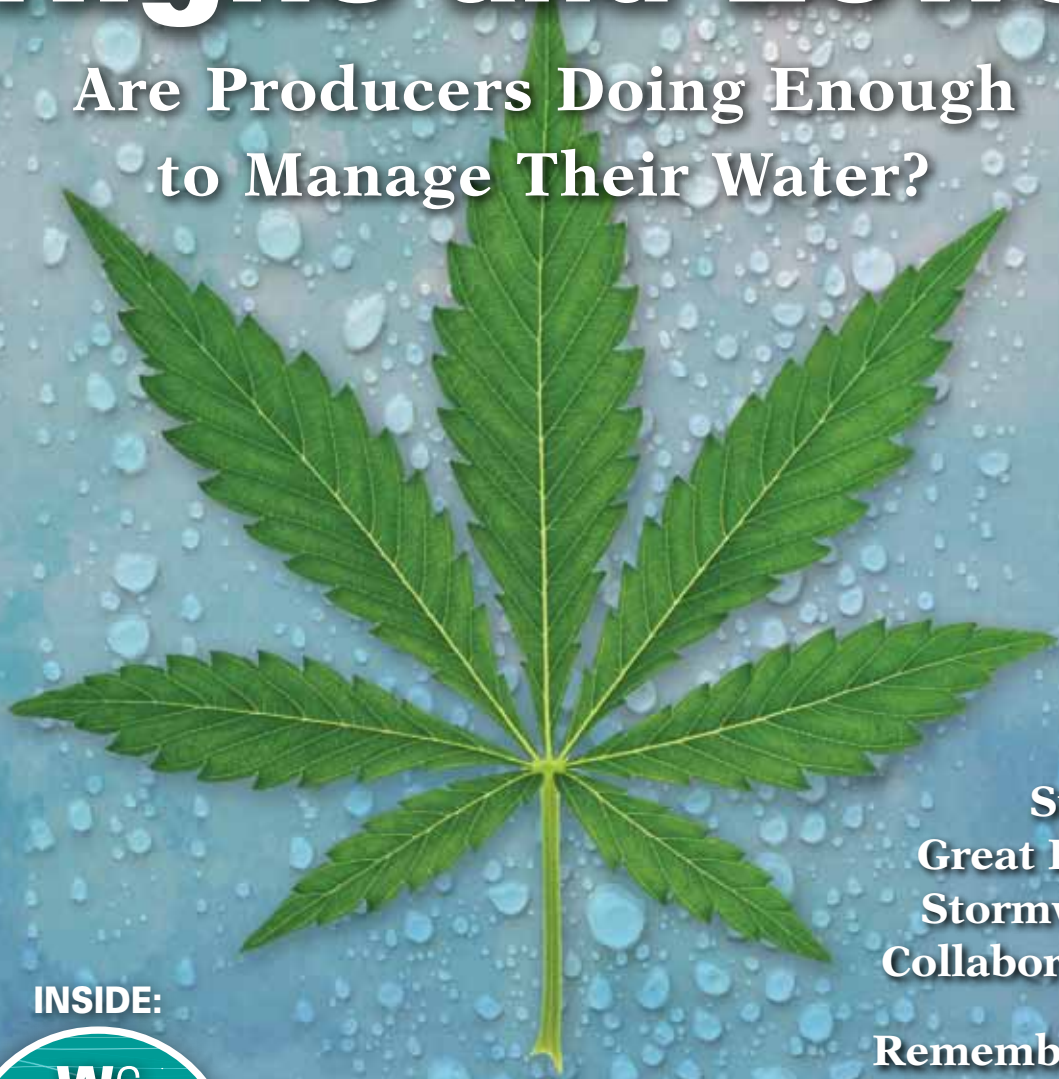


# WATER CANADA

## Cannabis Highs and Lows

Are Producers Doing Enough  
to Manage Their Water?



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Remembering  
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## SPECIAL FEATURES



### 8 The Adventures of Fatberg

BY NATHAN T. WRIGHT

### 29 Water Canada's Buyer's Guide 2019

A comprehensive directory  
of water products, services,  
and resources.

## WASTEWATER

### 10 The Buzz on Pot

Are cannabis producers properly  
managing their water use and  
treatment near the Great Lakes  
and beyond?

BY SAUL CHERNOS

## DRINKING WATER

### 18 Lessons Learned

What we learned from Walkerton  
and what's still on the wish list.

BY MICHAEL MASTROMATTEO

## WATER RESOURCES

### 20 Algal Aggravation

Efforts to overcome environmental  
and economic challenges for  
Lake Erie.

BY KATIE STAMMLER  
AND NATHAN WARKENTIN

## STORMWATER

### 22 Smarter Systems

Cyberinfrastructure strategies  
to control urban stormwater  
in the Great Lakes.

BY AMY ELLEDGE



10



18



20



22



27

### 24 Great Efforts

Great Lakes Stormwater  
Collaborative explores need  
for new stormwater tech.

BY GREGORY WILLIAMS

## FEATURES

### 26 New Water Recycling Strategy

How the food industry is  
cutting costs and reducing  
environmental impacts.

BY JOHN NICHOLSON

### 28 The Plastic Problem

Industry forum explores solutions.

BY TODD WESTCOTT

## COLUMNS

### 36 Rules & Regs

How to navigate the  
water quality trading roadmap  
for North America.

BY EDGAR TOVILLA

### 38 Groundbreakers

Artificial intelligence assistance  
for farming in the Great Lakes.

BY MARK MACDOUGALL

### 42 H2Opinion

Great expectations  
locally and globally.

BY CONNIE VITELLO

## DEPARTMENTS

### 5 Editor's Note

Farewell Readers

### 6 Front

Swim for Erie, special  
contributors, and more.

### 40 People & Events

Jobs, awards, contracts,  
and the latest event coverage.

# OCWA Jets Operations Challenge Team Top of Their Game at WEFTEC '18



L-R: Tom Nicol, Stephanie Baronette, Al Robdrup, Jason Mank and Marcel Misuraca (coach)



At OCWA, water is our business. This year, we are proud to celebrate 25 years of operating, maintaining and managing water and wastewater facilities across Ontario. Our operators are the best in the business and this was recently displayed at the Water Environment Federation's Technical Exhibition and Conference (WEFTEC) 2018.

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## Farewell Readers

BY KATHERINE BALPATAKY

**DEAR READERS OF WATER CANADA,**

This will be my last contribution to the editor's page of Water Canada, as I have made the difficult, yet purposeful, decision to navigate new waters. Leading the editorial direction of the magazine for the past three years has been a tremendous experience, not only for the opportunity to get to know so many heroic figures in the water sector, but also to explore and document the progress made in these propitious times for water management.

New infrastructure investments rippled across the country. Progress was made to amp up wetland preservation in Quebec and Manitoba. Leaders from public and private sectors came together to improve Canada's flood resiliency. Milestones in Indigenous water infrastructure and governance progress have been achieved. All the while Water Canada has been there to provide original frontline reporting, research, and analysis. I am honoured to have shared these stories.

I am grateful for Connie Vitello's willingness to leap in and collaborate with me as guest editor for the Great Lakes edition, and for her commitment to support future editions of Water Canada until the search for a new editor is completed. She has more than 20 years of experience in environmental journalism so you're in good hands. I would also like to thank the publishing team—most importantly Water Canada's publisher Todd Latham—for the contributions and support they have given me in the role of editor. I wish them the very best for the future. Last and certainly not least I would like to thank you—the contributors, readers, and advertisers—for helping to make Water Canada such a great trade publication.

My new role as director of corporate partnerships and business development with ALUS Canada will keep me happily entrenched in the water sector. In this new role, I will work with business leaders to cultivate high-impact partnerships that deliver brand value while achieving cleaner air and water, new wildlife habitats, and climate resiliency through the New Acre Project. So rather than say farewell, dear readers, it's to be continued. **wc**



**Connie Vitello** is the interim editor of Water Canada.

**Want to share your news and story ideas?**

Email [connie@actualmedia.ca](mailto:connie@actualmedia.ca)



**NATHAN T. WRIGHT**  
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**PG 10**



**EDGAR TOVILLA**  
Edgar is manager of  
wastewater operations for  
Peel Region in Ontario.  
**PG 36**

ABOUT THE COVER

**Cannabis and Water:**

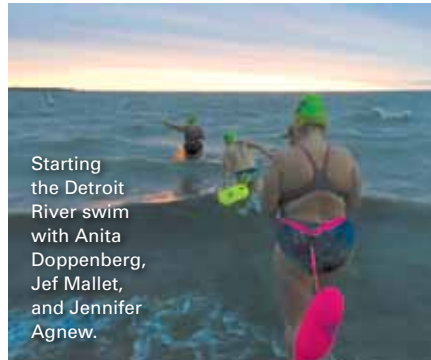
There has been an explosion in the industry, with the increased use of medical marijuana and recent legalization in Canada. These crops are major water users so growing it near the Great Lakes is popular. But use of fresh water and wastewater discharges are challenging. Learn about the latest technologies for treating wastewater from cannabis production. Are cannabis producers engaged enough with responsible water use methods and wastewater treatment?

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- **Update on the Safe Drinking Water for First Nations Act**
- **New small system solutions from the west coast**
- **First Nations water training program**

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Starting the Detroit River swim with Anita Doppenberg, Jef Mallet, and Jennifer Agnew.



