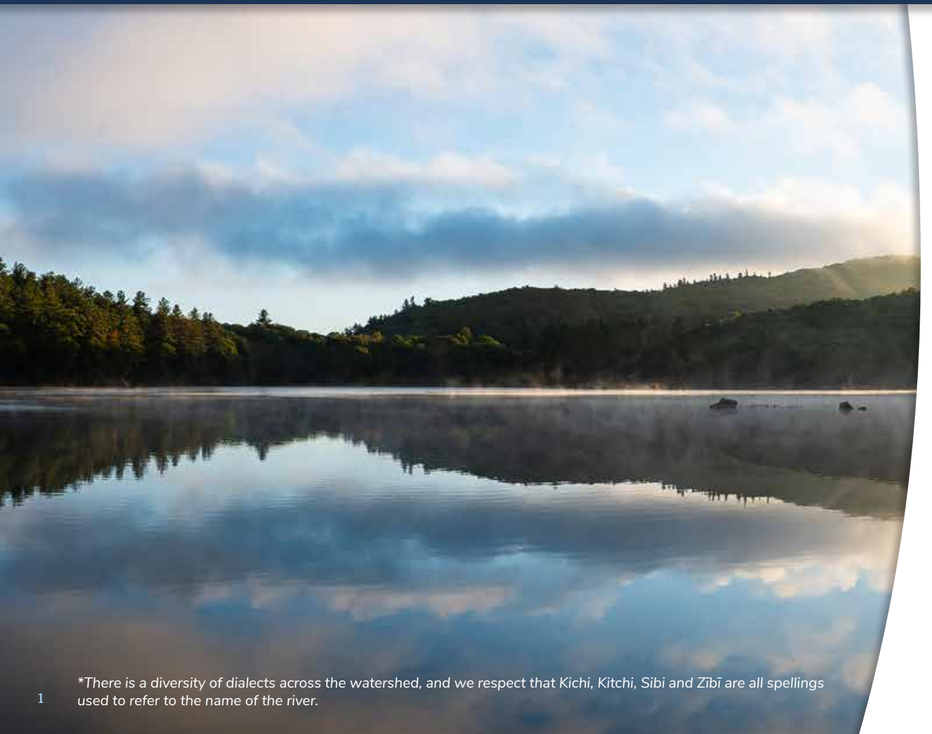
Ottawa Riverkeeper's

Watershed Report Card

2024

The watershed of the Kichi Zībī, known in English as the Ottawa River, is located on the unceded territories of the Anishinābeg Algonquin Nation. The people of the Anishinābeg Algonquin Nation are the traditional and ongoing stewards of these lands and waters.*

Ottawa Riverkeeper recognizes the legacy of colonialism that continues to have profound impacts on the rights of Algonquin people, and that there is urgent need for meaningful actions that truly confront this legacy.



**There is a diversity of dialects across the watershed, and we respect that Kichi, Kitchi, Sibi and Zībī are all spellings used to refer to the name of the river.*

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Ottawa Riverkeeper

Ottawa RIVERKEEPER®
GARDE-RIVIÈRE des Outaouais

Ottawa Riverkeeper is an independent, charitable organization that protects and promotes the ecological health of the Ottawa River and its tributaries. The organization was founded in 2001 and is a licensed member of the international Waterkeeper Alliance.

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Countless people have contributed their knowledge, analysis, and expertise on this report. A more complete list of acknowledgements, including funders and data sources, can be found at the end of this document.

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Left to right: Mark Bernards, Mark Bernards; Covers: Mark Bernards

About the Watershed

The Ottawa River is nested within the world's largest freshwater system, the Great Lakes-St. Lawrence watershed. On its own, the Ottawa River watershed has a surface area of more than twice that of New Brunswick and larger than many countries.

At a stunning length of 1,271 km, the Ottawa River is the largest tributary to the St. Lawrence River. Its flow can exceed that of all the Great Lakes combined.

The Ottawa River is a source of drinking water for over 2 million people. Its waters support an incredible diversity of flora and fauna such as river otters, sandhill cranes, Blanding's turtles, and lake sturgeon.

Why a Healthy Watershed Matters

All life depends on water. The health of our freshwater systems, in particular, must be safeguarded as an absolute priority. And yet, we cannot protect what we don't understand.

After years of research, this watershed report card is presented with the following key objective: to use the information contained within to protect our most precious asset, water.

A watershed is a natural border, defined by the area within which a single drop of rain will flow toward a body of water. In the Kichi Zībī (Ottawa River) watershed, we are all connected by this mighty river. And this river has a lot to tell us about how we're doing in our responsibility to care for the land and protect the water.

> ***"A river is a report card for its watershed."***
> *Alan Levere, Connecticut Department of Environmental Protection*

Though the footprint of the watershed is almost exactly the unceded and unsurrendered territory of the Anishinābeg Algonquin Nation, political and colonial borders now criss-cross the landscape. There are over 300 municipalities within, including the cities of Ottawa and Gatineau in the National Capital Region. The river itself has become a border between Quebec and Ontario for much of its length.

And yet, you cannot protect half a river.

This report card considers the ecological health of the region from a watershed perspective. The vast majority of this research is new, and the results are eye-opening. Some of the data used in the analysis has existed for decades, and yet this is the first time it is being analyzed with a watershed lens, thereby revealing findings that were previously unknown.

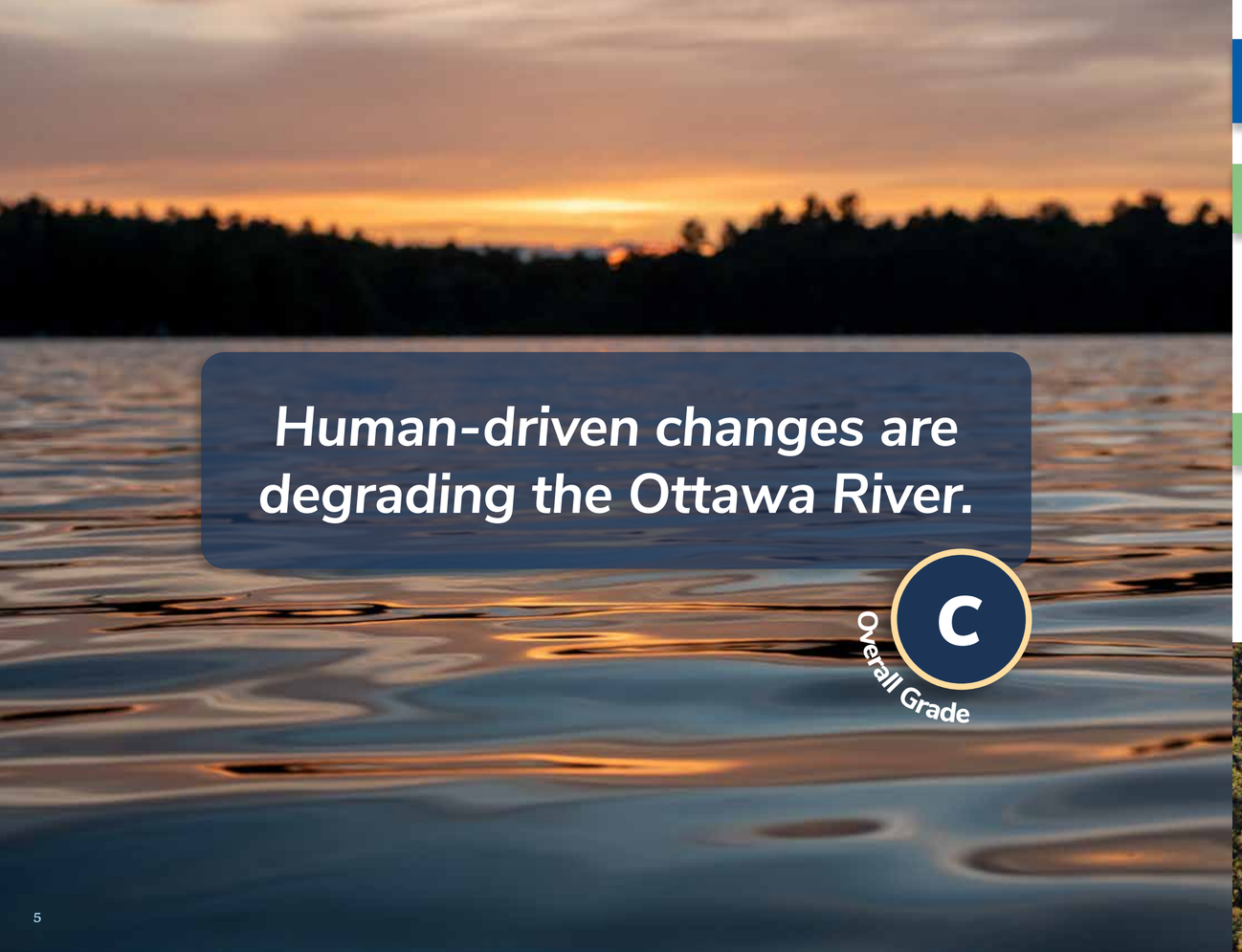
It is a complex task to measure the health of a watershed system. As water flows over the land, into rivers and lakes, any changes or threats ripple throughout an ecosystem. When one aspect of a watershed is pushed out of balance, the whole, both natural and human-built, suffers.

