over 60 years ago, the research site was used to develop peaceful and innovative applications from nuclear technology, mainly involving radioactive waste and decommissioning research. Today, the laboratory continues to support the Government of Canada's science and technology missions, namely through: supporting the development of biological applications, through testing the impacts of radiation on living organisms and improving the understanding of the impacts of radiation on living things; enhancing national and global security through non-proliferation and counter-terrorism work; and, carrying out environmental stewardship and radioactive waste management services on behalf of the Government of Canada. CNL is the second largest employer in Deep River and with staff and contracting salaries totaling over $250 million annually, the CNL contributes significantly to the region's economic strength.

3.2.4. SOCIAL DIMENSIONS

As stated, watersheds are complex socio-economic systems, in which the environment, economy and society are deeply connected. Similar to the economic section above, society's value is largely extrinsic based on how humans benefit and interact with a given region. These values are important; they add another dimension, aside from economic value, that connects humans to the land they occupy. Social considerations shape the way individuals perceive the watershed, and influence the way they wish to conserve it. In the three sections below, the various ways that humans connect to the watershed will be described, through consideration of heritage, current cultural values, and concerns for the future.

PAST: HERITAGE VALUES

Spanning two distinct provinces, French and English are the languages most commonly spoken throughout the area. Additionally, many festivals, National and regional museums, interpretive centres, heritage trails and other activities celebrate the past and current culture of the region (ORHDC, 2005). The significance of the Ottawa River and other rivers in the watershed is increasingly being recognized. In 1998, the Mattawa River was granted heritage designation through the Canadian Heritage River System (CHRS), and in 2007, the Rideau Canal was granted UN Educational, Scientific and Cultural Organization World Heritage Site Status. In July 2016, the Ontario portion of the Ottawa River was also granted heritage designation through the CHRS. In August 2017, the Québec portion of the river received a similar designation of "Lieu Historique", when it was recognized as a historic site under Québec's *Cultural Heritage Act*. To support designation, the Ottawa River Heritage Designation Committee produced three documents that detail the region's history and heritage (ORHDC, 2005).

Heritage is displayed throughout the region, both in the visible sense, through old buildings and infrastructure, family heirlooms, and physical locations, and through less visible activities, such as practices and customs handed down through the generations. This often includes language, recipes, family traditions, stories, and songs (ORHDC, 2005). Through the engagement process for the ORWS, three main themes emerged that described how various individuals and groups are connected to the Ottawa River watershed through heritage. Key themes included: memories and traditions; settlement and economic development; and physical structures, which are described below:

MEMORIES AND TRADITIONS

Many respondents valued the watershed for memories attached to the region. People shared stories of growing up or visiting the watershed decades ago. Some noted that based on their own upbringing and family connection to the area, the watershed was an ideal location to raise a family. One person expressed fondness of such memories, by stating "when I was growing up, although we lived elsewhere, the Ottawa Valley was a magic place in our family - my parents came from the Pontiac in western Québec and told us many tales of doings around the river." Others touched on experiences they had enjoyed in years past, such as camping, fishing and ice fishing (PlaceSpeak consultations, 2018).

SETTLEMENT AND ECONOMIC DEVELOPMENT OF THE WATERSHED

Recognition of the history of the Ottawa River watershed and surrounding landscapes was important to many respondents of the Study. Several celebrated the importance of the watershed for its role in pre-history and post-European contact history, including settlement of the Ottawa Valley, and the eventual designation of Ottawa as Canada's capital. Sentiments were articulated through statements such as "the (Ottawa) river and everything connected to it...is a reminder of the past and the critical lifeline that the river system played in the creation of the National Capital Region." More specifically, some noted the importance of initial economic growth and development of the region. The fur trade, forestry, farming, and hydroelectric generation were all mentioned as an integral part of the areas heritage (Public and Stakeholder consultations, 2018).

PHYSICAL STRUCTURES AND OTHER EXAMPLES OF HUMAN HERITAGE

Today, numerous historic buildings are still accessible, allowing residents and visitors alike to view and celebrate the history of the region. Notable structures include Rideau Hall, the Abbey Ruins at Mackenzie King Estate, the Log Farm in the Greenbelt, the House of Parliament, Maplelawn and surrounding gardens, the Central Chambers National Historic Site, and multiple residences throughout Ottawa and Gatineau (NCC, n.d.-a). Further details on heritage structures and other examples of human heritage can be found on the Directory of Federal Heritage Designations (Parks Canada, 2018). Also notable, are the historic artifacts that are believed to be submerged throughout the watershed. Heritage researchers, such as academics and those at the Research Institute in Maritime History and Underwater Archeology, note that, given the region's rich history, it is likely that heritage wrecks, remains of dams, mills and bridges, and traces of historic dwellings are covered by water throughout the watershed area, and especially prominent in reservoirs. A few respondents during engagement expressed gratitude and interest in these historic structures (Public and Stakeholder consultations, 2018).

PRESENT: CULTURAL VALUES

Culture accounts for social practices, customs and displays of human achievement, and overall has a large influence on how societies or communities of individuals interact. Examples of culture include language, religions, music, sports, and arts. A defining attribute of culture is how people shape and are shaped by the environment, through use and interaction (Rapoport & El Sayegh, 2005).

With millions of people living in, relying on, and influencing the Ottawa River watershed, culture within the region is deeply connected to the Ottawa River, its tributaries and diversity of ecosystems in the area. The environment influences various aspects of culture, while culture affects the values we assign to the region, often giving motivation to the management and conservation of certain areas.

Through qualitative analysis of text responses on PlaceSpeak, engagement questionnaires and emails, and coupled with existing literature and surveys, the values that the population assigns to their experiences throughout the watershed became evident. Several questions posed during the ORWS engagement process were used to gain feedback on the population’s experiences, values and understanding of the Ottawa River watershed. Questions included:

- Tell us how, when and where you use the Ottawa River watershed. What do you value most about it?
- Do you have any specific concerns about this watershed? Is there anything in particular that you think we should consider, or be aware of in the context of this study?
- Is your organization aware of any significant economic, cultural, heritage and natural that are central to overall ecosystem health and the wellbeing of communities in the region? For example these may include facts and trends on species diversity, species at risk, or local tourism among others.

Responses were diverse; however, the majority of responses were linked to one’s quality of life and identity.

QUALITY OF LIFE AND IDENTITY

Human wellbeing and ecosystem health are deeply connected. To maintain a high quality of life, diversity, productivity, and resilience of the ecosystem must be safeguarded (Prescott- Allen, 2001), which is also applicable to the Ottawa River watershed. The majority of feedback on the Study noted that nature should be conserved on some level, while culture, economic development and heritage should be recognized and celebrated to support a sustained quality of life (Public and Stakeholder consultations, 2018).

Many responses to the study noted that living in, and interacting with the watershed influenced who they are.

PHYSICAL HEALTH

Physical health, like nature, is connected to society's relationship to the watershed. A few respondents and various municipal bodies recognized the watershed for its contributions to human health. Notably, quality of drinking water, and access to freshwater for drinking and agriculture were mentioned several times. Additionally, many noted the service of the watershed's forests for providing clean air and other regulating services, as well as the flow of the river for carrying away potentially dangerous wastes, both of which contribute to overall health of the public (Public and Stakeholder consultations, 2018).

A CLOSER LOOK: COMMUNITY-BASED LAKE ASSOCIATIONS

"It's always the small pieces that make up the big picture"

Throughout Ontario there are hundreds of community-based Lake Associations, often made up of concerned individuals passionate about the stewardship of their land and waters. Lake Associations and individuals are instrumental in monitoring water quality at a local scale. Some lake associations often form organically over time, through community-based efforts, while others are catalyzed to address pressing environmental issues. Through interviews and exchanges with various lake associations, three overarching values became apparent.

COMMUNITY AND AWARENESS
During a meeting with members from the Saint Francois Xavier Lake Association, it was noted that members of the community had banded together in order to address environmental issues near their home. Many who lived around the lake came together to discuss the future management of the area, and to strategize ways to maintain water quality within the lake. One dedicated group conducted water quality testing and assessments in order to increase community knowledge of the lake's environment and evolution. Specifically, they took water samples to test for microbial conditions, nutrients levels, and other physical-chemical conditions, such as temperature and pH. Through this work, relationships were formed, knowledge was shared, and awareness was heightened regarding human influence on lake quality.

FULFILLMENT AND SENSE OF PURPOSE
One respondent noted that they became involved in their local Lake Association initially to help address problems they saw within their local lake, but later found a sense of fulfillment and purpose in monitoring the lake, researching environmental concerns, and educating those on the conservation of their local watershed.

CITIZEN SCIENCE AND DATA COLLECTION
To address local level water quality concerns, citizens have begun tracking water quality in hundreds of locations throughout the watershed. Lake Associations, individuals, and volunteers through Ottawa Riverkeeper and Water Rangers have collected data on water quality. Through a meeting with a Lake Association, it was noted that more structured guidelines were needed to assist in water quality monitoring and management.

AESTHETICS

The region's aesthetics and complex ecosystems were mentioned numerous times by respondents during engagement. Much of the Ottawa River watershed is valued for its natural beauty and contrasting seasons – snow-capped rolling hills, wild rivers, deciduous forests in the summer and fall, and the calmness of lakes and other water bodies. Many expressed similar views of enjoying the natural beauty throughout the watershed, with one respondent noting that they "enjoy its beauty, size, cleanliness, and its many moods". Many celebrated the value of nature for personal enjoyment, and noted that viewing, listening to and experiencing nature brought about personal fulfillment and connection to natural spaces. One respondent summed up the sentiment of many when stating "life is more enjoyable with these bodies of water close by." Another respondent touched on the dynamic nature of the river by stating "the Ottawa River is a long, majestic, varied body of freshwater. Each twist and turn provides a different vista and experience; it is like multiple river personalities in one". In contrast, others felt that pristine areas of the watershed no longer existed, and that it was important that users be made aware of these

less pristine areas, in order to bring about eventual change (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018).

ART

Given its natural beauty, many are drawn to the Ottawa River watershed as a source of inspiration. The 3,000 year old Migizi Kiishkaabikaan (Oiseau Rock) is one of the first examples of artwork based on the Ottawa River. Balanced on a cliff alongside the Ottawa River, the rock features a pictograph that represents Algonquin's traditional understanding of the spiritual and physical landscape (ORHDC, 2005). The Ottawa River has been the subject of poetry and photography, while Gatineau Park and Algonquin Park have often been the subject of paintings and various other mediums. Notably, the Group of Seven painted extensively in the Ottawa River watershed through the 1920s (ORHDC, 2005). Respondents throughout the engagement process noted that they looked to the watershed as a source of inspiration and wonder, and a few explicitly noted their enjoyment of photography in the area.

SPIRITUALITY

Many are drawn to the watershed for spiritual connection. In particular, the Ottawa River watershed holds a deep spiritual connection for Indigenous peoples, which was detailed in section 3.1. When tasked with developing a shared vision for the background study for nomination of the Ottawa River as a heritage river, members of the executive committee for the ORHDC noted that the watershed was a spiritual entity, not a commodity (ORHDC, 2005). In 2006, an Ottawa Riverkeeper report noted that journeying down the Ottawa River is a journey of spirit (Ottawa Riverkeeper, 2006). Through public engagement for the ORWS, one respondent noted that they appreciate the Ottawa River for "spiritual and intellectual stimulation", while others enjoyed the tranquility and soothing peacefulness brought by pristine areas. In contrast others appreciated connecting with untamed sections of the watershed, particularly in regions without hydroelectric dams and development (PlaceSpeak consultations, 2018).

RECREATION

Recreational pursuits were the most commonly mentioned value throughout the engagement process. During open door meetings, individuals spoke passionately about activities such as fishing in remote tributaries throughout the watershed, paddling wild rivers and surfing standing waves on the Ottawa River during the spring (Public and stakeholder consultations, 2018). In dozens of comments through online feedback, respondents expressed a passion for activities such as swimming, cycling, hiking, paddling, fishing, sailing and camping, among many others (PlaceSpeak consultations, 2018). Numerous responses highlighted that they enjoyed the watershed's nature on their daily commutes to work, through either walking or cycling. Many appreciated recreation in winter months, such as ice fishing, skating, snowshoeing, and cross country skiing were noted as popular. Recreation is highly regarded for its ability to help people build connection and concern for the natural environment. Those that participate in recreational activities, especially those that enjoy activities that involve appreciation of nature, often have stronger pro-environmental views (Jackson, 1986). A respondent echoed these findings, stating "the more that (people) interact with it (Ottawa River watershed) the more they will love it and champion its safety" (PlaceSpeak consultations, 2018). Furthermore, recreation is connected to one's overall wellbeing and sense of fulfillment (Flanagan, 1978); one respondent noted that they enjoy swimming and paddling, and stated that "the more time I spend in nature, the better I feel and the more productive I am in life and in work" (PlaceSpeak consultations, 2018). Others

enjoyed participating in activities that connected them with others; a few respondents stated they enjoyed kayaking and camping with friends and family or taking lessons for activities such as sailing or paddling (PlaceSpeak consultations, 2018).

A CLOSER LOOK: WHITEWATER RECREATION

"The River is a perfect blend of adventure and the essential Canadian experience in a natural setting" – Wally Schaeber

The Ottawa River watershed features the mighty Ottawa River, which from its headwaters declines 370 meters until its confluence. Given the change in height, the velocity of the river is fast paced and strong. Adding to the power and volume of the river are both major and minor tributaries, such as the Madawaska, Petawawa, Dumoine, Coulonge, Black, Gatineau, Lievre, Bonnechere, Rideau and South Nation. Paddlers are often drawn to the watershed for adventure, as well as to connect with nature, experience spiritual fulfillment and retrace historical voyages (ORHDC, 2005). While paddling and other types of recreation occur on all of these rivers, two are renowned for their whitewater paddling opportunities and were often mentioned in stakeholder engagement: the Dumoine and the Pettawawa.

The Dumoine River: Without cellphone service and only accessible through the Dumoine ZEC or by helicopter, the Dumoine River is regarded as among the most untouched regions in the watershed. Fed into by several smaller tributaries, and unencumbered by hydroelectric dams and other development, the 130 kilometer Dumoine River is celebrated for its whitewater paddling. From Lac Dumoine to the Ottawa River, the river travels through thirty nine waterfalls and rapids, seven of which have mandatory portages. An early adventurer of the river, Wally Schaeber, who has guided hundreds of people down the river through adventure tours, credits the river for having significant effect on all those that paddle on it (MacGregor, 2017).

The Pettawawa River: Beginning in Algonquin Park, the Pettawawa flows first by white pines and granite cliffs, before continuing through the town of Pettawawa and eventually into the Ottawa River. The 187 kilometer long river is favored by numerous paddlers, including former Prime Minister, Pierre Trudeau, due to its accessibility and natural beauty. Given this, the River is a major draw for both local and international paddlers (MacGregor, 2017). In May of each year, the town of Pettawawa hosts Canada's largest whitewater festival, the "Hell or High Water Festival", in addition to the "Upper Ottawa River Race and Paddle Festival", which is co-hosted with the City of Pembroke. Both festivals provide opportunities for locals and visitors alike to connect with the watershed, while in turn bring economic opportunity to the region

ACCESS

Connected to recreational pursuits is the ease of access to the watershed. Many respondents appreciated the fact that the ability to access nature and shorelines had not been limited by private ownership and development. In contrast, many noted that public access had been limited in some situations and feared that private owners would begin profiting from the watershed (PlaceSpeak consultations, 2018). Many went on to state that public access to shorelines is essential, especially if recreation is to be maintained. Additionally, some industries and municipalities recognized the importance of access to nature, notably water bodies, and built accessible and safe boat launches (Public and Stakeholder consultations, 2018). In somewhat of a contrast, excerpts from Roy MacGregor's book Original Highways: Travelling the Great Rivers of Canada (2017), celebrated the inaccessibility of certain areas, such as the undeveloped Dumoine River.

FUTURE: UPCOMING GENERATIONS

Conserving the global environment for the benefit of future generations is often highlighted as the key motivation for sustainable development, management and environmental policy development. Issues occurring at the watershed scale are challenging to address both spatially, and over time. The flow of water does not respect political boundaries, nor is it a fixed issue affecting only the current generation (Reed & Bruyneel, 2010). While efforts are being made at a global level to bring attention to environmental issues, a diversity of local level initiatives are also abundant and important. Within the Ottawa River watershed, recognition of future generations began to be considered more seriously in the 19th century, as pollution from sawmills impacted the river, and smoke from industry polluted the air. Controversy arose regarding industrial pollution in the region. The perception at the time was that politicians and industry favoured profits over protection of the environment (Gillis, 1986).

Through the ORWS, ensuring that the watershed is protected for the future was a value commonly stated (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). Respondents expressed gratitude and appreciation for the experiences they and their families have had in the watershed, and noted a desire to see similar experiences continued into the future (PlaceSpeak consultations, 2018).

A CLOSER LOOK: YOUTH

"We do not inherit the land from our ancestors; we borrow it from our children."

Youth have a large stake in environmental management, and often have fresh perspectives on how natural areas should be managed. During three sessions with middle and high schools, students were taught about the concept of a watershed, and how the health of the watershed is linked to various services used by students, such as drinking water, recreational pursuits, biodiversity and habitat. Although these sessions were limited, and not necessarily reflective of all youth opinion, sessions were valuable in providing a snapshot of what aspects of the watershed youth found important.

Interconnections within the watershed: Students expressed interest, concern and value for how water connects to almost all aspects of a watershed, and to daily life. For example students noted the impact that run-off from industry had on drinking water quality downstream, and expressed concern for how this would impact the health of wildlife. Students discussed the fact that if water supply and quality was somehow compromised that this would have far reaching implications on various other aspects of the watershed, such as wildlife, natural lands and drinking water for humans.

Continued access: Access to natural areas was important to students, as it allowed them to easily go out and connect with the outdoors. Students highlighted the accessibility of the outdoors as important to creating more awareness about the natural world, and helping to develop an interest in making earth-conscious decisions. Students noted that access was not only important for them, but also important for those in the future, so that others could continue to develop an interest in the natural environment.

Recreation: Students valued outdoor experiences that better connected them to nature. Fishing, kayaking, paddling and camping were noted as ways that students enjoyed connecting with the outdoors, often accompanied by family or friends.

Wildlife: Wolves, bears, eagles, fish and other wildlife were of large interest to students, with many expressing a motivation to conserve the environment based on the desire to better protect various species.

Governance: Discussions on how the watershed should be best managed, and who should collaborate on the management of the watershed were insightful. Students had varying perspectives on which stakeholders and how many should collaborate to ensure the watershed was better conserved. Indigenous peoples, scientists and academics, and environmental groups were recommended as being important to the collaboration process. Industry, media, teachers and government were also advocated for. The majority also felt that youth should have the opportunity to contribute to decisions, and the concept of having a youth council was discussed.

3.2.5. NATURAL VALUES

The following section will consider the intrinsic value of nature independent of the value human assigns to it. Recognition of ecosystem dynamics independent of humans, such as the importance of water quality to ecosystem health, environmental flows, species diversity and habitat were noted throughout the public engagement process (Public and Stakeholder consultations, 2018). Such responses acknowledged the importance of the interconnected

systems within the watershed, and expressed the need to ensure that voiceless users of the watershed, notably wildlife, ecosystems and plants, were accounted for. Intrinsic value is defined as the value that an entity has in itself, for what it is. Often, intrinsic values assigned to the environment are based on complexity, beauty, diversity, wonder and wildness (Sandler, 2012).

FRESHWATER

Anything living within a watershed requires a consistent supply of freshwater to continue maintaining life processes, while geology and geological processes are influenced by the flow, subsurface migration, and the freezing and thawing of water. Numerous responses through online public engagement for the ORWS, activities with youth, and open door meetings, touched on the fact that countless aspects of the natural world are connected through the flow of freshwater; notably biodiversity, ecosystems and wildlife in the region. (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018)

BIODIVERSITY

Biodiversity refers to the variety of life forms in a given area. Typically, biodiversity measures the mix of genetics, species and ecosystems (UNEP, n.d). During the public engagement process, many noted the importance of this diversity, and their interest and enjoyment in documenting levels of biodiversity through bioblitz activities, online platforms, such as iNaturalist, and regional level biological databases that act as libraries for scientific information.

The Ottawa River watershed provides habitat to a variety of terrestrial and aquatic species, including dozens of species at risk. In a recent health assessment of the Ottawa River watershed, WWF-Canada reported that 85 fish species can be found in the Ottawa River, with the rare river redhorse and lake sturgeon found throughout the region. Input to the ORWS also noted the value of other species at risk, such as the blanding's turtle and the American eel. Respondents shared their appreciation of wildlife through accounts of viewing various species, such as lake sturgeon, or through recognition of their importance (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). The watershed also provides important habitat and migration routes for roughly 300 bird species (ORHDC, 2005). One respondent valued the experience of viewing red phalarope, harlequin duck, Barrow's goldeneye and ravens in nature, while another noted the return of bald eagles. Another individual stated "we are landowners on the riverfront and are very fond of the natural beauty of the Ottawa River, the migrating birds and numerous species of birds" (PlaceSpeak consultations, 2018). There are also many mammals, amphibians and reptiles in the watershed, with mink, beaver, striped skunk, big brown bats, red foxes, woodchucks, eastern chipmunks, red squirrels, porcupines, white-tailed deer and raccoons frequently observed. Less commonly sighted, but abundant in specific areas, are wolves, lynx, moose, martens, black bears and wolverines (ORHDC, 2005). PlaceSpeak feedback noted that it is important that these species are recognized and protected (PlaceSpeak consultations, 2018).

3.3. RISKS TO NATURAL, ECONOMIC, CULTURAL AND HERITAGE VALUES

Given both ongoing local and global development, change is inevitable, and various factors have the potential to alter current conditions in the watershed. While not all changes in the watershed are regarded as negative, changes alter pre-existing conditions in the region. Changes within the watershed can have a multitude of ripple effects throughout various socio-economic dimensions, namely, the health of the ecosystem, the strength of the economy, and the wellbeing of society (Morrison et al., 2012). In order to assess what changes may threaten the watershed, Indigenous, public and stakeholder feedback was analyzed to generate a list of perceived risks that currently threaten the values described in section 3.1 and 3.2. Below various drivers of change and broad risk are grouped into themes and described. Specific concerns related to the health of the watershed will be discussed in Chapter 4.

Throughout the ORWS engagement process, feedback was obtained from the public and a variety of stakeholder groups. Examples of engagement questions used to determine what stakeholders consider to be threats include:

- Is your organization aware of any significant economic, cultural, heritage and natural values that are central to overall ecosystem health and the wellbeing of communities in the region? Can you describe some of the past, present and potential future threats to those values?
- Do you have any specific concerns about this watershed? Is there anything in particular that you think we should consider, or be aware of in the context of this Study?

Respondents typically answered questions in one of two ways: some identified what activities they viewed as causing issues in the watershed (e.g., climate change, resource extraction, increasing development), while others identified outcomes, such as water pollution, reduced access to the watershed, and invasive species, which are further detailed in section 4.4. Threats identified by respondents often applied to multiple values. For example, decline in water quality may have negative impacts on recreational opportunities, health of the population, ecosystem processes, and the agriculture industry. Given these interconnections, the threats identified by respondents have been grouped into either drivers or issues. Of note, the drivers and issues identified do not represent a comprehensive or scientifically supported list of threats; instead they summarize the input received through the ORWS engagement process (see Figure 3.3-1).

3.3.1. DRIVERS OF CHANGE

Many Indigenous groups, individuals and stakeholder groups noted what they perceived as causes of change in the Ottawa River watershed, with many expanding on why they felt drivers of change were of concern.

CLIMATE CHANGE

Throughout the engagement process, many stakeholders indicated climate change as an important concern, and touched on specific issues that result from climate change, notably flooding and ecosystem loss, as a threat to various values (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018).

The Intergovernmental Panel on Climate Change (IPCC) projects that current climatic patterns will continue to shift across the globe (IPCC, 2014). Canada's Annual Climate Trends and Variations Bulletin notes that temperatures have been increasing across Canada at twice the global rate, with the nation seeing an average temperature increase of 1.7 degrees Celsius (°C) since 1948. Furthermore, Canada has seen mixed changes in rainfall with northern Canada and southeastern Ontario experiencing increased levels of rainfall (ECCC, 2017a). Precipitation patterns have changed in Canada over the past century, and projections indicate that climate change will cause more frequent heavy precipitation events that can cause increased frequency of flooding (Lemmen and Lacroix, 2014).

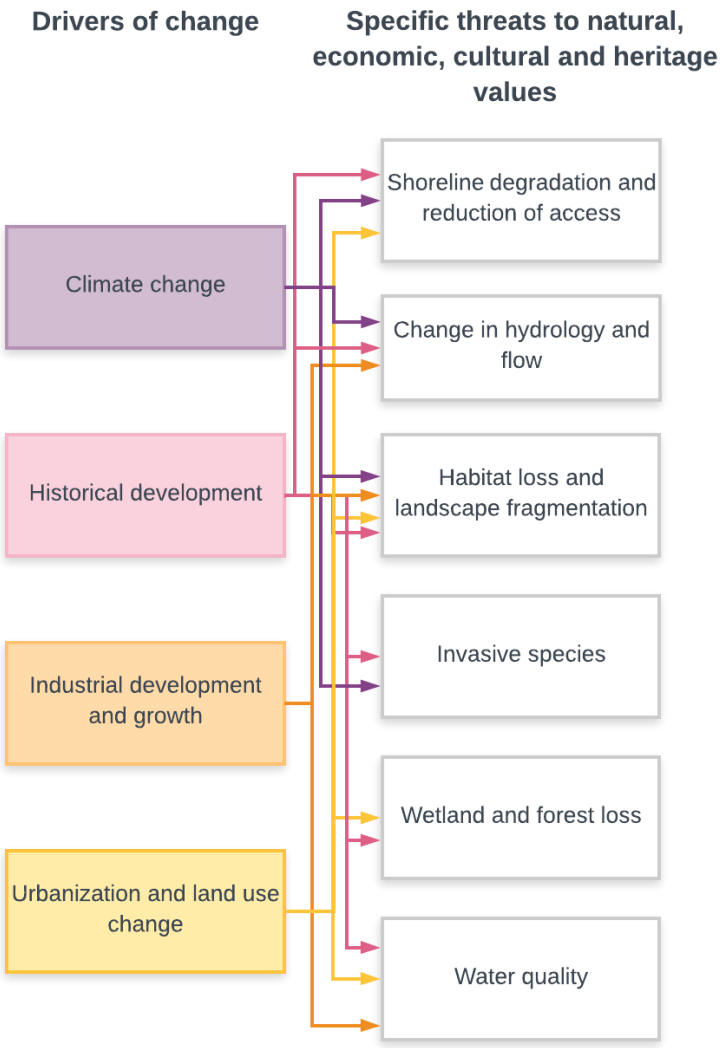


FIGURE 3.3 1. Illustration of the drivers of change and threats to values identified from input collected during the ORWS process

HISTORICAL DEVELOPMENT

Industrial and urban development remain key drivers in environmental change (ECCC, 2017b). Since European contact and the subsequent colonial settlement, there have been high levels of development in the Ottawa River watershed, which have degraded Indigenous traditional territory and livelihoods. Industrial development in the form of mines, hydroelectric dams and nuclear developments, in particular, have affected the lands and waters upon which Indigenous peoples rely for food, drinking water, recreation, and transportation. A member from the

Algonquin Nation Secretariat noted that they felt there was no consultation for projects such as “dams cutting travel routes for fishing and harming them in a process.” The Algonquins of Ontario pointed to reduced water quality, biodiversity loss, changes in water levels, and an overall decline in the health of the aquatic ecosystem, as exemplifying the negative impacts of industrial development on the watershed (Richardson, 2018). Hydroelectric projects, for example, largely built between the 1880s and 1960s, caused the flooding of Indigenous villages and sacred sites. They also created physical barriers that prevented access to the Ottawa River watershed, and disrupted the ability of Indigenous communities to rely on the watershed for food and transportation (Ottawa River Heritage Designation Committee, 2005). The Mohawk Council of Kanesatake gathered and compared the views of Mohawk elders and Mohawk children, and observed that the community’s relationship to the Ottawa River changed significantly within the past two to three generations. Through the ORWS, many respondents noted their concern about aging infrastructure, nuclear-related research, and the decommissioning of past development and nuclear waste facilities. Currently, CNL is proposing significant work at two of its facilities: the disposal of waste from Chalk River laboratories and the decommissioning of the Nuclear Power Demonstration Waste Facility in Rolphton, ON (Canadian Nuclear Safety Commission (CNSC), 2018a; CNSC, 2018b). Concerns raised during the Study engagement process were largely due to general uncertainty regarding the risks associated with nuclear waste storage, proximity of proposed waste storage sites to water courses, and what some people believed were flawed public engagement and subsequent approvals processes (PlaceSpeak consultations, 2018). Decommissioning of other infrastructure, such as dams and mining sites, may also lead to unintended consequences, such as changes in hydrological flow regimes and water quality contamination. Through the ORWS engagement process, one respondent noted that "old municipal wastewater infrastructure requir(es) updating", while others added that leaks or breaches in wastewater infrastructure concern them (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018).