The gang with guest swimmer Julia Notbomer (left) at Port Stanley.

Starting the Colchester Beach swim with kayakers ready to provide support.



# Making Waves to Protect Lake Erie

**IN SEPTEMBER 2018**, four swimmers took on the challenge to swim the north shore of Lake Erie. Their journey began in the Detroit River and ended 450 kilometres away at Crystal Beach. They swam through the day and night, checking in at 10 different locations in the watershed in 24 hours.

The idea for the swim challenge began with Josh Reid after he attended a Canadian Freshwater Alliance strategy session. The Alliance builds, connects, and supports freshwater initiatives across Canada. It works with NGOs, community groups, governments, and businesses to strengthen citizen voices and participation in protecting lakes and rivers. The organization is a project of Tides Canada’s shared platform.

According to the International Joint Commission’s Second Binational Great Lakes Basin Poll in 2018, the majority of Great Lakes residents (89 per cent) believe it is important to protect the Great Lakes for recreational purposes. The recreation and tourism sectors will be the hardest hit if nothing is done to address the algae blooms in Lake Erie.

Taking to the waters were four accomplished open-water swimmers: Jennifer Agnew from Harrow, Michael

Kenny from Cambridge, Josh Reid from Simcoe, and Anita Doppenberg from Niagara-on-the-Lake. The swimmers battled high winds and waves for most of the 24-hour challenge.

There was incredible support from communities along the swim route. Local radio, television, and newspapers interviewed the swimmers. Guest swimmers including cartoonist Jef Mallett joined in. Local youth did their own version of the swim closer to shore. Kayakers volunteered time to paddle support boats. Café owners treated the team to warm croissants and hot chocolate, and volunteers brought towels at all hours.

The Swim for Erie was a fantastic launch for the Freshwater Alliance’s Lake Erie Guardians program. The Guardians work together to network and mobilize concerned citizens, community groups, and businesses to help protect Lake Erie. From surfers and swimmers and cottagers to students and business owners, the Guardians are a diverse group. Each brings their own passion and skills to our movement. For further information, visit [lakeeriealive.org](http://lakeeriealive.org) —Staff

A view of Niagara Falls



## Positive Economic Return from Great Lakes Restoration Initiative

BY TODD WESTCOTT

**A NEW REPORT** shows that every federal dollar spent in the United States on Great Lakes Restoration Initiative (GLRI) projects from the program's launch in 2010 through 2016 will produce a further \$3.35 of economic activity in the Great Lakes region through 2036.

"This study describes what we already know in facts and figures: cleaning up legacy pollution and restoring aquatic habitat on the Great Lakes isn't only good for the environment, it creates jobs and fuels the regional economy," John Linc Stine, chair, Great Lakes Commission. "It's a positive legacy that States and our partner organizations can leave for future generations. The Great Lakes states are ready and excited to continue this critical work until the job is finished."

GLRI launched in 2010 and the U.S. Congress appropriated more than \$2.5 billion from 2010 through 2017 to fund more than 3,600 projects that have significantly improved environmental conditions around the region. While the GLRI was intended to accelerate environmental restoration of the Great Lakes and was not intended to stimulate the economy, the study shows that it created or supported thousands of jobs, approximately the same number of jobs per dollar of investment that would be created by a conventional

federal stimulus program designed to exclusively boost job growth.

"The research shows once again that programs like the Great Lakes Restoration Initiative can help the environment and our economy," said Molly Flanagan, vice president for policy, Alliance for the Great Lakes. "The GLRI is clearly a strong investment for the region, protecting our drinking water and recreation opportunities while supporting local economic growth and quality of life in communities across the region."

The study also found that GLRI increased the value that residents place on living in coastal areas: every project dollar spent between 2010 and 2016 produced quality of life improvements worth \$1.08 to residents as measured in housing values, leading to an overall increase of \$900 million in home values in Great Lakes coastal communities.

For further information, visit [glc.org/work/blue-economy/GLRI-economic-impact](http://glc.org/work/blue-economy/GLRI-economic-impact).



Todd Westcott is Water Canada's content and marketing manager.

Online at  
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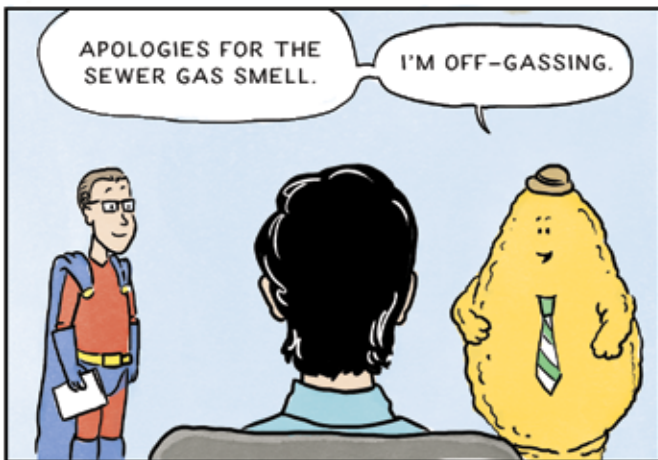
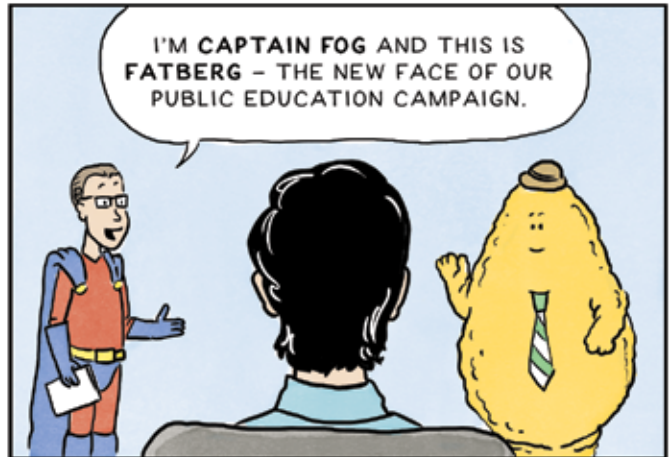


**VIDEO:** Watch Dahti Tsetso speak about Canada's first Indigenous Protected Area, the Edézhzhie.  
[bit.ly/Edézhzhie](http://bit.ly/Edézhzhie)

# THE ADVENTURES OF FATBERG



PRESENTED BY KSB CANADA, WATER CANADA & MESUG  
STORY & DRAWINGS BY NATHAN T. WRIGHT



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High maintenance: cannabis plants require extensive amounts of water so several greenhouse growers have turned to southern Ontario's agricultural heartland, in close proximity to the lower Great Lakes.



Cam Battley,  
Aurora  
Cannabis.

# The Buzz on Pot

Are producers properly managing water use? Legalization spurs thirst for more effective water treatment. **BY SAUL CHERNOS**

**WITH MEDICAL MARIJUANA LEGAL** for five years and the door opening to recreational use on October 17, 2018, Canada's cannabis growers are learning to navigate their crop's demanding water footprint.

In just a half decade, production has blossomed from well-hidden grow-ops into a rapidly maturing, investor-backed industry. Last year alone, Canadians spent \$5.7 billion on marijuana compared with \$16 billion on tobacco products and more than \$22 billion on alcohol, according to Statistics Canada.

With one in six adult Canadians consuming cannabis on an illicit basis, and an estimated 300,000 approved medical users, the market stands to be substantial. As Allan Rewak, executive director of the Cannabis Council of Canada, sees it, "Legalization is not about attracting new consumers but

about migrating existing illicit users to a fully regulated marketplace."

## Big business, big footprints

Still, cannabis is undeniably becoming a big business. Federally licensed cultivation facilities surpassed the 11 million square-foot mark this past summer, with some of the biggest players busy acquiring smaller ones. While outdoor growing isn't yet permitted, greenhouses and indoor cultivation facilities increasingly dot the country. At press time, Health Canada reported 120 licensed facilities, with 65 in Ontario, 25 in British Columbia, nine in Alberta, eight in Quebec, and 13 in other provinces.

Some of Canada's largest cannabis greenhouse growers have turned to southern Ontario's agricultural heartland, in close proximity to the lower

Great Lakes. Aphria has its headquarters and more than 1.4 million square feet of growing space in Leamington, near the north shore of Lake Erie, with plans to add another 700,000 square feet in 2019. Tilray launched more than 500,000 square feet this year in Enniskillen, south of Lake Huron. And Canopy Growth Corporation has 800,000 square feet in Niagara-on-the-Lake, a stone's throw from Lake Ontario. Factor in numerous, smaller players in the region and there's no doubt the relationship is budding between cannabis and the planet's largest body of freshwater lakes (by total area and second largest by total volume).

As a sales representative with Zwart Systems, a greenhouse and irrigation systems supplier in Beamsville in the Niagara fruit belt, Andrew Van Geest is optimally placed to keep watch on



Greenhouse city: Canadian regulations permit only indoor and greenhouse grow facilities such as Canopy Growth Corporation's Tweed operation in Aldershot, B.C.