Political borders have fractured the reality of how these natural systems work. As a result, the Ottawa River has fallen between the cracks of political priorities. Ottawa Riverkeeper, an independent charity founded in 2001, quickly came to realize that the Ottawa River was a "data-poor" river, rarely looked at holistically through its natural borders.

In 2018, Ottawa Riverkeeper launched the Watershed Health Assessment & Monitoring initiative: a long-term, comprehensive project to understand 14 key indicators of watershed health and the intricate linkages between them. Through our data collection and monitoring, we have identified key areas of watershed health, tied them together, and looked for the ways that changes in one can cascade into others.

This watershed report card is the first complete assessment resulting from these efforts.

Figure 1. *Ottawa Riverkeeper's 14 indicators come together to paint a full picture of the current health of the Ottawa River and its watershed.*



Human-driven changes are degrading the Ottawa River.

C

Overall Grade

Health Snapshot

The health of the Ottawa River watershed is under threat from several sources:

- **Climate change** is altering seasonal cycles, including disrupting typical flow patterns and the timing of ice formation and breakup.
- Excess **nutrients** from agriculture, sewers, and other sources are destabilizing the base of the food web by accelerating the growth of primary producers.
- Human activity is introducing new **contaminants** which threaten the ecosystem, often in unknown ways

To combat these threats, decision-makers must take action:

- **Protect wetlands, forests, and healthy shorelines** to preserve flow patterns, filter excess nutrients, and preserve habitat
- **Promote healthy land use practices** to reduce the introduction of excess nutrients and contaminants
- **Regulate, mitigate, and track the spread of contaminants** to better understand and combat their effect

Left to right: Mark Bernards & Jeff Veselak, Unsplash

We have assessed four categories of watershed health and graded them based on the trends observed in their related indicators:

Primary Productivity

P

B-

Biodiversity

Hg

C+

Physical Characteristics

O_2

C-

Human Development

C-

What Has Changed?

The health of the watershed is under threat from recent human activity, notably through shifts in land use, development, and climate change. Not all regions of the watershed experience these impacts in the same way, which can pose a challenge when summarising overall patterns in watershed health. However, when taking a closer look at all the indicators we have assessed, several notable trends emerge. Here is a summary of the good, concerning, and bad news that Ottawa Riverkeeper has identified in this watershed report card.

✓ Good

- Combined Sewer Overflows in the Ottawa area - the watershed's largest and most populated metropolis - have significantly decreased thanks to the introduction of the City of Ottawa's Combined Sewage Storage Tunnel infrastructure project. Other municipalities in the region are also ***taking steps to mitigate sewer overflows***, reducing their detrimental impact on ecosystems.
- At a watershed scale, the region remains primarily forested. This is excellent news for the overall health of the rivers in the watershed,as ***forested land helps insulate freshwater ecosystems*** from threats.

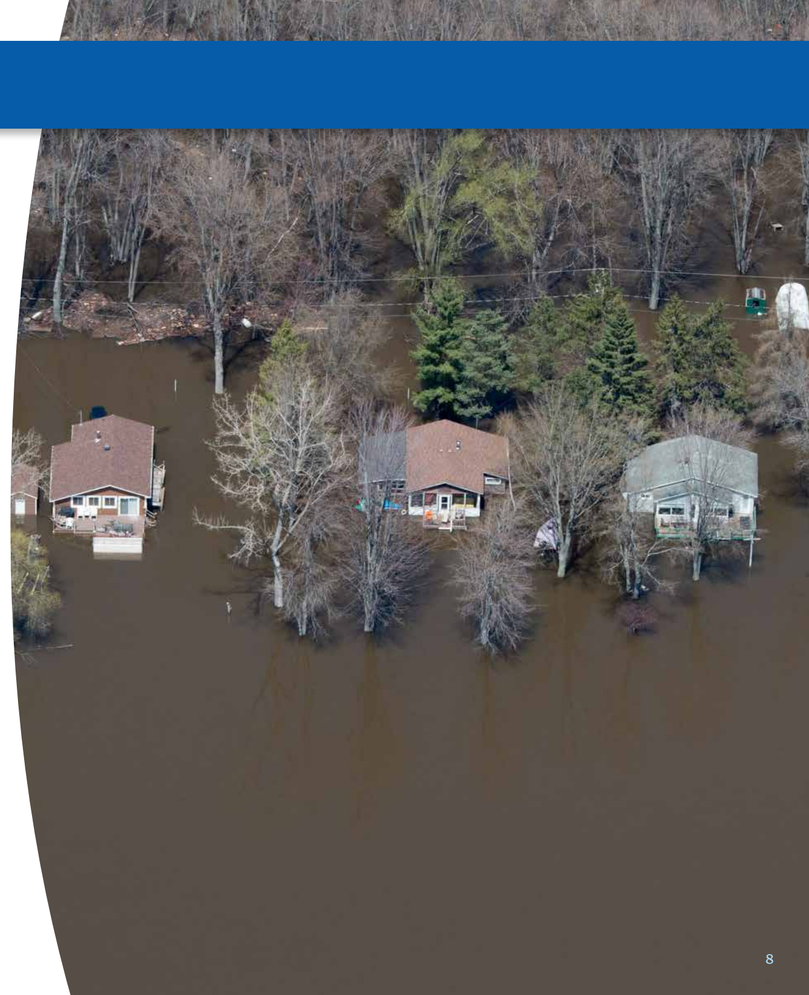
! Concerning

- An incredible number of fish species live in the Ottawa River watershed. This rich biodiversity is worth celebrating and protecting. However, ***fish populations are being severely affected*** by alterations to the physical characteristics of the watershed. Addressing these issues will ensure fish populations can be sustained. Additionally, current monitoring programs do not properly capture the variety of fish species present (or absent) due to the techniques used, making it even harder to track changes over time.
- Mercury levels in the Ottawa River are significantly higher than expected. Comparing the results to two areas impacted by industrial pollutants and contamination, Lake Ontario and Lake Saint Pierre (on the Saint Lawrence River), we found that ***the levels of mercury are consistently higher in the samples from the Ottawa River watershed***, which does not have comparable levels of industrial activity. While these levels are higher than expected, the average mercury levels remain below thresholds determined by consumption guidelines for 84% of species monitored. This remains a trend to monitor.
- Areas with extensive agricultural and urban land use in the watershed are disproportionately impacting water quality through runoff and wastewater discharge and increasing the amount of nutrients available in the river. ***Overloading of nutrients can be problematic for aquatic ecosystems*** as it can lead to excess plant growth and algal blooms, which can have localized negative impacts.

X Bad

- Flow patterns in the watershed are changing. There are two noticeable shifts. First, ***spring thaw and freshet are happening earlier in the year***. Earlier peak flows in the spring can disrupt established ecological cycles, as well as cause extreme flooding. The second shift is ***prolonged periods of low flows in the late summer***. Low flows can reduce habitat connectivity for aquatic species and result in higher water temperatures. Both changes were measured using 30-year time periods and are likely the result of climate change.
- Human development is adding ***many new contaminants*** to our watershed, some of which may have unknown consequences for ecosystems. Microplastics, per- and poly-fluoroalkyl substances (PFAS), road salt, and nuclear waste are just some of these contaminants, and others as of yet remain unknown. Testing, tracking, and monitoring for these contaminants is needed so these can be appropriately addressed.
- Anthropogenic, or human-caused, climate change is a known threat to the Ottawa River watershed. ***Climate change is already affecting the flow patterns of the river*** and will have a cascading negative impact on watershed health.