Notably, urban development (e.g., water utility infrastructure, roads, wastewater treatment, building construction), resource and related industry extraction (e.g., forestry, mining, cement processing) and electricity generation (e.g., hydroelectric power generation and nuclear research) were integral to the historical development and population growth of the Ottawa River watershed region (see section 3.2). At times through history, economic development of the region may have been prioritized over environmental protection (Smith, 2009; Fraser Institute, 2008); given this, historical development may have had larger environmental impacts than originally intended. In addition, infrastructure, such as in underground water and wastewater pipes and hydroelectric dams, alter the supply and flow of water (Federation of Canadian Municipalities, 2016).

INDUSTRIAL DEVELOPMENT AND GROWTH

Although the economic contribution of industries was noted by multiple respondents, others expressed concern with a variety of projects, especially those that involved resource extraction, discharge of effluents and pollutants, and the release of emissions into the atmosphere. One respondent noted their concern with a new proposed rare earth mine, and it's potential to contaminate water, stating "we greatly depend on the waterway for our traditional way of life." Another individual viewed mines as a threat to the region's cultural and economic security, noting the various tourism outfitters in their respective region, and stating that "mining in the area would negatively impact the environment and current use of the lake and local economy." Pollution, land use changes and erosion were also noted as negative impacts resulting from

industrial practices (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018).

A suite of different industries contribute to the Ottawa River watershed's economic development, providing jobs to thousands, and stimulating and diversifying economic growth. Extractive industries, such as mining and forestry are regulated through legislation, such as the *Canadian Environmental Assessment Act*, and through agencies, such as the National Energy Board. However, literature states that even highly regulated industries alter landscapes and have downstream impacts (Morrison et al., 2012). Industries that process natural resources, such as pulp and paper and cement industries, also impact the natural environment through production of effluent and greenhouse gas emissions. Agricultural run-off and municipal wastewater and sewage systems can further add to environmental change, through the introduction of effluents into waterways and ecosystems.

URBANIZATION AND LAND USE CHANGE

Throughout the ORWS engagement process, many noted the impacts that increased urbanization and subsequent development could have on the watershed. Some were concerned with the impacts that upstream development could have on downstream users. Many others were worried about how regulation and private land ownership may interact to impact the watershed, notably, loss of access for recreational opportunities, and potential issues with landowners developing their land in an unsustainable way (Public and Stakeholder consultations, 2018).

The region's growing population, coupled with the patterns in which people settle, alter the way the land is used, increasing housing demands, and exerting pressures on municipal utilities, such as drinking water, septic and sewer (Natural Resources Canada, 2013). Decision-making regarding the majority of land use change within cities falls under the jurisdiction of municipalities (Statistics Canada, 2017a). The way in which municipalities plan for increasing urbanization, as well as the level of permitting and enforcement in place to assess these issues, then affects the level of impact on the land and environment.

3.3.2. SPECIFIC THREATS TO NATURAL, ECONOMIC, CULTURAL AND HERITAGE VALUES

While some respondents to the ORWS noted the main drivers or causes of issues within the Ottawa River watershed, the majority identified specific conditions or problems that impact values associated with the watershed. These issues were identified as potential threats to the values identified in 3.2.

WATER QUALITY

There is a perception amongst some stakeholders and the public that water quality has declined in the Ottawa River watershed, which is viewed as a major threat to almost all values. Indigenous groups echoed similar views, noting that the younger generations have resigned themselves to a "dirty" river where their grandparents used to swim and fish in the Ottawa River (Bisson & Mohawk community of Kanesatake, 2018). Other Indigenous groups had concerns regarding mercury, acid levels and high volumes of pollen within water bodies. The Mohawk

Council of Kanesatake stated that swimming was enjoyed as a “past activity” as water quality has declined; 27% of the community members interviewed felt that water quality was the biggest concern. Specifically, two elders mentioned they “would never take their grandchildren to swim in the river despite the fact that it was something they enjoyed as children themselves”, while others “expressed sadness at having lost the accessibility of the river to swim.” . Additional feedback received highlighted the fact that water quality degradation could potentially impact several aspects of the watershed; notably the quality of life of citizens, economic losses to businesses and industry, and the maintenance of ecological processes (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). Numerous threats to water quality were identified. As discussed in section 3.3.2, many respondents expressed concern about how nuclear waste storage near the Ottawa River may impact water quality. It was also noted that nuclear power generators are of concern due to the radioactive particles they release into the river, as well as the potential to change the temperature of the river by using water to cool the nuclear reactors (Gehl, 2018). Another noted that nuclear substances are less of a risk, especially when compared to the risks of other substances, such as those that "arise from non-point source releases, such as agricultural inputs and point sources from sewage and pulp mill releases” (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). Point source pollution (i.e., a single identifiable source of pollution), and non-source pollution (i.e., pollution resulting from many potential sources), stem from a variety of municipal practices, agriculture, natural processes, and industries.

In addition, microplastics, largely driven by individual consumption habits and municipal waste management processes, were also identified as an issue that can severely degrade water quality. Respondents stated that they rely on a certain level of water quality for drinking (both in the watershed and downstream), recreational pursuits, irrigation, and several other activities. Others noted that fish and other wildlife species required high water quality for their continued survival (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). Indigenous peoples were especially concerned about the linkages between water quality and declining fish populations. The Métis Nation of Ontario shared that while the diversity of fish continues to represent an important natural value within the Ottawa River watershed, there has been a significant decline in the quantity and size of fish over the years (Odonaterra Community Environmental Strategies, 2018). The Mohawks of Kanesatake also reported decreases in fish numbers and size. Certain species, such as the Blue Walleye, have disappeared entirely since the 1970s (Bisson & Mohawk community of Kanesatake, 2018). More detailed information regarding water quality within the Ottawa River watershed is provided in sections 4.3 and 4.4.

CHANGE IN HYDROLOGY AND FLOW

Flow regimes account for the amount of water flow at a given time, how quickly flow changes, and the regularity of consistent flows, among various other factors. Throughout the ORWS engagement process, many groups and individuals noted the impacts of the May 2017 floods throughout the watershed, which had significant economic repercussions, posed health and safety risks, and caused ecological damages (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). One respondent noted that the issues associated with climate change will “fundamentally alter the hydrologic characteristics under which local economic interests and natural heritage systems have developed, resulting in significant stress and disruption to these systems”. Another person stated that “the flooding experience last spring (2017) was cause for concern” (PlaceSpeak consultations, 2018). Flow is highly impacted by precipitation, soil type, soil depth, vegetation cover, and watershed size, therefore drivers such as climate change, and changes in land cover and land use, can significantly alter flow patterns

(Berhanu et al., 2015). Flow of water, both in unmanaged rivers and rivers with dams, are increasingly being altered by climate change, at relatively equal amounts (Ficklin, Abatzoglou, Robeson, Null & Knouft, 2018) The flow of the Ottawa River and its tributaries largely impacts biodiversity, hydroelectric generation potential, shoreline integrity and other ecological processes. In addition, changes in flow regime that may be linked to climate change are anticipated to cause extreme events, such as flooding and drought, to become more frequent.

INVASIVE SPECIES

Several respondents during the ORWS engagement process expressed concern that invasive species may impact water quality, aesthetics, and recreational opportunities (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018). The presence of zebra mussels, Asian carp, emerald ash borer and eurasion millfoil have the potential to hinder the sport fishing industry, and access to lakes and other water bodies for recreational boating (FOCA, 2017). Many respondents also expressed concern that invasive species would impact the ecosystems and wildlife populations in the region (Public and Stakeholder consultations, 2018; PlaceSpeak consultations, 2018).

The spread of invasive species is largely attributed to transportation and navigation, as new species can be introduced via ships, planes and other modes of transport (Fisheries and Oceans Canada, 2018). The migration of invasive species is also linked to climate change and ecosystem dynamics (Crowl et al., 2008). As climate conditions change, introduced species are able to shift their habitats and prosper in regions that were previously less suitable. Additionally, extreme weather events allow some species to spread into previously uninhabited waterways, which is expected to be the case with the spread of Asian Carp (Koel et al., 2000). Once in a new ecosystem, many invasive species easily reproduce and thrive, due to the lack of natural predators, or the capabilities to out-compete naturally occurring species (Crowl, Crist, Parmenter, Belovsky & Lugo, 2008). Invasive species are further described in Chapter 4.

WETLAND AND FOREST LOSS

As was noted in section 3.2, wetlands provide significant services to the entire watershed. Water filtration, water storage, habitat, flood control and carbon sequestration are just a few of the services that wetlands provide to humans. Throughout the ORWS engagement process, many respondents noted concerns related to wetland loss. One respondent indicated that wetlands will be more susceptible to drying out, as temperatures and evapotranspiration increase as a result of climate change. Others pointed to urban and industrial development as being an additional driver in wetland loss (Public and Stakeholder consultations, 2018).

Loss of ecosystems threatens biodiversity, with the Ardoch Algonquin First Nation and Allies, noting that they traditionally benefited from much greater levels of biodiversity, and used over 240 local plants for food or medicine (Lawrence, 2013). This loss is also a threat to natural values, ecosystem services, and heritage, with one stakeholder group noting that "as urban expansion continues and associated land conversion continues, it is expected that (forest and wetland loss) will show further deterioration and reach critical thresholds" (Public and Stakeholder consultations, 2018). Overall, many felt the loss of wetlands and forests threaten economic, societal and natural values. Notably, if there is a loss of ecosystem services, a reduction in the aesthetic quality and recreational opportunities in the Ottawa River watershed could occur.

HABITAT LOSS AND LANDSCAPE FRAGMENTATION

Linked to wetland and forest loss, is landscape fragmentation. When key ecosystems are degraded, or removed entirely to make space for development, habitats become fragmented (Haddad et al., 2015). A few respondents expressed concern with this issue. Rivers in the Ottawa River watershed are highly fragmented due to hydroelectric infrastructure and dams controlling river flows throughout the watershed (WWF-Canada, 2009). As a result, migration patterns of wildlife and aquatic species are altered. World Wildlife Fund-Canada stated that the Ottawa River is one of the ten most threatened rivers in Canada; within their Watershed Reports, it noted "the Ottawa River is one of the most regulated river systems in Canada. Its natural flow regimes have been dramatically altered, compromising habitat and the diversity and distribution of the river's fish and shoreline vegetation" (WWF-Canada, 2009). Many respondents also expressed the importance of an individual's connection with nature through natural spaces; while many noted their concern that natural spaces were being lost. Consequently, many perceived a decline in natural spaces as potentially causing a decline in well-being and quality of life.

SHORELINE DEGRADATION AND REDUCTION OF ACCESS

Driven by an array of factors, access to, and degradation of shorelines is perceived as an issue within the watershed. One individual recommended that "limiting construction in lowland or environmentally sensitive areas along the river" was needed to manage destruction of shoreline areas, while another desired further permitting and enforcement, to ensure that shoreline degradation was further reduced (PlaceSpeak consultations, 2018). Removal of vegetation along shorelines increases rates of erosion and sedimentation, which then impacts species composition and flow of the river (Poff et al., 1997). For more information on shoreline degradation, refer to section 4.2 and 4.3.

Additionally, Indigenous groups expressed concern regarding limitations in fishing, hunting and gathering rights in the Ottawa River watershed; however, they are generally confined to harvesting in specific locations, and find that increased competition has resulted in their resources becoming increasingly depleted.

Others were concerned with private land ownership and development; notably, many respondents felt that private land reduced their access to the watershed. One respondent stated "universal public access to the shoreline is essential" but added the caveat that "sensitive areas should still stay protected." Another noted that the river and its tributaries are "continually under threat for its public access rights due to the privatization of river access. Hundreds (if not thousands) of international visitors come to visit this stretch of the watershed every year, let alone the thousands of Canadians who frequent it annually" (PlaceSpeak consultations, 2018)

4 DATA, MONITORING AND POTENTIAL INDICATORS

Private Member's Motion (M-104) states that, as part of its Study on the Ottawa River watershed, the Government of Canada should examine important watershed health indicators, such as water quality, biodiversity, and shoreline integrity. This chapter does not include an assessment of watershed health, rather, through engagement on the ORWS, as well as research into existing watershed health assessments and ongoing monitoring in the watershed, ECCC developeda list of potential watershed health indicators for consideration. In addition to health indicators, this chapter also examines responsibilities for monitoring activities, existing health assessments, available data, and discusses gaps related to data and information sharing.

4.1. INDICATOR THEMES AS IDENTIFIED BY MOTION M-104

An indicator is a quantifiable metric that is used to provide information about, describe, or evaluate, the state of the environment or area of consideration (OECD, 2003). While indicators are used for various purposes, there are several overarching criteria that are recommended for selecting appropriate indicators. For example, according to the OECD's Environmental Directorate, indicators should be (OECD, 2003):

- Easy to understand and communicate;
- Timely and relevant to the current policy context, and spatially and temporally representative of environmental conditions / pressures;
- Measureable through the incorporation of readily available, or well documented, data;
- Adaptable to changing information or conditions; and
- Founded in best practices and sound science.

> "The Rio Conference on Environment and Development in 1992, and other similar environmental milestone activities and happenings, recognized the need for better and more knowledge and information about environmental conditions, trends, and impacts. To achieve this, it was not only necessary to collect new and better data; new thinking and research with regard to indicator frameworks, methodologies, and actual indicators were also needed" (Segnestam, 2002, p. 1).

If appropriate indicators are selected, they can be an essential tool for tracking and measuring environmental performance, supporting policy evaluation, and supporting management decisions. Indicators are also used to communicate findings, and can help identify early warnings for changes to a system. In some cases, if there is lack of baseline data for an element of the environment, certain indicators can be used as "proxies" to help track system changes. In addition to environmental performance, indicators may also be used to examine impacts to the socio-economic values of a system (e.g., tourism, community health and wellbeing).

Indicators for consideration can be found from a wide variety of sources. Potential indicators examined in this Study were mainly derived from the following:

- Existing indicator programs, such as the Canadian Environmental Sustainability Indicators (CESI) Program (see text box below) and Agri-Environmental Indicators;
- Existing monitoring programs or health assessments (e.g., CA watershed health report cards); and
- Recommendations from Indigenous, public and stakeholder engagement, through the online engagement platform PlaceSpeak, and through the engagement guides (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018)

SUSTAINABILITY INDICATORS PROGRAM

The CESI program provides data and information to track Canada's performance on key environmental sustainability issues, including climate change, air quality, water quality and availability, and protecting nature. The indicators are prepared by ECCC with the support of other federal government departments, such as Health Canada, Statistics Canada, NRCan, AAFC, as well as provincial and territorial government departments. Designed to be relevant to the Government of Canada policy, the indicators are built on rigorous methodology and high quality, regularly available data from surveys and monitoring networks.

Below are examples of indicators identified and used by the CESI program to monitor trends related to wildlife and habitat:

- Species at risk population trends
- Population status of Canada's migratory birds
- Ecological integrity of national parks
- Extent of Canada's wetlands
- Sustainability of timber harvest

The CESI website was most recently updated in 2018 and provides access to national, regional, local and international trends through the use of graphics, explanatory text, interactive maps and downloadable data. Indicator results are linked to their key social and economic drivers and information is provided on how the issues are influenced by consumers, businesses and governments. Each indicator is accompanied by a technical explanation of its calculation. There is CESI data available for the Ottawa River watershed.

Using the best available knowledge, developing indicators can help understand the health, or state, of a watershed. As mentioned previously, the text of Motion M-104 identifies three broad indicators for consideration: water quality, biodiversity, and shoreline integrity. More specific and measurable indicators could be identified under each of these indicator themes, along with others. The following infographic (Figure 4.1-1), provides a brief snapshot of the watershed using some of the available data that falls under the three indicator themes.

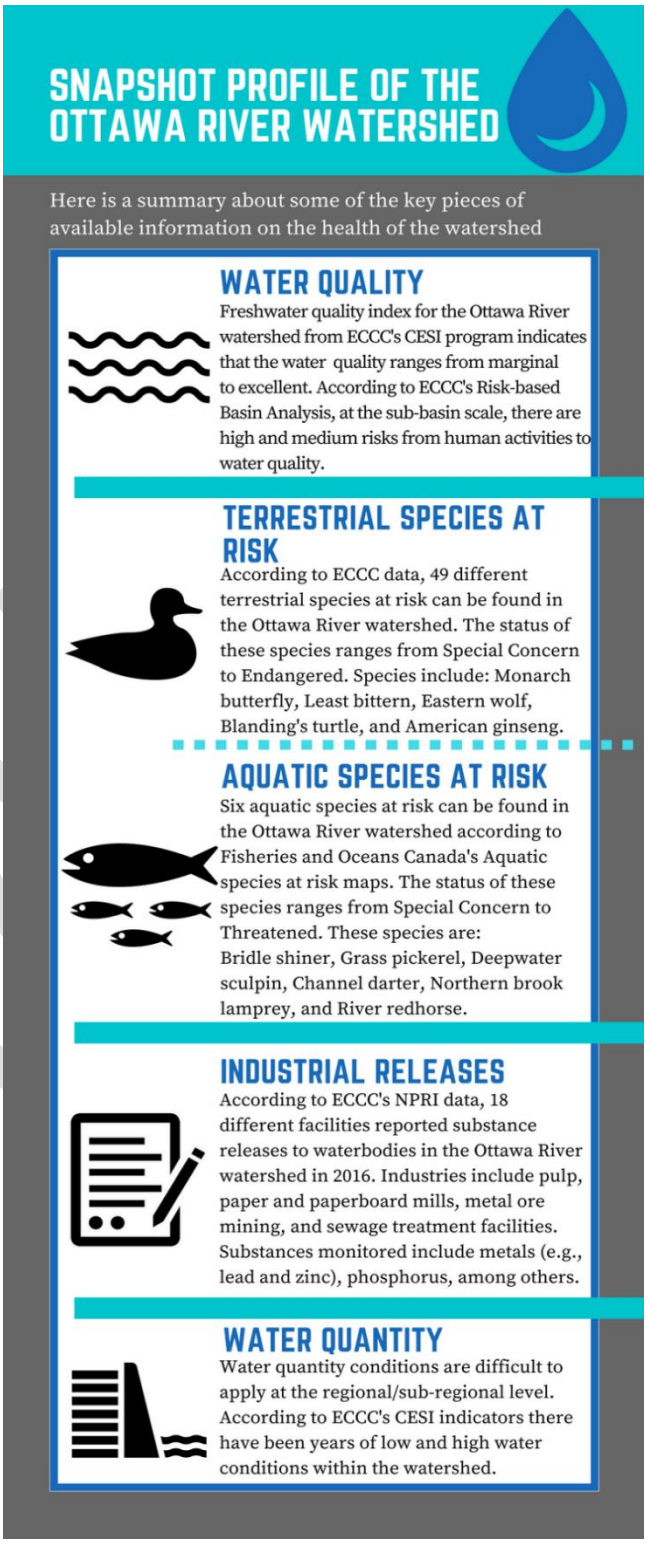


FIGURE 4.1-1. Snapshot profile of the Ottawa River watershed (DFO, n.d; ECCC, 2018c; ECCC, n.d; Public and Stakeholder consultations, 2018).

4.2. MONITORING AND DATA COLLECTION

NOTE: As you read this section, if your organization has some specific data for some of the mentioned monitoring programs that can be included to highlight health of the Ottawa River watershed, please feel free to share this information with ECCC.

Who is conducting monitoring in the Ottawa River watershed? Insufficient communication or understanding concerning monitoring activities in the watershed was a common concern raised by many throughout ECCC's engagement process (Public and Stakeholder consultations, 2018). This section will highlight some of the key monitoring and data collection programs that are relevant to the Ottawa River watershed, in order to gain a better understanding about gaps in baseline knowledge. A list of some of these programs and organizations that are undertaking data collection and monitoring can be found in Appendix H.

ECCC has developed a list of more than 75 different organizations or programs that are undertaking monitoring and/or data collection activities in the Ottawa River watershed. The programs are being run by various jurisdictions and groups, and are categorized in this section as follows:

- Indigenous peoples;
- Federal government;
- Provincial governments;
- Municipal governments;
- Local watershed management agencies (OBVs, CAs);
- Academics, NGOs, citizen science, and community-based monitoring;
- Industry

"Data collection is the means by which [data] are acquired for multiple uses…Monitoring is data collection with the more targeted purpose of detecting and drawing attention to changes in selected measures, particularly extreme changes." (National Research Council, 2004, p. 179)

It should be noted that this is not a comprehensive list, and therefore some information may be missing regarding monitoring and data collection initiatives.

4.2.1 SUMMARY OF MONITORING AND DATA THEMES

The word cloud below (Figure 4.2-1), provides a summary of key monitoring and data collection activities in the Ottawa River watershed. The size of the word corresponds to the frequency with which the theme emerged from the activities list. As you can see, "surface water quality" is the most common type of data that is being collected in the watershed. This theme includes physical-chemical data (e.g., pH, temperature, clarity, etc.), as well as data related to nutrients (e.g., total phosphorus content in the water), and microbial content of the water (e.g., bacterial *E. coli* levels). The next most common type of data being collected is related to groundwater quality, the monitoring of releases of harmful substances (e.g., sewage effluent, industry releases to water, etc.), and toxic substances (e.g., metals, pesticides, radioactivity, etc.).

Other monitoring and data collection activities include the examination of invasive species, aquatic invertebrates, species at risk, wetland cover, as well as socio-economic data, such as tourism information and demographics. The following subsections will discuss some of these monitoring and data collection methods in more detail.

There are also ongoing collaborative monitoring efforts within the watershed. For water quality and quantity monitoring, there are agreements in place between the federal and provincial governments. There is also collaboration between provinces and municipalities, for example, through the monitoring of municipal wastewater and sewage effluent. Provinces and OBVs also collaborate on a number of monitoring efforts, such as surface and/or groundwater quality. Some of these collaborations will be highlighted in the following subsections.

FIGURE 4.2-1. Word cloud representing the types of data being collected in the Ottawa River watershed.

4.2.2 INDIGENOUS PEOPLES

As previously discussed in section 1.3, Indigenous peoples of the Ottawa River watershed have a vast and rich history. For generations, Indigenous peoples have been making significant contributions to the understanding of the health of the Ottawa River watershed and some Indigenous groups have participated in partnership programs to monitor resources in traditional territories. For example, the Mohawks of Kahnawá:ke, in partnership with OBV Abrinord, participated in a water quality monitoring program that targeted two river locations within Tioweró:ton, a hunting area within their territory (Mohawk Council of Kahnawá:ke, 2018). This community has also completed other studies in the territory, including conducting wetland inventories, and conducting an evaluation of the status of a rare freshwater mussel.

For Indigenous communities, the deep spiritual and historical connection to the Ottawa River watershed has accumulated in a wealth of knowledge on the health of the watershed. Today, Indigenous groups continue to have a unique perspective on how the watershed has changed over time. The following quotes describe how traditional knowledge of different Indigenous communities contributes to the monitoring of, and to a greater understanding of, the health of the Ottawa River watershed.

"Their survival on this land for thousands of years has required them to apply their teachings to ensure the protection of the lands and waters that they rely on. […] There were consequences that occurred when they strayed from their natural teachings, instructions and laws. They were constantly monitoring the environment, and if changes occurred, they would adapt." – Algonquins of Ontario (Richardson, 2018)

"…members continue to occupy, manage, safeguard and intensively use the watershed as they carry our traditional and contemporary activities. These activities are based on self-determination and a history of Algonquin traditional knowledge, eco-logical sustainability and land governance." – Algonquin Nation Secretariat (Kitchisibi Ikidowin Anishinabe, 2018)

"The practice of activities in headwaters and outlet areas of the watershed (as well as areas in between) provide the Mohawks of Kahnawá:ke a unique perspective on the overall health of the watershed." – Mohawk Council of Kahnawá:ke, 2018

4.2.3 FEDERAL GOVERNMENT

There are several areas where the federal government undertakes monitoring and data collection activities in the Ottawa River watershed (see Figure 4.2-2). These include:

- The tracking of industrial releases to the environment, and the impacts of toxic substances / contaminants;
- Biodiversity and ecosystem monitoring (e.g., bird population trends, benthic invertebrates, protected areas, and species at risk);
- Greenhouse gases (GHGs) and air pollutant emissions;
- Surface water quality and quantity;
- Groundwater quantity and quality; and
- Meteorology (e.g., rainfall, air temperature, etc.).

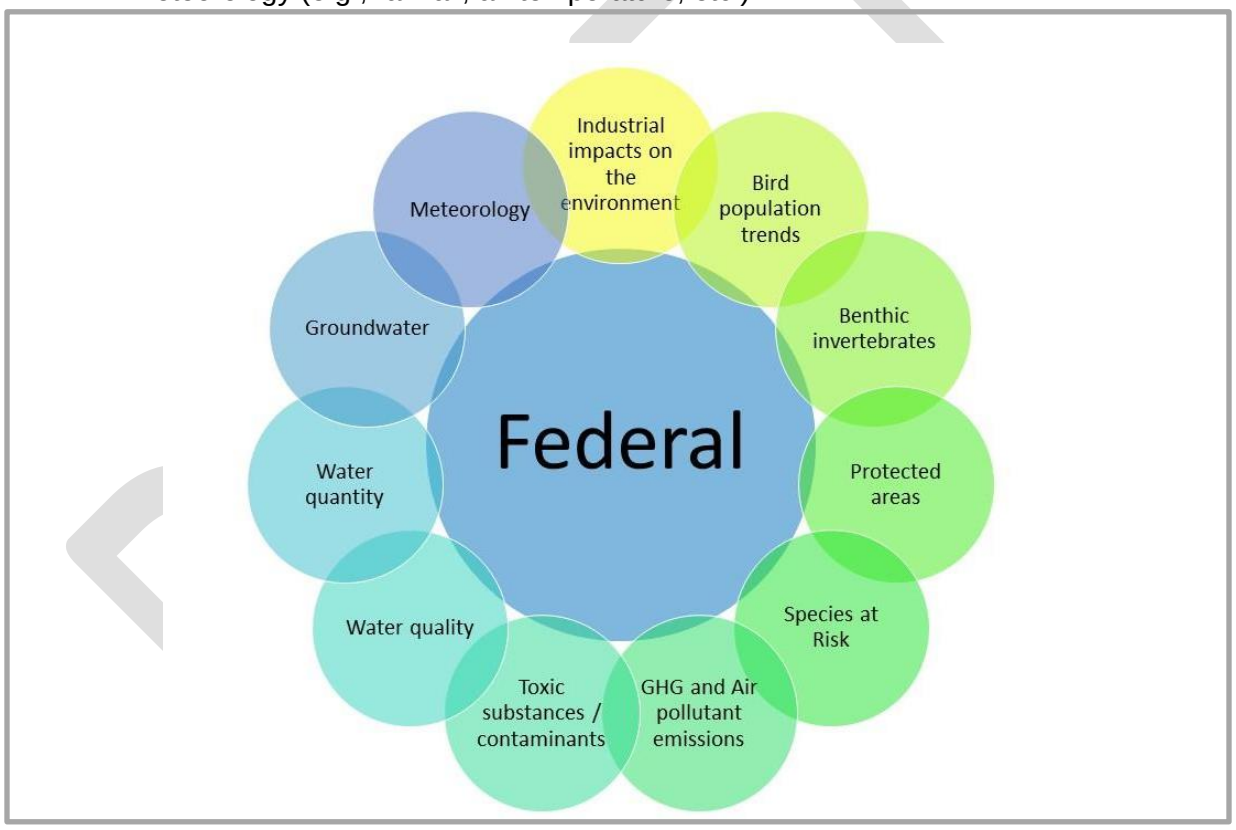


FIGURE 4.2-2. Summary of key parameters monitored / collected by the federal government.