In a greenhouse, cannabis plants are often grown in small individual cubes or planters, generally placed in rows on large tables.

the cannabis sector's interaction with water. "The questions are much better today than they were in 2013," says Van Geest, recalling a handful of very early producers using measuring cups to feed each plant uniform litres of water. "That's

**Treatment and recirculation systems not only save water but reduce long-term costs.**

how this industry started. They believed that watering by hand was more accurate than watering mechanically, even though that's not the case because you have human error when it's done manually."

Times have changed. Van Geest describes water delivery no longer by the

cupful but through two-litre-per-hour pressure-compensated drip systems that deliver precise amounts of water as-required, whether to 1,000 plants or 10,000 plants. "It's faster and no labour is involved," he explains. He recalls early growers unable to imagine the ease of recycling water. "They thought the water might become contaminated to a degree where it would harm the plant—that the plants' discharge could be toxic to the plant." Not so,

as Zwart's cannabis customers would quickly learn. Furthermore, nutrient levels can be adjusted in water returned to plants. Ebb-and-flood systems fill entire growing surfaces with water; plants draw what they need through capillary action, and the rest is returned into the system,

treated, reinjected with nutrients, and recycled back in successive feedings. Yes, leftovers again.

### **Irrigation systems: unique, boutique, and innovative**

With cannabis looking to become as mainstream as kale in your salad, all eyes are on designing irrigation systems that meet a grower's specific needs. "No two facility sizes are the same, even for customers with multiple facilities across the country," Van Geest explains. "Some want to be more boutique, others are trying to address the masses. Some are growing totally organic, so that's a different approach than with a commercial grade fertilizer. Some are growing in a building, others are growing in a greenhouse. Some are looking to produce oils, others are

## Fish Fuel Water Loop for Cannabis

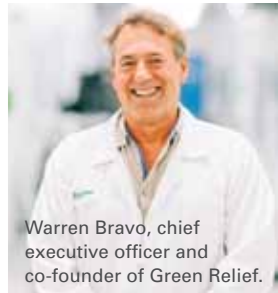
PHOTO: GREEN RELIEF



Purple Haze? The ultra-violet lighting appears more intense than it really is inside Green Relief's grow rooms.



Tilapia support the aquaponics set-up at Green Relief.



Warren Bravo, chief executive officer and co-founder of Green Relief.

**Just outside of Flamborough**, west of Toronto, a cannabis grower is using fish to fertilize crops. Merge aquaculture and the raising of fish with hydroponics (where plants root in water rather than soil) and you get aquaponics. It's a symbiotic system where plants feed on waste produced by fish—in this case tilapia.

Warren Bravo, chief executive officer and co-founder of Green Relief, got the idea from his wife Lyn Bravo, a landscape architect. What they envisioned as a vegetable greenhouse retirement project morphed into a cannabis start-up and a 32,000 square-foot building on the couple's farm.

"When my business partner and I were designing our building and talking to growers we were laughed at," says Bravo. "We took that as a challenge, and today nobody grows a cleaner, more robust cannabis plant than we do aquaponically."

Green Relief imports small fry from a New Mexico supplier, and when they reach 50 grams they're placed in tanks inside the growing rooms. Once the tilapia reach 700 to 900 grams in size, they're served for dinner at nearby homeless shelters.

"We feed the fish three square meals a day, the fish supply manure, and the solid waste is converted to NPK,"

Bravo says. NPK refers to nitrates, phosphorus, and potassium, fertilizer formed naturally through the waste.

Floating on styrofoam rafts, the plants absorb the water-borne nutrients through their roots, effectively cleaning the water. "It's a closed-loop recirculating system using 90 per cent less water than any other form of agriculture," explains Bravo.

Waste that ends up in outdoor retention ponds is treated with a system Bravo declines to discuss in detail but compares to a municipal waste treatment plant. "It's costing me \$1.5 million to build and is going to treat the water in a number of different ways depending on where the waste stream is coming from—whether its from the condensation lines from my HVAC or the waste from the fish treatment plant."

Green Relief plans to expand the farm and recently acquired a 100,000 square foot building in nearby Stoney Creek. Fish will be central to each operation.

The case for aquaponics is strong given pollution, scarcity, and other water issues, Bravo says. "There's all kinds of evidence that water's going to become a huge problem in the future, so if you're not latching onto sustainable agricultural techniques now you're going to be a dinosaur." WC

looking to produce young plants. All of these variables come into play when we're discussing the right irrigation approach."

Canopy Growth is a prime example. With sizeable space inside an old Hershey's chocolate factory in Smiths Falls, Ontario, and greenhouses across the country, the company has had numerous conversations about water consumption and treatment. Bryne-Lee Sorley, a project manager who helps oversee expansion activities, says Canopy facilities vary from location to location yet the principles remain largely the same. Rainwater is harvested wherever possible, wastewater is treated and reused, and energy and environmental measures are taken to help both the plants and the economic bottom line. "It's not necessarily too different from growing any other crop in a greenhouse," says Sorley.

The characteristics of a particular site determine the precise measures employed. Cisterns underneath Canopy's three Niagara greenhouses collect and contain water, while outdoor retention ponds serve its greenhouses south of Vancouver. Irrigation systems inside the old Hershey's factory resemble those inside the company's greenhouses, but the climate inside a building can be fully controlled, so Canopy adjusts lighting intensities to minimize the amount of water plants transpire and, in turn, volumes consumed. Canopy doesn't harvest rainwater at the Hershey's plant, because the building's roof doesn't facilitate that. But it does harvest from the rooftop gutters of its Niagara greenhouses and from the grounds surrounding the ponds in British Columbia. Only when Canopy needs to supplement natural and recycled sources does it turn on the municipal tap.

Lake Ontario and the Niagara River serve as powerful reminders of Canopy's water footprint. "Cannabis is a big consumer of water," concedes Sorley. She also

notes that treatment and recirculation systems not only save water but reduce long-term costs. “If you’re using sunlight you don’t need to be using additional energy, and so it’s the same idea with water conservation. If we can recirculate and reduce our water footprint, then that’s definitely the direction to go.”

While Aurora Cannabis, another of Canada’s largest producers, doesn’t grow near the Great Lakes, the company is well aware of its water footprint and has implemented measures such as water recirculation, rainwater harvesting, and retaining ponds at several of its sites and is looking to extend them company-wide. “Our target is to recycle 90-plus per cent of the water we use,” says Aurora chief corporate officer Cam Battley.

At Aurora Mountain, a 55,000 square-foot indoor facility north of Calgary, the company produces roughly 5,000

kilograms of cannabis annually. It’s treating wastewater with an aerobic waste digester supplied by Vancouver-based Micron Waste Technologies. The system digests the waste and denatures the spent water to remove active pharmaceutical ingredients and other impurities. “This leaves water that is clean enough to meet all municipal effluent standards, meaning that it’s now greywater that can be used for irrigation or could even be poured down the drain,” Battley says. The system is currently in trial mode to confirm its efficiency in handling cannabis. “If we successfully validate this cannabis version of the digester, we intend to install them at each of our production facilities,” Battley says, rattling off a list of sites in Alberta, Saskatchewan, Quebec, Ontario, and overseas.

Can a global company with products ranging from dried cannabis to oils and capsules, and sales as far away as Malta,

the Cayman Islands, and South Africa, pay heed to the environment and water protection? Aurora addressed that in 2017 when it purchased a \$1.5-million stake in Micron Waste. “This is technology that we think is a superior way to dispose of cannabis waste,” explains Battley. “That’s why we chose them as a strategic partner and made a strategic investment.”

In fact, Battley points out, Aurora has considered its environmental footprint from the very get-go, forgoing pesticides in favour of insects that predate on thrips and other common cannabis pests. “It’s just been assumed that if you’re inventing a brand new industry in the 21st century you want to make it as green as possible,” says Battley. “Our cultivation style is so tightly controlled that we haven’t had to deal with disease pressure, spider mites, or powdery mildew. These are things that are the

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Credit: Micron Waste Technologies



Staff at Micron Waste Technologies stand in front of the company's aerobic waste digester, dubbed the Cannavore. Dr. Bob Bhushan, Micron Waste Chief Technology Officer is second from right.

use at Aurora Mountain, dubbed the "Cannavore," essentially resembles a large shipping container. It integrates shredding, digesting, and water filtration functions to remove solids, nutrients, and active pharmaceuticals from wastewater, so it can be recycled back into the system or, if need be, dispatched down the drain.

**Environmental standards for cannabis production**

One issue coming to the fore is the need for environmental standards in cannabis production. "There's been tremendous effort from industry leaders and industry groups, including Micron Waste, to lead the charge in developing new regulations," says Wong. He describes active engagement with ASTM International (formerly the American Society for Testing and Materials) on new standards for contaminants such as active pharmaceutical ingredients and their impact on water.

scourge of cannabis production, so that's a measure of how confident we are in our production techniques."

At Micron, president Alfred Wong says the current crop of Canadian cultivators is well aware of water issues such as

scarcity and is keen to stay ahead of the regulations. "Aurora heard about our experiences in the food waste sector and reached out to us about a year and a half ago to engage us in developing a solution," says Wong. The aerobic digester in

"Pharmaceuticals, like opiates,

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amphetamines, and estrogen all have a significant impact on the aquatic ecosystem,” adds Wong. While legalization of cannabis is essentially moving it into the open market, regulations remain a relative grey area, with researchers looking to improve the understanding of specific implications of cannabis properties on water. “There is an impact, we just don’t know how severe the impact is. It’s just like when estrogen was found to cause sex changes in frogs—these things were found later on. So it’s important to be proactive.”