Left to right: Mark Bernards, Greg Marshall - Aerialphotographs.ca



Left to right: Mark Bernards, J K - Unsplash

Diving Deeper

Grading System

Ottawa Riverkeeper applied a variety of analytical techniques when developing the grading system for this Report Card. We consulted existing guides, such as WWF-Canada's *Technical protocol for the freshwater health assessment*, as well as the U.S. Environmental Protection Agency's Office of Water's *Recovery Potential Metrics Summary Forms*, to develop our grading system for the 14 watershed health indicators we analysed.

In each of the four categories explored in this Report Card, we gave each associated indicator equal weight in the grading process. This process assures that the analysis can be repeated consistently in the future. If an indicator lacked sufficient data, or the collected data hadn't yet been analyzed, these indicators were not included in the final grade. Where possible, we've included our expectations for how this new data or analysis might impact the final results. As we gather more data and complete more analyses, Ottawa Riverkeeper will provide updates and additional reports on these indicators.

Our grading scale is as follows:

A	B	C	D	F
>90%	89-75%	74-60%	59-50%	<49%

Primary Productivity — B-

Biodiversity — C+

Physical Characteristics — C-

Human Development — C-

Primary Productivity

Introduction

Primary productivity is the rate at which energy from the sun is converted into food through photosynthesis by the plants, algae, and phytoplankton living in aquatic ecosystems. These organisms are the crucial foundation for the ecosystem, sustaining all other species. Their growth and production in lakes and rivers are influenced by the presence of nutrients, such as phosphorus, which in turn profoundly influences the entire ecosystem.

Figure 2. This map of the Ottawa River watershed reveals a correlation between agricultural land use (highlighted regions) and observed algal blooms (depicted as points on the map).

Algal Blooms

Algae are a natural part of an aquatic ecosystem and provide an important base for the food web. However, when there is more algal growth than usual, algal blooms can appear. When these blooms increase in frequency and duration, they can damage ecosystems. These more severe blooms are often triggered by warm weather and an abundance of phosphorus. Algal blooms are expected to become more common as the effects of climate change are felt in the watershed and water temperatures rise.

The governments of Quebec and Ontario only track data on Blue-Green algal blooms, because these blooms can pose a significant health risk when they produce toxins. However, as an indicator of watershed health, it is important to track all types of algal blooms to better understand their frequency and the factors that may influence them. To have a better understanding of where algal blooms appear in the watershed, Ottawa Riverkeeper created a community-based monitoring program which encourages community scientists to track the presence of algal blooms throughout the summer and fall.

Given the relationship between excess phosphorus and algal blooms, we can see that blooms tend to be observed where there is a higher concentration of agricultural land in the watershed (see Figure 2).

There are multiple types of algal bloom. Ottawa Riverkeeper has received reports from community scientists about two types of blooms, those caused by Green algae which tend to appear as stringy or fluffy mats on the water, and those caused by Blue-Green algae (also called cyanobacteria) which tend to look more like spilled paint or soup.

Left to right: Wendy Ryan, Thibaut Petry

Primary Productivity

Total Phosphorus

Phosphorus is required for plant growth, including aquatic plants. Given that many species rely on plants and plant growth at different times in their life cycle, phosphorus levels can have massive impacts on an entire ecosystem. When too much phosphorus is present, more nutrients can accumulate in the downstream sections or a river system, contributing to excessive plant growth and algal blooms.

Adequate data on total phosphorus is not available for all sections of the watershed. For this reason, Ottawa Riverkeeper worked with community scientists who collected water samples throughout the spring and summer, helping to fill these data gaps. Samples were sent to a laboratory for analysis, and these results were compiled for this report.

How land is used around a body of water will impact the levels of phosphorus in the water. Data backs this up for the Ottawa River watershed as, in general, areas with a higher percentage of agricultural activities also have higher concentrations of total phosphorus (see Figure 3). The types of agricultural practices used can influence the amount of total phosphorus that runs off into rivers and streams and have a strong impact on the overall concentration of total phosphorus present in waterways.

Figure 3. Correlation between phosphorus levels and land use in the sub-watersheds of the Ottawa River.

Tamas Pap - Unsplash

Chlorophyll-a

Chlorophyll-a is a pigment that allows plants to photosynthesize. Measuring the presence of this pigment in the water gives a good indication of how productive an ecosystem is, and its ability to support further plant growth. A healthy ecosystem maintains a consistent range of Chlorophyll-a – not so low as to suggest a lack of plant growth, but not so high as to indicate an overgrowth of primary producers.

Government data for Chlorophyll-a is available throughout the portion of the Ottawa River watershed within Quebec, however, much less data is available from Ontario. Though Ottawa Riverkeeper launched an initial community-based monitoring project to track Chlorophyll-a and help fill these data gaps, there were significant challenges to its implementation. We are now considering new methodologies or approaches to gather comparable data in Ontario.

When analyzing the available data, it showed that the Ottawa River watershed has overwhelmingly good levels of Chlorophyll-a, at least on the Quebec side. Due to the correlation between phosphorus and plant growth, we anticipate that data from Ontario, where phosphorus levels are higher, would also have higher levels of Chlorophyll-a.

Findings

In regions with a high percentage of agricultural land use, such as the South Nation watershed and around Lake Temiskaming, there are higher total phosphorus concentrations. The same regions also displayed a high frequency of algal blooms. In addition, urban areas contribute total phosphorus through stormwater runoff, combined sewer overflows, and effluent from wastewater treatment plants.

While urban and agricultural land uses are contributing to an increasing number of persistent algal blooms, this negative trend can be turned around through actions that reduce the levels of nutrients entering rivers and streams. Climate change also needs to be considered, as the influx of nutrients will be harder to mitigate with more intense storms and warmer weather.

Grade **B-**

Introduction

Healthy aquatic ecosystems can support a wide range of species and organisms. A variety of fish, birds, reptiles and mammals can be observed throughout the watershed, while the small insects, bacteria, and molluscs are harder to spot, they also play important roles. The presence or absence of species can be a clue to the health of a river ecosystem and what stress it might be under, especially when changes are tracked over time.

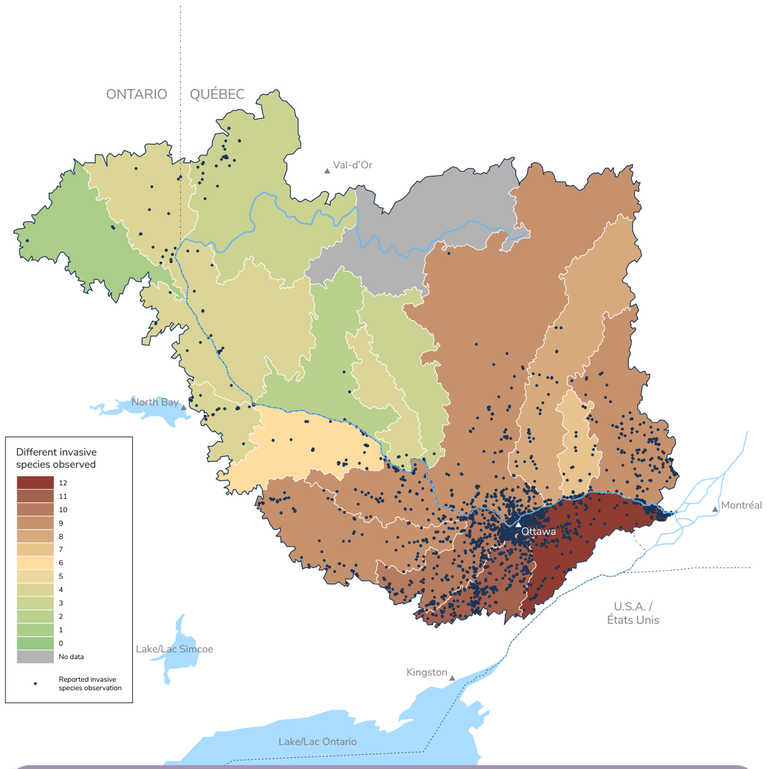


Figure 4. Invasive species observed in the Ottawa River watershed, showing their concentration in the southern reaches of the region.