The federal government addresses water quality issues under various statutes, including the *Fisheries Act*, and the *Canadian Environmental Protection Act, 1999.* Federal activities include monitoring, scientific research, and leadership on the development of guidelines for water quality. ECCC, for example, undertakes monitoring of freshwater quality and quantity, pursuant to agreements with the provinces enabled under the *Canada Water Act*. ECCC's Fresh Water Quality Monitoring and Surveillance program implements a risk-based adaptive management framework for examining freshwater quality and aquatic ecosystems to better target monitoring

activities to the risks of contaminants and human activities in Canadian watersheds (ECCC, 2017d). Activities under this program include long-term physical-chemical water quality monitoring, the Canadian Aquatic Biomonitoring Network (CABIN), automated water quality monitoring, site or issue-specific surveillance programs, and the use of the risk-based basin analysis tool (RBBA). RBBA is a flexible tool that allows for a more comparative analysis within sub-basins. RBBA methodology, supporting data and results are very useful and reflect workflows supported and used in many federal departments and NGOs, nationally and internationally (Public and Stakeholder consultations, 2018). Because of agreements with the provincial governments, provincial water quality monitoring site information is shared with ECCC through the Fresh Water Quality Monitoring and Surveillance program.

CABIN involves the collection of information on benthic invertebrates, and a database in which partners of the program have access to tools for storing and managing their data and studies (ECCC, 2018e). Benthic invertebrates are organisms that live in/on sediments at the bottom of rivers, streams, and lakes, and they act as important indicators of the health of water bodies. CABIN's training program also provides the knowledge and skills required to conduct this type of biomonitoring.

ECCC's Water Survey of Canada is responsible for the collection, interpretation and dissemination of standardized water resource data and information in Canada (ECCC, 2018f). This program is also conducted in partnership with the provinces and territories enabled by the *Canada Water Act* (ECCC, 2018b). The Hydrometric Network, operated by the Water Survey of Canada, provides real-time water quantity data for approximately 2200 stations across Canada (ECCC, 2018f). All stations in the Ottawa River watershed (approximately 18 long-term stations) collect water levels and stream flow data, while some also collect information related to air and water temperatures. It should be noted that in Québec, the MDDELCC is the main operator of the water quantity monitoring network, and ECCC provides funding through the cost share agreement with the province for the operation of stations of federal interest in the watershed.

The National Pollutant Release Inventory (NPRI) is Canada's legislated and publicly accessible national inventory of pollutant releases (to air, water and land), disposals, and transfers for recycling (ECCC, 2017c). Pollution prevention data submitted to the NPRI is analyzed and outlined in the NPRI annual summary report. Pollution prevention activity data submitted by facilities is also summarized in ECCC's *Pollution Prevention in Practice* fact sheets. Public access to NPRI data is provided through the annual summary report, an online data search tool.

In 2002, a partnership was established between ECCC, the Canadian Space Agency, Ducks Unlimited, and the North American Wetlands Conservation Council (Canada), to create the Canadian Wetland Inventory: a national approach to establish a consistent framework to map wetlands, in order to build Canada's capacity to respond to local, regional, national and international drivers on wetlands. The vision of the program is to (Ducks Unlimited Canada, 2018b):

- Focus conservation, restoration and wetland monitoring programs;
- Assess changes in wetland abundance and classification in relation to climate change concerns;
- Assist industry, governments and conservation groups to develop land use policies and protocols; and
- Measure performance of those policies and protocols against landscape sustainability objectives.

By using aerial photography and satellite images, wetlands in the Ottawa River watershed are being identified and monitored. The online progress map displays wetland areas across Canada, and is being used to assess future wetland loss, degradation and restoration (Ducks Unlimited Canada, 2018c).

The information from the programs identified above is provided to the CESI program, which tracks Canada's performance on key environmental sustainability issues (previously described in section 4.1). The indicators developed from the data are used to monitor trends. Indicator themes tracked in the Ottawa River watershed include GHGs and air pollutant emissions, harmful substances, water quality, water quantity, and protected areas. Federal monitoring and data collection programs, as well as data collected from the provincial governments through data collection agreements is used to support this program.

Similar to ECCC's CESI program, AAFC has, since 1993, been compiling and analyzing data, and reporting on agri-environmental indicators, in order to measure key environmental conditions, risks, and changes resulting from agriculture, and to track the practices used to mitigate risks of the management practices (AAFC, 2016). Indicators monitored by this program include soil health, water quality, wildlife habitat, nutrients, microbial conditions, and pesticides.

NRCan, through the Geological Survey of Canada, is responsible for the Groundwater Geoscience Program that conducts mapping and assessment activities of key Canadian aquifers. The data, made available through the Groundwater Information Network, provides baseline information and scientific knowledge to inform water management and protection. Groundwater assessment includes geological mapping, regional hydrogeological assessments to monitor movement and distribution, and modelling (NRCan, 2017; NRCan, 2018a). Through the Canada Centre for Mapping and Earth Observation, NRCan also uses satellite sensors to retrieve hydrology-related parameters of vegetation and soils for the groundwater Geoscience Program, and provides Emergency Geomatics Service in support of Public Safety Canada's emergency management efforts to monitor and map flood extent in near real-time (NRCan, 2017; NRCan, 2018b).

The Canadian Nuclear Safety Commission (CNSC) collects environmental samples from the Ottawa River watershed as part of their Independent Environmental Monitoring Program. A wide range of sample media (e.g., air, water, sediment, etc.) are analyzed for a range of hazardous and nuclear substances with the results posted and downloadable from the CNSC web site. However, these activities are localized in nature, generally focusing on the Ottawa River between Deep River and Pembroke and associated sub-watersheds (CNSC, 2018a).

FIGURE 4.2-3. Summary of Government of Canada monitoring and data collection program

4.2.4 PROVINCIAL GOVERNMENTS

As identified in section 1.3, provinces have key roles and responsibilities related to the protection of freshwater resources, implemented through legislation and through a variety of programs. Figure 4.2-4 summarizes the key parameters monitored and collected in the Ottawa River watershed by the provinces of Ontario and Québec. These include the monitoring of surface and groundwater quality and quantity, toxic substances, and the status of species and habitats.

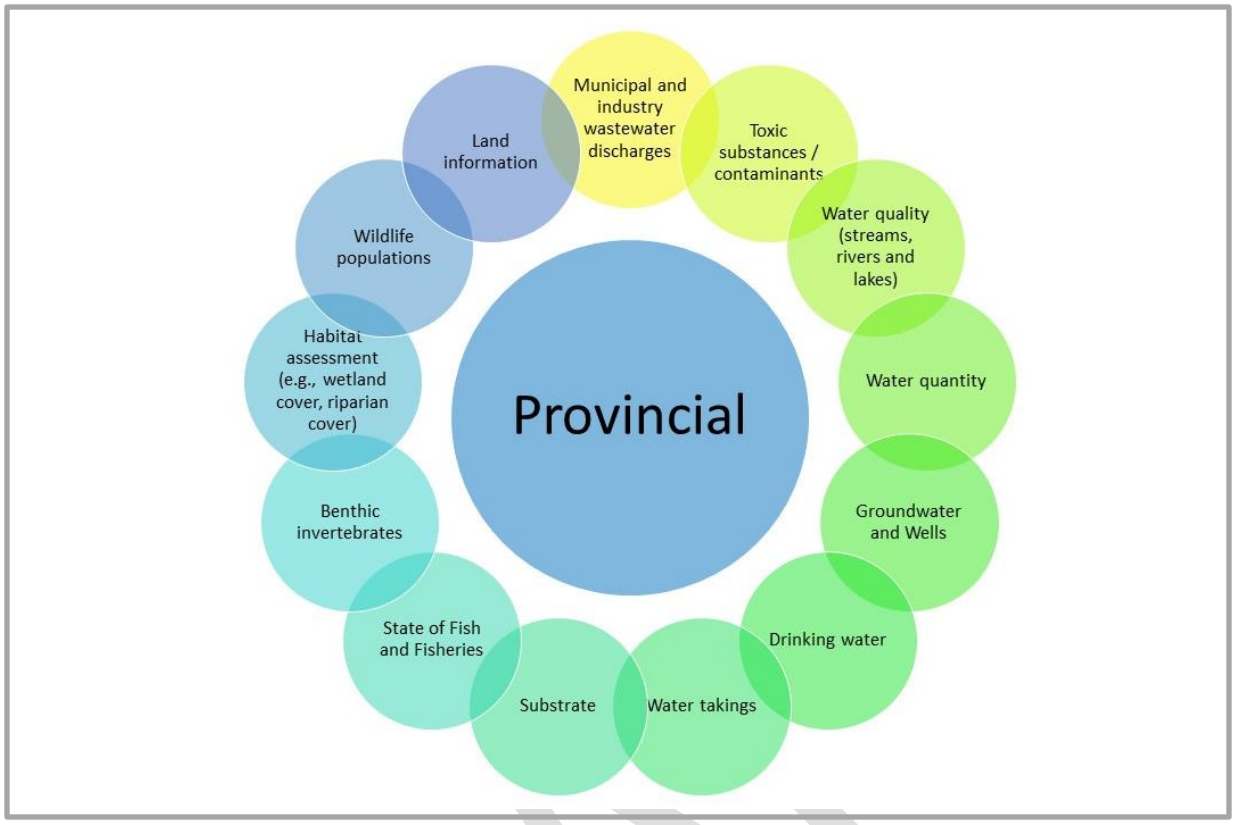


FIGURE 4.2-4. Summary of key parameters monitored / collected by the provinces of Ontario and Québec.

ONTARIO

The Ontario government undertakes many monitoring programs. The following are a few examples of those implemented by the Ontario provincial government that are undertaken in the Ottawa River watershed (see Appendix H for more information).

The Provincial Water Quality Monitoring Network is a collaborative program between the Ministry of the Environment, Conservation and Parks (MOECP) and CAs, municipalities, and provincial parks. The program provides stream water quality monitoring for a number of parameters, including chlorophyll a (used for tracking algae growth), nutrients, and metals (Government of Ontario, 2018b). MOECP's Provincial Groundwater Monitoring Network provides long-term regional groundwater monitoring in order to track potential changes in physical-chemical conditions (e.g., temperature, pH, water clarity, etc.) and water level conditions (MOECP, 2018b). MOECP also has a volunteer-based Lake Partner Program that collects water-quality data to monitor trends in about 800 Ontario inland Lakes (MOECP, 2018c). The program, conducted in partnership with the Federation of Ontario Cottagers' Associations, collects information related to nutrients, and other physical-chemical conditions of the lakes. The Ontario Benthos Biomonitoring Network is also a collaborative program that monitors the ecological condition of lakes, streams and wetlands (Government of Ontario, 2013a). Data collected for this network include benthic invertebrate species counts, habitat conditions, and the physical-chemical conditions of the water.

Ontario MNRF operates the Broad-scale Monitoring Program to collect information on lake fisheries for each of the fisheries management zones in the province, as part of the province's obligations under the Ecological Framework for Fisheries Management (MNRF, 2018a). Every five years, information is collected for a representative number of lakes per fisheries management zone. Information collected includes distribution of fishes, amount and diversity of fishes in the lakes, physical-chemical conditions of the water, nutrient levels, some metals (e.g., iron), zooplankton, contaminant sampling, and fishing activities.

MNRF is also responsible for the Provincial Wildlife Population Monitoring Program as required under the Environmental Assessment Requirements for forest management on Crown Lands. This monitoring program collects long-term trend data to support the evaluation of forest management practices in maintaining wildlife (MNRF, 2018c). A variety of wildlife species are monitored including species such as moose, marten, pileated woodpecker, and white-tailed deer. Methods of assessment will also vary depending on the monitoring objectives of the region under assessment; however, some methods may include the use of breeding bird surveys, migration monitoring and nocturnal owl surveys. For a summary of monitoring and data collection programs raised in this section, see Figure 4.2-5.

FIGURE 4.2-5. Summary of key Government of Ontario monitoring and data collection programs.

QUÉBEC

The Government of Québec is responsible for a variety of monitoring programs. This section will highlight a few examples of some of the programs implemented in the Ottawa River watershed. Additional information on the monitoring programs described below, as well as many others, can be found in Appendix H.

MDDELCC's river water quality monitoring program, *Réseau-Rivières*, is one of the province's primary methods for collecting information on surface water quality. The objective of the network is to collect data on, and monitor trends of water quality, in order to implement mitigation methods to improve the health of the aquatic environment (MDDELCC, 2018h). The parameters of assessment include physical-chemical conditions (e.g., pH, turbidity, suspended solids, dissolved organic carbon, conductivity, temperature, metals), chlorophyll a (i.e., used to monitor algae growth), microbial content (e.g., bacterial *E. coli* levels), and nutrient levels (e.g., total phosphorus, total nitrogen). MDDELCC's *Réseau de surveillance volontaire des lacs* (voluntary lake monitoring network) focuses on understanding trophic levels of a large number of lakes in order to track their evolution over time. This network helps to determine and track lakes that are showing signs of eutrophication and degradation. Parameters for assessment include physical-chemical conditions, nutrients, detection of invasive aquatic plants, characterization of riparian buffers, and tracking blue-green algae blooms (MDDELCC, 2018e).

The purpose of MDDELCC's *Suivi de la santé du benthos* (monitoring of benthic community health), is to assess the health status of shallow habitats and streams (MDDELCC, 2018g). Parameters for monitoring include identification of benthic invertebrates, state of their habitat, as well as water quality parameters, such as physical-chemical conditions, microbial content, and the presence of toxic substances. MDDELCC indicated that this type of monitoring is important for the assessment of the integrity of the aquatic ecosystem, to monitor the evolution of biodiversity over time, to evaluate and verify effects of known sources of pollution on the health of the ecosystem, and to evaluate the effects of aquatic restoration activities (MDDELCC, 2018g).

MDDELCC also monitors groundwater levels and quality (MDDELCC, 2018d), the presence of pesticides in surface and groundwater (MDDELCC, 2018l, 2018m), the presence of cyanobacteria in lakes (MDDELCC, 2018j; Public and Stakeholder consultations, 2018), and the state of fish communities (MDDELCC, 2018k; Public and Stakeholder consultations, 2018). These programs collect information on parameters such as physical-chemical conditions of the environment under assessment, as well as nutrient levels, and microbial content.

MDDELCC is the main operator of the water quantity monitoring network in Québec. It conducts flood monitoring in collaboration with municipal authorities and observers in the field (Sécurité Publique, 2016). Hydrometric data that is collected and analyzed by the MDDELCC is used to manage dams operated by the MDDELCC or by other owners, and to monitor rivers during floods and periods of low water (MDDELCC, 2015b). For a summary of the monitoring and data collection programs described in this section see Figure 4.2-6.

FIGURE 4.2-6. Summary of key Government of Québec monitoring and data collection programs.

4.2.5 MUNICIPAL GOVERNMENTS

There is a wide range of monitoring mandates across municipalities of Ontario and Québec. Figure 4.2-7 presents some of the key parameters that are monitored by municipalities in the Ottawa River watershed. As outlined in section 1.3, municipalities operate and manage water supply and sewage services, as well as provide some watershed protection. This role includes the responsibility for the monitoring and reporting of municipal wastewater and stormwater data to the provinces, as well as monitoring the water quality of local beaches. Municipalities in Québec are also responsible for sharing groundwater samples in order to examine potential impacts to this resource. The impacts of residential development on the environment, and

residential/industrial pressures to water use, are also tracked in some municipalities (Public and Stakeholder consultations, 2018). In many cases, partnerships are established between the municipalities and OBVs/CAs in order to collect various data to help characterize water quality and quantity in the region. This data is often used in municipal development plans (Public and Stakeholder consultations, 2018).

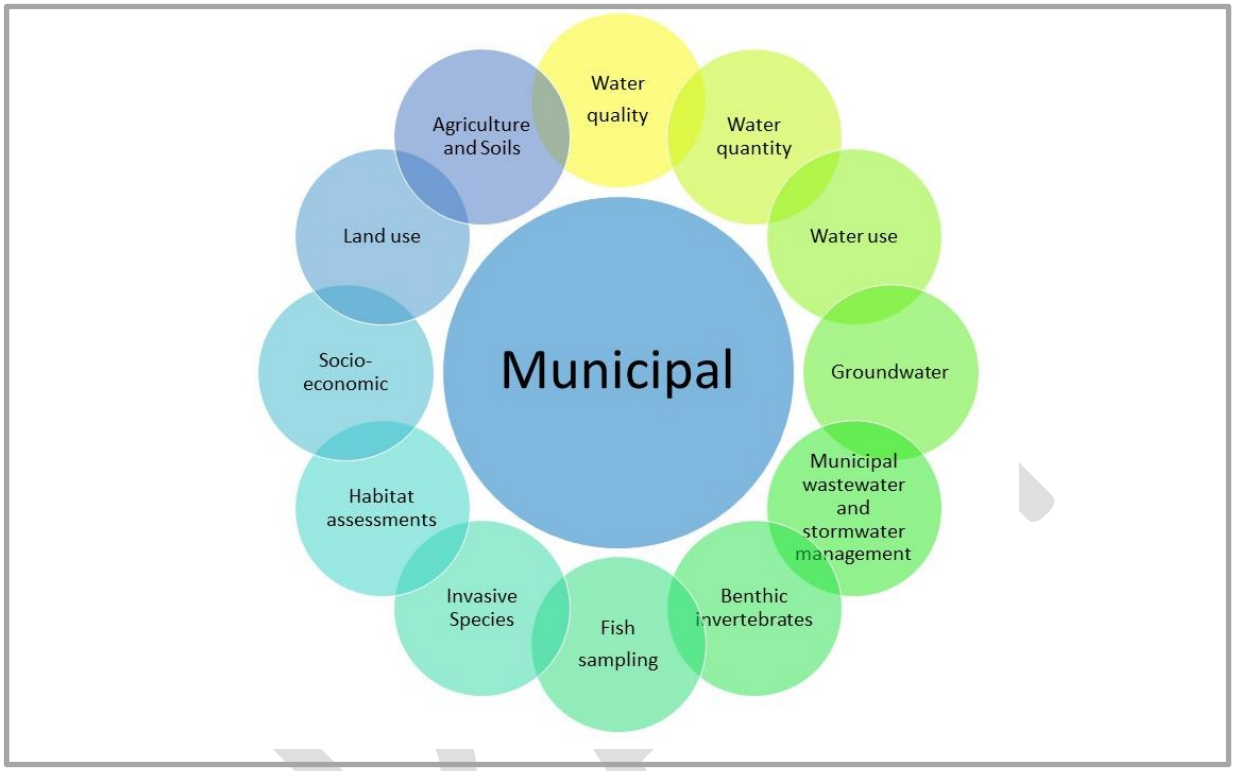


FIGURE 4.2-7. Summary of key parameters monitored / collected by municipalities.

There are many different monitoring and data collection programs undertaken by the hundreds of municipalities throughout the Ottawa River watershed. The following is an example of one program that has been implemented in the National Capital Region. The City of Ottawa collects a variety of information including demographic data and projections; employment; land use; agriculture and soils data; water quality data in the main stem of the Ottawa River and tributaries; drinking water quality; flood risks; sewage discharges; and water quantity data. It is also responsible for the City Stream Watch Reports, which is a volunteer program involving partnerships with 10 different agencies (including CAs) to monitor streams within the city. The purpose of the program is to obtain, record, and manage the information of the physical and biological characteristics of city creeks and streams, while also ensuring that the natural features are valued (MVCA, 2018a; RVCA, 2018). Parameters for assessment examined through these reports include:

- Stream and habitat assessments;
- Benthic invertebrate identification;
- Fish sampling;
- Stream temperatures;

- Identification and removal of invasive species;
- Stream rehabilitation and shoreline restoration projects; and
- Stream garbage clean-up.

4.2.6 LOCAL WATERSHED MANAGEMENT AGENCIES

CAs and OBVs that work within the Ottawa River watershed play a vital role in the conservation, restoration and responsible management of water, land and natural habitats. Figure 4.2-8 summarizes the key parameters monitored and collected in the Ottawa River watershed by these local watershed management agencies. These parameters include the monitoring of surface and groundwater quality and quantity, toxic substances, and the status of species and habitats.

FIGURE 4.2-8. Summary of key parameters monitored/ collected by watershed management agencies.

CONSERVATION AUTHORITIES

An important role that CAs play in the Ottawa River watershed is in the collection and monitoring of the health of the sub-watersheds. CAs partner with “municipal, provincial and federal governments, as well as landowners and other groups, to deliver community-based, practical solutions to a range of natural resource challenges” (Conservation Ontario, 2018a). Such partnerships include their participation in the Provincial Water Quality Monitoring Network, Provincial Groundwater Monitoring Network, Hydrometric Network and others initiatives in the province of Ontario. They are also responsible for the CA Watershed Report Cards that provide an analysis of watershed health for their area of jurisdiction (these reports are discussed further in section 4.3).

As was mentioned in section 1.3, there are five CAs in the Ottawa River watershed: Mississippi Valley (MVCA), North Bay-Mattawa (NBMCA), Raisin Region (RRCA), Rideau Valley (RVCA), and South Nation (SNCA). The following illustrates the wide range of ongoing monitoring and data collection being done by CAs. MVCA monitors a number of environmental indicators for surface and groundwater, aquatic species, and benthic invertebrates (Public and Stakeholder consultations, 2018). It also maintains geo-spatial datasets that allow trends to be tracked and assessed over time. NBMCA participates in the collection of meteorological data (e.g., rainfall and snow accumulation), surface and groundwater quality and quantity, and aquatic species (including benthic invertebrates). NBMCA has indicated that the majority of this monitoring is done in partnership with federal and provincial governments (Public and Stakeholder consultations, 2018).

RRCA participates in precipitation, streamflow and water level monitoring. It also assists partner municipalities and MNRF with Flood Forecasting and Warning, and Low Water Response (RRCA, n.d.). RVCA collects data on key watershed characteristics and environmental indicators relating to hydrometrics, surface and groundwater, forest and wetland cover, aquatic species and benthic invertebrates. RVCA has indicated that 56 sites are monitored as part of its baseline monitoring program to assess the contribution of nutrients, bacteria, metals and other parameters from tributary streams of the Rideau River and upper watershed lakes (Public and Stakeholder consultations, 2018). RVCA is also responsible for the Watershed Watch Program which helps identify trends in water quality of 39 major lakes in its jurisdiction. Similar to MVCA, RVCA maintains geo-spatial datasets in order to track trends and changes over time.

SNCA collects data on surface and groundwater quality and quantity, species at risk, invasive species, stream morphology, and habitat cover. This CA also collects recreational related data by monitoring daily use of parks and trails, as well as the monitoring permits for its hunting and trapping program. In addition, SNCA has completed several partner projects with Indigenous communities. These projects were focused on identifying and protecting culturally and naturally significant species that are important to Indigenous communities (Public and Stakeholder consultations, 2018).

ORGANISMES DE BASSIN VERSANT

As identified in section 1.3, one of the main goals of the OBVs is to develop and monitor the implementation of their respective water master plans. In addition, OBVs in the Ottawa River watershed support the monitoring of environmental conditions within their respective jurisdictions. The OBVs in the watershed are COBALI, COBAMIL, COBAVER-VS, ABRINORD, OBVT, OBV RPNS, ABV 7. This incorporates collecting surface water quality data in partnership with MDDELCC's *Réseau-Rivières* surface water quality program and volunteer lake monitoring program (Public and Stakeholder consultations, 2018). The programs discussed below are examples of different types of monitoring and data collection being conducted by OBVs in the watershed.

COBALI has participated in the characterization of its sub-watershed, including through the monitoring of surface water quality of tributaries and lakes (COBALI, n.d.). COBAMIL likewise collects surface water quality samples, the parameters of which include physical-chemical conditions (e.g., temperature, pH, conductivity, etc.), nutrient levels, microbial content (e.g., bacterial *E. coli* levels), and chlorophyll a (i.e., used to monitor algae growth) (COBAMIL, n.d.). It also conducts inventories of invasive aquatic plants. COBAVER-VS indicated that it is

responsible for the coordination of a monitoring program for invasive Asian Carp, characterizing fish habitat, conducting fish inventories, and identifying riparian buffers (Public and Stakeholder consultations, 2018).

ABRINORD's program for monitoring water quality examines parameters, such as benthic invertebrates, microbial content, suspended matter, nutrients, and conductivity of the water. In addition, ABRINORD has been involved in mapping wetlands in partnership with Ducks Unlimited Canada, and mapping river courses in collaboration with MRC d'Argenteuil to monitor flow dynamics (ABRINORD, n.d.). ABRINORD also supports MDDELCC's groundwater program, *Programme d'acquisition de connaissances sur les eaux souterraines* (PACES).

OBVT indicated that it undertakes a program to characterize physical-chemical conditions of waterbodies and conduct an inventory of benthic invertebrates, in collaboration with local schools (Public and Stakeholder consultations, 2018). It is also responsible for a volunteer-based well-water program, a network for monitoring invasive species, monitoring of aquatic plants, and pesticide analysis. In addition, OBVT operates a harmonized database on the quality of surface water from the region (*Géomont*) (Public and Stakeholder consultations, 2018).

OBV RPNS has also partnered with Ducks Unlimited Canada to map wetlands in its area of jurisdiction. This OBV has been involved in the characterization of tributaries, shorelines, and aquatic grass beds (OBV RPNS, 2018). Part of this characterization supports monitoring of invasive aquatic plant species. ABV 7 is similarly involved in monitoring for invasive plant species, such as myriophyllum moss grass and Eurasian water-millfoil. ABV 7 also monitors for beach erosion, and has been responsible for the characterization of some riparian buffers and lake sediments in its area of jurisdiction (ABV 7, n.d.).

4.2.7 ACADEMIC / NON-GOVERNMENTAL ORGANIZATIONS / CITIZEN SCIENCE / COMMUNITY-BASED GROUPS

Many organizations and individuals contribute to the development of knowledge about the health of the Ottawa River watershed. This is being done through a variety of methods, and by examining parameters, such as water quality, toxic substances, as well as characterizing waterbodies, monitoring wildlife, invertebrates and vegetation, and conducting habitat assessments (see Figure 4.2-9).

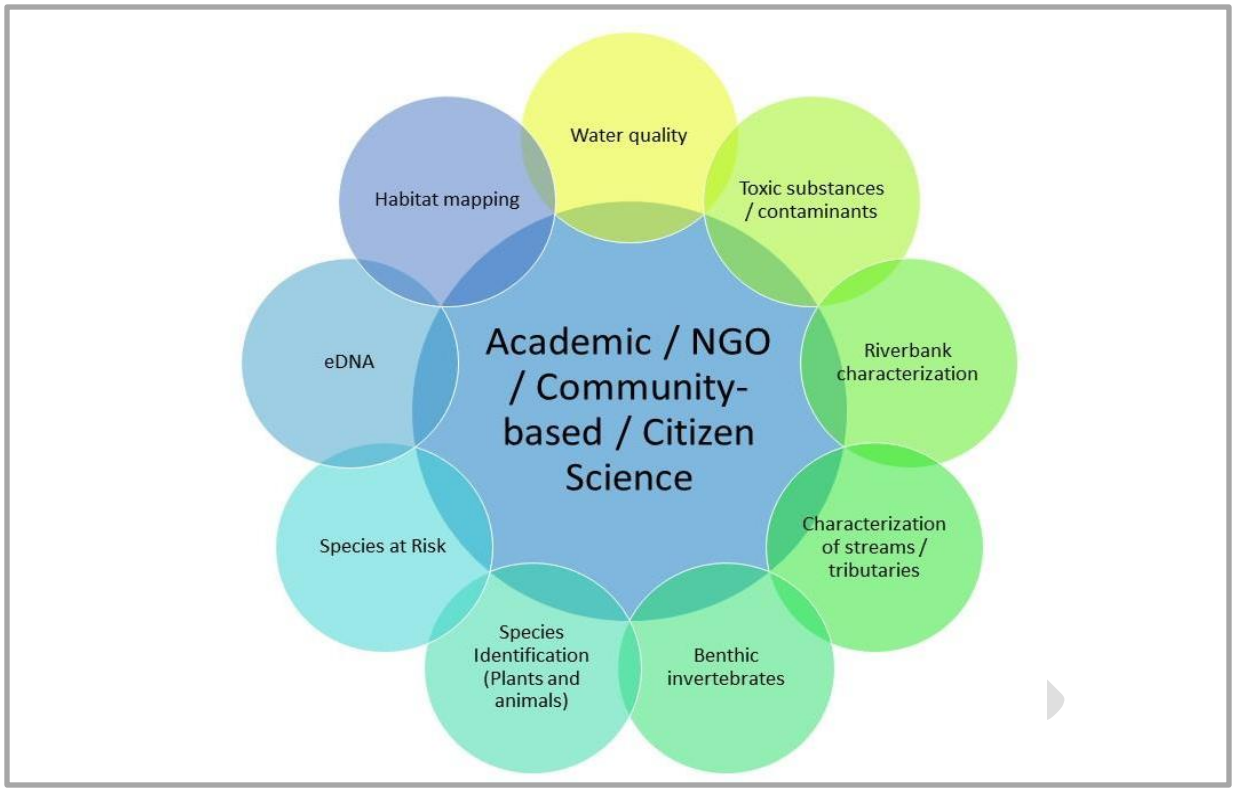


FIGURE 4.2-9. Summary of key parameters monitored /collected by Academics, NGOs, Community-based organizations, or citizen scientists.