As the cannabis sector continues to evolve, Wong anticipates busy times. He also predicts best practices dovetailing with those of other agricultural and food industries facing similar challenges such as odour issues from industrial-scale compost sites. “We see value in processing organic waste, and we’re trying to do that for the cannabis industry—protecting the environment and digesting organic waste, to be able

to extract the water from organic waste and purify it so it can be reused back into farms or be discharged safely into the environment.”

Micron isn’t alone on this journey. Econse Water Purification Systems co-founder Derek Davy says his company is active in agriculture as well as the craft beer, winery, and vegetable washing markets. He foresees extending his company’s wastewater technology to a burgeoning cannabis sector. “It’s an integrated system that treats and purifies the water for reuse or discharge,” says Davy, adding that he doesn’t see cannabis as terribly different from other greenhouse crops in terms of water usage and wastewater. “Treating it (cannabis) is a piece of cake compared to the challenges of treating the water in a brewery or winery,” he says, citing higher levels of solids and nutrients in those two markets. “They’re tremendously more dirty compared to this. This is a cakewalk.”

In the end, treating cannabis may or may not be a cakewalk. However, the immediate challenge is landing customers and proving the technology works. “I’m cautiously optimistic,” Davy says when asked about the scale of opportunity for the water industry. “Whether it’s the cannabis sector, the food and beverage sector, or any other manufacturing here in Canada or abroad, any industry that steps up and does the right thing, I’m extremely encouraged and excited about being a part of.”

As Davy and others are hoping, because it’s a new industry “there’s an opportunity to get things right from the beginning rather than retroactively, and that’s always the right way to do things.” *wc*

Saul Chernos is a Toronto-based freelance journalist and frequent contributor to Water Canada.

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# 1

Peterborough-Kawartha-Haliburton designated as a Regional Centre of Expertise for Sustainable Development by the United Nations University as endorsed by UNESCO – 1 of only 8 RCEs in Canada.

The Walkerton tainted water disaster of 2000 resulted in the deaths of seven residents. Tougher drinking water standards and monitoring systems are now in place but there are ongoing gaps that still need to be addressed.



# Lessons Learned

What have we learned from Walkerton and what's still on the wish list?

BY MICHAEL MASTROMATTEO

**MANY OF ONTARIO'S** water protection specialists applaud the strides made in water quality and protection since the tainted water disaster in Walkerton nearly 20 years ago. But while there are more regulatory safeguards in place since Walkerton, there are still concerns about other potential threats to Great Lakes water just below the surface.

The tainted water disaster of May and June 2000 resulted in the deaths by E. coli poisoning of seven Walkerton Ontario residents. More than 2,000 others were made ill by the outbreak, and the Walkerton area community suffered more than \$150 million in economic losses. A provincial inquiry investigating the incident eventually recommended several policy and regulation changes designed to prevent similar outbreaks in Ontario and across all Canadian jurisdictions.

## Remembering the recommendations

Key recommendations resulting from the Walkerton inquiry touched on source water protection through a “multi-barrier” approach, including the training and certification of operators, a quality management system for water suppliers, and more competent enforcement. In Ontario, these requirements were incorporated into the province's Safe Drinking Water Act (2002), and the subsequent Clean Water Act (2006), which embraced a “source to tap” water protection focus.

Now nearly 20 years on, water safety experts are in a position to reflect on the effectiveness of water protection initiatives since the Walkerton disaster. “The fact that a second Walkerton-type disaster has not occurred suggests that the province is doing something right,” says Carl Kuhnke, chief executive officer (CEO) of the Walkerton

Clean Water Centre (WCWC). The centre was established in 2004, four years after Walkerton, to provide education and training to drinking water system owners, operators, operating authorities and the public. To date, high quality training has been provided to more than 75,000 participants in Ontario.

Kuhnke reflects that while the overall water protection system has been tightened up significantly, this is no time to become complacent. He cites the growth of blue-green algae (microcystins) as an emerging threat to the Great Lakes water system, one that is likely being exacerbated by the warming temperatures associated with climate change. Other water quality watchdogs echo the improved water quality programs since 2000, with a sense of wariness for the coming decades.

Terry Bender, vice president of operations for the Ontario Clean Water

Agency (OCWA), suggests the Walkerton incident has spurred provincial legislators to a new vigilance about water protection. "Ontario is one of the most highly-regulated water jurisdictions in North America and utilizes a multi-barrier approach to ensure water safety," says Bender. "To comply with these regulations, the province has set out mandatory certification and training for all drinking water operators, with re-certification essential throughout their employment within the water industry."

Bender adds that municipal officials, thanks largely to availability of training and educational opportunities, are now much more aware of their responsibilities regarding water treatment regulations and are in a better position to make any decision that could impact public health.

"Another significant impact to water quality has been the advancement in technology," he adds. "New tools have been introduced to allow for 24/7 monitoring of water treatment facilities (and) this ensures immediate notification should any abnormalities occur within the regular parameters."

In the wake of the Walkerton incident, the province established the office of Chief Drinking Water Inspector, to help coordinate all oversight and monitoring of water protection programs. The position was recently re-branded Chief Compliance Officer, to reflect the more proactive regulatory stance.

### Remaining concerns

Although the Walkerton disaster ushered in a much more vigilant water protection regime, there are still concerns about drinking water quality on many of Ontario's First Nations communities. Because First Nations communities are regulated by the federal government, there remain gaps in bringing the benefits of recent technology and enhanced administrative practice to all these communities.

Craig Baker, general manager of First Nations Engineering Services near London, Ontario, agreed that while Walkerton led to enhanced water-related regulation in force today, these new tools don't readily flow to their communities.

"It is important to understand that First Nations are governed by federal

jurisdiction and the federal government does not have corresponding water regulations," says Baker. "Indigenous Services Canada (ISC) has adopted provincial regulations as a best management practice when it comes to the design of water supply systems on reserve. In fact, the Indigenous Services water system design manual that was produced after Walkerton references the Ontario procedures for the design of water supply systems."

Baker said the response to the Walkerton disaster has substantially improved the quality of the design of water supply systems on reserve. Funding and service level problems, however, have proven difficult to overcome. "Since Walkerton, Indigenous Services

Canada has promoted and required that licensed operators maintain water systems on reserve," he says. "However, these added levels of service for First Nation water supply systems are almost completely negated by the lack of operational and maintenance funding the First Nations receive from ISC to operate their infrastructure once it is constructed." WC



Michael Mastromatteo is former associate editor of Engineering Dimensions magazine (Professional Engineers of Ontario) and

is currently a freelance writer with more than 30 years of experience.

## Walkerton Wish List: Experts weigh in with critical water quality action items

### More proactive regulatory oversight

Carl Kuhnke, CEO of the Walkerton Clean Water Centre, pines for proactive and ever-vigilant regulatory oversight among water system authorities so that none is ever tempted to rest on past laurels. "It's key to adopt this forward-looking administrative attitude to ensure water protection policy is future focused and does not rely on outdated regulations that might have addressed conditions of 20 or 30 years ago."

### Improved relations with First Nations

Craig Baker, general manager of First Nations Engineering Services, wishes for improved relations between First Nations communities and their federal government regulators so hard won technological and policy enhancements are fully realized and put into practice on First Nations communities far and wide. "The funding First Nations receive is only a subsidy, and the First Nation is expected to come up with the difference. Often the First Nation does not have access to additional funds and as a result, new assets often do not reach their design life as a result."

### Design systems better for end users

Bruce Matthews, CEO of Consulting Engineers of Ontario, a community crucial to water quality safety and protection, has a more specific request for engineering practitioners. "Engineers can't design fool-proof systems," says Matthews. "What engineers must do is design processes, systems, and equipment with full knowledge of the attributes and capabilities of the end-user population. Proper incorporation of human factors engineering will minimize the risk of introducing deficiencies in the interface between the system operator and the processes and equipment with which they interact." WC



# Algal Aggravation

Collaborative efforts to address priority areas making progress.

BY KATIE STAMMLER AND NATHAN WARKENTIN

**HARMFUL ALGAL BLOOMS (HABs)** in the western basin of Lake Erie are a persistent, international issue. HABs have increased in size and severity in recent years. They have resulted in the closure of beaches throughout the western basin, and of water treatment plants on Pelee Island in Ontario and in Toledo, Ohio.

There have been efforts to address the environmental and economic challenges posed by HABs. Both the binational 2012 Great Lakes Water Quality Agreement and the domestic 2014 Canada-Ontario Agreement recognize the issue of phosphorus loads contributing to HABs. In 2016, a target was set to reduce phosphorus by 40 per cent to Lake Erie from its tributaries. This included eight priority watersheds in the western basin.

## Largest concentrations in Canada

The Leamington tributaries in Essex County and the Thames River have been identified as the priority tributaries in Canada. In February 2018, the Canadian and Ontario governments released a joint Lake Erie Action Plan containing actions to achieve this target. The United

States federal and state governments also released their plans in 2018.

The Leamington tributaries are a group of small watercourses in the Leamington and Kingsville area that drain directly to the western basin of Lake Erie. They have high concentrations of nutrients and there are localized persistent HABs near the mouth of the tributaries. This area is host to the largest concentration of greenhouse operations in North America and nutrient losses from greenhouses were suspected to contribute to the high nutrient levels.

