


Watershed Quality Indicators Monitoring Emerging Contaminants

This project is part of the extended **Integrated Watershed Management (IWM)** initiative, focusing on reducing flooding impacts and enhancing Muskoka River Watershed (MRW) health. It's one of seven chosen for expansion from the original twelve projects. This initiative supports and advances the implementation for an IWM approach for the entire MRW.



You can find more information on the Phase One Report – “Water Quality Indicators” and the accompanying Summary Factsheet on the District of Muskoka Website at: www.muskoka.on.ca/iwmprojects

Background

One of the long-term focal points of the overarching IWM project is to assist in the development of a comprehensive water quality monitoring program for the MRW. The District Municipality of Muskoka (DMM) recognizes that numerous successful programs are currently in place within the watershed and seeks to build on the successes of those programs.

At Issue


There has been an increase in concerns about emerging contaminants like pharmaceuticals, pesticides, engineered materials, and microplastics. These substances pose unknown biological effects and persist in water. Drugs such as antibiotics and antidepressants have been found in affected rivers, warranting further research on their impact. These contaminants are widespread, present in wastewater treatment plants, surface water, groundwater, and drinking water.

Scope

The primary focus of this project was to:

- Document emerging threats to water quality based on a literature review with emphasis on relevant
- Issues in the MRW
- Develop a list of priority parameters
- Provide guidance for incorporating emerging contaminants into the Muskoka Riverine Monitoring
- Program and associated reporting recommendations

Did You Know?



Emerging contaminants that are most relevant in the MRW include active pharmaceutical ingredients, personal-care-product additives, pesticides, engineered nanomaterials and microplastics. Antibiotics, antimicrobials, antivirals, and antidepressants have been demonstrated to be broadly detectable in wastewater-impacted rivers, however ongoing research is required to determine the impact of these compounds on the aquatic receiving environment.

Emerging Contaminants in Muskoka River Watershed

Pharmaceuticals in Water

- Ontario Ministry of the Environment, Conservation and Parks (MECP) discovered 27 different pharmaceuticals and hormones in both source and drinking water. Common medications like carbamazepine (for epilepsy), gemfibrozil (for regulating lipids), and ibuprofen (an anti-inflammatory) were frequently found in Ontario drinking water.
- Wastewater treatment plant effluents are primary sources of drug pollution in surface waters.
- Conventional treatment methods struggle to effectively remove these substances.
- Contamination from domestic septic tanks and veterinary medicines contributes to waterway pollution.
- Drugs like diclofenac, naproxen, and ibuprofen (anti-inflammatory medications) even in small amounts, harm microalgae, duckweed, zooplankton, and freshwater hydra.
- Diclofenac, specifically damages kidney tissue and intestinal villi in Rainbow Trout at certain levels.

Antibiotics in Water

- Sulfamethoxazole, azithromycin, and ciprofloxacin, antibiotics found in water, are toxic to algae, aquatic plants, and cyanobacteria.
- These antibiotics are also linked to fostering resistance genes in microbial communities.

Microplastics (MPs)

- Microplastics (MPs) are tiny plastic particles that threaten life in both land and water ecosystems. They come from sources like synthetic fibers, household items, and car tires. When consumed, they harm organisms and can carry environmental toxins.
- MPs get into ecosystems through rivers, drainage systems, agriculture runoff, and wastewater plant effluents. Urban sources, like washing machines, significantly contribute to MP pollution, especially through wastewater treatment plants.
- MPs cause internal injuries to aquatic life and absorb toxins, potentially passing them on upon ingestion.
- Nanoplastics (NPs) pose an additional worry due to their size and higher ability to absorb pollutants.

Nanomaterials

- Engineered nanomaterials (ENMs), such as titanium dioxide and zinc oxide nanoparticles, are widely utilized, for instance, in products like sunscreen. They enter water during different stages and can be harmful to aquatic organisms.
- ENMs, found in surface waters from products like sunscreen, harm microalgae and zooplankton.
- Their effects on benthic organisms and long-term exposure require further study.

Did You Know?



Common sources of MPs to the environment include synthetic and semi-synthetic clothing fibres (e.g., polyester, nylon, acrylic, cellulose acetate), household and industrial paints, car tires (i.e., polypropylene), fishing nets and ropes, industrial abrasives, and personal care products (i.e., microbeads). MPs are often classified as fibres, fragments, foams, films, and beads.

Did You Know?



Washing machines shed tons of tiny plastic fibers from synthetic clothes—more than 1900 per wash! These microfibers end up in wastewater plants, but these plants aren't built to catch such small particles. So, when they release treated water, especially during heavy rain, they're likely sending microplastics into rivers and streams.

Priority Parameters

1. Agricultural

Parameters

- **Glyphosate** is the most widely used herbicide in Canada and should be assessed.
- **2,4-D** is commonly used for weed control and should be included in monitoring.
- **Neonicotinoids** are extensively used in Ontario for corn and soybean crops.

Priority Locations:

- Three Mile Lake Tributaries
- Shadow River
- North Branch Muskoka River Upstream of Mary Lake
- Muskoka River Downstream of Bracebridge

2. Water and Wastewater Treatment Facility

Parameters

- **Caffeine** is recommended as a human influence tracer.
- **Sulfamethoxazole** is deemed most applicable to the MRW from the detected pharmaceuticals in Canada.
- Monitoring should follow a schedule based on seasonal flow regimes.

Priority Locations:

- Huntsville/Fairy Lake
- Baysville
- Bala
- Oxtongue River
- Bracebridge and Muskoka Beach
- Port Carling

Reporting Framework Recommendations:

1. Perform an annual in-depth analysis of contaminants data.
2. Include summaries, tabular data, and statistical interpretation.
3. Compare environmental conditions with guideline values.
4. Recommend actions for exceeding metrics and program revisions.
5. Consider more robust analysis in 2 to 5-year reporting based on data availability and non-detect rates.



For the complete report and further information on Integrated Watershed Management (IWM), the twelve projects (including the seven extended ones), and efforts towards an Integrated Watershed Management approach for the Muskoka River Watershed, please visit www.muskoka.on.ca/iwmprojects.

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