Invasive Species

Invasive Species are a threat to native biodiversity. These are species introduced to a region where they were not naturally found, through intentional, unintentional, or accidental human activity, and that are known to be harmful to native biodiversity. They can outcompete local species for resources or predate on them directly. Therefore, despite seeming to add to the biodiversity of a region, introducing invasive species is often extremely detrimental to the overall health of ecosystems.

To collect data on the presence of invasive species, we developed an information guide, shared stories and information with community scientists, and used social media to drive interest in reporting invasive species to our website or on existing crowd-sourced sites people were already using. We then compiled the data to complete the analysis.

There was a higher diversity and number of invasive species reported in areas with large populations (see Figure 4). Of all the reports received, 65% came from the Rideau, Mississippi, and South Nation sub-watersheds. This predominance may be a result of reporting bias as areas with high population density may also have an increased likelihood of reporting. They may also be under more pressure as they are popular areas to boat and fish. Many aquatic species are easily transported from one region to the other through equipment or on boats if not properly cleaned.

Typically a newly introduced invasive species is quick to establish itself, and some come to dominate their new habitat. However, this does not always occur. While one very common aquatic invader, the zebra mussel, is present in the watershed, it is not often found in the Ottawa River itself. The waters that flow from the Canadian Shield do not have the nutrients, specifically the calcium, that this species needs to grow.

Invasive species include various organisms; some introduced plants and zooplankton can wreak havoc on the habitats of vulnerable species. For example, invasive phragmites (European Common Reed) reduce endangered turtle habitats in our watershed.

Another example is the spiny waterflea, which has been reported in the northern regions of the watershed. The spiny waterflea outcompetes the native zooplankton species. Fish species find it easier to eat the native zooplankton, therefore the fish have a harder time eating enough when spiny waterfleas are present.

Fish Richness

Fish Richness is measured by the number of fish species found in a given area. Available data from historical sources gives an estimate of 86 species of native fish within the Ottawa River.

The sampling of environmental DNA (eDNA) has emerged as a modern technique for measuring which species of fish are present in a body of water. Ottawa Riverkeeper collaborated with researchers from the University of Guelph's Centre for Biodiversity Genomics to collect over 500 samples of eDNA from Hudson to Ville Marie, Quebec to try and fill some of the data gaps in the existing fish data collected by Ontario's Ministry of Natural Resources and Forestry. Although the results from this eDNA sampling have yet to be analyzed, this method shows great potential to explain more about fish richness, especially concerning rare or harder-to-catch fish that have not been reported in recent years.

Habitat fragmentation has significantly altered the ability of fish to move through rivers within the Ottawa River watershed. This has had a devastating impact on American eels which can no longer migrate into or out of the Ottawa River, resulting in a 99% decline in their population and extirpation from the upper reaches of the river. Fragmentation also restricts the movement of lake sturgeon, a fish species which can migrate hundreds of kilometres during their lifespan.

Changes to fish communities, such as habitat loss and fragmentation or preferential fish harvesting, can alter the number and distribution of fish species present. When some of these species have a stronger influence on the river's ecosystem, this shift in fish communities can have additional impacts on the ecosystem and biodiversity overall.

Benthic Invertebrates

Benthic invertebrates are small animals that live at the bottom of rivers and lakes. These benthic species – leeches, small crustaceans, and the larval forms of insects – can have drastically different tolerances for pollution and allow for water quality to be considered over a longer time period. It can be challenging to be on a site to collect a water sample when a pollutant is present in the water, but the impact of these contaminants can be captured through the composition of the benthic invertebrates present. Monitoring reference sites can help to identify which species are found in a region and therefore is used as an indicator of water quality for similar streams in the region.

Ottawa Riverkeeper, Kitigan Zībī Anishinabeg, and Kebaowek First Nation have been working together to conduct benthic invertebrate monitoring at small streams throughout the watershed. The focus has been on collecting reference site data to have enough information should a comparison be needed for a site impacted by a contaminant or disturbance. The data has been added to the Canadian Aquatic Biomonitoring Network (CABIN) and the samples are analyzed at the University of Guelph's Hajibabaei Lab in the Centre for Biodiversity Genomics as part of the STREAM program.

Given that the sites are predominantly reference sites, there is a healthy variety of benthic invertebrates present including mayflies, caddisflies, and stoneflies. We have even caught salamanders when sampling; these sensitive amphibians are quickly released back into the streams.

Water Mercury

Mercury is found naturally in very small quantities in river systems around the world. In its most toxic form, methylmercury, it is known to affect the nervous systems of vertebrates. The geology, topography, and land cover of the Ottawa River watershed have been shown to allow the mercury present to be converted into methylmercury.

The presence of mercury in the watershed was assessed using data available from provincial fish consumption guides. Data was available for approximately 26,000 records, which included 37 different species at around 540 sites from 1970 to 2022.

Mercury levels in fish samples from the Ottawa River watershed are lower than they were in the 1970s when this data was first available. This can be attributed to policies that helped to reduce emissions of mercury in Ontario and Quebec as well as agreements to mitigate the incidents of acid rain. These regulatory steps had an overall positive contribution to aquatic health.

Katy Alambo

The term "benthic" comes from the Ancient Greek word βένθος (bénthos), which means "the depths of the sea." It is used to describe things at the bottom of a body of water.

While most fish in the Ottawa River watershed have mercury levels below the Canadian threshold of 0.5 ppm, the watershed's average concentration is higher than Lake Ontario and Lac Saint-Pierre, both of which are known to typically have higher levels of contaminants due to various industrial activities. This discrepancy is likely due to the Ottawa River watershed's geology and the prevalence of dams, rather than any specific industrial sources.

While mercury levels remain lower than in the 1970s, mercury levels in fish have been increasing in recent years. Various factors contribute to higher mercury levels, including mercury emissions, atmospheric emissions, land-use change, climate change, flooding from dam infrastructure, higher temperatures, wastewater, and invasive species.

Predatory fish species, such as Walleye and Northern Pike in the Ottawa River watershed, have higher mercury levels due to bioaccumulation and biomagnification.

Bioaccumulation: Older and longer-lived species absorb mercury compounds from their food, leading to accumulation in their tissues.

Biomagnification: Mercury accumulates up the food chain, resulting in larger predators having higher concentrations in their tissues.

Findings

The Ottawa River watershed's rich biodiversity has changed dramatically in recent history. This includes changes such as the decline of fish species like the American eel, to the introduction and establishment of many harmful invasive species. Large-scale development and resource extraction activities such as commercial fisheries, logging, mining, and hydropower production have been largely detrimental to aquatic habitats, further affecting a variety of species found throughout the rivers in the watershed. Climate change also plays an important role as changes in temperature, water levels and flow could detrimentally impact native species that are reliant on specific conditions.

To preserve native species, actions like protecting habitats such as wetlands, building fish passage around dams, monitoring for and tracking the spread of invasive species, and reducing sources of pollution are vital. It is important to monitor and analyze findings more holistically, by understanding and addressing issues through a watershed lens.

As the levels of mercury found in the watershed demonstrate, the Ottawa River watershed remains vastly understudied. More research into contaminants is needed to see if other ecological impacts are also not being adequately monitored.

Grade **C+**

Introduction

Lakes and rivers can vary significantly based on the physical and chemical qualities of the water they contain, and the land through which they flow. These characteristics have substantial impacts on the ecosystems that form in and around rivers.