The following examples of monitoring and data collection activities in the Ottawa River watershed were highlighted through ECCC's engagement process. These examples are also summarized in Figure 4.2-10.

"Citizen science is science that is accessible to everybody. It means that more people can participate. The purpose is not just to collect data, it's also to educate and engage the public. To me, it has to be an accessible format – you need to make sure the language and the tools are affordable, accessible, and easy to understand."
– Kat Kavanagh

CITIZEN SCIENCE

Citizen science is the active engagement of citizens in scientific activities and processes. Citizens volunteer to be contributors in research and can participate through different levels of commitment. A variety of organizations currently facilitate citizen science and research within the Ottawa River watershed (Kieslinger, Schäfer, Heigl, Dörler, Richter, A., & Bonn, 2017)

Water Rangers' website allows anyone to examine existing data, report issues, such as algae blooms, and record observations of waterbodies (Water Rangers, 2018b). Water Rangers has collected over 18,000 observations from different sources, some of which were taken within the Ottawa River watershed. Water Rangers' water quality testing kits allow individuals to conduct tests for physical-

chemical conditions, such as dissolved oxygen, water temperature, conductivity, pH, air temperature, water clarity, water depth, alkalinity and hardness. The kits also provide containers to collect samples of suspected pollutants (e.g., oil, etc.). In an interview with Ingenium Canada, Water Rangers co-founder Kat Kavanagh stated that the organization is "trying to give the average person access to water quality testing, either through viewing existing data, or by having the ability to add in their own observations and data" (Swanston, 2018).

Ottawa Riverkeeper's Riverwatch program has over 50 volunteers who, together with Ottawa Riverkeeper, work to find solutions to local issues (Ottawa Riverkeeper, 2018b). As a Riverwatcher, individuals may participate in Ottawa Riverkeeper's citizen science water quality testing program. Parameters for monitoring include the detection of invasive species, species at risk, water colour, algae blooms and shoreline issues. According to Ottawa Riverkeeper's website, observations recently made by Riverwatchers led to the identification of two toxic blue-green algae blooms in the Ottawa River watershed (Ottawa Riverkeeper, 2018b). Ottawa Riverkeeper also announced in August 2018 that they are developing a Citizen Science Hub (Ottawa Riverkeeper, 2018a). As part of this Hub, volunteers can learn about the health of the river, as well as use water quality testing kits, which will be purchased by Ottawa Riverkeeper, to test water quality throughout the watershed.

iNaturalist is another example of a citizen science program. A joint venture with the California Academy of Sciences and the National Geographic Society, this program is a global "crowdsourced" species identification system and online occurrence recording tool (iNaturalist Canada, n.d.-a). With over 500,000 observations recorded in Canada, this application and website helps individuals identify plants and animals and share their observations broadly. This program has been used by students of St. Laurent Academy in Ottawa as part of their biology class (Public and Stakeholder consultations, 2018). Ontario Parks has also partnered with this organization, asking citizens to help identify species at risk in Ontario's provincial parks (iNaturalist Canada, n.d.-b).

An example of an individual citizen scientist conducting ongoing monitoring in the watershed is in Lac St. Francois Xavier. An individual indicated through ECCC's public and stakeholder engagement processes that they have been collecting water quality data for Lac St. Francois Xavier since 1970 (PlaceSpeak consultations, 2018). The reasoning for conducting these assessments is that they hope to increase community knowledge of the lake's environment and evolution, and to bring together the community to take action. They have been taking water samples for parameters such as microbial conditions, nutrients levels, and other physical-chemical conditions, such as temperature and pH.

> "Citizen science is the best way to engage people and increase their awareness on the quality of the Ottawa River and its watershed." – PlaceSpeak consultations, 2018

COMMUNITY-BASED MONITORING

In 2015, after the release of its *Watershed Reports*, WWF-Canada launched a National Community-based Freshwater Monitoring Program. Three sites were sampled in the Ottawa River watershed, in collaboration with ECCC. This program uses environmental DNA (eDNA) technology to compare genetic content collected via water samples in order to identify benthic

invertebrates (WWF-Canada, 2017b). The genetic samples are compared to an existing global DNA barcode library. According to WWF-Canada, this technique is “easier, faster and more accurate than traditional manual analysis of benthic invertebrates, ensuring data gaps can be filled comparatively quickly and conclusions made about watershed health in a more timely and cost-effective manner” (WWF-Canada 2017b).

Identified through ECCC’s PlaceSpeak engagement, the Bonnechere River Watershed Project is a community-based volunteer organization that has been surveying the health of the Bonnechere River and its watershed since 1999 (PlaceSpeak consultations, 2018). Parameters that this organization has been monitoring over the years include benthic invertebrates, physical-chemical conditions of rivers, lakes and streams, nutrients in water bodies, and the effects of lake stratification on lake ecosystems (PlaceSpeak consultations, 2018).

Friends of the Gatineau River and H20 Chelsea are also examples of organizations involved in community-based monitoring. Friends of the Gatineau River’s water quality monitoring program is supported by municipalities in the region (La Pêche, Cantley and Chelsea), as well as clubs and associations that use the river for recreational purposes (Friends of the Gatineau River, 2018). Water quality testing of the microbial content of the river takes place once a month during the summer months. Started in 2003, H2O Chelsea is a volunteer program in the municipality of Chelsea whose purpose is to acquire knowledge of the water resources in the region (Municipality of Chelsea, 2012). This program uses volunteers, with local university support, to sample surface and groundwater quality. Parameters tested include physical-chemical conditions, microbial content, and presence of metals.

ACADEMIC AND OTHER ORGANIZATION STUDIES

Fédération des lacs de Val-des-Monts is an organization that was created with the mission to protect and improve water quality in the Val-des-Monts region (Fédération des lacs de Val-des-Monts, 2015). The Federation has put forward the Val-des-Monts Integrated Watershed Management Project to study all the accessible and inhabited lakes of the Rivière Blanche watershed, through the collection of lake inventories. Parameters used in these inventories include the monitoring of physical-chemical conditions, riverbank characterizations, identification of species (including species at risk), indicators of beaver presence, and the characterization of tributaries, outfalls and major culverts. It is the intention of the Federation to use this information to help create a Water Master Plan (Fédération des lacs de Val-des-Monts, 2015).

The Kipawa Lake Preservation Society is a group of residents located in the area surrounding Kipawa Lake. Their goal is to lobby for the protection of the region from threats to ecosystems and nearby communities (Kipawa Lake Preservation Society, n.d.). This organization has been conducting surface water quality testing of the Kipawa watershed (PlaceSpeak consultations, 2018). Parameters monitored include metals and other pollutants, physical-chemical conditions, microbial content, and nutrients.

Daniel Spitzer with A-MAPS Environmental Inc., Jesse Vermaire from Carleton University, and Michael Yee from RVCA conducted an aquatic environmental mapping project, in which the team developed and tested software mapping modules to help with water quality and vegetation mapping in Ontario lakes (PlaceSpeak consultations, 2018). They found that processed satellite images can be useful for:

- Estimating macrophyte biomass;
- Monitoring growth of aquatic vegetation;

- Mapping algae and suspended particulates;
- Surface temperature mapping;
- Monitoring snow and ice patterns; and
- Monitoring lake thawing processes

FIGURE 4.2 10. Summary of key Academic, NGO, Community-based, and Citizen Science activities.

4.2.8 INDUSTRY

There are several industries that operate in the Ottawa River watershed, including nuclear, forestry products, and hydroelectricity (see section 3.2). Each industry that participated in ECCC's engagement process indicated that they, in one form or another, contribute to the data collection and monitoring of the waterbodies in the Ottawa River watershed system. Figure 4.2-11 describes some of the key parameters/data that is collected by industry. As indicated above, through the NPRI, industries in the watershed are legislated to provide the federal government with an inventory of pollutant releases (to air, water and land), disposals, and transfers for recycling. This includes taking samples of surface and groundwater to test water quality using physical-chemical parameters, such as pH, temperature, conductivity, and toxic substances (Public and Stakeholder consultations, 2018). Some industries, such as hydroelectricity, also have biodiversity programs for tracking the status of species. Benthic invertebrates and species at risk are often the focus of biodiversity programs conducted by industry (Public and Stakeholder consultations, 2018). Water quantity monitoring (water levels and flows) is also a primary responsibility of hydroelectric companies, such as Ontario Power Generation and Hydro-Québec.

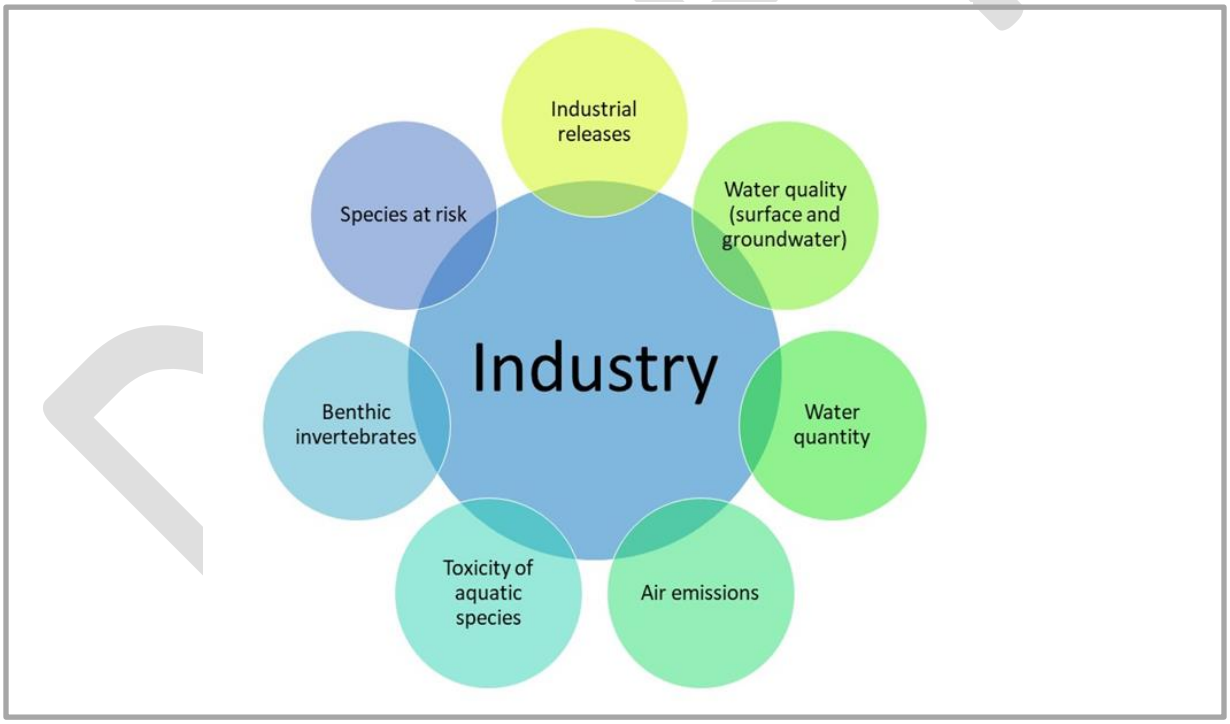


FIGURE 4.2-10. Summary of key parameters monitored / collected by Industry.

4.3. EXISTING ASSESSMENTS OF THE HEALTH OF THE WATERSHED

This section will provide a brief overview of some prevalent health assessments that have been conducted about the Ottawa River watershed, including an examination of the indicator themes assessed through this Study. This section will also discuss any trends or issues identified, as well as highlight some data gaps and opportunities presented through those assessments.

4.3.1 OVERVIEW OF EXISTING ASSESSMENTS ABOUT THE OTTAWA RIVER WATERSHED

GOVERNMENT OF QUÉBEC – "SUMMARY PROFILE OF THE OTTAWA RIVER WATERSHED"

In 2015, the government of Québec prepared a summary of the information available on the Ottawa River watershed, with a focus on the Québec portion of the watershed, which, as previously mentioned, represents approximately two thirds of the whole watershed. Conducted by the MDDELCC, the profile describes watershed characteristics, including some of the physical, economic and social elements of the watershed. The profile was developed from existing data, some of which came from the province's monitoring programs discussed in section 4.2, as well as from other data collection programs led by organizations such as the OBVs. Some of the key health indicator themes identified in the summary include water quality, groundwater, biodiversity, and protected areas. The summary also includes information regarding industries operating in the watershed and their interactions with the environment. (MDDELCC, 2015a)

CITY OF OTTAWA – "CHARACTERIZATION OF OTTAWA'S WATERSHEDS: AN ENVIRONMENTAL FOUNDATION DOCUMENT WITH SUPPORTING INFORMATION BASE"

This report focuses on the characterization of Ottawa's watersheds (City of Ottawa, 2011), and aims to provide information on the health of the City of Ottawa's watercourses to the residents and visitors of the Ottawa area. The report also features information to guide planning approaches undertaken by the City to protect local rivers and streams. The report includes a compilation of existing information on, and provides a characterization of, the City's watershed and sub-watersheds, as well as identifies data sources and gaps. Indicator themes analyzed in the report include topography, climate, hydrology, water quality, groundwater, land use, and biodiversity.

ONTARIO CONSERVATION AUTHORITY WATERSHED REPORT CARDS

As indicated in section 4.2, CAs deliver a variety of watershed management programs and services, including the monitoring of watershed conditions. In 2013, CAs began

developing Watershed Report Cards, as a means of standardizing the examination of local environmental issues, tracking changes over time, and identifying priority action areas (Conservation Ontario, 2018c). Report cards are released every five years; they monitor for surface water quality, forest conditions, and wetland cover. Groundwater is also included in a few of the report cards. The 2018 report cards have been released for the MVCA (2018b), the NBMCA (2018), and the SNCA (2018), which operate within the Ottawa River watershed. The RVCA watershed report cards have been evaluated at the subwatershed level, with one of the subwatershed reports released annually since 2012 (includes Jock River Subwatershed Report, 2016; Kemptville Creek Subwatershed Report, 2013; Lower Rideau Subwatershed Report, 2012; Middle Rideau Subwatershed Report, 2015; Rideau Lakes Subwatershed Report, 2014; Tay River Subwatershed Report, 2017). RRCA last evaluated by waterbody region in 2017 (RRCA, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i).

ORGANISMES DE BASSIN VERSANT WATER MASTER PLANS

As was indicated in section 1.3 on roles and responsibilities, in the Ottawa River watershed, each OBV is required to develop a Water Master Plan. These documents are a planning and decision-making tool for water management, in order to promote best practices and identify local objectives and targets for the ecosystem and watershed communities (COBAVER-VS, 2018). Four overarching sections are developed for each plan:

- Profile – Biophysical, environmental and territorial characteristics are identified for the OBV's area of jurisdiction;
- Diagnostic –the OBV establishes links between observed problems and their potential causes;
- Issues and trends – An issues assessment is developed that builds off of the diagnostic; and
- Action Plan – Priority areas and actions are identified to be implemented.

While each OBV plan contains the same sections, the content within the plans, as well as indicators used, vary between OBVs. Examples of indicator themes that may be included in the diagnostic documents include: water quality, biodiversity/ecosystems, hydrology, groundwater, land use and industry impacts, and topography.

The Water Master Plan diagnostic, and issues and trends sections from all OBVs within the Ottawa River watershed are examined in section 4.3.2 (i.e., ABV 7, 2014; Abrinord, 2015; COBALI, 2013; COBAMIL, 2011; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013).

OTTAWA RIVERKEEPER 2006 RIVER REPORT

Published in 2006, Ottawa Riverkeeper's River Report was developed to inform broad audiences about the physical and biological conditions of the Ottawa River watershed (Ottawa Riverkeeper, 2006). This report provides an overview of watershed characteristics, including ecological values. The report was intended to be the first of a

series of river reports in order to identify trends, as well as changes in impacts and pressures to the ecological integrity of the Ottawa River watershed. Though published in 2006, the information contributes to the understanding of the state of the watershed. Themes identified and explored in the report include hydrology, climate change, water quality, and biodiversity.

OTTAWA RIVERKEEPER WATERSHED HEALTH COMMITTEE PROCESS

In 2017, Ottawa Riverkeeper established the Watershed Health Committee, an advisory body made up of approximately 20 volunteer experts. The committee is intended to design and lead a health assessment of the Ottawa River watershed (Ottawa Riverkeeper, 2018c). The committee is working to examine available data, potential watershed health indicators, as well as monitoring protocols in effect across the watershed. Ottawa Riverkeeper has indicated that the results of this exercise will be presented online in the form of a report card, in order to strengthen data sharing networks, as well as inform both the public and decision-makers. The most recent Watershed Health Committee workshop was held in March 2018 to discuss a framework for conducting the health assessment, existing data, integration of traditional knowledge, and potential indicators. Indicator themes to be explored further include ecosystems (e.g., water quality, forest cover,), human/ecosystem interactions (e.g., invasive species, land use), governance, science-policy interface (e.g., monitoring, data/information management, reporting), and traditional knowledge.

ECCC is providing financial support, along with others, to the Ottawa Riverkeeper for the development of a suite of indicators for the Ottawa River watershed. The Ottawa Riverkeeper will employ an interdisciplinary, interprovincial and expert advisory Ottawa River Watershed Health Committee to help build consensus on a common set of watershed health indicators. The committee will engage representatives from governments, Indigenous peoples, watershed agencies, environmental groups, academia, and industry in this task. Indigenous knowledge research and meetings with Indigenous communities will also be undertaken to incorporate Indigenous knowledge into the indicator development process. A final report is anticipated in March 2019, which will include an analysis of the recommended indicators, such as data availability, compatibility and credibility, as well as the effectiveness and relevance of the indicators to assess the health of the Ottawa River watershed.

WORLD WILDLIFE FUND CANADA WATERSHED REPORT

In 2013, WWF-Canada began a health and threats assessment of Canadian rivers, working to gather existing data in collaboration with community organizations, water agencies, Indigenous peoples, researchers, governments and industries (WWF-Canada, 2017a). The purpose of this assessment was to “help identify priority actions to ensure all waters in Canada are in good ecological condition by 2025” (WWF-Canada, 2017a, p. 4). WWF-Canada identified and assessed 25 major watersheds in Canada. Results for the Ottawa River watershed were released in 2015 (WWF-Canada, 2015). Four metrics were chosen for the health assessment framework (hydrology, water quality, benthic macro-invertebrates, and fish) to represent key elements of the aquatic ecosystems.

These metrics are also commonly monitored in most Canadian jurisdictions (WWF-Canada, 2017a). Indicators were also developed for each metric.

4.3.2 OVERVIEW OF TRENDS, ISSUES, AND GAPS IDENTIFIED IN THE HEALTH ASSESSMENTS

It should be noted that the methods used for the health assessments discussed in the previous section are not standardized, and vary across the different studies. Therefore, the purpose of this section is to provide some high-level comparisons and identification of common themes among the different studies.

SURFACE WATER QUALITY AND HYDROLOGY

Findings from the assessments discussed in the previous section indicate that there is a range in surface water quality across the Ottawa River watershed, varying from poor to excellent. There are several concerns related to the protection of water quality in the Ottawa River watershed, which can lead to the deterioration of water quality, and indirectly impact ecosystem health overall. Some of these issues include the following:

- **PHYSICAL-CHEMICAL CONDITIONS**
  (e.g., temperature, dissolved oxygen, pH, alkalinity) (ABV 7, 2014; City of Ottawa, 2011; MDDELCC, 2015a; Ottawa Riverkeeper, 2006)
  - Some cases of low alkalinity were attributed to the geology of the area (noncarbonate bedrock or soils). Alkalinity is the buffering capacity of water; low alkalinity suggests that water is more susceptible to changes in pH.
- **ELEVATED NUTRIENTS (PHOSPHORUS), CYANOBACTERIA, AND RELATED EUTROPHICATION**
  (Abrinord, 2015; ABV 7, 2014; City of Ottawa, 2011; COBALI, 2013; COBAMIL, 2011; OBVT, 2013; Cyr, 2016; Ottawa Riverkeeper, 2006; MDDELCC, 2015a; RRCA, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i; RVCA, 2012; RVCA, 2013; RVCA, 2016; SNCA, 2018)
  - Found to be prevalent in areas with higher agricultural land use, and areas where there are more untreated municipal wastewater releases
- **HIGHER BACTERIAL COUNTS**
  (*E. coli*) (Abrinord, 2015; ABV 7, 2014; Cyr, 2016; City of Ottawa, 2011; OBV RPNS, 2014; RRCA, 2017a, 2017b, 2017c, 2017d, 2017g, 2017h, 2017i)
  - Found to be prevalent in higher agricultural areas, and areas where there are more untreated municipal wastewater releases
- **PRESENCE OF HEAVY METALS AND TOXIC SUBSTANCES**
  (e.g., pesticides) (Abrinord, 2015; City of Ottawa, 2011; COBAMIL, 2011; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013; Ottawa Riverkeeper, 2006; WWF-Canada, 2015)
  - Linked to industrial and agricultural activities

- **TURBIDITY AND AN INCREASE OF SUSPENDED MATTER**
  (Abrinord, 2015; ABV 7, 2014; COBAMIL, 2011; Cyr, 2016; OBV RPNS, 2014; SNCA, 2018)
    - Increased turbidity, greater sedimentation, and suspended matter linked to areas of lower forest cover, increased urbanization, and high levels of industrial activity

The City of Ottawa (2011), COBAMIL (2011), MDDELCC (2015a), RVCA (2013), and WWF-Canada (2015) all indicated in their assessments an increasing trend of water quality deterioration, though the time period of assessment varied by study.

A number of the studies examined also raised a number of issues regarding the hydrology of the watershed (i.e., water quantity and water dynamics). The majority of concerns raised were related to flooding in the region (COBALI, 2013; COBAMIL, 2011; Cyr, 2016; OBV RPNS, 2014). Potential causes identified for flooding exacerbation in the watershed include an increase in extreme precipitation events, land use changes, and an increase in beaver activity. On the other hand, large dams and reservoirs alter the natural flow regime, flooding cycles and magnitude of floods (WWF-Canada, 2015). The ORRPB estimated that flows during the flooding peak in 2017 were reduced downstream of the major reservoirs (e.g. by approximately 20% at the Carillon dam)(ORRPB, Feb 15, 2018 post on ORRPB website).

A couple of studies (Abrinord, 2015; WWF-Canada, 2015), also noted the impacts to biodiversity and ecosystems due to water-level fluctuations in the watershed. Future water use, and the effects on water levels in the watershed, were also cited as potential sources of future conflict (e.g., potential for overconsumption of clean drinking water) (COBALI, 2013; COBAMIL, 2011; ABV 7, 2014; OBV RPNS, 2014; Abrinord, 2015).

Knowledge gaps and opportunities identified in some of the reports included:

- Data insufficiency related to water quality, usage, and sources of pollution
- Identification of potential climate change impacts on water resources
- Improve knowledge concerning how the river system operates
- Improve data information sharing
- Work in partnerships to protect water sources

GROUNDWATER

According to MDDELCC (2018p), groundwater is the most economically accessible water supply source in Québec, due to its abundance, quality and proximity to consumers. From the studies that considered groundwater in their assessment, groundwater quality is generally considered to be good in both Ontario and Québec (ABV 7, 2014; NBMCA, 2018; SNCA, 2018). However, many assessments did not include groundwater, making it difficult to conclusively assess the overall quality. One of the main concerns that was raised in relation to groundwater, is the potential for natural

or anthropogenic (i.e., human caused) activities to contribute to the deterioration of groundwater quality (e.g., from mining) (ABV 7, 2014; Cyr, 2016; OBVT, 2013).

Knowledge gaps and opportunities identified in the reports included:

- Data gaps on groundwater quality (e.g., limited information for private wells)
- Identification of potential climate change impacts on water resources
- Improve ways to disseminate information

BIODIVERSITY / ECOSYSTEMS

Wetland cover and forest cover are the most common biodiversity indicators examined in existing health assessments. The forest and wetland cover indicator targets used in the majority of assessments were 30% and 10% coverage respectively. Wetland cover ranged across the watershed, but for the majority of assessments, the coverage exceeded the 10% target. Forest cover also varied across the watershed; however, forest cover often fell below the 30% target. In terms of identifiable trends, a number of assessments have observed declines in forest cover in their assessment areas, with greater losses of forest cover occurring in urban areas (NBMCA, 2018; RVCA, 2012; RVCA, 2013; RVCA, 2015; RVCA, 2016). In one study (SNCA, 2018), forest cover was also linked to trends in water quality. SNCA (2018) observed that “good” forest cover, especially in riparian areas, led to “good” stream health (and vice versa).

A number of the examined studies also identified several issues in relation to biodiversity and ecosystems:

- **LOSS OR DEGRADATION OF HABITAT**
  (e.g., terrestrial, wetland, riparian, spawning grounds) (Abrinord, 2015; ABV 7, 2014; COBALI, 2013; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013; Ottawa Riverkeeper, 2006; MDDELCC, 2015a; MVCA, 2018b; RRCA, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i; SNCA, 2018; WWF-Canada, 2015)
  - Industrial activities (e.g., deforestation, dams), general land use changes, and climate change were identified as potential causes for the loss or degradation of habitats in the watershed

- **DETERIORATION OR LOSS OF BIODIVERSITY**
  (e.g., species at risk, overexploitation of species) (Abrinord, 2015; ABV 7, 2014; COBALI, 2013; Cyr, 2016; MDDELCC, 2015a; OBVT, 2013; Ottawa Riverkeeper, 2006)
  - Causes identified for changes in biodiversity include changes in land use, climate change, as well as impacts from pollution (e.g., bioaccumulation/biomagnification of toxic substances)
- **RAPID INCREASE IN THE NUMBER AND DISTRIBUTION OF INVASIVE SPECIES**

(Abrinord, 2015; ABV 7, 2014; COBALI, 2013; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013; Ottawa Riverkeeper, 2006; WWF-Canada, 2015)

- Examples include the presence of Zebra Mussels, Eurasian Water-Milfoil, and the European Elm Bark Beetle

- **BARRIERS TO MOVEMENT OF VARIOUS SPECIES**
(COBALI, 2013; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013; Ottawa Riverkeeper, 2006; WWF-Canada, 2015)
    - A concern often brought up in the context of fish migration, and the challenges for fish to migrate to spawning grounds through areas with hydroelectric operations.
    - Habitat fragmentation caused by the building of roads and rail lines is also a concern for terrestrial species.

Knowledge gaps and opportunities identified in the examined reports above included:

- Need for more vegetation mapping
- Sparse baseline data on benthic invertebrates
- Examination of tools for dealing with barriers to species movement
- Support reforestation efforts
- Improve knowledge of habitat functions

LAND USE / SHORELINE INTEGRITY

Many reports did not incorporate land use and shoreline integrity as indicators for monitoring health and trends; however, those that did, provided valuable insight into the influence that the indicators have on the health of the Ottawa River watershed. SNCA (2018), for example, observed that areas with lower scores of forest cover were prone to erosion and sedimentation, while the MDDELCC (2015a), indicated that relicts of past forestry operations, including abandoned logging camps, piers and docks have contributed to increased shoreline degradation. Despite a lack of reporting across the watershed, erosion and sediment displacement in water bodies are concerns from industrial, economic and recreational activities in the watershed, which in turn can cause deterioration in water quality, aquatic habitats, and fish spawning sites (ABV 7, 2014; COBALI, 2013; COBAMIL, 2011; Cyr, 2016; OBV RPNS, 2014; OBVT, 2013; Ottawa Riverkeeper, 2006).