In 2012, the Essex Region Conservation Authority (ERCA) began a study to compare nutrient concentrations in watercourses influenced by greenhouse effluent to those without greenhouses. The results were published in the 2018 edition of the journal *Science of the Total Environment*. The study examined data for 14 watercourses sampled bi-weekly from 2012 to 2016. Nine of the watersheds contained greenhouses within their boundaries. Data showed that the mean concentration of nutrients in all the watercourses is higher than the Provincial Water Quality Objectives due to the agricultural nature of the area.

However, the mean concentration of phosphate and total phosphorus were approximately 28 times higher, and 20 times higher in greenhouse-influenced watercourses. (Note: This project received funding support from the Government of Ontario. Such support does not indicate endorsement by the Government of Ontario of the contents of this material.)

## Greenhouse grower initiatives

The Ontario Greenhouse Vegetable Growers (OGVG) have been collaborating with provincial ministries to reduce potential environmental harm resulting from greenhouse farming activities for many years. The development of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) "Self-Assessment and Best Management Practices (BMPs) for Water and Fertilizer Use in Greenhouse Vegetable Production" in 2013 helps growers to scrutinize their operation and prioritize areas for on-farm water use improvement.

OGVG and ERCA also work with key organizations to ensure well-designed funding programs are available and promoted to growers to ensure high

uptake and effective results. Over the past decade, growers have invested heavily in recirculation technologies that allow them to capture and re-use water and nutrients within the greenhouse, reducing inputs and conserving valuable limited natural resources.

Since 2010, more than 1,900 new and existing greenhouse vegetable acres have been transitioned to nutrient recirculation, reducing fertilizer consumption by 30-50 per cent per acre and reducing sector-wide fertilizer losses by 70 per cent on a per acre basis. Currently, more than 93 per cent of the acreage represented by OGVG recirculate. In addition, growers monitor their storm water retention ponds monthly to ensure that nutrient levels are below an acceptable level. Lastly, OGVG developed a dye test protocol for greenhouse facilities to analyze recirculation system function to further demonstrate that no nutrients are being unknowingly lost to the environment.

**Other collaborative efforts**

ERCA and OGVG also work with various partners to develop innovative solutions to reduce, mitigate, and measure phosphorus losses and changes in the environment. For example, the Town of Kingsville completed a sanitary sewer expansion in 2015 that provides a reliable solution for the management of both domestic waste and excess fertilizer solution originating from residential and greenhouse properties.

Other municipalities, specifically Leamington, are currently assessing the feasibility of a large sanitary sewer expansion project that would support economic development while being protective of the environment. In addition, two new wetlands were created near the mouths of key tributaries to improve the natural capacity of the watersheds to process excess nutrients. ERCA's water quality monitoring program has expanded to enable the calculation of nutrient loads and provide

the ability to track changes in phosphorus concentrations and loads over time as a result of implemented BMPs.

It will take several years of international effort to see a marked improvement given that HABs are a persistent problem in Lake Erie. The work that ERCA, OGVG, and farmers are doing is one part of a much broader effort to reduce the impact of HABs in Lake Erie. OGVG and ERCA are committed to reducing nutrient inputs to the Great Lakes and encourage all contributors do their part to help tackle this environmental concern. WC



Katie Stammler is water quality scientist at Essex Region Conservation Authority and Nathan Warkentin is energy and environment analyst at the Ontario Greenhouse Vegetable Growers.

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Remotely operated control structure, part of Ann Arbor's smart stormwater system.

# Smarter Systems

## Cyberinfrastructure strategies to control urban stormwater in the Great Lakes region.

BY AMY ELLEDGE

**"IF I HAD AN ULTIMATE VISION...** it would be that there would never be a flood ever again in any city in the world." Dr. Branko Kerkez of the University of Michigan made that bold statement in 2015 as he embarked upon a project to apply intelligent cyberinfrastructure to control urban stormwater.

"In the era of self-driving cars, digital assistants, and other smart things, can the same level of autonomy and 'intelligence' be embedded in water systems? Such technologies have the potential to dramatically reshape adaptation to some of the greatest water challenges, such as floods and droughts," said Dr. Kerkez.

### Great Lakes funds for new water systems

This type of curiosity and leadership is at the heart of the \$14 million portfolio of innovations in water management

funded by the Great Lakes Protection Fund (GLPF). With an \$800,000 grant, Dr. Kerkez and his team of academic, industry, and municipal partners are using information technology to reconfigure otherwise static urban water systems into systems that can adapt to real-time weather conditions.

Through the use of valves, pumps, and gates intended to enhance existing green and grey infrastructure, flows are controlled in response to sensor readings and weather forecasts. Forecasting allows the system to prepare for an event, and sensor readings are fed into algorithms to determine how best to utilize the stormwater capacities and treatments already available.

Those digital decisions impact activities on the ground: as a storm event moves across the landscape, the allocation of storage becomes dynamic.

An intelligent system can activate gates and valves to strategically hold back water, slowing the flow if the system becomes overwhelmed. Increased retention also provides an opportunity to optimize the ecosystem services of green infrastructure, maximizing filtration, and minimizing nutrient outflows.

### Real-time testing and results

Dr. Kerkez's GLPF-funded team is testing this real-time stormwater control system in the City of Ann Arbor where a series of basins drain into a large-capacity constructed wetland intended to mitigate downstream flooding. They have found that one strategically-placed valve, controlled remotely as part of a smart system, was able to hold back an estimated five to seven million gallons of water, allowing the site to function like a wetland that was 50 per cent larger.



Dr. Branko Kerkez and a sensor node, part of Ann Arbor's smart stormwater system.



From the perspective of the deputy water resource commissioner, the City of Ann Arbor is saving an estimated \$1 million in avoided new construction costs. That additional volume of retention significantly reduces the stress on flood-prone areas downstream. It also presents an opportunity to improve downstream water quality by reducing

Smart controls help achieve multidimensional system improvements, and healthier Great Lakes.

nutrients (including phosphorous), salt and other pollutants that are filtered out because of longer retention times and controlled release.

This type of a coordinated, adaptive system provides a unique solution to infrastructure issues faced by most

urban centers in the Great Lakes region. For municipalities on a tight budget, it provides low-cost enhancements to utilize existing infrastructure more efficiently. This could mitigate the pressure for new construction or the replacement of degrading infrastructure.

As part of the GLPF funding, sensors and controllers are actively informing decisions in the Great Lakes region in Ann Arbor, Toledo, and Milwaukee. As the data shows improved system conditions and as the technology becomes more ubiquitous, other communities have taken notice. Additional collaborations include Detroit and Benton Harbor, Michigan; Pittsburgh, Pennsylvania; Dallas, Texas; and Mexico City.

At [open-storm.org](http://open-storm.org), Dr. Kerkez has made available the technologies and case studies explaining these smart water systems. The technology is open-source so that cities can deploy their own sensors and monitor the performance of their

existing infrastructure. The available documentation and tutorials provide the information to cities about how to deploy smart water assets to control the flow of water across their landscape.

The ability to know when an urban water system has reached capacity, and to have an action plan ready when it does, better enables water managers to protect their assets and residents. Deploying smart controls to achieve multi-dimensional system improvements—including reduced costs, improved infrastructure performance, reduced flooding, and improved water quality—will reconfigure how cities think about increased volumes of rainfall and how to achieve healthier Great Lakes. For further information about GLPF, visit [glpf.org](http://glpf.org). *wc*



Amy Elledge is communications manager for the Great Lakes Protection Fund in Evanston, Illinois.



Like a rowing team, the Great Lakes Stormwater Collaborative involves an ongoing group effort of several sectors, working in tandem to take on various challenges.

# Great Efforts

Great Lakes Stormwater Collaborative explores the need for new stormwater tech.

BY GREGORY WILLIAMS

**THE GREAT LAKES STORMWATER COLLABORATIVE (GLSC)** is a membership-based organization run by volunteers that strives for broad, balanced membership across multiple sectors of stormwater management. The organization and its members recognize that the credibility of its work products derives from the fact they were developed through a collaborative process. This enables consideration of a wide range of concerns and perspectives. The GLSC aims to make decisions by consensus attained through a good-faith effort to meet the interests of all stakeholders.

## GLSC objectives

GLSC is working to protect the Great Lakes and their watersheds by addressing the knowledge gaps and management practices barriers between the supply and demand for stormwater technology.

The GLSC plans to achieve its vision through pursuit of the following objectives:

- Help match available, verified innovative stormwater technology and practices to the needs of communities;
- Build confidence in the performance of innovative stormwater technology and practices through education, advocacy, robust metrics, and performance standards;
- Evaluate and promote the life-cycle costs and associated benefits (e.g., triple bottom line and co-benefits) of innovative stormwater technology and practices; and,
- Advance and promote post-development/installed ownership, inspection, maintenance, and performance assessment of innovative stormwater technology and practices.

GLSC is the result of a two-year, region-wide stakeholder engagement process directed by the Great Lakes Commission and Lawrence Technological University in Southfield, Michigan. An advisory team, consisting of public and private stakeholders, guided this work, which explored the need for a stormwater technology transfer collaborative exclusively for the Great Lakes region.