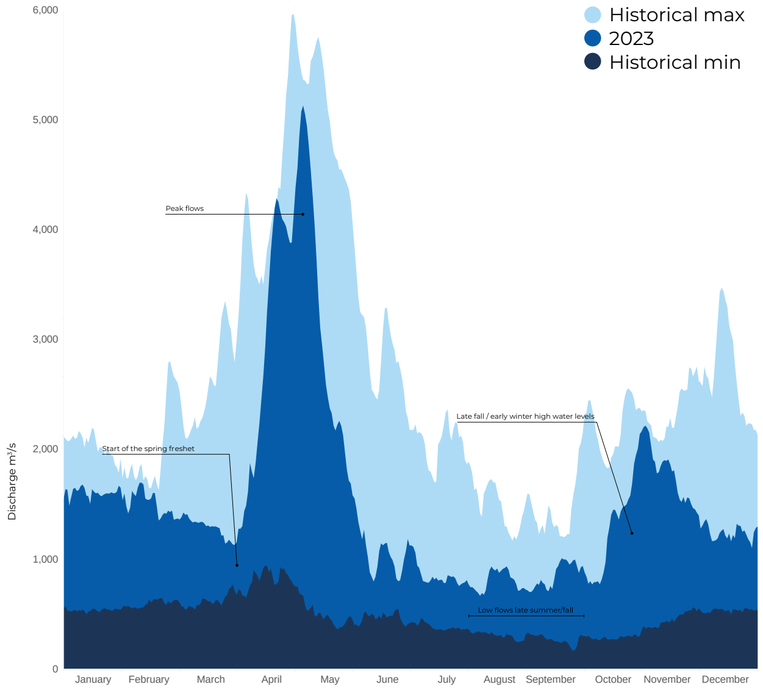


Figure 5. High variance in flow levels at the Britannia location. This is a useful reference when considering flow pattern changes in the watershed.

Flow

The flow of a river is influenced by several factors within a watershed; topography, land cover, characteristics of rainfall, as well as the amount of snow and when it melts. High flows increase the ability of a river to transport sediment through erosion and cause damage to built infrastructure. Meanwhile, low flows can impact ecosystems by reducing the amount of suitable habitat available to fish and other aquatic organisms.

The flow data used in our analysis was obtained from long-term monitoring stations located along the Ottawa River and its principal tributaries. The data was obtained from the Water Survey of Canada's National Water Data Archive and Ontario Power Generation. For the Ottawa River at Carillon, only monthly mean data was available from the Ottawa River Regulation Planning Board which limited some of the analysis that could be completed. Seventeen active stations with an average flow of over 10 m3/s and data available for at least 50 years were selected. Guidance for the analysis was provided through WWF-Canada's *Technical protocol for the freshwater health assessment.*

The spring freshet, a period of faster flow due to snowmelt and seasonal rainfall, has been occurring earlier in the year. For the Ottawa River watershed, the changes to the timing of the spring peak flow are approximately 0.8 days/decade earlier, which, while slower than the average across Canada (2 days/decade), is a concern. The shifting flow patterns in the Ottawa River and its tributaries also capture higher flow in many regions. Of the 16 stations analyzed, 62.50 % show an increasing trend in peak flow over time, while 68.75% had an increase in medium flow when compared between two time periods (1961-1990 and 1991-2020).

Both the total number and the cumulative number of days with low flow during the late summer were also assessed, and both have been increasing in many parts of the watershed. Longer periods of low flows are likely placing greater stress on aquatic ecosystems which may also coincide with increased temperature and decreased dissolved oxygen. Climate change is likely influencing these prolonged periods of low water flow, but dam infrastructure which maintains recreational water levels in the summer months may also be contributing to this situation.

The combination of these two long-term trends is a cause for concern. They may lead to the reduction or displacement of native fish species and can have far-reaching, ecosystem-wide impacts.

Martin Lipman

Physical Characteristics

Water Temperature

Water temperature impacts both the biological and chemical makeup of aquatic environments. It influences both plant and animal growth, as well as the ways in which materials dissolve in the water. Biological activity slowly increases as temperatures rise, until reaching temperatures after which increases will harm aquatic organisms. The same effect can occur at lower temperature ranges if the increase in temperature happens quickly.

Ottawa Riverkeeper collaborated with many people in different regions of the watershed to track temperature data in rivers and streams. This included installing 41 data loggers in small streams that were accessible by road. Despite efforts to secure these devices and make it clear that they were part of a research project, some of the loggers were removed from the streams in which they were placed.

Of the data collected, the most consistent sites were all from the Coulonge River watershed and shared by the Nagadjitòdjig Akì (Guardians with the community of Kitigan Zìbì Anishinabeg). This data shows that larger bodies of water have more stable temperatures than smaller ones. Small bodies of water fluctuate quite a bit more, and they tend to get warmer faster, which can be a source of increased stress on the ecosystem. These fluctuations in temperature make smaller bodies of water more vulnerable to climate change and other disturbances. Notably, where riparian connectivity is intact, the shrubs and trees along the shore provide shade which can cool the water and slow the flow of stormwater. Therefore, a healthy shoreline can reduce both the fluctuation in temperature and the maximum temperature overall.

Ice On / Ice Off

Ice formation and breakup are important to river systems, as they impact water chemistry, biological activity, and the physical processes that affect watersheds. “Ice on” is the point at which a body of water is fully covered by ice, and “ice off” is when that ice completely disappears.

Ottawa Riverkeeper collected observations about ice on and ice off from community members, who submitted the dates that ice on was observed in the early winter and when ice broke up in the spring. There was also historical data which was consulted to determine baseline trends. Additional sources of ice on / ice off data are collected by IceWatch.

Of the sites where data has been available for over 20 years, 75% show signs that ice is dissipating earlier in the year. This is in line with the findings that spring freshet is occurring earlier in the year, highlighting the impact of higher temperatures on the spring melt.


Max Finkelstein

Dissolved Oxygen

The amount of oxygen that is available in the water is crucial to aquatic organisms. The level of dissolved oxygen varies more in aquatic environments than oxygen levels in the atmosphere. It can be affected by water temperature, fluctuations in flow, and the amount of plant activity, including algae, in the water.

Dissolved oxygen data is collected by Ontario’s Ministry of Environment, Conservation and Parks. Similar data is not available in Quebec. This data does show that for the majority of the sites, but not all, dissolved oxygen concentrations are very good. However, further research is needed to monitor dissolved oxygen across the watershed more consistently.

Data has shown dangerously low levels of dissolved oxygen concentrated in the South Nation River. This tributary of the Ottawa River is in the southern part of the watershed and has a lower average flow rate than other tributaries. The low dissolved oxygen levels may be related to high nutrient concentrations in the area (see Figure 3). High levels of nutrients lead to plant growth and algal blooms, which then consume oxygen in the water when they decompose as well as the slower velocity of the river.

Findings

The physical characteristics of the rivers within the Ottawa River watershed are showing clear signs of being influenced by climate change. These shifts have direct impacts on the ecosystems in and around these rivers. Additionally, water temperatures will fluctuate and dissolved oxygen levels will be affected. This will have profound implications for species that have adapted to the historical conditions of the Ottawa River watershed.

As climate change exacerbates existing changes to river systems like dams, agriculture, and urbanization, ecosystems will undergo further shifts. To mitigate these impacts, efforts are needed to curb nutrient runoff, monitor changes in flow patterns, and prevent development in wetlands and flood zones. This approach can both protect ecosystems and help limit the potential flooding risks associated with these ongoing changes.

Grade **C-**

Introduction

Human activity can have huge ramifications on watershed health. Changes to the surrounding land and the introduction of substances to the environment can be the source of major detrimental health impacts. Maintaining natural spaces such as forests and wetlands, as well as healthy riparian buffers, can help mitigate these impacts.