Knowledge gaps and opportunities identified in the examined reports above included:

- Need for improved understanding of physical structure and flow dynamics of streams
- Risk mapping of soils and slopes
- Focus on revitalizing shorelines with native trees and shrubs

- Create shoreline buffers for habitat and erosion control

4.4. VIEWS ON WATERSHED HEALTH

The engagement process associated with the ORWS sought input from various groups to help identify knowledge, data, and information that could assist in furthering the understanding of watershed health. Views were collected from numerous sources, including from Indigenous peoples, public comments on PlaceSpeak, submissions via email, and from engagement guides submitted by various interest groups. Types of watershed health information requested through the ORWS included the following:

- Issues or concerns related to the health of the Ottawa River watershed
- Types of data collection/monitoring being conducted in the watershed (addressed in section 4.2)
- Themes or specific indicators that should be considered
- Information gaps, or where information is missing/hard to find, related to the health of the watershed

Summarized in the sections below are the views expressed by stakeholders in the watershed.

4.4.1. VIEWS ON ISSUES OR CONCERNS RELATED TO THE HEALTH

Through various means of input, Indigenous groups, the public, and stakeholders expressed many concerns in relation to the health of the Ottawa River watershed (see Figure 4.4-1) (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). The most common concern was related to water quality, and more specifically, the impacts that pollution or the release of harmful substances into the water will have on watershed ecosystem health.

Other water quality concerns expressed include issues related to the physical-chemical conditions (e.g., increasing water temperatures, decreased oxygen availability in the water), cyanobacteria (i.e., blue-green algae), and the increase in algae blooms, potential climate change impacts, and sedimentation (i.e., the deposition of suspended particles in the water, which can bury critical aquatic habitats).

Threats to biodiversity were the second most common issue theme expressed. Specific issues related to biodiversity include the loss of critical habitat and the fragmentation of ecosystems. Fragmentation can severely affect migration of fish species, which in turn has cascading impacts to fish spawning. General health of species and concerns for population decline was another common issue identified (Public and Stakeholder consultations, 2018). This includes issues related to the increase in the number and distribution of invasive species, increase in the number of species at risk, impacts to

benthic invertebrates, potential impacts of climate change, and overall ecosystem degradation.

Concerning issues of land use, respondents were most concerned about industrial and economic activity impacts to the water and ecosystems of the Ottawa River watershed (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). This includes concerns about nutrient loading (i.e., increasing phosphorus levels in the water) from agricultural activities, and contaminant impacts to the river system from the Chalk River nuclear facility. Other land use concerns include the removal of natural spaces, and degradation of shorelines. Hydrological concerns identified include the potential climate change impacts on water flow and levels (e.g., extreme precipitation events), as well as the potential for loss of critical habitats, and the fragmentation of ecosystems from changes in flow regime. Though not as prevalent, a few respondents also expressed concerns about air quality in the watershed, specifically relating to GHG emissions and particulate matter (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018).

Finally, there were also a few comments expressed on PlaceSpeak regarding transparency in relation to the health of the watershed. Individuals expressed concerns that there may be duplication of efforts related to data collection and monitoring due to a lack of transparency or information sharing of watershed health activities. Others took issue with a lack of transparency or communication about the state/health of the watershed, and noted a lack of transparency or communication about pollution releases (PlaceSpeak consultations, 2018).

> "Please include means of regular, media friendly reports on the findings. When there are findings that show the river at risk, these should be made public in an active way…"
> – PlaceSpeak

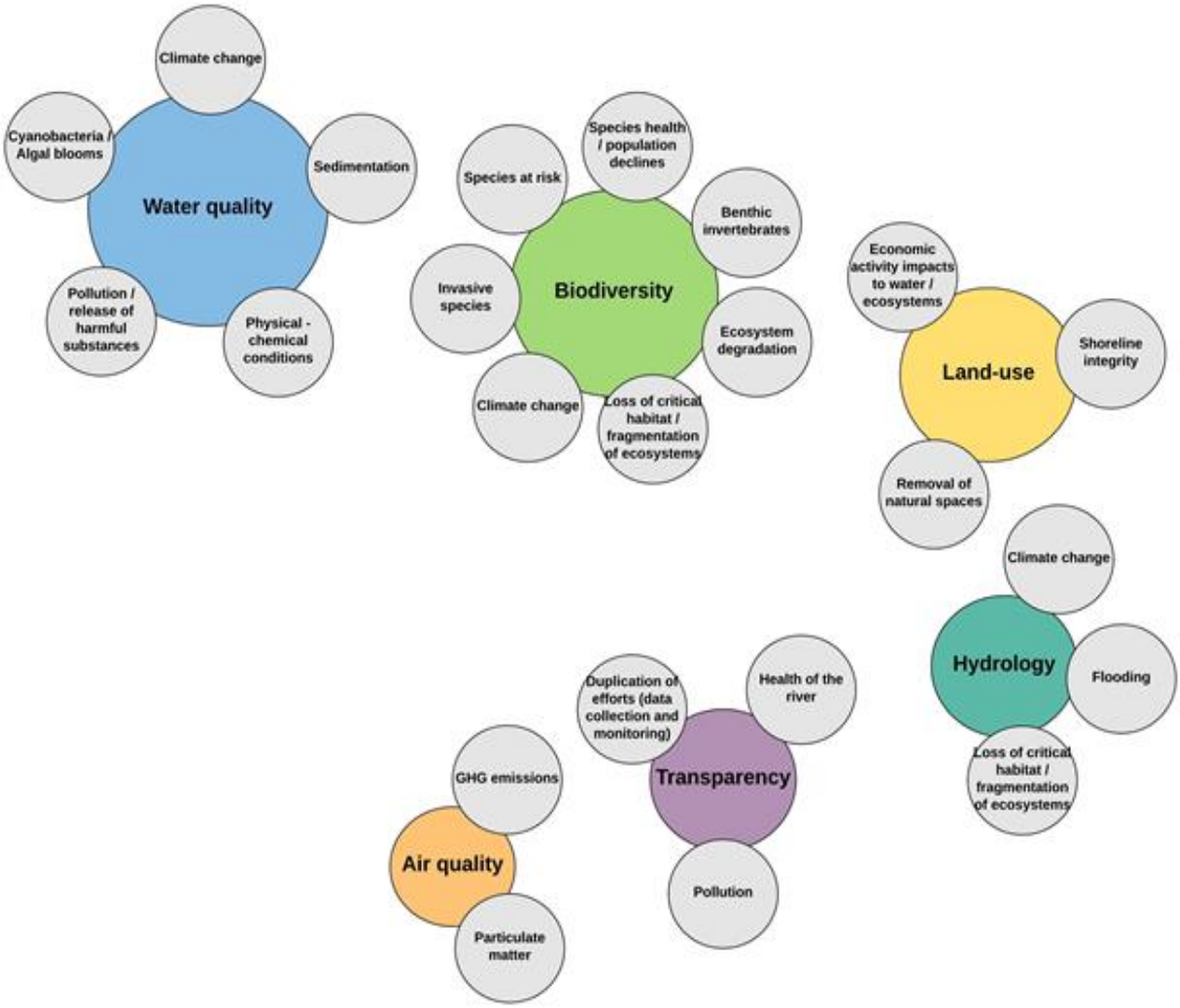


FIGURE 4.4-1. Summary of views on issues and concerns related to the health of the Ottawa River watershed.

4.4.2. VIEWS ON POTENTIAL INDICATORS FOR CONSIDERATION

This section presents potential indicators that could be considered in future work on watershed health for the Ottawa River watershed. Sources of information for potential indicators came from online and other stakeholder engagement input, existing monitoring and data collection programs, as well as from the existing health assessments examined in section 4.3. From these sources, 58 potential indicators were identified for nine different indicator themes (see Table 4.4-1). While indicators are presented in this report, more work is needed to fully evaluate the indicators suitable for an assessment of the Ottawa River watershed.

The indicator themes of water quality and biodiversity were the most frequently proposed indicators for consideration. Many of the respondents indicated the importance of examining the following specific indicators for those themes:

- **WATER QUALITY**: physical-chemical conditions, point and non-point source pollution/industrial discharges, nutrients, and microbial conditions (e.g., *E. coli*); and
- **BIODIVERSITY**: Habitat cover (forest, wetland, riparian and protected areas cover), presence of benthic invertebrates, trends in terrestrial and aquatic species (e.g., fish, moose and bird populations), and invasive species.

Land use and hydrology were other commonly expressed indicator themes by respondents. Land use indicators include shoreline cover and development, water use, urban development, soil conditions (e.g., quality, moisture), industrial and economic activities in the watershed, and stormwater and wastewater management. The hydrological indicators include water flows and fluvial dynamics (i.e., forces that act on the riverbed), water levels, depth, balance, and substrate.

While not as prominent as the themes listed above, other important indicator themes that emerged through engagement included:

- **GROUNDWATER**: water levels, physical-chemical conditions, annual consumption and location of aquifers;
- **CLIMATE**: Trends in precipitation, seasonality, snow and ice patterns, temperature, and growing degree days;
- **GEOGRAPHY**: Geology, soil conditions (e.g., quality, moisture), topography, hydrography (i.e., physical features of the lakes and rivers);
- **SOCIO-ECONOMIC**: Demographic data and projections, human and community health, tourism data and historical sites; and
- **AIR QUALITY**: pollutant emissions.

In addition to the identification of potential indicators, respondents made a number of recommendations in regards to how to develop and assess watershed health indicators. For example, several respondents specified the need for clear monitoring objectives to frame the development of indicators. Other respondents mentioned the idea of a "whole-of-watershed" approach to assessment in order to determine monitoring objectives and identify which indicators to measure (PlaceSpeak consultations, 2018).

> "To really understand the ecosystem of a lake you must cover many diverse disciplines and topics. The list that is evolving based on my work understanding my lake includes: Geology, Biology/Limnology, Chemistry, Hydrology, History, Users/Usage, Urban Planning, Development, Stakeholders/Interest groups, Etc. A lake and its watershed is a living system and is very complex with many parts that are tightly interconnected." – PlaceSpeak consultations. 2018

Respondents also identified citizen-science and community-based monitoring as effective means to monitor indicators and contribute to the development of baseline conditions.

However, several respondents also noted that monitoring and assessment of indicators requires a certain level of technical expertise. For example, in terms of biodiversity, "acquiring the taxonomic expertise would be essential" (i.e., expertise in species identification) (PlaceSpeak consultations, 2018). Other stakeholders also expressed concerns that there may be some challenges involved in identifying healthy thresholds for some indicators, such as hydrology (i.e. water quantity) (ORRPB, 2017).

TABLE 4.4-1. Summary table of potential indicators by indicator theme, derived from Indigenous groups, public and stakeholder engagement.
The number in brackets beside the indicator is the number of times it was mentioned.

INDICATOR THEME	POTENTIAL INDICATORS
WATER QUALITY	Beach closures (2)
	Blue-green algae (cyanobacteria) (6)
	Fish consumption advisories (1)
	Microbial conditions (e.g., *E. coli*) (30)
	Nutrients (36)
	Physical-chemical conditions (e.g., temp, pH, clarity) (48)
	Point and non-point source pollution/industrial discharges (19)
	Sediment quality (1)
	Toxic substances (e.g., metals, pesticides) (4)
	Visual observations (1)
BIODIVERSITY	Barriers to migration (1)
	Benthic invertebrates (17)
	Environmental DNA (1)
	Habitat cover (forest, wetland, riparian and protected area cover) (44)
	Habitat trends (7)
	Invasive species (13)
	Limnology (1)
	System productivity (1)
	Species at risk (both wildlife and plants) (6)
	Terrestrial and aquatic species trends (e.g., fish, moose, and bird populations) (19)
	Terrestrial and aquatic plant biomass (3)
	Terrestrial and aquatic species distribution (1)
HYDROLOGY	Fluvial dynamics (5)
	Substrate type (1)

	Water balance (3)
	Water depth (1)
	Water flow (17)
	Water levels (17)
LAND USE	Agriculture activities (7)
	Industry operations in the watershed (4)
	Land cover (9)
	Recreational/transportation use (5)
	Shoreline cover (7)
	Shoreline development (5)
	Stormwater and wastewater management (5)
	Urban development (3)
	Water use (6)
GROUNDWATER	Annual consumption (1)
	Location of aquifers (2)
	Water levels (2)
	Groundwater recharge (2)
	Physical-chemical conditions and toxic substances (e.g., temp, pH, metals) (10)
CLIMATE	Growing degree days (i.e., heat index that can be used to predict when a crop will reach maturity) (1)
	Precipitation trends (6)
	Seasonality trends (1)
	Snow and ice patterns (2)
	Temperature trends (5)
GEOGRAPHY	Ecological region (1)
	Geology (4)
	Hydrography (1)
	Shoreline stability (3)
	Soil conditions (e.g., quality, moisture) (7)
	Topography (2)
SOCIO-ECONOMIC	Demographic data and projections (4)
	Heritage sites (1)
	Human/community health (2)
	Tourism information (2)
AIR QUALITY	Pollutant emissions (3)

4.4.3. VIEWS ON KNOWLEDGE AND INFORMATION GAPS

Beyond seeking input on watershed indicators, views were sought on potential gaps in watershed knowledge. Gaps identified through the broad public engagement process included insufficient data to track trends in biodiversity, including invasive species, and a lack of understanding on the overall state of groundwater. Respondents also expressed concerns that many known and emerging contaminants are still poorly understood, including their potential impacts to an ecosystem and its elements (e.g., impacts of pesticides). Others expressed the need for increased mapping efforts for wetlands, land development, soil erosion, and for enhanced shoreline characterization. Our analysis suggests that monitoring for water quality and quantity produces the most data of any indicator (as seen in section 4.3); however, several respondents indicated that data is missing or insufficient in this field (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018).

> "As a Nation, little is known about the cumulative impact human activities have had or currently have on the river. It is recommended that Environment Canada conduct an in-depth analysis of the status of the water, the quantity of pollutants that the waterway is composed of, and the extent pollutants/human activities (e.g. operations of dams, municipal/industrial wastewater systems) have had an environmental impact on the water to provide a clear picture of the issue at hand." - Algonquin Anishinabeg Nation Tribal Council. 2018

> "The study must pay particular attention to sustainability and cumulative effects pertaining to Indigenous nations and activities." - Mohawk Council of Kahnawá:ke, 2018

It is important to note that a lack of knowledge surrounding cumulative effects within the Ottawa River watershed was of particular concern to Indigenous groups, such as the Algonquin Anishinabeg Nation, and the Mohawk Council of Kahnawá:ke (Algonquin Anishinabeg Nation Tribal Council, 2018; Mohawk Council of Kahnawá:ke, 2018).

Below are several statements made by Indigenous groups highlighting the importance of both recognizing cumulative effects and incorporating Indigenous knowledge.

In addition, Indigenous groups expressed the need for the incorporation of traditional knowledge in watershed health assessments (i.e., the balance of traditional knowledge and science), in order to support the development of baseline data.

"Management plans must include Indigenous knowledge. Unfortunately, Indigenous knowledge has been dismissed in the past in favor of more accepted scientific knowledge. The issue will also pose huge barriers for collaboration among Indigenous communities and industry/government, etc." - Mohawk Council of Kanesatake (Bisson & Mohawk Community of Kanesatake, 2018)

"The success of the initiative lies in a balanced alliance of both traditional knowledge and scientific knowledge" - Algonquin Anishinabeg Nation Tribal Council, 2018

"Carry out an Indigenous Knowledge Study of the Ottawa River to document Algonquin knowledge of the watershed" - Algonquins of Ontario (Richardson, 2018)

"The [Regional Impact Assessment] must be driven by science and Indigenous knowledge to limit the possibility for bias in the document" - Mohawk Council of Kahnawá:ke, 2018

"Stewardship and the effort of cleaning up the Ottawa River must move forward in full collaboration with Indigenous science and Indigenous knowledge."

A number of respondents indicated that one of the largest limitations to understanding the health of the watershed is an uncoordinated approach to data collection within the Ottawa River watershed. Respondents specified a lack of “whole of watershed” approach to assessments, and a lack of knowledge concerning data collection initiatives in the watershed and where the data is located (“information is scattered”) (PlaceSpeak consultations, 2018). In addition, others have indicated that a number of datasets are incomplete or out-of-date, and that there is compatibility, comparability, and sometimes even credibility issues with previously collected data.

> “Geo-spatial data sets such as land cover and other related features are important sources of information to assess watershed health. Many of these data sets have not been updated or are being updated by individual users.” – Engagement Guide (Public and Stakeholder consultations, 2018)

> “...the growing recognition of the limits of Western science in solving environmental problems of increased complexity and magnitude has resulted in in calls for the incorporation of Indigenous knowledge systems in resource management and development.” - Algonquin Nation Secretariat: (Kitchisibi Ikidowin Anishinabe, 2018)

5 ACHIEVING INTEGRATED WATERSHED MANAGEMENT

5.1. DEFINING WATERSHED MANAGEMENT

Water is complex to manage. Its dynamic nature does not coincide with institutional, social and political boundaries (Biswas, 2004). Over the last half century, Integrated Water Resources Management (IWRM) has emerged as a guiding conceptual framework to address increasingly pressing water issues. A variety of definitions have been presented to explain the concept. The most commonly used definition comes from the Global Water Partnership, as follows:

> "IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems."
>
> GWP, 2011

5.2. IMPLEMENTATION OF WATERSHED APPROACHES

There is no universal recipe for success when implementing IWRM approaches, however some success factors have been identified (Davenport, 2003; Gangbazo, 2004):

- Focus collaboration and coordination efforts at the watershed-level in order to effectively address cross-jurisdictional boundary issues, as well as impacts that result from conflicting uses;

- Promote a participatory approach and develop a strong communication plan. This will help raise awareness on important issues, as well as gain public support. Knowledge and information sharing is also important between practitioners and the public;
- Integrate science and use reliable data. This will assist in setting measurable targets and improve the understanding of the health of the watershed. Consequently, conservation priorities will be easier to identify and restoration actions will be more effective when implemented; and
- Promote collaboration that involves government(s) in order to better influence decision-making and leverage sustainable funding.

The first success factor—that naturally occurring watersheds should be used as the boundary for integrated planning—is perhaps the most frequently mentioned precursor to effective implementation of IWRM. As a result, many scholars and institutions use the terminology Integrated Watershed Management (IWM) (Wang et al. 2016, Heathcote, 1998; Qui, 2017; Ramin, 2004; Genskow & Born, 2006; Barham, 2001; CCME, 2016).

Watersheds have been referred to as logical geographical management units, given the ability to consider the causes and effects that impact water quality; the ability to link upstream and downstream issues; capacity to consider water allocation based on the full watershed; and it has also proven to be a useful boundary for educating and involving the public (Qui, 2017). Blomquist and Schlager (2005) stated that, ideally, IWM would be implemented through cooperation and coordination of existing agencies or through some form of watershed authority. Qui (2017) further expanded on this by developing four integral components to be applied to the IWM framework:

- A collaborative institutional structure: This should be established among leading organizations that participate in watershed management within a specific watershed. This could include scientists, governments, technology, and local communities. If a government agency or multiple government agencies are part of the structure, they should be familiar with all jurisdictional roles and responsibilities related to water.
- A watershed alliance: To be formed and operated with broad public participation.
- A decision support system: this involves the development of a watershed alliance, and evaluation and implementation of best management practices and watershed management plans.
- A multi-tier extension outreach education and research program: This component is based on the success of the three other components, which then contribute to the extension outreach, education and research programs.

Various IWM approaches have been adopted internationally, as collaboration at the watershed scale has gained traction; countries and regions include: Australia, New Zealand, the European Union (EU), the U.S., and basins coving multiple countries, such as those in southeast Asia and southern Africa (see section 5.4.1). Additionally, several Canadian regions, provinces and territories have incorporated this approach into

watershed management, through grassroots approaches, law and policy (see section 5.4.2). In 2016, the federal-provincial-territorial CCME released a summary report of IWM approaches in Canada, designed to "enhance the capacity of jurisdictions to apply integrated watershed management principles and to develop policies and programs consistent with the principles" (CCME, 2016). As part of the analysis, CCME developed a list of 11 Principles of IWM (see Table 4.2-1). These eleven principles were used as the primary criteria used to consider water/watershed management within the Ottawa River watershed, as well as for selecting domestic and international case studies.

TABLE 5.2-1. Principles of Integrated Watershed Management (CCME, 2016).

1	Geographical Scale: The watershed should be the planning boundary for integrated watershed management, and should be at an appropriate scale to address the issues under consideration in a way that recognises its connectedness to upstream and downstream watersheds.
2	Ecosystem Approach: An interconnected process should be considered that uses best available knowledge, considers cumulative impacts, and promotes watershed and sub-watershed approaches.
3	Adaptive Management: Flexible and continuous improvement and adaptation of approaches, policies and management should be undertaken by incorporating new knowledge and innovative design, practices and technology
4	Integrated Approach: Land, water and infrastructure planning, investment and management should consider the direct, indirect or potential impacts and their interdependencies.
5	Cumulative Impacts: IWM planning should consider cumulative effects on the environment and the interdependency of air, land, water and living organisms.
6	Precautionary Principle and No Regrets Actions: Caution should be exercised to protect the environment when there is uncertainty about environmental risks.
7	Proactive Approach: Environmental degradation should be prevented. It is better for the environment and more cost-effective to prevent degradation of the environment than to clean it up after the fact.
8	Shared Responsibility: The responsibility for policy and program development and implementation should be shared within the mandate of all actors at the appropriate scale.
9	Engaging Communities and Aboriginal Peoples: IWM processes should recognize and duly support the identity, culture and interests of local communities and Aboriginal peoples. IWM processes should enable meaningful participation by local communities and Aboriginal peoples who have a vital role in IWM because of their knowledge and traditional practices.
10	Sustainable Development: The right to development should be fulfilled to equitably meet economic and societal needs while not compromising the environment for present and future generations.
11	Natural Capital: Natural capital should be protected and managed to reduce short- and long-term negative financial impacts. Natural systems provide goods and services of environmental, economic, social, cultural and spiritual value.

5.3. BENEFITS AND CHALLENGES OF INTEGRATED WATERSHED MANAGEMENT

The implementation of IWM approaches may result in numerous benefits. Indeed, it can allow for a broad array of interconnected issues to be addressed more effectively, with plans that are developed in a coordinated way (Conservation Ontario, 2018d). The benefits can be financial, social, environmental, or administrative. Perhaps most notably, IWM provides an opportunity to strengthen relationships and collaboration amongst authorities and stakeholders. Collaboration, in turn, allows for resources to be used sustainably. Similarly, increased communication between collaborating parties can lead to more consistent and coherent initiatives (Browner, 1996). For example, the involvement of researchers and academics can improve integration of science into decision-making, as well as foster innovative ideas. In addition, greater public participation can promote a sense of belonging and of collective responsibility (Gangbazo, 2004). Benefits of improved scientific integration could positively impact watershed health; potential outcomes include improved water quality and erosion control, more resilient biodiversity and habitats, economic activities and recreation opportunities that are more sustainable, and a greater ability for communities to adapt to climate change. Such outcomes ultimately lead to an improved quality of life for people living in the watershed (Conservation Ontario, 2012).

Challenges associated with advancing IWM can vary significantly from one watershed to another and so does the extent to which such challenges are addressed. Below are some common challenges experienced when implementing IWM in Canada and globally; it should be noted that they are generally interrelated (Heaney, 1993; Gangbazo, 2004; CCME, 2016).

- **SCOPE:** Watershed boundaries do not typically align with political boundaries, which can create challenges in identifying the appropriate decision-making authorities
- **FUNDING:** When many people benefit from IWM actions, it can be difficult to identify who should fund stewardship initiatives, and the extent to which individual initiatives should be funded
- **COMPLEXITY:** problems can be specific to a certain area of a watershed; it can be difficult to appropriately reflect such localized issues in larger watershed planning processes
- **ROBUST SCIENCE:** Knowledge and data gaps can lead to management decisions that do not adequately account for the watershed's reality
- **CONFLICTING INTERESTS:** It can be difficult to have diverse groups with diverging or even opposite interests agree to common objectives for watershed management
- **ADMINISTRATIVE BURDEN:** It can be challenging to establish an effective, efficient and equitable governance structure that would not duplicate efforts conducted by others, and that would not exacerbate any existing administrative burden

- **TIME:** Planning processes can be time-consuming and take longer than expected

International and Canadian case studies of IWM implementation will be further explored in sections 5.4.1 and 5.4.2.

5.4. CASE STUDIES IN WATERSHED MANAGEMENT

Consideration of international and domestic examples of watershed management approaches offers valuable lessons and insights on how other regions are incorporating principles for watershed management, such as the CCME IWM principles described in section 5.2. Examples were chosen based on the ways in which their experiences may inform efforts to improve collaboration in the Ottawa River watershed, and/or in which their membership, structure, mandate, and other characteristics have aligned with the CCME IWM Principles and/or enabled the successful implementation of integrated watershed governance. Of note, achieving integration in water management is an iterative process, and there is often not a prescribed end goal. It is possible that none of these examples fully implements all principles of IWRM or the CCME's 11 IWM principles. Each of the examples illustrates existing watershed management approaches that aim to achieve effective water governance and management, often through using IWRM or CCME IWM principles either intentionally or unintentionally. In all cases, approaches are tailored to local conditions and are reflective of jurisdictional structures, stakeholder views and/or environmental conditions. Lessons learned in watershed management, specific to the Ottawa River watershed, were also communicated by Indigenous communities through the consultation process associated with the ORWS. Those views are also provided in this section.

5.4.1. INTERNATIONAL CASE STUDIES

Water is connected to multiple sectors, places and people, as well as across geographic and temporal scales (OECD, 2015). Watershed management, therefore, often requires multiple levels of government to collaborate on watershed specific approaches (Wang, 2016). With the acknowledgement that "water crises are often primarily governance crises" (OECD, 2015), many intergovernmental organizations, forums, and institutions have established goals, best practices and frameworks for effective watershed management. On the international stage, there has been considerable work by international multilateral organizations, such as the UN, Organisation for Economic Co-operation and Development (OECD), GWP, and others, to develop a consensus on optimal watershed management principles, and encourage their adoption. Global guiding principles and international case studies for watershed management are discussed further in Appendix I.

Brandes et al., (2014) notes that consideration of successful international examples of watershed management, especially those that detail mandate, scope of power, and clear sets of roles and responsibilities, are integral to building local support and legitimacy. Examples are especially useful as they provide a tangible focal point for reference, which

in turn helps to leverage financial commitment and capacity. The same paper states that "one of the best ways for practitioners in new organizations to learn is through the experiences of others in similar situations, as it helps organizers learn more about the successes and challenges that similar organizations or models have faced" (pg. 41, 2014). The following international case studies highlight unique international approaches that incorporate the principles of IWM. A more extensive list of existing international watershed management approaches is provided in Appendix J.

THE EUROPEAN UNION AND WATER FRAMEWORK DIRECTIVE

In 2000, European Parliament and Council adopted new legislation to better harmonize water management in the EU. Titled the Water Framework Directive (WFD), the policy details a uniform set of guidelines, while allowing regions to tailor approaches to local conditions. Notably, the framework requires that the entire EU be divided based on physical boundaries of naturally occurring river basins. Furthermore, it states that leadership and regulatory powers regarding water be disseminated to a river basin scale, and that river basin authorities be formally recognized. Structures of these authorities vary throughout river basins; however, all authorities are required to have some aspect of public participation and citizen engagement, to ensure transparency, and citizen empowerment. At the time of implementation, individual countries had varying levels of river basin management structures in place. France and Poland had decentralized river basin approaches already in place, while nations such as Germany, Norway and Sweden had largely centralized water management approaches, and were required to make significant changes in their approach to water management (Jager et al., 2016).

Overall, the WFD strives to ensure that the quality of Europe's surface and groundwater is protected. Specifically, the framework states that all river basins must achieve "good ecological status" by a series of set deadlines. Good ecological status involves using reference conditions to set water quality objectives, as well as the assurance that surface waters receive both ecological and chemical protection, while also ensuring that levels of groundwater are quantified (Jager et al., 2016; European Commission, 2016). Additionally, planning for public consultation, water pricing policies and risk management were also noted in deadlines for implementing the Directive (European Commission, 2016). Overall, the EU WFD demonstrates what can be developed at a large multi-jurisdictional scale, using a combination of top-down guidelines that require shared responsibility for river basins, and bottom-up strategies, to support decentralized, locally appropriate methods for watershed governance.

OKAVANGO RIVER BASIN WATER COMMISSION

In 1994, with the support of various development agencies, the governments of Angola, Namibia and Botswana signed an agreement to establish the Okavango River Basin Water Commission (OKACOM). The shared basin starts in Angola, flows through Namibia and eventually into Botswana, where it feeds into the second largest inland delta in the world. The watershed is largely undeveloped due to past civil conflicts in Angola, and recognition and protection of biodiversity in Botswana's Okavango delta. In 2007, the agreement evolved to include three separate branches: the Commission, the Steering Committee, and the Secretariat. The Commission has a membership of nine,

three from each participating country, and is tasked with setting and supervising policy objectives. The Steering Committee, made up of science-driven task forces, provides technical advice through three main groups: biodiversity, hydrological systems, and institutional structures. Lastly, the Secretariat addresses administrative and financial matters. At the watershed scale, OKACOM, and its related committees, strive to ensure good water governance at the basin scale through incorporation of various principles and practices.