The project included extensive interviews with almost 50 stormwater professionals from the public and private sectors in the Great Lakes region. From these interviews, a needs assessment was created that identifies barriers to stormwater technology transfer and whether a regional collaborative could help overcome those barriers. The needs assessment was vetted and validated through focus groups in Mississauga, Ontario, Cleveland, Ohio and Appleton, Wisconsin.



The report Stormwater Technology Transfer in the Great Lakes Region: A Needs Assessment was published in 2017. As a result, the GLSC was created to address the needs identified by all the participants in the exploratory process.

The first meeting of the GLSC took place in November 2017 at Lawrence Technological University. The more than 40 attendees elected co-chairs to lead the collaborative and an executive

GLSC is working to protect the Great Lakes and their watersheds by addressing the knowledge gaps and management practices barriers.

committee was also formed. The GLSC kickoff event also established the guiding principles, structure, and function of the group, and addressed initial priorities.

**Next steps**

Since the kick-off event the leadership team has been working to build the network and lay the groundwork to meet the need for stormwater technology knowledge transfer in the Great Lakes region.

The GLSC invites any interested party to suggest an initiative, join the leadership team, make introductions to projects or prospective members. GLSC aims to build partnerships with other stormwater related organizations and invites any partnership ideas.

For further information, contact the GLSC at [glsc@glc.org](mailto:glsc@glc.org). wc



Gregory Williams is a member of the GLSC and a managing director of Good Harbour Laboratories in Mississauga, Ontario.

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The top view of the MBR.

Image courtesy: membrafil

# New Water Recycling Strategy

How the food industry can cut costs and reduce environmental impacts.

BY JOHN NICHOLSON

**A SUCCESSFUL BUSINESS** has management and staff that constantly look for ways to make money and ways to save money. When it comes to managing wastewater generated by a business, ways of saving money may flip into ways of making money. Algoma Orchards, located near the Town of Newcastle, Ontario, has already started this process.

## Food industry and water challenges

In some jurisdictions in North America, municipalities will allow the discharge of wastewater containing high biochemical oxygen demand (BOD), high total suspended solids (TSS), or other pollutants in excess of the sewer use bylaw in exchange for a fee for treatment. This is typically done if the municipality has excess treatment capacity at its wastewater treatment plant.

In the food industry, it is not

uncommon for a facility to pay a municipality annual fees into the tens of thousands of dollars or more to treat wastewater that does not meet the sewer use bylaw. For some food plants, the additional cost of wastewater treatment is justified as its own treatment facility is not required.

Some companies in the food industry opt to treat their wastewater on-site prior to discharge. There are pros and cons to this option. The pros include the ability to control costs through the management of one's own wastewater and the potential to recycle water. The cons include dealing with potential odour issues, space restrictions, and the need for specialized training of staff to operate the treatment system.

With the growing challenge of water supply in some jurisdictions, the focus on water recycling has grown in popularity. Process wastewater is becoming too

precious a resource to simply flush down the drain. Water recycling and reuse have growing in popularity.

## Algoma Orchards case study

Algoma Orchards is a family-run company that specializes in growing apples and producing apple cider. They have been in business for more than 50 years. Algoma Orchards is one of Canada's largest apple companies with a fully integrated production facility that packages annually over 36 million kilograms of apples for wholesale, presses nearly four million litres of juice, and produces a variety of prepared products such as baked goods and gourmet foods.

Algoma had a two-fold problem. First, water was supplied to the facility from on-site wells. The amount of water needed for processing apples was on the verge of outpacing the amount of water that could be supplied by the



The membrane bioreactor, the heart of the water recycle system.



Kirk Kemp with former MPP for Northumberland-Quinte West Lou Rinaldi, accepting the Premier's Award for Agri-Food Innovation Excellence.



Kirk Kemp, president of Algora Orchards, with the water recycle system that results in annual savings in sewer use over-strength sewage charges of \$200,000 annually.

wells. The second problem was that the wastewater from the facility exceeded the local municipalities sewer use bylaw for BOD and TSS.

One option for solving the water supply problem was to pay for a water supply line from the local municipality. However, the rural location meant that the cost of pipeline would be considerable.

## On-site treatment and recycling processes provide a self-reliant water system.

An option considered for the problem of the high-strength wastewater, was to continue to pay high fees related to treating the over-strength wastewater.

Another option that was to recycle and reuse the process wastewater. The answer on which path to choose came down to a cost-benefit analysis and a calculation on the payback from the cheapest option.

### Strategic solution

Algora engaged the services of Toronto-based Altech Solutions to develop and implement the water recycling system. The heart of the water recycle system is a membrane bioreactor (MBR). The advantage of a MBR in an industrial setting is that it is compact. The aerobic microorganisms in the MBR removes the BOD from the wastewater and the ultra filtration system removes any suspended solids. The water is polished with an ultraviolet disinfection system.

In 2009, Algora Orchards opened a 165,000-square foot production facility that included a potable water treatment system, a state-of-the-art rainwater harvesting system and MBR for treatment and reuse of greywater. These on-site treatment and recycling processes provide a self-reliant water system for the facility, reduce its demand on local groundwater supplies and ensure an abundant, sustainable supply of water for the production lines and the retail bakery.

Together, the rainwater and MBR systems can largely meet the daily

requirements for process water, with small withdrawals from the well to provide process make-up water and to supply potable water for staff and the bakery.

The MBR treats all the greywater collected from the facility processes including the apple flume, apple washing, bottle washing, pressing and filling equipment and more. It can provide up to 35,000 litres of treated effluent, which then passes through a reverse osmosis system. Treated effluent from the MBR is blended with harvested rainwater in a storage tank to ensure sufficient, on-demand supply. Final disinfection of water from the storage tank is performed using an ultraviolet light system before it is reused in the production processes. The result of this new recycling system in annual savings is \$200,000 annually. [wc](#)



John Nicholson is president of Environmental Business Consultants.

# The Plastic Problem

Searching for solutions and properly framing the problems with industry.

BY TODD WESTCOTT



L-R: Ingrid Thompson, Pollution Probe; Shelley Snider, Ice River; Bob Masterson, CIAC; Carol Hochu, CPIA; Rod Phillips, Ontario Minister of the Environment, Conservation and Parks; Mark Fisher, CGLR; Chris Hilken, Pollution Probe; and Ken Faulkner, Nova Chemicals.

**PRESSURES ON THE ENVIRONMENT** are mounting, and pollution from plastic waste has quickly floated to the top of the pile. So much so that industry, government, and environmental groups are rapidly coming together to find solutions.

The Great Lakes Plastics Forum recently convened in downtown Toronto as an opportunity for key stakeholders to talk solutions for the root problem.

“The issue has been described as one of marine litter, associated with very poor or nonexistent waste practices in key Asian economies,” said Bob Masterson, president and CEO, Chemistry Industry Association of Canada (CIAC). “Personally, I found the science discussion of fibers in the Great Lakes sobering, and it made me think about the issue in Ontario in a different way than perhaps I had in the past.”

A figure shared at the event: roughly nine million tonnes of plastics are entering the Great Lakes annually. But it’s not simply a water resource issue; that’s just a symptom.

“We did see a number of examples of real leadership from industry today, but as an environmentalist I look at it, and I say, yeah, there’s some great leadership, but they’re doing it because it differentiates them in a competitive market,” said Chris Hilken, CEO, Pollution Probe. “The challenge is going to be: How do we get beyond individual leaders to get a whole society to behave in a similar way?”

“It’s going to take all of those voices and stakeholders working together

to find the right solutions,” said Mark Fisher, CEO, The Council of the Great Lakes Region (CGLR).

A pathway towards solutions seems to be well posted, with a clear direction for everyone seeking to move in that direction. Attending stakeholders voiced a chorus of concern over current solutions in place to reclaim plastics from waste streams. Some, whose job it is to be in the know on the matter, described standing over their recycling bin, municipal guide in hand, and at a complete loss as to which receptacle a piece of plastic should be discarded into.

“We’ve had a Cadillac blue box system [in Ontario] for—what—40 years?” asked Fisher. “And we still send roughly 80 per cent of plastics to the landfill.” The inconsistent regulatory approach from the municipal, provincial, and federal levels, as well as across the Great Lakes into the U.S. were roundly called out as a part of the plastic problem.

“If we’re going to be successful, we need to look at how we’re creating that supply that’s ultimately being recycled, reused, and recovered for a variety of purposes,” said Masterson. “I think that is a key solution, both in terms of what industry needs, but also what government needs to do to in creating that market place.”

“Inhale complexity, exhale simplicity!” said Carol Hochu, CEO, Canadian Plastics Industry Association (CPIA), reciting a mantra that arose in various forms throughout the day. In order to get buy-in from the public, a consistent and simple approach to diverting plastic from

waste streams was agreed to be essential. “The other point about the standardized basket of goods that John Coyne [vice president and general counsel, Unilever] made was not only to gain scale in market development, but to make it simple.”

But can we get there? “Ontario is extremely complex, especially when we compare it to other jurisdictions in Canada and the United States,” said Fisher. “Everything we do is much more complex, and the outcomes often aren’t as good for the balance between the economy and the environment.”

Using guilt and instituting a regulatory stick were sounded as important tools to reach that goal: a zero-waste province and country.