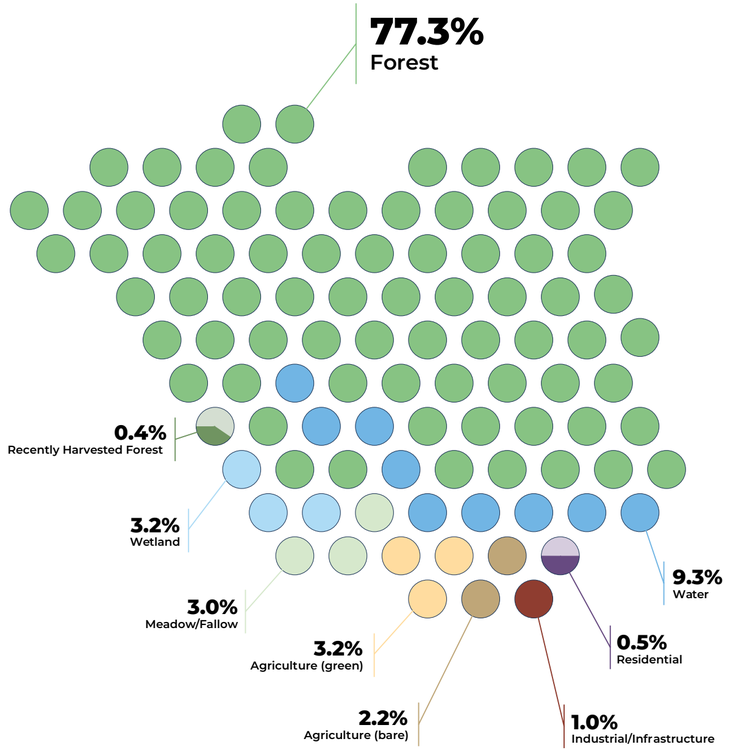


Figure 6. Overview of the relative land use in the Ottawa River watershed. Each dot roughly corresponds to 1% of land, which helps illustrate the vast amounts of forest cover and relatively low levels of development at a watershed scale. The geographic placement of land use is not accurate but positioned to lightly match corresponding land use trends in regions of the watershed.

Land Use

The land around a river or lake has a huge potential to influence it, especially if the nature of that land changes. Most of the land in the watershed, just over 77%, is forested (see Figure 6). To date, around 10% of the land in the watershed has been altered to support human activities, including agriculture, municipalities, and other industrial activities. Wetlands and water make up the remaining land use.

Land use for the watershed was determined from a 10m land use layer developed using Google Earth Engine, a cloud-based image analysis platform that used JavaScript to help determine the appropriate classification of the watershed. This work was completed through a collaborative project with Carleton University.

Agriculture comprises the most signifi-Agriculture comprises the most significant change in land use brought about by humans. This shift is concentrated in two areas: the southeastern and the northwestern parts of the watershed. Notably, these regions also correspond to high total phosphorus concentrations (see Figure 3) and where algal blooms are most often observed in the watershed (see Figure 2).

Recently harvested forest was the most challenging land use to classify and may be underrepresented in this analysis, and at times, meadows or fallow fields may be misclassified as recently harvested forest cover. Even with this taken into consideration, this land use change remains a low to very low threat to the health of the watershed when using WWF-Canada's *Technical Protocol For The Freshwater Threats Assessment*.

Riparian Connectivity

The riparian zone is the transition space between aquatic and terrestrial ecosystems and is crucial for river health. A healthy shoreline provides habitat, shade, erosion protection, and can also absorb or filter pollutants from entering the river. It plays a vital role in connectivity between the water and the land. Human activity routinely changes the makeup of riparian zones, most often through the removal of vegetation and the addition of hard, non-absorbing materials. This interrupts the connectivity and interaction required by these two linked ecosystems to thrive.

It is very challenging to analyze riparian connectivity for a watershed the size of the Ottawa River watershed. For this report card, a full analysis of the disruption in riparian connectivity was not completed. However, riparian connectivity loss occurs most often where there have been significant human activities and this was considered in the assessment.

Martin Lipman

Combined Sewer Overflows

Combined Sewer Overflows (CSOs) are when sewage from cities is dumped into waterways, typically as a result of rainy weather overwhelming a combined sewer system's capacity. They can deliver pollutants, extra nutrients, and harmful bacteria and pathogens to the river.

Ottawa Riverkeeper commissioned Fondations Rivieres to produce a report of incidents of CSOs and the performance of wastewater treatment facilities. The scope of this work was restricted to Quebec municipalities, prioritizing those on the Ottawa River as well as those on tributaries within proximity to the Ottawa River. It is worth noting that comparable information is publicly available in Ontario. The report confirmed that larger municipalities are responsible for the majority of CSO events as well as releases of partially treated wastewater during heavy rainfall events.

Most CSOs in the Ottawa River watershed occur within the National Capital Region, given that it is the most heavily populated region. The number of incidents has gone down recently thanks to the construction of the Combined Sewage Storage Tunnel in the City of Ottawa. This large piece of infrastructure stores excess runoff and prevents it from being released into the river. It is limited by its maximum capacity, as the system can still be overwhelmed during large rainfall events. However, since its introduction in 2020, the number and volume of CSO events in the city of Ottawa have been significantly reduced (see Figure 7).

Figure 7. Decreases in CSOs from the City of Ottawa over time, including a considerable dip after the opening of the Combined Sewage Storage Tunnel in 2020.

Robbie Palmer - Unsplash

While not as considerable as the initiatives taken in Ottawa, other municipalities, including Gatineau, have taken steps to reduce the number of CSOs and the volume of sewage discharged in their municipalities. This includes investing in monitoring equipment to capture when and for how long overflows occur, separating combined sewer infrastructure, and investing in green infrastructure to reduce the volume of stormwater runoff. There is still much to be done, but each of these steps is an improvement to this complex and costly issue.

Findings

Changes in land use are often examined at the watershed scale. As the Ottawa River watershed is predominantly forested, at this scale land use in the Ottawa River appears to be in good health. However, development does not occur equally across the watershed. This creates areas where changes which negatively impact ecosystems over time are experienced more significantly.

In growing urban centres near the river, and with the expansion of agricultural lands in southeastern Ontario and the northwestern part of the watershed, some areas of the watershed have changed more dramatically than others. These areas also correspond to where CSOs occur and reports of disconnected riparian areas. Further understanding of the impact of development at a local scale shows that parts of the Ottawa River and its tributaries are much more degraded than others.

Focused efforts are required in regions where land use changes have significantly impacted ecosystems. Remaining wetlands, forests, and natural spaces need to be preserved, and riparian connectivity should be restored through shoreline preservation and planting. Momentum should be maintained on reducing the influx of nutrients to the river in developed areas, by continuing to limit Combined Sewer Overflows and reducing nutrient runoff from agriculture.

Grade **C-**

Contaminants of Emerging Concern

Introduction

There are many ways that human activity is having an impact on the river and freshwater ecosystems beyond the 14 indicators identified within Ottawa Riverkeeper's Watershed Health Assessment and Monitoring initiative.

Contaminants of emerging concern are substances that have been or are being introduced into the environment and that persist for a very long time. They have detrimental or poorly understood consequences. As a result, they are some of the most challenging threats to address in a watershed.

Below are the contaminants of concern that Ottawa Riverkeeper has been looking into. This is not a conclusive list, and there are others that we have not been able to study in a meaningful way.

Radioactive Waste

Chalk River Laboratories, roughly 200 kilometres upstream of Ottawa-Gatineau, opened in 1944 during the Second World War. It has since been a site of research and development for the nuclear industry in Canada. These activities create radioactive waste, a broad category of contaminants which pose threats to freshwater health.

Historical events at the Chalk River Laboratories site have resulted in pollution and contamination from radioactive waste. This includes the melt-down of an experimental reactor in 1952 which led to a significant amount of contaminated water penetrating the ground beneath the facility. Legacy waste from past activities continues to be of concern despite many steps to address these waste management areas on the Chalk River Laboratories site. In addition, the site is currently being revitalized for future research including a proposal Small Modular Reactor (SMR) and the construction of an Advanced Nuclear Materials Research Centre.

Ottawa Riverkeeper has worked on developing a better understanding of the operations at Chalk River Laboratories and how these operations are regulated. This includes participating as intervenors in key process steps such as the proposal for the Near Surface Disposal Facility (NSDF), the Operating Licence Renewal Hearing for the Chalk River Laboratories site, and in the 2018 Regulatory Oversight Reports.

Beyond our work within the watershed, Ottawa Riverkeeper also intervened in the development of a federal policy for addressing radioactive waste that was generated from activities other than from nuclear reactors. Our submissions argued that stronger regulations from the federal department were necessary to manage radioactive waste. Ottawa Riverkeeper has consistently advocated for the precautionary principle to be applied to all aspects of radioactive waste management for both new policies and when licensing facilities.

Microplastics

Microplastics are small plastic particles introduced into the natural environment in various ways. They can be from larger plastics that break down, materials that are released or shed small pieces over their lifetime, or from manufactured microbeads which have been banned in Canada since 2018. Ottawa Riverkeeper volunteers contributed numerous samples to the research into the prevalence of microplastics in the Ottawa River in collaboration with Dr. Jesse Vermaire's lab at Carleton University, publishing co-authored papers on their findings.