Primary concerns within the watershed are variations in hydrological flow, changes in sediment dynamics, changes in water quality, and changes in biota, all of which are driven by a combination of population dynamics, land use changes, poverty, and climate change (OKACOM, 2012). The mandate and structure of the agreement requires proactive planning and the designation of responsible authorities to respond to any extreme event; shared responsibility for joint monitoring; information exchange amongst the three countries; and a dispute resolution mechanism that aims to achieve conflict prevention and consensus. Local programs are used to build capacity and knowledge of watershed issues within communities, and act as an avenue to obtain public feedback (Green, 2013). The Commission is supported through budgetary commitments by the three countries involved, as well as by international donors.

COLORADO WATER CONSERVATION BOARD BASIN ROUND TABLES

Driven by a significant drought in 2005, the State of Colorado began working on a new approach to manage water. To assist in development of a new policy, stakeholders from eight sub-watersheds within the state of Colorado, as well as stakeholders from the Denver Metropolitan area, were brought together in a series of round tables (Koebele, 2015). Round tables are vehicles for stakeholder groups to come together to share perspectives, values and strategies, and are characterized by their balanced format, which facilitate equal participation and contribution by multi-interested stakeholder groups. They provide the opportunity for peer learning, strategic collaboration, and if desired produce recommendations, or make decisions on pre-established issues. Round tables can be formed as a standalone structure, or to facilitate collaborations for a council or a board (Koebele, 2015; Fraser Basin Council, 2015). In this case, round tables were developed through a “grassroots” process that allowed for stakeholders and citizens to discuss their water consumption, environmental and recreational needs related to water. Group sizes were based on population of the given region.

Each round table was tasked with assessing sub-watershed scale needs, and to develop consensus-based recommendations to deal with future challenges, such as population growth and climate change. Each round table was advisory in nature and met either monthly or bi-monthly to discuss issues and goals within their watershed. Notably, each round table was provided funds from the state’s government, in order to finance operations and water related projects linked to respective goals. Identification and initiation of specific projects that sub-watersheds required were noted as one of the biggest successes of the round table process, as funding allowed for region specific infrastructure upgrades and increases in water-related community education. Other notable outcomes were the production of policy briefs and tools, and increased collaboration among stakeholder groups. To further encourage collaboration and communication amongst the nine round tables, a separate collaborative group, the

Interbasin Compact Committee, was also formed. The recommendations and knowledge shared by these nine sub-watersheds was eventually used to inform Colorado's first statewide water plan (Koebele, 2015). Released in 2015, the *Colorado Water Plan* establishes state wide priority areas, critical actions and measurable objectives to guide implementation of the plan (Colorado Water Conservation Board, 2015).

MEMORANDUM OF AGREEMENT BETWEEN NEW YORK CITY AND STAKEHOLDERS FORM THE CATSKILLS AND DELAWARE WATERSHEDS

Upon the introduction of Motion M-104, MP David McGuinty acknowledged New York City's Memorandum of Agreement (MOA) as an opportune way to manage water resources. Signed in 1997, the MOA is an institutional framework involving New York City and stakeholders from the Catskills and Delaware counties. Dozens of stakeholder groups were involved in the agreement process: community members, farmers, various levels of government, and industry. Historically, New York City was recognized for having among "the best urban water supply system in the world in terms of quality, reliability, and innovative management". Regardless of this, new laws from the U.S. Environmental Protection Agency required that the city treat and filter their water to ensure a certain level of quality (National Research Council, 2000, p.45).

The majority of New York's municipal water supply comes from watersheds northwest of the city. Faced with a shortage of new water supply and the potentially large and on-going cost of increased water treatment and filtration, the city opted to use a different approach to ensure high water quality, collaboration with upstream users in the Catskills and Delaware counties, where 90% of water came from. Policy and regulation enforcement for the MOA are overseen by the New York City Department of Environmental Protection and other state and local government agencies, while different programs, such as the Watershed Agriculture Program, and the Catskill Watershed Cooperation, work on activities such as source water protection and stakeholder coordination, respectively (OECD, 2016).

Through the MOA, an economic value was assigned to ecosystem services and their role in maintaining water quality. New York City redirected funds that would have gone toward building new water treatment infrastructure into the rural communities within the Catskills and Delaware watershed, and towards acquisition of watershed lands. In turn, these communities curbed agricultural run-off, water intensive industry processes and other development to ensure the protection of the ecosystem, including clean water. Through implementation of best management practices, 350 farms have reduced pollution loads, such as coliform bacteria and phosphorus by 50%. Additionally, the MOA has funded a suite of new economic, education, and infrastructural projects in the upstream communities as a payment for deferred growth in the region. The MOA is celebrated as a successful case of payment for ecosystem services, in addition to its recognition of the interconnections between ecosystem health and water quality, prioritization of upstream protection and ecosystem services. Additionally, the agreement has resulted in equity, power sharing, economic growth, and community development (Hanlon, 2017).

WHANGANUI RIVER CLAIMS SETTLEMENT

In March of 2017, the Whanganui River (New Zealand) was formally recognized as having the legal rights of a human. Upon colonization in 1840, the Māori (the Indigenous peoples of New Zealand) lost numerous rights to their familial lands, and since 1874 the Whanganui people have been fighting to regain ancestral claims to the land and their sacred river (Bliss, 2017). After eight years of formal negotiations with the Māori in the region, the Parliament of New Zealand passed the Whanganui River Claims Settlement resolving historical claims with seven different Whanganui Iwi, while setting a historical precedent by giving a river human status. Previously, the river was controlled by multiple freshwater management jurisdictions and the federal government, and the water within it was treated as a public good. Under this new system, the river is no longer valued anthropocentrically, but rather valued intrinsically, recognized as its own being (Talbot – Jones, 2017). Under the new legislation, a diverse set of groups will assist in caring for the river, while two legal guardians were appointed by the courts to ensure the voice of the river is effectively represented. One guardian was elected from Maori Iwi stakeholders, and one elected from the Crown. Additionally, a River Strategy Group was formed to ensure that stakeholders adhere to legislation. To guarantee that financial resources are available to ensure protection and effective management of the river, $1 million was set aside to develop a legal framework for the river, $80 million is available for financial redress, and another $30 million is available for restoration to a “pristine state” (Zimmer, 2017).

5.4.2. CANADIAN CASE STUDIES

In 2009, the Canadian Council of Ministers of the Environment (CCME) endorsed a Canada-wide strategic vision for water, outlining goals to help ensure that “Canadians have access to clean, safe and sufficient water to meet their needs in ways that also maintain the integrity of ecosystems” (CCME, n.d.). In 2016, CCME released its summary report of Integrated Watershed Management (IWM) practices in Canada, as well as 11 principles to guide implementation of IWM. The principles are designed to “enhance the capacity of jurisdictions to apply integrated watershed management principles and to develop policies and programs consistent with the principles” (CCME, 2016). The summary report, which reiterated CCME’s Strategic Vision for Water, found that most jurisdictions have either formally or informally adopted IWM in policy and/or legislation. As mentioned in section 5.2, the summary report also presented a number of IWM Principles.

Much like international examples explored in section 5.4.1, Canadian watershed management bodies differ in many ways, including in membership, structure, mandate, and the activities that they carry out. For example, in terms of membership, some bodies have federal government representation, like the Fraser Basin Council and the Bras d'Or Lakes Collaborative Environmental Planning Initiative, while others do not have federal representation, like Conservation Authorities and the Regional Round Table for the Upper St. Lawrence and Greater Montréal. In other cases, such bodies are exclusively intergovernmental in nature, like the Mackenzie River Basin Board. Governance bodies also differ in the involvement of Indigenous peoples and stakeholder groups. For

example, some governance bodies include Indigenous representatives as members; others engage Indigenous communities through events or fora.

In a 2015 investigation of the potential factors to support successful collaborative watershed governance arrangements, the Fraser Basin Council found that “no one size or shape fits all” (Fraser Basin Council, 2015), and that collaborative watershed governance arrangements are shaped by local environmental, socio-economic, and political characteristics. As part of its analysis, Fraser Basin Council produced an Overview of Structures for Watershed Governance (Fraser Basin Council, 2015), illustrating that governance arrangements may take many forms. Below is an adapted version of that Overview.

TABLE 5.4-1. Overview of Structures for Watershed Management (Fraser Basin Council, 2015).

GOVERNANCE STRUCTURES	TYPICAL CHARACTERISTICS
Umbrella	Helps coordinate groups with related goals
Partnership	Limited number of entities working together towards shared objective(s) with joint investment of resources
Round table	Multi-interest, oriented around a geographic area/community
Society	Often has charitable status, can consist of diverse interests
Council	Includes government representatives and may be legislated
Combination	A combination of two or more of the above structures (e.g., sometimes a collaborative watershed governance structure will have a partner Society to leverage financial resources)
Evolution from one structure to another	Expects transition from a start-up structure to another structure at a later point

Despite the diversity of watershed management approaches in Canada, lessons learned may be drawn from many. Below are case studies from across the country. *A more comprehensive overview of existing Canadian watershed management bodies is provided in Appendix K.*

FRASER BASIN COUNCIL

Established in 1997, the Fraser Basin Council is a non-profit organization composed of 38 directors, including three representing the federal government, three representing the province of B.C., one representative from each of the eight regional districts overlapping with the watershed, as well as one representative from each of the eight Indigenous language groups in the area. Sixteen of the 38 directors are appointed by the aforementioned representatives, and include two from each of five geographic areas of the basin, three basin-wide directors focused on economic, social and environmental sustainability, one director representing youth, one director with experience in the finance sector, as well as one impartial chairperson. The Council is also composed of sub-committees which focus on specific regions and/or issues, including at the sub-

watershed level. The Fraser Basin Council is guided by the Charter for Sustainability, a good-faith agreement among Fraser Basin residents, organizations, governments, and Indigenous Peoples. The Charter includes four directions: understanding sustainability; caring for ecosystems; strengthening communities; and improving decision-making. It's main focus is to advance "sustainability in B.C., with a core focus on the Fraser River Basin; support leaders in government, business and community organizations in finding collaborative solutions" (Fraser Basin Council, 2018).

The Fraser Basin Council is a neutral body, with government representation, that makes decisions based on consensus. As a result, it is able to provide direct feedback to government on policy issues, as well as facilitate cooperation, build trust, and enable information exchange amongst groups whose interests and perceptions may diverge from one another. The Council's sub-committee structure supports smaller-scale community/collaborative watershed governance and planning, and allows the allocation of funding towards specific stewardship and sustainability projects at the local scale. The Fraser Basin Council's Charter for Sustainability resembles Ottawa Riverkeeper's 2015 Gatineau Declaration, which lays out key actions to, among other things, create new forums, or adapt existing ones, for improving collaboration in the Ottawa River watershed, as well as recognize people, businesses, organizations, and communities that uniquely promote sustainable watershed management (Ottawa Riverkeeper, 2015).

Through ECCC's engagement process, the large majority of respondents stressed that greater collaboration is needed for the whole Ottawa River watershed, including with all levels of government (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). Many also stressed the need to ensure that any new governance arrangement make decisions based on consensus, in order to foster trusting relationships amongst all parties, despite any diverging interests.

MACKENZIE RIVER BASIN TRANSBOUNDARY WATERS MASTER AGREEMENT

The Mackenzie River basin is interprovincial/territorial and overlaps with the traditional territory of a number of Indigenous groups, much like the interjurisdictional nature of the Ottawa River watershed. In order to move towards more integrated management of the Mackenzie River basin, in 1972, the governments of Canada, Yukon, Northwest Territories, British Columbia, Alberta, and Saskatchewan created the Mackenzie River Basin Intergovernmental Liaison Committee, followed by the Mackenzie River Basin Committee in 1977 and, ultimately, the Mackenzie River Basin Board (MRBB) in 1997 (The Forum for Leadership on Water, 2016). The MRBB was established through the Mackenzie River Basin Transboundary Waters Master Agreement, a non-binding agreement that sets out principles for shared management of interprovincial and territorial waters. Membership of the MRBB consists of three federal representatives and two representatives from each of the five provincial/territorial jurisdictions within the basin. In addition, one representative from each jurisdiction must be of Indigenous ancestry. The main functions of the MRBB are to (1) provide a forum for communication, coordination, information exchange, and incorporation of traditional knowledge; (2) recommend objectives or guidelines for quality and quantity; (3) encourage consistent monitoring; and (4) report on the state of the aquatic ecosystem every five years.

The four main functions of the MRBB are very similar to the needs expressed by those engaged through the ORWS. Through the engagement process associated with the Study, a large proportion of respondents, particularly stakeholders and Indigenous peoples, identified a need for better communication, coordination, information exchange, and incorporation of traditional knowledge (Public and Stakeholder consultations, 2018). The MRBB and the associated Agreement may be described as important models for successfully integrating Indigenous interests in decision making processes, which is very much aligned with CCME IWM Principle 9 on Community and Indigenous Engagement. Of note, a guiding principle for the inclusion of Indigenous interests—which is increasingly applied within the context of the Mackenzie River Basin Transboundary Waters Master Agreement, and supported by leading experts in watershed co-management—is that of collaborative consent. The term "collaborative consent" was initially coined to describe decision-making processes followed by territorial and Indigenous governments in the Northwest Territories to establish water-related agreements and legislation. The seven hallmarks of collaborative consent are as follows (Phare et al., 2017):

- Collaborative consent is based on respect, trust and the art of diplomacy between governments;
- All governments recognize each other as legitimate authorities;
- Collaborative consent tables are decision-making tables, which means that representatives must have the authority to participate fully and make decisions at the table;
- The scope of issues considered through the process can be extensive and ultimately must be satisfactory to all parties;
- Collaborative consent starts at the front-end and all governments commit to remaining at the table for the "long haul";
- Each government's interests must be dealt with in a satisfactory manner from their own point of view; and
- The process generates real outcomes

Collaborative consent is not exclusive to the MRBB, and has emerged as a guiding principle used in various processes, including the development of the bilateral agreements between the Northwest Territories and Alberta, and the Northwest Territories and British Columbia, in 2015 (Phare et al., 2017). As part of those agreements, a Memorandum of Understanding was signed between the Government of the Northwest Territories and Indigenous governments, establishing the roles and responsibilities of Indigenous peoples under agreements, and to ensure the process would be carried out in good faith. Through collaborative consent, Indigenous and non-Indigenous governments commit to collaborating over the long term, with a goal of obtaining each other's consent on decisions, policies and plans moving forward. As is the case in the Mackenzie River Basin, many Indigenous communities live within, rely on, and have strong longstanding ties to the Ottawa River watershed. The principle of collaborative consent was raised as a potential best practice through the Indigenous consultation process for the ORWS (Richardson, 2018).

CONSERVATION AUTHORITIES IN ONTARIO

Some Ontario's CAs were established by the provincial government and a number of municipalities in the 1940s, in response to flooding and erosion occurring across the province. Under Ontario's Conservation Authorities Act, passed in 1946, provincial government watershed management authorities were delegated to these new, independent watershed-scale organizations. Over time, CAs became involved in a wider range of activities and responsibilities, and today, CAs have formally adopted an IWM approach (Conservation Ontario, n.d.). With the passage of Ontario's Bill 139 in December 2017, Building Better Communities and Conserving Watersheds Act, the role of CAs in watershed management may expand. Among the roles and responsibilities of CAs is the requirement to develop and implement source water protection plans in designated areas. Source water protection plans are developed by multi-stakeholder Source Protection Committees which generally include Indigenous, municipal, and non-governmental members. Source water protection plans are also developed in consultation with the general public and, ultimately, approved by the provincial government.

While CAs receive funding from diverse sources, they are funded primarily by municipal levies and self-generated funds (i.e., fees for services). CAs manage relatively large amounts of funds relative to other watershed management agencies in Canada. In 2013, for example, Ontario's 36 CAs delivered programs and services totaling approximately $290 million, with more than 3,600 staff (Conservation Ontario, 2017). The Grand River CA and the Lake Simcoe Region CA are the only Canadian watershed governance models to have received the Thiess International Riverprize, in 2000 and 2009, respectively. The Riverprize is awarded to watershed management agencies by the International River Foundation to "recognise exemplary initiatives in protection, restoration and sustainable management of the world's rivers" (International River Foundation, n.d.).

Ontario's CAs successfully implement many of the CCME IWM Principles. In a 2014 analysis by Mitchell et al., CAs were found to be particularly good models for watershed management, largely because they obtain significant funding from a variety of sources, have clearly defined roles and responsibilities in relation to other levels of government, and prioritize stakeholder engagement (Mitchell et al., 2014). The capacity of CAs to acquire sizable funding from a variety of sources empowers them to strive towards IWM Principles 1, 2, 3, 4, and 5, that is, to take relatively ambitious, ecosystem-wide, and integrated actions that consider cumulative impacts. In addition, the fact that CAs have clearly defined roles and responsibilities, and have been delegated provincial authorities through legislation, supports IWM Principle 8, on shared responsibility. Mitchell et al. also viewed the establishment of source water protection plans as particularly successful and innovative. Protecting the surface or groundwater that supplies municipal drinking water systems reduces the risk of drinking water contamination and associated threats to human health. It is a proactive approach, as per IWM Principle 7.

UPPER ST-LAWRENCE AND GREATER MONTRÉAL ROUND TABLE

Through engagement on the ORWS, the RRT for the Upper St. Laurence and Greater Montréal—which, of all RRTs, is responsible for the largest population centre—provides another model of governance. OBVs, in particular, highlighted the effectiveness of the RRT's structure in ensuring a collaborative process that is not biased towards the desires or motivations of one group. Launched in September 2015, the RRT is coordinated by local ZIP committees that were already well established and well connected to key stakeholders (Port de Montréal, 2015). The ZIP committees oversee three separate entities within the larger RRT structure: a Regional Forum, a Strategic Advisory Council, and Concertation Sub-Committees. Membership in the RRT is open to all, and the Regional Forum is an annual event that is open to all RRT members. It provides an opportunity for broad engagement of all interest groups in the region, and to seek input on the priorities of the RRT, as well on the membership of the Strategic Advisory Committee. As a result, and as per CCME Principle 9, the Regional Forum could be deemed as supporting meaningful participation of local communities.

Membership on the Strategic Advisory Committee is limited to a number of key groups, as identified by the ZIP committees. There are currently 35 organizations on the Committee, which represent First Nations, the municipal sector, the community sector, the IWM sector, and the economic sector. Those representing the economic sector include the Port of Montreal, Hydro-Québec, and Québec's professional farmers' union - the Union des producteurs agricoles (Table de Concertation Régionale Haut St. Laurent – Grand Montréal, n.d.). The participation of such private sector actors supports CCME IWM Principle 10, on Sustainable Development, to meet economic and societal needs without compromising the environment.

BRAS D'OR LAKES COLLABORATIVE ENVIRONMENTAL PLANNING INITIATIVE

The Bras d'Or Lakes Collaborative Environmental Planning Initiative (CEPI) is a collaborative effort to protect the Bras d'Or lake system in Nova Scotia. It was established in 2003 at the initiative of five Mi'kmaq First Nations who called for the development and implementation of an overall environmental management plan for the lake system. Similar to the Fraser Basin Council's Charter for Sustainability, all the Mi'kmaq communities, municipal, provincial, and federal agencies, and citizens with an interest in the Bras d'Or watershed signed the Bras d'Or Charter, committing them to the new Bras d'Or Lakes CEPI. CEPI's vision is to lead a unique collaboration of partners that incorporate both traditional and western perspectives in order to foster a healthy and productive Bras d'Or Lakes watershed ecosystem. CEPI is also guided by a Terms of Reference which outlines its vision, guiding principles, objectives and governance structure. Objectives are a balance of environmental, social, cultural and institutional priorities to ensure the health and sustainable use of the watershed ecosystem.

CEPI's Senior Council consists of the five Mi'kmaq First Nation Chiefs, federal Regional Directors General, provincial Deputy Ministers, Mayors, and Wardens. It meets semi-annually to review and endorse CEPI's activities and overall direction. CEPI is also supported by a Management Committee, consisting of one representative from each of

the government partners and four ex-officio members, including the CEPI Secretariat. The Committee, which meets monthly, is responsible for oversight and management of activities. An Elders Council and a Youth Council provide unique guidance to the Senior Council and the Management Committee, and Task Teams are created by the Management Committee to implement specific aspects of the overall work plan. Since the signing of the Bras d'Or Charter in 2005, a number of notable accomplishments were made, including State of the Environment reports, an ecosystem overview report, as well as the establishment of an Organizations of the Bras d'Or network—a collaborative body consisting solely of non-governmental partners. From 2012 to 2014, CEPI also undertook a comprehensive analysis of monitoring gaps in the watershed, with support from ECCC's Atlantic Ecosystem Initiative program (Bras d'Or CEPI, 2018).

Through the engagement process of the ORWS, CEPI indicated that the relatively high number of committees within its overall structure may create an administrative burden (CEPI, 2018); however, that burden may be outweighed by the associated benefit of having high accountability within the organization. CEPI has also indicated that the leadership role undertaken by Mi'kmaq, alongside representatives of other governments, not only reflects a nation-to-nation approach, but also allows for Indigenous traditional knowledge and spirituality to be integrated within CEPI's structure and activities. Of note, CEPI supports the guiding principle of Two-Eyed Seeing which, according to Elder Albert Marshall of the Mi'kmaq Nation, is when you "learn to see from one eye with the best in Indigenous knowledges and ways of knowing, and from the other eye with the best in Western (or mainstream) knowledges and ways of knowing ... and learn to use both these eyes together for the benefit of all" (Marshall & Bartlett, 2017). Indigenous communities have indicated, through the ORWS, that the value of traditional knowledge should be recognized to a greater extent (see section 4.4).

5.4.3. INDIGENOUS LESSONS LEARNED IN WATERSHED MANAGEMENT

A number of governance best practices were communicated by the Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, and Métis Nation of Ontario for the ORWS. Below is a summary of those views. Indigenous input that is more specific to the potential creation of a new collaborative body is included in section 6.2 of the report.

Prior to European contact and settlement, the Ottawa River watershed was managed by Indigenous peoples in a way that recognized its status as sacred. The management system applied by Algonquins, for example, is fundamentally holistic and relationship-based, not transactional and anthropocentric. The Algonquin Anishinabeg Nation explained that for Algonquin peoples, the idea of looking at individual elements of an ecosystem, in and of themselves, falls outside of the Anishinabe belief system. Rather, achieving balance between all components of an ecosystem and physical environment is prioritized. The focus of ecosystem and environment protection is not solely on the water, but also includes the ecosystem around it—the forests, the animals, and the actions of the people. For example, moose feed from the river, and fish live in the river; studying these two animal populations may give an indication as to the state of their immediate environment (Algonquin Anishinabeg Nation Tribal Council, 2018). Similarly,

the Algonquin Nation Secretariat expressed that all aspects of the watershed must be considered—"trees, roots, animals, medicines, air"—as a reflection of the understanding that every life form is integrated and tied to the wellness of another (Kitchisibi Ikidowin Anishinabe, 2018). Such beliefs are consistent with IWM Principles 1, 2, 4, and 5, which involve taking an ecosystem and integrated approach that recognizes the "interdependency of air, land, water and living organisms" (CCME, 2016). In addition, the Mohawk Council of Kanesatake noted that it is uniquely positioned to inform integrated management of the Ottawa River watershed because it is "at the confluence of the Ottawa and St. Lawrence rivers", reflecting the fact that the health of the Ottawa River watershed has implications on the health of other watersheds downstream (Bisson & Mohawk community of Kanesatake, 2018). The Algonquins of Ontario provided ECCC with additional information on the spiritual significance of the Ottawa River. According to the Algonquins of Ontario, Algonquin peoples believe, as original stewards of the Kitchissippi (Ottawa River), that the management of the watershed would greatly benefit from an infusion of Anishinabe values and teachings. Algonquins of Ontario explained that the Algonquins are guided by the spirit and intent of the Teachings of the Seven Grandfathers. These teachings, listed below, have been passed down from generation to generation, and continue to be practiced today. Recognizing such beliefs applies to CCME IWM Principle 9–that IWM should "duly support the identity, culture and interests of local communities and Aboriginal Peoples" (CCME, 2016). The teachings are as follows:

- "Honesty (Gwayakwaadiziwin): Honesty in facing a situation is to be brave
- Humility (Dabaadendiziwin): Humility is to know yourself as a sacred part of Creation
- Respect (Minaadendamowin): To honour all Creation is to have Respect
- Bravery (Aakode'ewin): Bravery is to face the foe with integrity
- Wisdom (Nibwaakaawin): To cherish knowledge is to know Wisdom
- Love (Zaagi'idiwin): To know Love is to know peace
- Truth (Debwewin): Truth is to know all of these things" (Richardson, 2018)

The Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, and the Métis Nation of Ontario expressed a strong desire for watershed management to involve Indigenous peoples in a way that is meaningful and inclusive, and for Indigenous peoples to be recognized as rights holders whose knowledge can make valid and important contributions to understanding the watershed. The Algonquin Nation Secretariat, for example, expressed that current consultation practices involved in watershed management are flawed, and that the rights and interests of Indigenous peoples are not taken into account when developers notify communities about a process that is already underway (Kitchisibi Ikidowin Anishinabe, 2018). Métis Nation of Ontario voiced similar views, calling for rights-based consultation in areas where Métis Nation of Ontario communities assert rights (Odonaterra Community Environmental Strategies, 2018). Furthermore, the Mohawk Council of Kahnawá:ke stated that an assessment of monitoring activities and data gaps in the Ottawa River watershed is required, and that such an assessment needs to be driven by both science and Indigenous knowledge, in order to "limit the possibility for bias" (Mohawk Council of Kahnawá:ke, 2018).

In order to better recognize Indigenous rights and interests, the Algonquin Anishinabeg Nation Tribal Council called for Algonquin Peoples to have a “strong—and at the very least equal—voice” within any new governance arrangement (Algonquin Anishinabeg Nation Tribal Council, 2018). Similarly, Mohawks of Kanesatake community members called for equal representation for all Indigenous and non-Indigenous communities (Bisson & Mohawk community of Kanesatake, 2018). Finally, Algonquins of Ontario listed four elements as common amongst successful watershed governance arrangements: (1) indigenous co-leadership, including “full partnership of Indigenous organizations in developing the governance structures and participating at the top levels of decision-making”; (2) recognizing sovereignty and jurisdictional rights, as in “recognizing conflicting views of sovereignty and jurisdiction while also finding a way to move forward in decision-making”; (3) consensus, as an essential element for ensuring that governance structures remain equitable; and (4) whole-of-watershed thinking, much like IWM Principle 1 which promotes the use watershed boundaries for scoping management activities (Richardson, 2018).

6 VIEWS ON WATERSHED MANAGEMENT APPROACHES

As per the text of Private Member's Motion M-104, one purpose of the study is to examine the potential creation of a new collaborative body, such as an Ottawa River Watershed Council. Participants in the engagement process for the ORWS were encouraged to share their views regarding challenges in the implementation of IWM in the watershed, and if a Council would be an appropriate means of addressing those challenges. Furthermore, participants were asked to provide input on what the potential structure, mandate, and membership of a Council could be, and who should provide funding if a Council were to be established. The governments of Québec and Ontario did not provide views on the potential creation of a collaborative body or the use of IWM principles.

6.1. VIEWS ON BARRIERS TO INTEGRATED WATERSHED MANAGEMENT IN THE OTTAWA RIVER WATERSHED

Through the engagement process for the ORWS, Indigenous groups, provincial governments, municipalities, CAs, OBVs, and other key stakeholders were asked whether they supported IWM as an appropriate approach to watershed management, and whether they experienced challenges in implementing aspects of the CCME IWM Principles (see section 5.1 Defining Watershed Management). While the general consensus was that IWM is the ideal approach to watershed management, a number of challenges in the implementation of the principles were raised, notably with regards to capacity, collection and integration of data, engagement of communities and Indigenous peoples, and consensus building.