“I think on top of that, there’s strong consensus about how we have to change the mentality about plastics and get people to understand that value of it,” said Hilken. “There’s actually some very key things we can do going forward and some advice we can give to the Environment, Conservation, and Parks Minister of Ontario about how we should be moving forward to ensure that we are keeping plastics out of our fresh water and, particularly, the Great Lakes.”

Participating organizations will be taking the forum’s outcomes, a consensus on what works and what doesn’t work, to the Ontario government and will keep engaging on the matter. **wc**

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Todd Westcott is Water Canada’s content and marketing manager.

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**Lystek International Inc.**

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N



**NCS Fluid Handling Systems Inc.**

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**Netzsch Canada**

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X



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Xylem is a leading water technology company committed to "solving water" by creating innovative and smart technology solutions to meet the world's water, wastewater and energy needs. In a world of ever-growing challenges, Xylem delivers innovative water technology solutions throughout the cycle of water. Our technological strength across the life cycle of water is second-to-none. From collection and distribution to reuse and return to nature, our highly efficient water technologies, industrial pumps and application solutions not only use less energy and reduce life-cycle costs, but also promote sustainability.



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# Water Quality Trading

Is there a roadmap for success in North America? BY EDGAR TOVILLA

**WATER QUALITY TRADING (WQT)** is not a new concept. Implemented in North America in the 1980s, WQT is now applied in many parts of the world to cost-effectively reduce nutrient loadings on waterbodies. It's essentially a transfer of costs among willing partners to reduce contaminants. This transfer varies according to contaminant source, loading, location, scale, governance structure, and management approach. WQT requires clear policies regulating discharge sources, to enable the flexibility to comply with their regulatory obligations by trading credit equivalencies, caps, or ratios.

Has the WQT system adapted sufficiently over time to adjust for new sources of contamination and other factors?

## Lessons learned

WQT programs have grown over the past 25 years in many North American jurisdictions. These programs have been specifically designed to reduce nutrient loadings and improve water quality in lakes, rivers, coastal areas, and watersheds. In fact, according to a 2017 edition of the Journal of Environmental Management, they have been documented with mostly positive outcomes in the following areas: Lake Okeechobee in Florida; Lake Simcoe in Ontario; Chesapeake Bay Area in Maryland and Virginia; Colorado River in Arizona; Jordan Lake Watershed in North Carolina; Miami River in Florida; Minnesota River Basin in Minnesota; and, the Chatfield Reservoir in Colorado.

## Current challenges

The impetus of WQT comes from the premise that in developed countries point sources, such as municipal and industrial sewage treatment plants (STPs), were the primary source of nutrients entering bodies of water. However, with the more stringent effluent quality nutrient requirements, it is now non-point sources, such as agriculture and stormwater, that have become the primary source.

Recent reports from the Ministry of

the Environment, Conservation and Parks (MECP) provide a clear picture of the current situation. The Lake Simcoe Phosphorus Reduction Plan (2010) identified 56 per cent of total phosphorus (TP) sources discharges on Lake Simcoe with these non-point sources. The Ontario government's Phosphorus Reduction in Lake Erie from Canadian Sources (2017) identified 71 per cent of soluble reactive phosphorus load and 93 per cent of the TP load in Lake Erie attributable to non-point sources. This study noted that "contribution from urban point sources, including municipal STPs, combined sewage overflows (CSOs) and industrial direct discharges, is estimated to be only 10 to 15 per cent."

## Key elements for success

A successful program requires a strong foundational regulatory and governance framework to make it successful. The reports regarding North American cases suggest the following key elements should be included in any WQT program:

**Baseline:** The water quality baseline needs to be well defined. The amount of pollution reduction and reduction targets will define the size of the trading market.

**Economics:** The basic economics to sustain trading needs to be understood. This is not only the capital and operating

costs comparatives, but also the social and environmental costs that would enable the supply and demand market. This is the system of economic incentives that can prompt farmers, industry, regulators, and municipalities to adopt a system of trading rules to reduce costs. An effective WQT system requires an adequate supply of non-point sources as well as sufficient demand from point sources.

**Trading system:** The appropriate trading system, which can be classified in closed systems (cap-and-trade) and open systems (credit or offset) should involve water quality offsets, or credits, relying on uncertainty ratios, or loading equivalents.

**Monitoring:** The long-term sustainability of trading needs to have strong monitoring and calibration to maintain trading costs, ratios, or trading caps. This is a built-in flexibility to adapt to potentially moving targets. Trading ratios must adjust to the inherent uncertainty of non-point sources overtime.

**Policies and governance structure:** The framework needs clear policies, regulations and organizations (governmental and non-governmental, hence the term governance) to sustain long term investments and operating and monitoring costs. No industrial discharger or municipality will invest

**Table 1: Ontario's Sewage Treatment Plants with WQT and Total Phosphorus Offset Arrangements**

	SITE NAME	DATE APPROVED	TP OFFSET
1	Village of Casselman – Lagoons	Jul-2001; Last amended: Aug-2006	South Nation River Conservation Authority (SNRCA); TP offset monitoring agreement
2	Township of North Dundas – Winchester Sewage System	Mar-2000; Last amended: Oct-2010	TP Management Agreement with the SNRCA; TP target of 640 kg/year
3	Municipality of The Nation's Central Landfill	Oct-2002	TP Management Agreement with the SNRCA
4	Laféche Environmental Inc. – Eastern Ontario Waste Handling Facility	Jul-2003; Last amended: Apr-2011	TP Management Agreement with the SNRCA (non-point sources); TP target of 240 kg/year
5	Laféche Leblanc Soil Recycling Inc. – Soil Recycling Inc.	May-2006; Last amended: Jan-2010	TP Management Agreement with the SNRCA
6	Township of Russell's Lagoon	Oct-2012	TP Management Agreement with the SNRCA; TP target of 123 kg/year to the Castor River
7	GFL Environmental Inc. – Moose Creek	Mar-2014	TP Management Agreement with the SNRCA
8	Town of New Tecumseth's Tottenham STP	Apr-2014	No 3rd party monitoring; Agreement under a by-law; TP target of 39 kg/year into Beeton Creek; includes both point source and non-point sources

Source: Edgar, 2018

in WQT without certainty regarding the regulatory framework.

### Regulatory barriers

While the federal legislation offers a regulatory framework under which a WQT system could function, any WQT would necessarily require a provincial regulatory framework (or state government support in the USA). The Lake Winnipeg and Lake Simcoe cases in Canada provide significant research and pilot projects respectively where we can draw lessons learned in terms of the use of the key elements of WQT.

Research in the Journal of Great Lakes Research associated with Lake Winnipeg identifies the need to balance nutrient loadings entering the basin by sub-basins with cap and trade limits by source. This balance is meant to incentivise supply and demand, which would require a significant monitoring effort to determine offset ratios. In the case of Ontario, Lake Simcoe has increased adopters of TP offset projects. Ontario has a total of eight site-specific WQT projects (see Table 1, an updated version of the 2015 original), both industrial and municipal, some of them active since 2001. There is significant performance-based data accumulated from these WQT cases worth examining, which will likely assist in establishing guidelines to promote further WQT in Ontario and other jurisdictions.

The Chesapeake Bay Area is a good example that combines federal and multi-state permitting under a watershed-based approach. As reported by the U.S. EPA in 2018, this program has consistently achieved since 2007, more than 5,000 tonnes of nutrients removal per year, at an estimated 20 per cent of the cost of conventional point-source treatment. Guidelines and case studies are developed by state and federal regulatory agencies to continually manage this watershed.

### Cost calculations

According to Dianne Saxe, in the November/December 2017 edition of Water Canada, the cost of removing TP using tertiary or quaternary point source treatment is about \$45,000 and \$100,000 per kg, respectively. This estimate considers data from the Midhurst STP and the Upper York Sewage Solutions, both in Lake Simcoe with TP regulatory

requirements of 0.02 and 0.03 mg/litre.

In contrast, removing TP from non-point sources cost much less. A review of the South Nation River Conservation Authority (SNRCA) data notes that “investments” from municipal STPs fund approximately 50 to 100 per cent of the costs of projects from non-point sources throughout the watershed. The SNRCA acts as the broker and clearinghouse. The reported cost of TP removal by WQT on SNRCA managed projects is an average of \$300 per kg. Other historic estimates in Florida bring WQT at non-point sources up to \$7,000 per kg of TP removed, and with average cost savings of 76per cent in comparison with conventional point-source treatment.

### Roadmap for success

Partnerships among provincial/state/territorial governments, the agricultural industry, municipalities, industrial dischargers, independent monitors and research institutions are essential. Through these partnerships, studies, monitoring, and research could provide the evidence-based data to assist in developing guidelines and standards to establish the necessary regulatory framework (policy tools) to keep WQT as a viable option for many polluted lakes and basins.

The Canada-Ontario Lake Erie Action Plan (2018) includes specific actions to evaluate the feasibility of using WQT as one of the mechanisms in the tool box to address phosphorus reductions. This action has the potential to open opportunities for more standardized WQT and for municipalities to address contaminant loadings from other non-point sources to achieve their own TP reduction targets.

Further, as per Robert Haller’s Rules & Regs column in the March/April 2018 edition of Water Canada, the Halifax Harbour, the Victoria Capital Regional District, and St. John’s Harbour are good examples that could benefit with WQT. Recent legislative developments illustrate federal and provincial interest to keep exploring and experimenting WQT in Canada where it makes financial and economic sense. wc

Edgar Tovilla is manager of wastewater operations for Peel Region in Ontario.