The data shows that microplastics, specifically microfibres, are found all along the length of the Ottawa River, including in parts of the river with lower human populations. Microfibres are long thin pieces of plastic that are usually shed from plastic-derived clothing materials such as polyester. They are typically shed when these fabrics are laundered, but can also be shed into the air when these clothes or materials are used.

A subsequent research initiative tracked plastic pollution within river and shoreline sediment. These results showed a lower level of microplastics, suggesting that due to the Ottawa River's high spring flow each year, plastics within this watershed aren't being stored within the freshwater environment; microplastics are introduced into the Ottawa River, but they do not remain embedded within this ecosystem as previously feared. However, while microplastics are moving downstream to other locations through natural processes over time, they are not being removed from the environment.

Left to right: Martin Lipman, Melissa Mascarenhas

Road Salt

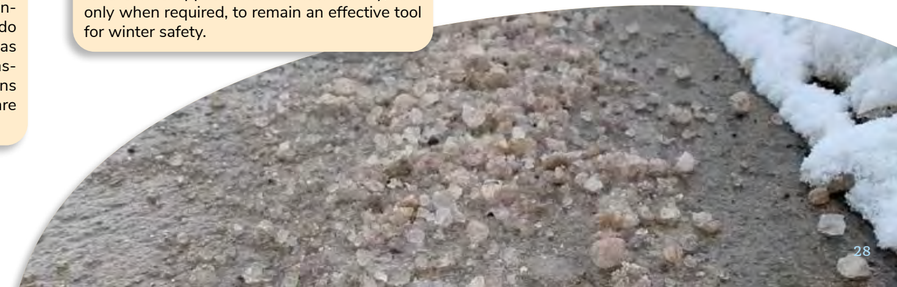
Ottawa Riverkeeper has been tracking the presence of road salt in urban waterways within the National Capital Region for several years. Chloride, a byproduct of road salt contamination, can cause damage to aquatic ecosystems by interfering with the reproduction and respiration of many species. Although not a significant threat to the Ottawa River itself due to the volume of water in the river, excess road salt use can have extremely negative impacts on urban creeks and streams that are an important part of the river system.

Data from our monitoring shows that Chloride levels throughout the winter are routinely above the thresholds for chronic and acute toxicity. Freshwater species exposed to concentrations of Chloride that exceed the acute toxicity threshold immediately experience long-term harm whereas chronic exposure causes harm when the conditions persist for multiple days. A troubling finding is the persistence of Chloride throughout the summer and fall, with Chloride concentrations remaining high enough to negatively impact these streams' ecosystems year-round. There is an urgent need to reduce the amount of road salt applied for the sake of vulnerable urban ecosystems. This can be accomplished through shifts in behaviour so that road salt is applied more conservatively, and only when required, to remain an effective tool for winter safety.

Per and Poly-fluoroalkyl Substances (PFAS)

PFAS are a family of chemical substances that are known to be toxic and harmful to human health and freshwater ecosystems. Known colloquially as "forever chemicals", these chemicals are especially concerning due to their extreme persistence – they do not break down under natural conditions. PFAS are found in many substances including fire extinguishing materials, food packaging, non-stick cookware, and personal care products. Their presence in these materials means they are often introduced to freshwater ecosystems through their use. There are numerous potential health impacts from exposure to PFAS as well as the potential for bioaccumulation.

PFAS have been widely detected in freshwater ecosystems across North America. Ottawa Riverkeeper has advocated that steps be taken to ensure PFAS are properly grouped as a class of chemicals by the federal government and steps are taken to ensure they do not continue to pollute aquatic environments. Investment in testing and monitoring rivers and lakes is required to facilitate mitigation and slow the spread of these contaminants.



What Needs to Be Done

Although this report card highlights many negative trends affecting watershed health, there is reason to be hopeful. All of the issues brought to light through this research can be mitigated or eliminated. Outlined below are the priority action areas that, if addressed, will have the greatest positive impact on improving watershed health.

Respect Indigenous water rights

Indigenous Nations are the traditional and ongoing caretakers of these lands and waters. Decision-makers must advance government-to-government, nation-to-nation relationships by developing pathways for co-governance of watersheds with Indigenous Nations. For the Ottawa River watershed in particular, which is the unceded and unsurrendered territory of the Anishinabeg Algonquin peoples, it is imperative that non-Indigenous decision-makers duly consult with and take meaningful action to respect the full rights held by Algonquin Nations.

Address Changes in Flow Patterns

Extreme changes in flow patterns, such as flooding and drought, are heavily influenced by climate change. These changes result in disrupted ecological cycles and habitat availability for the species that depend on these ecosystems. While there are limitations to how spring freshet can be managed, adaptation efforts can be extremely beneficial. This includes the protection and restoration of riparian habitats and wetlands which can help buffer changes in flow. The extended periods of low flow and drought also need to be further researched so they can be mitigated. Raising awareness about the link between climate change and the occurrence of flooding and drought can help. However, it is imperative that climate change be immediately confronted to prevent further extreme flow patterns.

Left to right: Mark Bernards, Larissa Holman, Matthew Brocklehurst, Mark Bernards, Martin Lipman, Matthew Brocklehurst, Mark Bernards

Promote Sustainable Land Use Practices

Decision-makers at all levels must prioritize policies and initiatives that promote sustainable development, balancing the imperative for environmental conservation with economic growth. Human development and land use activities have had profound impacts on the health of the watershed and must be confronted with sustainable land use practices, including forest conservation, riparian buffer restoration, and responsible agricultural management. Policies that reduce the nutrients entering the river through agricultural runoff and further reduce Combined Sewer Overflows and effluent from wastewater treatment are essential.

Regulate Contaminants

There is a pressing need to expand our understanding of the risks posed by contaminants and implement proactive measures to protect waterways from their harmful effects. Substances such as microplastics, PFAS, road salt, and radioactive waste can have detrimental effects on water quality, aquatic life, and human health. While efforts to monitor and mitigate the impacts of certain contaminants like road salt are underway, enhanced monitoring programs, regulatory actions to limit the use and discharge of harmful substances, and public education campaigns about these contaminants are needed.

Protect Endangered Species

Habitat restoration initiatives and advocacy for infrastructure improvements, such as the installation of eel ladders and other types of fish passage, are essential for the survival and recovery of vulnerable species. Collaborative partnerships between government agencies, Indigenous communities, conservation organizations, and other stakeholders are needed to implement effective conservation strategies and preserve the rich biodiversity of the Ottawa River watershed.

Fund Robust Data Collection and Monitoring

The Ottawa River watershed is poorly understood relative to other watersheds in Canada. While funding and research often focus on the St Lawrence and Great Lakes region, the Ottawa River is often not included, despite being a major part of these watersheds. This pattern of under-investment has led to gaps in understanding, such as the surprisingly high mercury levels identified in our findings. Other concerning trends, including shifts in flow or the presence of contaminants and pollutants, could be going unnoticed. This watershed needs an increase in support and funding for research and data gathering in order to protect it.

What You Can Do

As a member of the public:

- ☐ ***Advocate for sustainable land use practices.*** Help protect a forest, restore a shoreline, or support responsible and sustainable agricultural management.
- ☐ ***Mitigate the impact of contaminants.*** Learn about the sources of pollutants entering waterways, reduce your use of harmful substances like PFAS, and spread the word to encourage public action.
- ☐ ***Protect endangered species.*** Support habitat restoration initiatives in your local area, and advocate for infrastructure improvements that help species at risk.
- ☐ ***Become a community scientist.*** Join in with local community-based monitoring programs and volunteer to collect valuable data on watershed health.
- ☐ ***Get involved!*** Join your local watershed protection organization to learn about the issues in your area and participate in their programs.