Capacity can be defined as the appropriate mix of financial, material and human resources, which also encompass expertise and water infrastructure (Cervoni, Biro, & Beazley, 2008; Treasury Board Secretariat, n.d.). Respondents to the ORWS generally expressed that a lack of capacity often represents barriers to effective implementation of IWM (Public and Stakeholder consultations, 2018). Funding human resources, knowledge and materials were highlighted by watershed-based organizations and NGOs as a barrier to their activities and practices, ranging from comprehensive monitoring, language translation, and enhancing local expertise.

Algonquins of Ontario, Algonquin Anishinabeg Nation Tribal Council, and Algonquin Nation Secretariat identified capacity constraints as being an important barrier, and expressed an interest in building local expertise and understanding through funding and other knowledge building opportunities (Public and Stakeholder consultations, 2018). Local watershed management groups, such as CAs and OBVs, expressed that they lacked vital resources, notably staff, time and funding, which has limited their ability to monitor the watershed (Public and Stakeholder consultations, 2018). Environmentally-focused organizations, such as local Lake Associations echoed the same sentiment. In some cases, a lack of resources has required groups to prioritize actions, and has limited the implementation of an integrated, ecosystem approach (IWM Principle 2) that takes cumulative impacts into account (IWM Principle 5).

Groups also expressed that collecting and integrating data into decision-making, at the watershed level, can be challenging, particularly because research projects are often focused on smaller-scale issues (Public and Stakeholder consultations, 2018). If data is not accurately integrated into decision-making and not communicated to the public, a lack of public understanding and awareness of watershed issues may result. This, in turn, can lead to less public demand for, and funding towards watershed stewardship initiatives. A barrier to the implementation of IWM Principle 2, “adopting an ecosystem approach”, as well as Principle 9, “engaging communities and Indigenous groups”, includes the lack of proper science awareness integration with communities.

The meaningful engagement of local communities and Indigenous peoples is another challenge expressed by some local watershed management organizations. For example, while some OBVs have reserved seats for Indigenous representatives on their administrative boards, Indigenous representatives may not have the capacity to participate (Public and Stakeholder consultations, 2018). Inconsistencies in Indigenous engagement have sometimes resulted in uncertainty regarding the concerns and desires of local communities, and the inability to effectively and collectively address them. Furthermore, Algonquin Nation Secretariat and Algonquins of Ontario expressed that without greater decision-making authority, and the capacity to develop and enforce policies or regulations, concerns that have been identified are all the more difficult to address. In other words, it has been difficult to “share the responsibility for policy and program development and implementation within the mandate of all actors” or IWM Principle 8 (CCME, 2016).

Of those stakeholders or communities who are more successfully implementing IWM, groups have expressed that it is difficult to build consensus on priority issues, and identify a course of action. The Ottawa River watershed has several bodies involved in its management, resulting in fragmented jurisdictional responsibilities (see section 1.3 *Roles and Responsibilities in the Ottawa River Watershed*). Often, this fragmentation results in overlaps or gaps in mandated roles and responsibilities. Respondents also noted that this fragmentation hindered the ability to gather knowledge about the watershed, share information, monitor, and collect data. Diverging priorities can also impede the development of strong partnerships between groups. In addition, because the benefits of IWM implementation are often only visible in the long-term, it is difficult to maintain momentum and collective action towards a common goal. These trends may impede implementation of IWM Principles 6, 10, and 11, in particular, which relate to the

application of the precautionary principle, ensuring sustainable development in the watershed, and protecting its natural capital.

Given the views discussed above, the two overarching challenges expressed throughout the ORWS are a lack of capacity and jurisdictional complexity. These barriers are further exacerbated by the interprovincial nature of the Ottawa River watershed, and the unique language requirements that exist within it (i.e., the use of French and English languages as primary working language).

6.2. VIEWS ON THE POTENTIAL CREATION OF AN OTTAWA RIVER WATERSHED COUNCIL

Feedback on the potential creation of an Ottawa River Watershed Council was collected throughout the engagement process associated with the ORWS, including public comments made on the online citizen engagement platform PlaceSpeak, individual email submissions to the Study email account, and engagement guides submitted by various interest groups. The views expressed are summarized below.

6.2.1. COUNCIL MANDATE

The Algonquins of Ontario, the Algonquin Anishinabeg Nation, the Algonquin Nation Secretariat, the Mohawk Councils of Kahnawá:ke and Kanesatake, and Métis Nation of Ontario were generally of the view that a Council should be empowered to better ensure meaningful consultation of, and collaboration with Indigenous peoples, and to further watershed protection. Specifically, multiple Indigenous groups expressed a need to better understand the baseline health of and the ecological threats to the watershed, and to improve integration of Indigenous knowledge. The Mohawk Council of Kahnawá:ke, for example, proposed the completion of a Regional Impact Assessment as a first activity to be carried out by a new Council. Similarly, Algonquin Anishinabeg Nation stressed the need for a baseline health assessment of the watershed, followed by the development and implementation of a plan to improve watershed health. However, Algonquins of Ontario cautioned against “reinventing the wheel”, and that a new Council should strive to draw on existing skills, expertise and knowledge held by Indigenous communities, relevant government agencies and other stakeholder groups (Mohawk Council of Kahnawá:ke, 2018; Richardson, 2018).

Algonquins of Ontario also stated a study on existing Indigenous knowledge should be carried out and be “incorporated into the governance framework and decision-making processes regarding watershed governance, stewardship, and protection.” As was also discussed in section 5.4, many Indigenous groups stressed the importance of drawing on existing Indigenous knowledge, with Algonquin Anishinabeg Nation highlighting the importance of gathering and incorporating traditional knowledge into management (Algonquin Anishinabeg Nation Tribal Council, 2018).

In terms of the role of governments, from a regulatory perspective, many respondents indicated that governments have adequate legislation in place to protect the Ottawa River watershed (Public and Stakeholder consultations, 2018); however, some expressed concern that governments may not have the capacity to properly enforce existing legislation (PlaceSpeak consultations, 2018). Other respondents stated that regulations are not well integrated between provinces and between orders of government, leaving gaps in environmental protection (e.g., protection of species at risk). On the other hand, some believed that no further regulatory action was needed (Public and Stakeholder consultations, 2018). In terms of federal involvement specifically, a number of respondents indicated that the federal government has the unique ability to bring together groups from across the watershed and, therefore, should participate in the operations of any new collaborative body. Similarly, all Indigenous groups consulted indicated that the federal government should be involved in watershed management. Many discussed the federal government's commitment to reconciliation and a renewed, nation-to-nation relationship, as important drivers for ensuring that Indigenous rights and interests are represented and respected. In fact, some argued that the federal government should have a strong presence; according to the Mohawk Council of Kahnawá:ke, "a federally coordinated process is likely to be more effective to ensure that the appropriate partners and resources are at the table to undertake concrete actions" (Mohawk Council of Kahnawá:ke, 2018). While the Algonquin Nation Secretariat acknowledged the importance of collaborative governance and nation-to-nation agreements, they also expressed concern regarding government involvement, noting there are potential risks to Anishinabe people in participating in federal and other non-indigenous governance initiatives" (Kitchisibi Ikidowin Anishinabe, 2018). According to the Algonquin Anishinabeg Nation, the main focus of the federal government should be to support the implementation of watershed management initiatives led by Indigenous peoples (Algonquin Anishinabeg Nation Tribal Council, 2018).

Nearly all views expressed by stakeholders and individuals supported increased collaboration in the Ottawa River watershed. Many stated that a current lack of collaboration was one of the greatest challenges facing the watershed, particularly due its interprovincial nature. Many respondents expressed interest in establishing a Council to coordinate watershed management across borders, support IWM approaches, address issues, and set priorities for action (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). The need to convene diverse interest groups from across the watershed to share information and help identify concerns was widely recognized as a gap missing from current management practices.

> I fully support the formation of an Ottawa River Watershed Council to address the multiple issues, concerns, risks and complexities faced by a diverse set of interests involving multiple, even competing jurisdictions." (PlaceSpeak consultations, 2018)

The majority of those supporting improved collaboration believed that a coordinating body was an effective strategy. Those that opposed the establishment of a Council did so for a number of reasons, including concerns relating to costs, the duplication of efforts, or the belief that a Council would lead to over-regulation of the watershed. A small minority of respondents cited

opposition to a Council based on a belief that there were no gaps in governance or knowledge of watershed health. Indigenous groups consulted generally viewed the establishment of a new collaborative body as a positive path forward. They were supportive of the formation of a new watershed-based collaborative body, on the condition that their rights and related interests would be strongly reflected within its mandate, structure and membership. (Algonquin Anishinabeg Nation Tribal Council, 2018; Bisson & Mohawk community of Kanesatake, 2018; Kitchisibi Ikidowin Anishinabe, 2018; Mohawk Council of Kahnawá:ke, 2018; Odonaterra Community Environmental Strategies, 2018; Richardson, 2018).

There was widespread agreement from nearly all respondents that the mandate of any new Council should be to: facilitate the sharing of data and information; identify knowledge gaps; foster cooperation and engagement; and in general, focus on non-regulatory work (PlaceSpeak consultations, 2018; Public and Stakeholder consultations, 2018). A number of respondents highlighted the importance of creating a space to coordinate efforts amongst groups that already collect information about the health of the watershed. For example, some suggested that the monitoring and reporting activities of governments, CAs and OBVs could be better aligned. In addition, to facilitate public engagement, education, and awareness, many respondents recognized data transparency and public accessibility as important components of a Council's mandate.

The following quotes, taken from engagement guides received by ECCC and from public comments made on PlaceSpeak, capture the views held by many respondents in regards to the mandate of a collaborative body:

> "A single database to record and share information is essential to managing a large geographical area with so many people and businesses populating it." – PlaceSpeak consultations, 2018

> "(A coordinating body should) work with all organizations within the Ottawa River watershed to collect, analyse and report on environmental data and conditions, and facilitate the identification of priority actions based on an IWM approach." - Public and Stakeholder consultations, 2018

"The Council should assemble and make all existing data publically available." – Public and Stakeholder consultations, 2018

"(The ideal role of a Council would be to) provide a central portal/location for information and guidance with respect to watershed protection and community development/education." – Public and Stakeholder consultations, 2018

In addition to the views expressed by respondents about what they believed should be included in a Council's mandate, there were a similar number of suggestions about what a Council should not do. Some individuals strongly expressed that a Council should not be granted authority to regulate or govern the watershed in any capacity, and suggested that the Council must work within existing regulatory frameworks (Public and Stakeholder consultations, 2018). Should a Council make recommendations concerning the management of the watershed, many respondents felt that such recommendations should be non-regulatory in nature and non-binding (Public and Stakeholder consultations, 2018). Respondents largely believe that no new level of regulatory protection is required, and that a Council would not be the appropriate group to introduce such regulations. There was also notable concern that a Council should not duplicate the efforts of OBVs, CAs, or other existing bodies in the watershed, such as the ORRPB.

6.2.2. COUNCIL STRUCTURE AND MEMBERSHIP

Respondents also provided feedback on the structure and membership of a potential Council. Indigenous groups had varied opinions about structure and membership of a potential Council. All Indigenous groups proposed that they have a larger role in leadership, membership, decision-making authority, and/or monitoring capabilities. Most groups called for structures through which authority over the management of the watershed would be shared equally among Indigenous groups and government institutions. For example, the Algonquins of Ontario, the Algonquin Nation Secretariat and the Mohawk Council of Kanesatake all advocated for a "co-governance" structure which, according to the Algonquins of Ontario, refers to "two or more self-governing entities coming together to share authority and decision-making over a jurisdiction" (Richardson, 2018). Most groups also highlighted the importance of involving women, elders and youth: women are the traditional keepers and guardians of water, elders hold a wealth of knowledge, and youth have motivation and a vested interest in the future of water and the watershed. While most Indigenous groups expressed the need for collaboration with broader stakeholder groups, specific groups were rarely mentioned. Members of the Mohawk Council of Kanesatake did note, however, that it was "not in favour of having Ottawa Riverkeepers as custodians or leaders of [a] governing council" as it was felt that Ottawa Riverkeeper did not demonstrate alignment with the Algonquin nation on past issues ((Bisson & Mohawk community of Kanesatake, 2018) , 2018).

Additional views regarding structure of the Council were also raised by Indigenous groups. The Algonquins of Ontario, for example, proposed that Memoranda of Understanding be negotiated between the Algonquins of Ontario and Crown regulatory bodies, clarifying "shared roles, responsibilities, authorities, and jurisdiction regarding matters that could impact the Ottawa River watershed" (Richardson, 2018). The Algonquin Anishinabeg Nation stated that Indigenous representation must be proportionate to other governments, and not limited to one or two token seats within a Council (Algonquin Anishinabeg Nation Tribal Council, 2018). The Algonquin Nation Secretariat highlighted a desire to be closely involved in the design of a new Council in a way that does not "dilute or compromise their long-held values, rights and title towards customary lands or their independence as a sovereign people" (Kitchisibi Ikidowin Anishinabe, 2018). The Mohawk Council of Kanesatake added that all representatives of a new Council should have the appropriate expertise, education and commitment to protect the watershed, independent of any personal or economic gain (Bisson & Mohawk community of Kanesatake, 2018). In addition, Métis Nation of Ontario suggested a structure involving the formation of an independent Métis Nation of Ontario Ottawa River Watershed Committee, as well as a broader Ottawa River Watershed Management and Policy Table. They specified that a new Management and Policy Table should be required to be consulted and be advised by the Métis Nation of Ontario Ottawa River Watershed Committee (Odonaterra Community Environmental Strategies, 2018). Finally, it was noted that it is important that a council "rely on and include Indigenous people who are trained in Indigenous science and philosophy in real and collaborative ways" (Gehl, 2018).

The views of stakeholders and individuals received regarding structure were similar, while those regarding membership were very diverse. Most respondents indicated that they would prefer if a Council was structured as a round table, where the views of all members are considered equally (Public and Stakeholder consultation, 2018). This was suggested frequently throughout the engagement process, as a means by which members can share ideas and information on an equitable level. A few respondents proposed that a Council be structured as a board of directors with various sub-committees. One respondent suggested a tiered Council, with each sub-watershed being responsible to provide a representative to a larger watershed-wide Council (PlaceSpeak consultation, 2018). A top-down approach was criticized by one organization who cited that such a structure discourages the sharing of information (Public and Stakeholder consultation, 2018).

The most common suggestions for membership included municipal, provincial, and federal governments, Indigenous peoples, CAs and OBVs, industry representatives, and Ottawa Riverkeeper. In addition to these groups, there were also suggestions that other environmental NGOs (e.g., Ducks Unlimited, World Wildlife-Fund Canada), the ORRPB, academics, land associations, and youth also be included. A few respondents suggested that Ottawa Riverkeeper should play a coordinating role and act as the secretariat for the Council.

Two notable rationales behind the membership suggestions were funding and accountability. For example, it was suggested that having elected municipal representatives on the Council was very important, as elected municipal representatives are directly accountable to taxpayers (Public and Stakeholder consultation, 2018).

However, some respondents expressed concern regarding the financial obligations that may come with membership on a Council, suggesting that the financial constraints of certain interest groups could be an important barrier that may need to be considered if a Council were to be established (Public and Stakeholder consultation, 2018).

6.2.3. FUNDING OF A COUNCIL

Many participants in the study recognized that in order for a Council to fulfill its mandate, sustained resources would be required.

None of the Indigenous groups consulted explicitly noted views on who should fund a Council. However, all groups did suggest that establishing and operationalizing a Council, including Indigenous participation, would require financial support. The Algonquins of Ontario highlighted funding structures already used by existing watershed management bodies. For example, trusts used by the Waikato River Authority in New Zealand were favoured by the Algonquins of Ontario as they allow for "consistency and year-to-year security that allows for long-term planning." Taxation authorities and shared funding schemes were also highlighted by the same group, given their successful use in some existing watershed boards in Canada (Richardson, 2018).

> "(Funding) should be distributed and can come from a percentage from each municipality / stakeholder into a collective pot." – Public and Stakeholder consultations, 2018

As demonstrated by the views expressed by certain interest groups in the previous sections, external funding may be required to ensure that all stakeholders have an equitable opportunity to participate on a Council. Respondents largely viewed two groups, government and Council members, as being best positioned to provide the funding required to operate a Council.

Those in favor of a government-supported Council felt that the federal government would be best positioned to provide the financial and technical support for the long-term success of the Council. However, mandating funding from all levels of government may place pressure on some smaller townships, as some indicated that they would be unable to pay the municipalities' share of a Council (Public and Stakeholder consultation, 2018). Some respondents, who specified that funding for a Council should be distributed between all members, suggested that funds could be redistributed to implement actions within the watershed based on priority. Defining priorities could be a point of contention should a Council be established; however, one group suggested that funding should be allocated as follows: "Funding should be provided to the organizations that have the capacity to collect, analyse and report on indicators. Incentive should be provided to areas within the watershed that currently are not covered by an existing watershed organization" (Public and Stakeholder consultations, 2018).

7 FUTURE CHALLENGES AND OPPORTUNITIES

The perspectives shared with ECCC through consultation and engagement assist in understanding the present health of the Ottawa River watershed, and the interests, values and concerns of those who occupy it. When considering the next steps for the watershed, it is important to consider not only the present interests and concerns, but also the potential future challenges and opportunities that the watershed may encounter. The following sections explore potential future challenges and opportunities for the Ottawa River watershed, by identifying emerging trends, and their potential impacts through a foresight analysis, and examine potential opportunities to enhance collaboration in the watershed.

7.1. FORESIGHT ANALYSIS

Foresight analysis, as described in Chapter 2, has been included in this Study to help ECCC understand what influences the Ottawa River watershed, how it may evolve, and what challenges or opportunities may arise in the future. This section is not intended to provide predictions about the future, and the information provided in this section does not constitute recommendations for what should be done in the future.

ECCC convened a series of internal sessions that focused on identifying current assumptions, building mental models of the system, and discussing emerging trends (change drivers) that relate to watershed governance. These included disruptive technologies, shifting ideologies, and new economic interests. The identified change drivers contributed to the development of insights into the future of the Ottawa River watershed as a means of identifying potential implications for watershed governance. Relationships between change drivers (defined in section 7.1.2) and commonly held assumptions were also identified, to determine their validity under plausible future circumstances. The forward-thinking nature of foresight provides a powerful context to identify potential future challenges and opportunities in watershed governance, develop more robust and resilient policy, and ultimately improve the protection of the watershed.

7.1.1. SYSTEM ASSUMPTIONS

At the outset of the foresight analysis process, 84 commonly held assumptions were identified by ECCC that were either embedded in the Study, or that are currently

influencing policy makers. The assumptions that were identified covered themes such as motivation for change in watershed governance, the roles of various authorities (including government), and how watershed health is assessed, amongst others. Examples of assumptions include:

- collaboration within the Ottawa River watershed needs to be improved;
- a healthy environment enhances the quality of life for all;
- sustainable economic development requires a healthy environment; and
- public desires openness and transparency in the sharing of data; and sufficient baseline data is available to diagnose watershed health.

Assumptions shape perceptions and influence decisions, and are therefore one of the fundamental building blocks of creating mental models of the system of study. Defining, and eventually testing assumptions, is a strategic point of intervention in foresight analysis to gain a better understanding of the system of study, and to identify where policy weaknesses may exist (Policy Horizons Canada, 2016). In section 7.1.4, the validity of ten commonly held assumptions identified by ECCC, are tested.

7.1.2. CHANGE DRIVERS

Change drivers are weak signals that could disrupt at least one of the system elements of the Ottawa River watershed in the next 15 years. ECCC scanned domestic and international media, industry reports, academic journals, amongst other sources of information, to identify seven change drivers across the three sub-themes: disruptive technologies, shifting ideologies, and new economic interests.

DISRUPTIVE TECHNOLOGIES

WIRELESS WATER MONITORING SENSORS AND SATELLITE COMMUNICATION

ECCC undertakes a number of initiatives to address environmental issues in Canada, one of which is to conduct science-based research to facilitate policy and regulatory development (Government of Canada, 2017a). Access to current and reliable data is central to science-based decision-making, which requires extensive monitoring and reporting. Data acquired from water monitoring, for example, is one of the many sources of information that contributes to decision-making in the Ottawa River watershed. Conventional water monitoring processes are labour and time intensive, relying on manual sample collection followed by laboratory testing and analysis, which limits timely or proactive responses to concerns in the watershed (Pule, Yahya, & Chuma, 2017). To overcome the limitations of conventional water monitoring, substantial investment is being made to develop wireless sensor technologies that offer remote, real-time data collection with minimal human intervention.

BCC Research anticipates that the global market for water quality sensors will reach USD $4.6 billion by 2022 (approximately $6.1 billion Canadian (CDN)), with groundwater and surface water monitoring making up the largest section of the market (Kumar, 2018).

Recent advances in water monitoring technology offer continuous, multi-parameter in-situ measurements of water quality indicators, such as nitrate, turbidity, and suspended solids. Real-time results can be communicated through a range of interfaces, enabling early identification and response to threats.

Similar to the market for water quality monitoring technology, the market for satellite communications technology is also growing globally. BCC Research anticipates that the global market for satellite communication technology should reach USD $7.5 billion (approximately CDN $9.9 billion) by 2022 (Guarev, 2018). Growth in the field of satellite communications technology has many implications for environmental monitoring, including improved communication with remote areas that have an absence of wired networks, real-time data transfer and information sharing, and monitoring of fixed or changing features.

Widespread adoption of sensor and satellite technologies to replace conventional water and environmental monitoring strategies is limited by affordability, large energy requirements to run automated sensors, and security concerns, amongst others. The projected growth of sensor and satellite industries could help alleviate these concerns in the future, introducing new opportunities and challenges that may disrupt conventional water and environmental monitoring in the Ottawa River watershed, and across Canada.

BLOCKCHAIN

Blockchain technology is a digital platform that authorizes and stores records or online transactions without the need for a central authority (Public Safety Canada, 2018). Blockchain can provide services, such as issuing licences, creating smart contracts, or processing payments for services upon completion. The traceability and authenticity of data stored in blockchain reduces the risk of fraud and compromise, as no one party can modify, delete or attach any records without all parties reaching consensus (Public Safety Canada, 2018). While initially designed for the cryptocurrency Bitcoin, the application of blockchain has proven much more versatile, with the potential to reach all fields, including the areas of water and environmental governance (Chapron, 2017).

Four areas where blockchain may provide opportunities relating to water and environmental governance is in ownership, traceability, incentives, and policymaking (Chapron, 2017). The technology can be used to certify and timestamp the existence of ownership of entities, such as land titles or data. The decentralized, open source and open access platform that blockchain runs on could be applicable to scenarios where data is being collected by multiple parties (Weisbord, 2018), as is currently the case for water quality monitoring in the Ottawa River watershed.

Joining blockchain technology with advances in sensor and satellite technologies may offer opportunities to improve on existing governance practices, such as tracking and reporting on energy or resource use, or could facilitate new strategies, such as offering incentives for sustainable behaviours (Chapron, 2017). Blockchain can help ensure that funds allocated for specific purposes, like conservation projects, are being used appropriately by tracking transactions, or establishing smart contracts that only release funds once project milestones are achieved (Chapron, 2017). Blockchain ensures that commitments are honoured in an immediate and verifiable manner, which facilitates the

creation of trust between all parties involved. The Canadian company GuildOne Inc., for example, is working to use blockchain technology to create smart contracts that would help build trust and strengthen relationships between Indigenous peoples and the energy sector.

Blockchain technology offers a realm of possibilities to water and environmental governance; however, widespread adoption may be limited by a number of factors, including concerns of network influence (one party gaining more than 50% of control of the network), and the role of human error in data input. Solving these challenges may facilitate the widespread adoption of the technology, and if accomplished, could change water and environmental governance in Canada.

ARTIFICIAL INTELLIGENCE

Advancements in sensor and satellite technologies are generating more data than ever before, helping researchers, industries, and decision-makers assess the health and predict the behaviours of species and ecosystems (Palminteri, 2018). The Government of Canada's Open Information initiative and other similar initiatives, have improved public access to data, helping to drive innovation and new solutions to environmental problems. A new challenge, however, has emerged alongside recent progress in data availability: how to manage and interpret large amounts of information. Various tools are being developed to help resolve this issue, many of which involve the use of Artificial Intelligence (AI). AI is a subfield of computer science that uses programming to solve problems, by allowing computers to learn from prior experience, and interpret data and visual scenes (Public Safety Canada, 2018).

The application of AI to analyze large datasets and help solve water and environmental challenges has already begun. Programs have been written to address a number of environmental issues, such as classifying land use through satellite imagery (Zhang & Roy, 2017), using environmental input factors (e.g., ecology, precipitation, temperature) to predict the migration of vector-borne diseases (Hwang, Clarite, Elijorde, Gerardo, & Byun, 2016), and helping decision-makers respond to invasive species (Xiao, Greiner, & Lewis, 2018). In the latter example, researchers at the University of Alberta developed an algorithm that identified patterns from 143 documented attempts to eradicate invasive species, by assessing the environment, the type of invader, and the mitigation method used in each prior attempt. The program uses these patterns to predict an outcome of various eradication strategies on a given environment, to help decision-makers identify the best course of action (Xiao, Greiner, & Lewis, 2018).

The implementation of AI in water and environmental governance could change how decisions are made in the future. Although there has been progress in the field of AI, a number of limitations to widespread adoption remain. To identify patterns and make recommendations, many AI programs require access to substantial amounts of data. Data availability is improving; however, it remains a limitation to AI, particularly for remote areas. Another risk to AI is hidden biases from the data used to train the system (Brynjolfsson & Mcafee, 2017). With the continued advancement of sensor, satellite, and blockchain technologies, it is conceivable that some of these limitations may be alleviated in the future, providing more opportunities for AI to contribute to water and environmental governance.

SHIFTS IN IDEOLOGY

RECOGNITION OF INDIGENOUS RIGHTS

The federal government has made it a priority to renew the relationship between the Government of Canada and Indigenous peoples. In doing so, the Government is making recognition and implementation of the rights of Indigenous peoples the basis for all relations between Indigenous peoples and the federal government (Government of Canada, 2018a). Chapter 5 outlines the actions and principles that guide the federal government's commitment to a renewed, nation-to-nation relationship.

In recognition of the importance of a renewed relationship with Indigenous peoples, various industries have started to prepare for how strengthened rights of Indigenous groups may influence how their businesses operate. The Residential and Civil Construction Alliance of Ontario for example, suggested in their 2016 Megatrends report on the *Impact of Infrastructure on Ontario's and Canada's Future*, that growing legal recognition of the rights of Indigenous peoples in Canada will likely increase demand for infrastructure to serve remote communities (Fenn, 2016). The Megatrends report notes that the widened scope of Indigenous rights in connection with traditional lands will likely subject infrastructure projects to new conditions and timing, particularly due to the enhanced need for consultation and/or community benefit agreements for projects affecting traditional Indigenous lands (Fenn, 2016).

Recognition of the value of incorporating Indigenous perspectives into environmental and water governance is not exclusive to Canada, as many other countries are working with Indigenous groups to facilitate better management of the environment. As a means of shared governance and territorial management, the governments of Australia, Brazil, New Zealand, and Ecuador have granted Indigenous groups control over how to conduct biodiversity conservation on their own land through recognized Indigenous Protected Areas (IPAs) (Porta, Racine, & Vaughan, 2017). IPAs deliver environmental, cultural, social, health and well-being, and economic benefits to Indigenous peoples, while preserving heritage and providing training and education opportunities for Indigenous peoples in remote areas (Porta, Racine, & Vaughan, 2017).

RECOGNITION OF THE VALUE OF ECOSYSTEM SERVICES

As described in section 3.2.1, ecosystem services are outputs and attributes of ecosystems that in some way provide value to humans (Epanchin-Niell, et al., 2018). Systemic failure to recognize the value in maintaining healthy ecosystems to provide these services has contributed to a global decline in biodiversity (TEEB, 2008). As discussed in section 3.2, value has historically been assigned to ecosystems primarily based on the provisioning services they provide, such as the production of fish or timber, which is largely defined by market demand for the product (Federal, Provincial and Territorial Governments of Canada, 2010). More recently, however, the non-market value of ecosystem services is being realized, partially attributed to the recognised impacts of climate change, and the depletion of natural resources, on both humans and the environment.

Recognition of the non-market value of ecosystem services is emerging through numerous fields, which in some cases is leading to fundamental shifts in the way the environment is being protected. For example, a Finnish study found that countries that exhibit annual increases in forest growth tend to score higher on the UN's Human Development Index (Kauppi, Sandström, & Lipponen, 2018). In this instance, value is being created by conserving resources, rather than exploiting them, leading to improvements in human well-being. Recognition of the value of ecosystem services has also led to cases where rivers have been granted the same legal rights as humans, in an effort to curb pollution and preserve the resource (Safi, 2017), as was introduced in chapter 5. These types of movements promote the sustainable management of resources, and suggest a growing recognition for the intrinsic value in protecting ecosystems.