As a decision-maker:

- ☐ ***Support and respect Indigenous water rights.*** Advance government-to-government, nation-to-nation relationships for watershed governance.
- ☐ ***Promote inter-jurisdictional cooperation.*** Help to harmonize legislation and policies across federal, provincial, and territorial governments to ensure coherent water management.
- ☐ ***Take a watershed approach.*** Help establish governing bodies or councils that collaborate across levels of government and with non-governmental stakeholders to consider ecological, social, economic, and cultural values across the watershed.
- ☐ ***Invest in nature-based climate solutions.*** Improve freshwater ecosystem health and meet climate change and biodiversity targets by providing funding, tools, and information to help regions and municipalities adapt to climate change , in addition to mitigation efforts.
- ☐ ***Fund community-based monitoring.*** Fill dangerous gaps in data collection and build public interest in environmental protection by providing increased funding for community science at a watershed scale.

Methodology

In 2018, Ottawa Riverkeeper completed the Ottawa River Watershed Report (Phase One). This report included a scan of available data in the watershed from a variety of sources and highlighted which ecological indicators could be used to provide an assessment of the health of the Ottawa River and its tributaries. Using the 14 indicators selected for the Watershed Health Assessment and Monitoring initiative, as well as introducing a section on Contaminants of Emerging Concern, a variety of data sources were used. Ottawa Riverkeeper launched several community-based monitoring programs to fill some of the data gaps within the watershed, while in other cases, data was compiled from provincial and local data sources for analysis. Each section includes a brief note about data sources and methodology but for many a longer, more detailed report was developed and these reports are available on Ottawa Riverkeeper's Open Data Portal.

Within the subgroups of ecological indicators, each indicator was weighed equally and a grade was assigned accordingly. Where data had not yet been compiled and a proxy could not be identified, then this indicator was not assigned a value to be used toward the groupings' final grade.

Left to right: Mark Bernards, Mark Bernards

Data Sources

Much of the data used in the Report Card was from Ottawa Riverkeeper's community-based monitoring activities. Below are additional sources of data we consulted:

- *The Canadian Aquatic Biomonitoring Network*
- *City of Ottawa*
- *Google Earth Engine*
- *iNaturalist*
- *Nagadjitòdjig Akì*
- *National Ecological Framework for Canada (Agriculture and Agri-Food Canada)*
- *Naturewatch*
- *Ontario's Ministry of Environment, Conservation and Parks*
- *Ontario's Ministry of Natural Resources and Forestry*
- *Ontario Power Generation*
- *Ottawa River Regulation Planning Board*
- *The Provincial (Stream) Water Quality Monitoring Network (Province of Ontario)*
- *Quebec's Minister of the Environment, the Fight Against Climate Change, Wildlife and Parks*
- *SENTINEL-2 data*
- *Ville de Gatineau*
- *The Water Survey of Canada's National Water Data Archive*

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Ottawa Riverkeeper has relied on the support, assistance, and previous efforts of many people in the creation of this report. It is our organization's strong belief that public participation and collaboration in scientific research build better results and a deeper understanding and appreciation for the river.

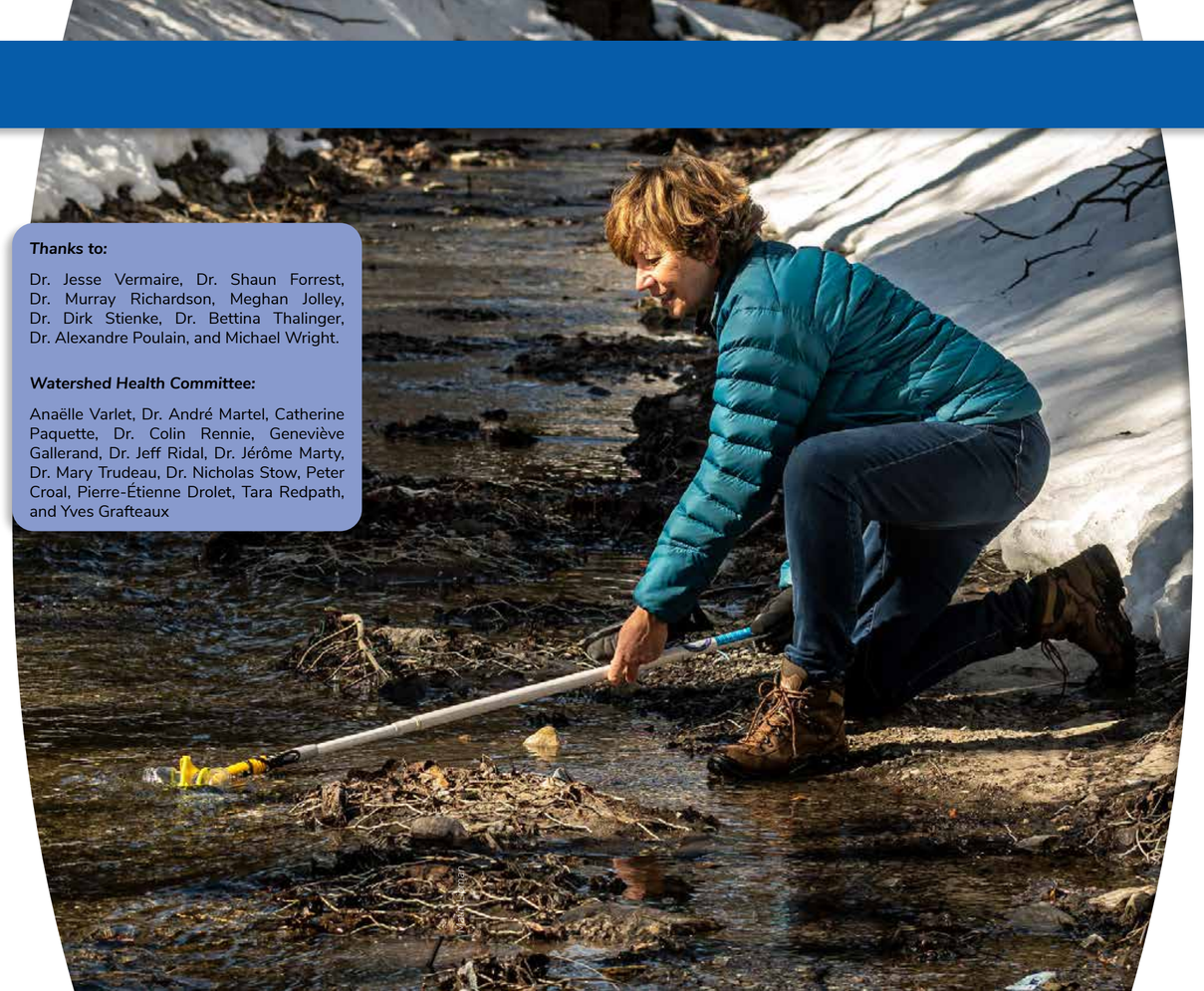
Ottawa Riverkeeper's data collection was built through community-based monitoring. This means that much of the data presented in this report was collected by ordinary people; community scientists who volunteered their time to help deepen our collective knowledge of this magnificent waterway. This report would not have been possible without their tireless efforts, and we are deeply grateful to everyone who participated in this research. We are also grateful to researchers who worked with Ottawa Riverkeeper on a variety of different projects and deepened the understanding of the Ottawa River through this research.

We would like to thank the members of Ottawa Riverkeeper's Watershed Health Committee. Made up of experts from many fields who volunteered their time, this committee was instrumental in the initial construction of the Watershed Health Assessment and Monitoring initiative this report is built upon. Additionally, these experts have been an important part of the building of this report, reviewing data, analysis, and findings. Their knowledge and feedback is deeply appreciated.

The Watershed Health Assessment and Monitoring initiative benefited greatly from the input of Anishināabeg Algonquin communities, who provided insight into the initial study this program was based upon. Meegwetch. In addition, we would like to thank Kebaowek First Nation and Kitigan Zībī Anishinabeg for their willingness to work with Ottawa Riverkeeper to co-develop projects that continue to contribute to the understanding of aquatic ecosystem health in the Kichi Zībī watershed. Chi Meegwetch.

We are also grateful for the many sources of open data that we consulted throughout this project. These datasets were instrumental in building a historical picture of watershed health for many indicators. Ottawa Riverkeeper is a strong believer and champion of open data. All of the data collected by Ottawa Riverkeeper and the community scientists we recruited is available for anyone to use via our Open Data Portal.

Finally, this report would not have been possible without the amazing current and former staff of Ottawa Riverkeeper, especially members of the science team, who have worked to support its creation. Their work to protect the Ottawa River and its tributaries every day is layered into every page of this report.



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