NEW ECONOMIC INTERESTS

INNOVATIVE INSURANCE POLICIES

The effects of climate change on property and critical infrastructure can be detrimental to individuals, business owners, and governments alike (Nottingham & Yeo, 2018). The costs of natural disasters in Canada, measured through Disaster Financial Assistance Arrangement payments and insurance claims, has increased in recent decades (IBC, 2015).

Since the 1900s, floods have accounted for 40% of natural disasters in Canada, which is more than twice as frequent as the next most-common disaster (Insurance Bureau of Canada, 2015). From 1983-2008, Canadian insurers faced annual claims on natural disaster relief ranging from CDN $200-500 million; however, since 2009 annual claims have consistently exceeded CDN $1 billion (Insurance Bureau of Canada, 2015). The number of flood disasters (floods with major impacts on people and assets) around the world nearly doubled in the decades before and after the year 2000, largely due to increased flood risk from urbanization, population increases, and development in flood hazard-prone areas (Keating, et al., 2014).

In response to the risks that climate change poses on property owners, new insurance policies are emerging to cover weather related threats that previously could not be covered. In May 2018, for example, Canada's first storm surge insurance plan was introduced to homeowners in British Columbia and Nova Scotia (Adriano, 2018). In addition to the recognition of the risk that climate change poses on human infrastructure, the growing recognition of the value of ecosystem services has also led to an emerging trend in insurance policies. In Mexico's state of Quintana Roo, for example, conservation funds collected by the tourism industry are partially being used to purchase an insurance policy to protect coral reefs in the Cancun and Puerto Morelos areas (The Nature Conservancy, 2018). Coral reefs can reduce wave energy by 97% before reaching the shore, protecting coastal communities and industries from the effects of severe storms (The Nature Conservancy, 2018). This innovative policy contributes to the protection of the region's USD $10 billion tourism industry (approximately CDN $13 billion), while conserving a valuable natural asset, and potentially signaling a shift in conservation strategies globally.

WATER AS A COMMODITY

Water prices in Canada largely reflect a perception that freshwater is abundant throughout the country, as on average Canadians are charged approximately one-quarter of European water prices, and about three-quarters of American domestic and industrial prices. Internationally, climate, geography, conflict, and instability, all play large roles in the distribution and access to water resources.

Many dimensions of the UN's Sustainable Development Goals, including health, food security, and poverty reduction, are contingent on access to freshwater in sufficient quality and quantity. However, in 2015, 844 million people lacked access to basic water services to provide freshwater, and 2.3 billion people lacked access to basic sanitation services (UN, 2018). Many countries that have water security concerns face further challenges from inadequate infrastructure leading to water loss through leakage, and water theft via illegal wells and pipelines that divert water for private sale (Felbab-Brown, 2017). For example, the cities of Karachi, Pakistan, and Delhi, India, lose 30 to 35% of water annually, due to inadequate infrastructure and theft (Felbab-Brown, 2017). The sale of illegally sourced, untreated water in India has created a black market for water worth millions of dollars, diverting funds from the government, and limiting their ability to respond to the threats that contribute to, and are associated with water shortages (Felbab-Brown, 2017).

It is important to note that water abundance doesn't necessarily negate the possibility of water theft. Brazil for example holds approximately 13% of the world's freshwater reserve, the most of any country in the world; however, 37% of water is lost annually, approximately half of which is to theft (Felbab-Brown, 2017). Although widespread cross-border water smuggling has not yet materialized, population growth, climate change, and unstable geopolitical relationships have contributed to the emergence of water theft and illegal trading in many areas around the world, which could be a signal of potential change in the future.

7.1.3. POTENTIAL IMPACTS ON THE WATERSHED

The purpose of identifying change drivers in foresight analysis is to uncover what impacts may come from the realization of those changes, and discern where a system may be vulnerable in the future. ECCC attempted to uncover these potential impacts by using the aforementioned change drivers to build insights about plausible futures for the Ottawa River watershed. Once insights were established, first, second and third order impacts were identified for each of the four key system elements (i.e., governance values, natural values, economic values, and social/cultural/heritage values). First order impacts are those that would immediately result from the realization of the insights identified, such as more data being generated from increased monitoring. Second order impacts are those that result from the realization of the first order impacts, for example, more data from monitoring would lead to better tracking of health indicators. Likewise, third order impacts are those resulting from the realization of second order impacts. Continuing with the previous example, this could be in the form of a better diagnosis of watershed health.

While it is difficult to discern with any certainty the likelihood or extent to which these change drivers may come to fruition, developing insights and identifying potential impacts is an important tool for policy development. Most policy research is focused on the expected future–that is, high probability, high impact developments that could disrupt operations (Policy Horizons Canada, 2016). The foresight method helps policy makers identify challenges and opportunities that are of low or unknown probability and potentially high impact, which are often discounted or unidentified (Policy Horizons Canada, 2016). Considering all plausible challenges and opportunities that could occur in the future, ultimately encourages more proactive policy development.

INSIGHT 1 – DISRUPTIVE TECHNOLOGIES

The introduction of new technologies into water governance has the potential to impact the Ottawa River watershed. Insights about the potential future of the watershed were developed based on the automation of water monitoring sensors, the introduction of blockchain technology in data sharing and collaboration, and the use of AI to help decision-makers organize data and prepare response plans to water-related concerns. Some of the potential opportunities identified from these insights include enhanced coordination and communication between stakeholders and jurisdictions; a better understanding of ecosystem services, water use, and anthropogenic impacts to the environment; and greater public awareness of environmental health. ECCC brainstormed that these changes could contribute to an improved ability to identify emerging concerns and protect resources in the watershed. As discussed in section 3.3, input from both stakeholders and Indigenous groups in the watershed revealed that many respondents are concerned that invasive species may affect water quality, ecosystems, wildlife populations and recreational opportunities in the watershed. The use of AI to identify, and help respond to invasive species, could prove useful in mitigating this concern in the future. Alongside these benefits, however, also come a number of challenges to water governance, such as the need for additional resources to respond to issues identified through enhanced monitoring, and the introduction of cyber security threats through automated “smart” technologies. These potential challenges may require policy intervention in the future.

INSIGHT 2 – SHIFTING IDEOLOGIES

Greater recognition of the rights of Indigenous peoples in Canada and the value of ecosystem services each have the potential to change water governance in the Ottawa River watershed. The insights developed from these change drivers led to the identification of a number of potential opportunities, including the potential to increase the incorporation of traditional knowledge into decision-making and the possibility to assign greater value to ecosystem services. Alongside these opportunities, ECCC brainstormed a number of potential challenges to water governance, such as an increasing need to negotiate data sharing arrangements, heightened public expectations of industries operating within the watershed, and conflict over views regarding best management practices between various authorities. Policy intervention may be required to respond to these challenges.

INSIGHT 3 – NEW ECONOMIC INTERESTS

The trends identified in this section contribute to numerous insights about plausible futures for the Ottawa River watershed. For example, the emergence of insurance policies to respond to the risks of climate change, particularly through concerns of overland flooding, could influence the lives of many Canadians, particularly those living in coastal, or flood prone areas. The Insurance Bureau of Canada estimated that damage caused by two extreme storm and flooding events in eastern Ontario and western Québec in April and May of 2017 resulted in more than CDN $223 million in insured damages (Insurance Bureau of Canada, 2017). The actual figure was likely much higher as most homeowners were not covered by overland flood insurance (Ottawa Business Journal, 2017). Emerging insurance policies may provide citizens with better protection from flood-related damages, could spur investment in climate resilient infrastructure, and could present challenges relating to insurance affordability and inequality in lower-income communities. Hence, increased availability of flood insurance in Canada will allow homeowners to transfer some portion of their flood risk to the financial markets.

Homeowners are not likely to be the only group affected by emerging insurance plans, as insurance plans that are implemented to protect ecosystem services could have substantial impacts on conservation and business strategies. The realization of a future where governments, watershed organizations, industries, or communities use insurance policies to protect various natural features may lead to a number of opportunities. ECCC brainstormed that these opportunities could include better ecosystem health and accountability for damages, an enhanced appreciation for the value of a healthy environment, and a strengthened relationship between the environment and the economy. One of the most notable challenges that ECCC discussed from this insight, relates to how value is assigned to ecosystem services.

The second change driver was the emergence of the threat of water theft and illegal trade, which presents a number of potential challenges to water governance in Canada. Scarcity and affordability are the two drivers of present water theft around the world. While ECCC doesn't anticipate that this will become a nation-wide concern in the near future, regional water scarcity induced by drought, over-exploitation of groundwater reservoirs in regions of increased industry or agricultural activity, or widespread infrastructure failures induced by natural disasters, could introduce localized water stress in the future. China, for example, has imposed restrictions on water consumption in certain geographic regions where water scarcity is a concern, which has led to requirements to import water from more water-rich regions (Xu, 2018). The challenges of regional water scarcity, and the threat of water theft or illegal trade, may justify global policy action in the future to introduce an emergency water network to re-distribute water to stressed areas, or increase monitoring and enforcement should illegal trade become prevalent.

7.1.4. TESTING ASSUMPTIONS

To respond to potential changes that may occur in the Ottawa River watershed, it is important to examine the fundamental assumptions that currently underlie water and

environmental policies in Canada and make revisions accordingly (Policy Horizons Canada, 2016). Figure 7.1-1 presents a sample of the potential relationships between change drivers, and commonly held assumptions that underlie current policy. Assumptions that remain valid in futures where change drivers are realised, are viewed as being credible and should guide planning in the future (Policy Horizons Canada, 2016). Those assumptions that remain uncertain may require further research to verify their validity, while those that are vulnerable should be reconsidered (Policy Horizons Canada, 2016). The degree to which any one driver may affirm, or refute the assumptions presented remains uncertain; however, identifying potential relationships and weaknesses is the first step to preparing for plausible futures.

One of the system assumptions that ECCC identified was that there is a lack of awareness regarding the value of ecosystem services. This assumption may need to be re-evaluated based on the role of emerging change drivers. The weak signals that contributed to the establishment of the change driver: innovative insurance policies, such as the Quintana Roo coral reef insurance plan, suggest that industries are beginning to recognize that the health of the environment is fundamental to the sustainable operation of their businesses.

The relationship between the change driver, monitoring technologies, and the system assumption that it will become increasingly expensive to manage the watershed, is a slightly more complicated example of an assumption that may need to be reconsidered in future policy design. Autonomous monitoring technologies are becoming increasingly affordable, and resilient to various weather conditions, suggesting that widespread adoption may be attainable in the relatively near future. Should an autonomous monitoring program be implemented in the Ottawa River watershed, it is reasonable to assume that the up-front cost could be substantial. Examples of the costs associated with such a program could include the installation and maintenance of new monitors, the establishment of a program to manage the data, and perhaps the creation of a team to respond to threats identified through enhanced monitoring. These costs initially suggest that the assumption is valid; however, it is also important to consider the costs of failing to improve monitoring in the watershed. The benefits of increased monitoring capacity through autonomous sensor technologies could help identify threats in the watershed that would otherwise go undetected. The availability of this data could lead to an increase of the frequency of pollution related fines, which could reduce environment-induced health-related costs.

Foresight Analysis is an effective tool to identify potential policy problems on an approximately 15 year time horizon. The change drivers and insights identified are not intended to be predictive, but rather provide an evidence-based platform to begin thinking about future challenges and opportunities. By identifying change drivers and developing insights about plausible futures for the watershed, ECCC is better positioned to identify trends and potential threats. The foresight process has also helped ECCC to identify potential opportunities to enhance collaboration and the adoption of IWM principles in the watershed. These opportunities are discussed in section 7.2.

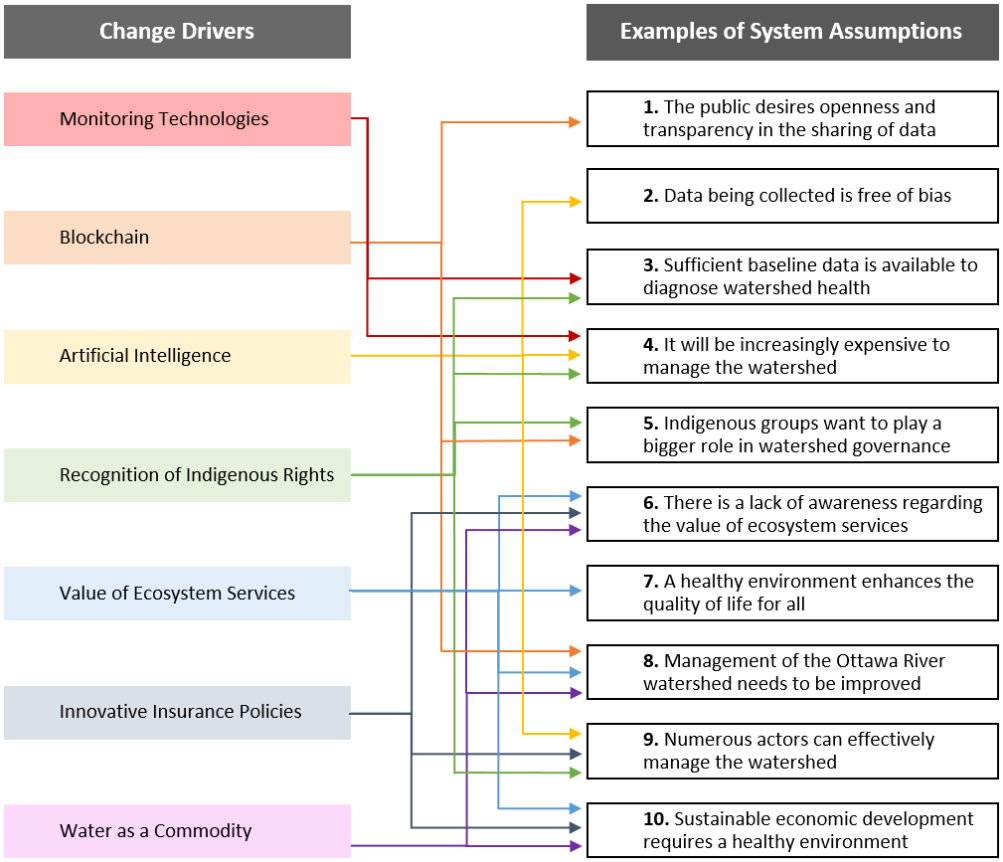


FIGURE 7.1-1. Change drivers that may disrupt commonly held assumptions related to the Ottawa River watershed.

7.2. OPPORTUNITIES WITHIN THE WATERSHED

As discussed previously, there are multiple challenges in achieving IWM and collaboration in the Ottawa River watershed (see chapter 6). These challenges limit the overall ability to ensure collaborative management and protect natural, economic, cultural, and heritage values. Indigenous consultation, stakeholder and public engagement, literature reviews and foresight analysis have helped ECCC to identify some current gaps, and articulate where opportunities may exist. Opportunities have been categorized into six themes: collaboration, the role of Indigenous Nations and collectives, strategic planning, information sharing and accessibility, monitoring and data, and watershed knowledge.

7.2.1. COLLABORATION

Feedback received throughout the ORWS highlighted challenges in coordinating across multiple jurisdictions and stakeholder groups within the watershed. Challenges associated with collaboration were often perceived to be due to lack of a knowledge and

information sharing platform, the absence of a central watershed-specific governance structure, and language barriers. Many respondents also expressed that there were gaps regarding strategies, incentives and/or opportunities to ensure more effective communication within and between orders of government, including with Indigenous peoples and stakeholder groups. Some groups also stated that stakeholder groups and/or local communities were not sufficiently being engaged in existing collaborative efforts. The leveraging of local universities and others with specialized knowledge was noted as a gap. Respondents noted that there are multiple universities in the region with expertise that could provide information on the watershed.

Overall, there was general consensus amongst respondents that there was a need, and an opportunity, to improve collaboration within the watershed. Various stakeholder and Indigenous groups demonstrated an interest and willingness to be involved in new collaborative processes. Of note, many respondents expressed that funding may be necessary to support some groups and individuals, so that they are able to meaningfully participate. Many respondents agreed that opportunities to create a new collaborative body or Council should be explored further. Respondents generally suggested that a potential Council should have broad membership, remain politically neutral, and make decisions based on consensus. In addition, based on expressions of interest made during the engagement process of the ORWS, there may be an opportunity to include youth to a greater extent in collaborative initiatives concerning the Ottawa River watershed.

7.2.2. THE ROLE OF INDIGENOUS NATIONS AND COLLECTIVES

All of the Indigenous groups consulted highlighted gaps in the involvement of Indigenous Nations and collectives in existing water-related decision-making, monitoring, and stewardship initiatives within the Ottawa River watershed. The Algonquin Anishinabeg Nation, for example, noted that management activities related to groundwater and surface water are currently inadequate, and that Indigenous knowledge should be valued more greatly. Many other Indigenous groups echoed similar concerns regarding the inclusion of Indigenous knowledge in management practices, such as research and assessments. Algonquin Anishinabeg Nation and Algonquin Nation Secretariat highlighted that current watershed management activities do not recognize the rights and related interests of Indigenous peoples, and that past consultations undertaken by the Crown and industry lacked legitimacy, as input was not taken into account (Algonquin Anishinabeg Nation Tribal Council, 2018; Kitchisibi Ikidowin Anishinabe, 2018).

All Indigenous groups consulted felt there are also opportunities to include Indigenous knowledge to a greater extent in Ottawa River watershed initiatives and decision-making processes. They all expressed that they hold and collect valuable traditional knowledge, which has the potential to inform decision-making. Algonquins of Ontario recommended that an education endowment be established to support development of internal capacity, and Algonquin Nation Tribal Council recommended that “youth receive some type of educational awareness within schools. Youth need to be involved in solving the problem” (Algonquin Anishinabeg Nation Tribal Council, 2018). The provinces of Ontario and Québec, for example, have water, watershed and/or wetlands issues built into their

secondary level curriculums (Ministry of Education, Ontario, 2017; Ministère de l'Éducation et de l'Enseignement supérieur, n.d.). Indigenous youth surveyed through one independent consultation demonstrated a concern and interest in water issues, while a separate Indigenous report stated that indigenous youth should be encouraged to pursue environment and/or scientific fields, as they would have the unique potential and capacity to conduct scientific testing, while coming from a background of rich Indigenous knowledge.

There is a clear opportunity and desire from Indigenous groups to collaborate with federal, provincial and municipal governments to conserve of the Ottawa River watershed. A potential new collaborative body was viewed as an important opportunity to recognize Indigenous rights and related interests in the management of the Ottawa River watershed, perhaps most notably, a step towards meaningful consultation practices. All Indigenous groups consulted proposed possible governance approaches, in varying detail (see section 5.4 and 6.2). Other unique opportunities for greater Indigenous involvement, identified during the foresight analysis for the ORWS, included the development of Indigenous Protected Areas (see section 7.1) and the granting of legal personhood to water bodies (identified by the Algonquin Nation Secretariat and detailed in sectioa

7.2.3. STRATEGIC PLANNING

There is a global consensus that effective watershed management requires some form of a strategic plan, framework, and/or guiding principles (Wang et al., 2016; CCME, 2016; ECCC, 2010; Brandes & O'Riordan, 2014). This report presented various best practices and guiding principles, notably the 11 CCME IWM principles (section 5.2). Additionally, success factors of existing watershed management bodies were described in Chapter 5. Although the combined geographic scope of activities led by CAs and OBVs covers much of the extent of the Ottawa River watershed, the combined scope does not cover the watershed in its entirety. Further, members of the public and Indigenous groups stressed the need for a comprehensive plan or strategy that is tailored to the Ottawa River watershed. Algonquin Nation Tribal Council (2018), for example, noted the need for a "comprehensive and solid action plan to ensure the preservation and protection of the ecological health of the Ottawa River and surrounding area, which would encompass both the surface water and the groundwater".

There may be an opportunity to develop a strategic plan for the Ottawa River watershed, given the significant demand expressed by key stakeholder groups and Indigenous peoples. Many viewed strategic planning as an opportunity to strengthen collective responsibility in the watershed, better recognize pressing issues affecting the watershed, and or highlight natural, economic, cultural and heritage values associated with the watershed. Many Indigenous groups stressed the desire for such plans to be co-developed with Indigenous communities, in order to ensure that their views are acknowledged and respected.

7.2.4. INFORMATION SHARING AND ACCESSIBILITY

As was discussed in Chapter 4, one of the primary challenges identified through engagement on the ORWS is the absence of a central data-sharing mechanism, such as an online platform, to exchange information about the health of the watershed. Those who provided feedback frequently cited concerns regarding difficulty in finding information about the status and health of the watershed. One township indicated that there is lots of data and information already being collected by various branches of government, and other organizations; however, not all parties are aware of the extent of data that others are already collecting (Public and Stakeholder consultations, 2018). Respondents on PlaceSpeak and in engagement guides also noted a lack of information on, and awareness of how individual actions could potentially impact the watershed, with some respondents linking lack of awareness and education to irresponsible behaviors.

Addressing information sharing challenges presents a number of opportunities to improve collaboration and understanding about the health of the Ottawa River watershed. Many respondents viewed improving communication and transparency as an effective mechanism to improving the overall understanding of the health of the watershed (Public and Stakeholder consultations, 2018). Some respondents called for the creation of a place for information sharing, such as a data portal or central platform, to host information that is being collected in the watershed (Public and Stakeholder consultations, 2018).

7.2.5. MONITORING AND DATA

In addition to challenges in data accessibility and the capacity to share data, engagement on the ORWS showed that many individuals perceive there to be gaps in current monitoring and data collection activities. Some respondents indicated that across the watershed monitoring is fragmented as differing types of indicators are being monitored, there are different protocols in place to assess indicators, and some data is out-of-date (Public and Stakeholder consultations, 2018). Many groups cited that gaps in monitoring were due to capacity and resource constraints, as well as a lack of communication.

In addition, a perceived lack of standardization across the Ottawa River watershed has led to concerns related to compatibility, comparability, and sometimes even credibility of previously collected data. It was also suggested that the development of monitoring priorities, protocols, and indicators could help identify where there are additional gaps, duplication, or opportunities.

7.2.6. COMPREHENSIVE BASELINE WATERSHED KNOWLEDGE

Much of the feedback received through the ORWS suggested that inconsistent monitoring and insufficient access to information are limiting the ability to assess the health and socio-economic conditions of the Ottawa River watershed. There is a perception that inadequate baseline data in many regions of the watershed has made

tracking trends in watershed health difficult, a product of both insufficient monitoring and oversight of the Indigenous knowledge held by Indigenous peoples (Algonquin Anishinabeg Nation Tribal Council, 2018; Kitchisibi Ikidowin Anishinabe, 2018; Richardson, 2018 PlaceSpeak consultations, 2018). In addition, respondents suggested that there is a lack of socio-economic data being collected, leading to gaps in understanding the values associated with the watershed.As indicated in section 4.4, many respondents suggested that adopting a whole-of-watershed approach could improve our understanding of ecological functions, such as hydrologic connectivity. Several Indigenous groups also highlighted other potential opportunities for further work in the watershed. The Mohawk Council of Kahnawá:ke suggested that a Regional Impact Assessment could be conducted to assess the current state of the watershed and the impacts of current activities on humans and wildlife, as well as to identify priority areas for improvements, and to determine the carrying capacity of the watershed for additional development (Mohawk Council of Kahnawá:ke, 2018). Similar input from the Algonquin Anishinabeg Nation suggested there is an opportunity to conduct a cumulative effects assessment to determine the extent of impacts that pollutants and human activities have had, and will have, on the environment (Algonquin Anishinabeg Nation Tribal Council, 2018).

> "The natural heritage features in the upper portions of the watershed support species diversity and water based tourism although values are not well documented" - Public and Stakeholder consultations, 2018

CONCLUSION

The intention of the Study was to provide an overview of the economic, cultural, heritage and natural values associated with the Ottawa River watershed, based on Motion M-104. This included identifying possible threats to those values; the existing and potential indicators for assessing the health of the Ottawa River watershed; and the barriers to effective management of the Ottawa River watershed, as well as opportunities to enhance collaboration within the watershed moving forward. Through stakeholder engagement, Indigenous consultation, and review of existing reports and academic articles, various themes and views emerged.

The Ottawa River watershed region has a rich history; notably, the watershed has been home to Indigenous populations for numerous generations. The Ottawa River and its many tributaries were also vital to the exploration and settlement of Canada, and the eventual growth of the National Capital Region. Today, the watershed provides numerous services to over two million people. Urban and rural forests, wetlands, grasslands and freshwater systems provide vital services; notably air and water filtration, flood and erosion control, carbon sequestration and waste treatment. Maintaining health of the Ottawa River watershed also contributes to economic growth and quality of life; water flow in multiple rivers is harnessed to generate power for the region, while forestry, mining and other industries rely on the region's natural resources. Throughout public engagement and Indigenous consultation, respondents expressed appreciation for the regions diverse landscapes and services, with recreational opportunities, aesthetics, spiritual activities, and a diversity of wildlife were valued by both residents and visitors.

The monitoring of the Ottawa River watershed involves multiple organizations with over 75 different groups or programs currently engaged in monitoring and/or data collection activities. Similar to monitoring, the management of the watershed involves multiple jurisdictions and diverse identity groups, including groups whose primary interests in the watershed don't necessarily align. Insufficient communication and coordination among groups and lack of standardized approaches were frequently mentioned as problems throughout the engagement process, with many respondents noting that these deficiencies threatened the ecological health of the watershed. Through the engagement process, several perceived threats to values and to the health of the watershed were raised. It was felt by many respondents that management and monitoring of the Ottawa River watershed is disjointed, leading to duplication, gaps and inefficiencies in monitoring, data collection, conservation, and management. Others expressed concerns regarding poor water quality, declining levels of biodiversity, risk of flood, industrial releases, among other issues.

To address concerns raised about coordination, information sharing, and potential gaps in scientific information in the Ottawa River watershed, the formation of a new collaborative body was identified by some participants in the study as a potential path forward. Respondents indicated that such a mechanism could be supported by a strategic framework and IWM principles. Notably, improved integration of Indigenous knowledge, collection and sharing of data and identification of appropriate watershed health indicators, were highlighted through public engagement and Indigenous consultation as a way to identify gaps and duplication, while assisting in the development of baseline health conditions. It was found through a foresight exercise that analysis of emerging technologies and shifting ideologies may be valuable in

addressing potential future challenges and recognizing prospects for improved stewardship, governance and innovation within the watershed.

ORWS participants identified various potential pathways to leverage opportunities and to overcome present and future challenges through building on past and current initiatives within the Ottawa River watershed.

Below is a summary of the suggestions identified through the engagement, consultation and research processes for the ORWS.

1. Enhanced collaboration, communication and information sharing among interested groups.

The main suggestion was:

- A collaborative body (various names were recommended through the engagement process including Ottawa River Watershed Roundtable and Ottawa River Watershed Council)

2. Improved involvement of Indigenous peoples, and incorporation of traditional knowledge.

Strategies proposed to enhance involvement included:

- Meaningful consultation of Indigenous groups and improved incorporation of their views
- Opportunities for monitoring and gathering of information on the watershed by Indigenous communities directly
- A balancing of scientific knowledge with traditional knowledge

3. Opportunity to develop a strategic plan to propose a clear vision, common goals and guiding principles.

Stakeholders noted that a strategic plan could be developed through:

- Consideration of CCME IWM principles
- Analysis of existing frameworks of other watershed bodies both domestically and internationally

4. Potential to improve coordination of monitoring, data collection and use of scientific and socio-economic data to improve watershed knowledge:

- Academics and stakeholders noted that standardized data and monitoring requirements were necessary, as was
- use of a “whole of watershed” approach

5. Opportunity to improve information sharing and accessibility of information regarding the watershed. Participants noted this could be facilitated by:

- A central knowledge and data sharing platform

THANK YOU

ECCC hopes that this report will contribute to the knowledge base about the Ottawa River watershed, and that it will support dialogue on how to promote the long-term sustainability of the Ottawa River watershed. Parts of this report will also add to the discourse about watershed management and collaboration across Canada.

This report would not have been possible without input from Indigenous communities, the provinces of Québec and Ontario, municipalities, Conservation Authorities, Organismes de bassins versants, non-governmental organizations, businesses, stakeholder associations, youth and individual citizens. Thank you for your contributions and for your genuine concern and passion regarding the protection of the Ottawa River watershed