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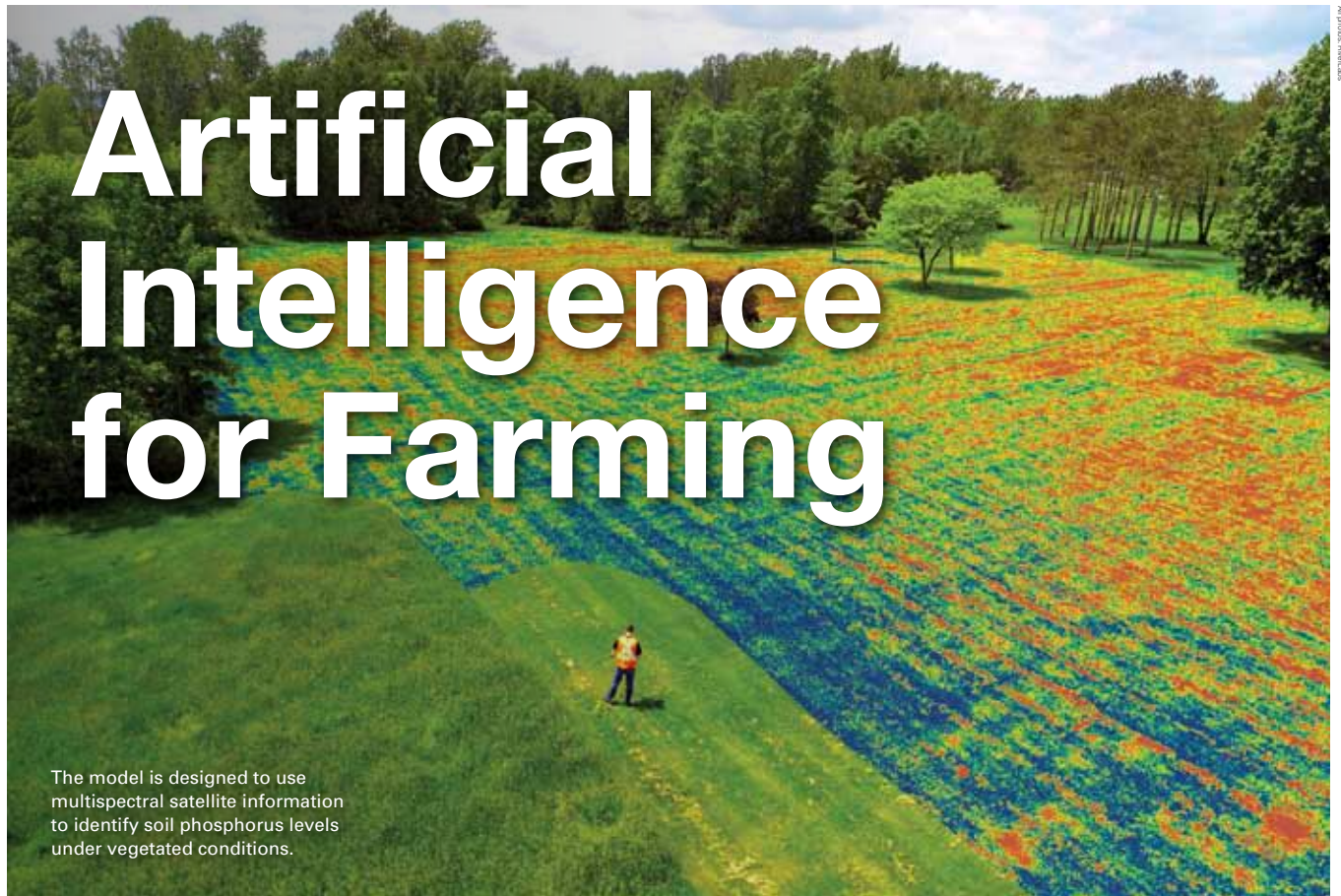


Image: RiverLabs

# Artificial Intelligence for Farming

The model is designed to use multispectral satellite information to identify soil phosphorus levels under vegetated conditions.

## Detecting phosphorous hot spots in Great Lakes agriculture. BY MARK MACDOUGALL

**THE CONVERSION OF MARSH LANDS** into agricultural lands has long provided some of the most productive agricultural lands across Canada and the globe. These lands contribute millions of dollars to regional economies, and provide a reliable food source for an ever growing population.

Historically, the goal of most agricultural industries was to deliver the highest yield product, with the lowest production costs possible. Often this came at the expense of the environment, as other than cost, little consideration was given to nutrient management. Today, the negative impacts of decades of intensive agriculture on water quality and ecosystems health are being felt across Canada.

Ontario-based RiverLabs and its multidisciplinary team is working to develop improved methods of monitoring and identifying hotspots of nutrients across a landscape, to better focus nutrient management efforts.

They draw upon a demonstrated knowledge-based in areas of analytical laboratory services, microbiological testing, and customized research development to provide an organization with optimal and flexible solutions adapted specifically to client needs.

### The challenges

In Ontario, the development of intensive agriculture has contributed to wide spread water quality issues in much of the province, including the Lake Simcoe basin. The southern Lake Simcoe watershed is of great interest as it has a long history of eutrophication due to rigorous agricultural operations and naturally rich soils, but also has one of the quickest growing populations in Canada. This is problematic as Lake Simcoe and its tributaries are a recreational hotspot for boating, swimming and fishing, as well as a drinking water source for nearly half a million Ontarians.

### The solutions

Starting in 2016, a team from RiverLabs began the development of the Spectral Landscape Nutrient Estimate (SLANE) model, designed to remotely identify sources of nutrients in surface soils at landscape scales. The model is named after a Slane, an Irish, spade-like tool used for cutting turf and boggy material, and was widely used to transform marshlands in Europe and North America into agricultural lands in the 1800s. SLANE is a fitting name for this model, as it designed to use multispectral satellite information to understand soil phosphorus levels under vegetated conditions.

By training an artificial intelligence algorithm to detect relationships between multispectral data and soil phosphorus concentrations, SLANE aims to help watershed managers identify hotspots of non-point source nutrients, and improve their ability to target best management practices and conservation efforts. Similar

The RiverLabs facility, the Applied Research and Technical Services branch of the River Institute, in Cornwall, Ontario.



to efforts using multispectral imagery to understand water quality and predict algal blooms in lakes, SLANE transposes the nutrient-pigment relationship upstream into the watershed, to understand and

By combining artificial intelligence and multispectral data, we can continue to improve environmental monitoring, and better understand complex problems.

identify the sources of nutrients before they reach the water. This is an essential tool for watershed managers struggling to limit non-point source nutrient contributions and face resource limitations when implementing solutions.

Within the initial pilot study, SLANE was able to correctly identify soil phosphorus concentrations 71 per cent of the time. While this shows that there is room for improvement, this initial phase also provides a strong foundation to continue to refine the model. Building

on the development of the SLANE model, RiverLabs' next steps will be to attempt to directly link soil phosphorus hotspots with observations of water quality. Model estimates can be paired with existing nutrient transport and soil conservation models such as RUSEL2 and SWAT, which are already being used by agencies within Ontario to estimate soil loss and nutrient loading in tributaries. This will provide stakeholders with high resolution risk maps detailing where nutrients are at highest risk of loss, as well as provide estimates of nutrient loading on receiving waters.

### Next steps

Within the Lake Simcoe basin, there is hope that the use of multispectral imaging and artificial intelligence may provide a powerful tool to limit non-point source phosphorus inputs by allowing managing agencies to

pinpoint best management practices and conservation efforts. More broadly, this shows the potential to be adapted in other watersheds, such as Lake Erie and Lake Winnipeg, which suffer similar eutrophication due to agricultural non-points source phosphorus. It could also provide stakeholders with a better understanding of phosphorus hot spots in remote areas where the collection of environmental baselines is difficult to achieve through on-the-ground sampling.

By combining artificial intelligence and multispectral data, we can continue to improve environmental monitoring, and better understand complex problems that face aquatic systems. The inclusion of big data into the decision-making processes may allow for improvements and efficiencies to water management nationwide. [wc](#)



Mark MacDougall is a biologist and project coordinator at River Labs in Cornwall, Ontario.

## APPOINTED



**SARAH RANG** joined the organization as the new deputy director (Canada). The Great Lakes and St. Lawrence Cities Initiative has more than 100 member municipalities, on both the Canadian and U.S. sides of the Great Lakes, which seek to protect and restore the Great Lakes and St. Lawrence.

Rang has a combined 25 years of experience working in environmental programs, and focussing on water, climate change, and sustainability. In the new role, she will work with partners to coordinate Great Lakes and St. Lawrence Cities Initiative programs, including the Thames River Phosphorus Reduction Collaborative, designed to reduce phosphorus entering the Thames River and Lake Erie, and ongoing work on water quality, quantity, and building resilient cities. For further information, visit [glsicities.org](http://glsicities.org) or [thamesriverprc.com](http://thamesriverprc.com).



**PETER HUCK**, a civil and environmental engineering professor and industrial research chair in water treatment, was recently awarded more than \$3 million to continue his research program at the University of Waterloo. As part of the Natural Sciences and Engineering Research Council of Canada (NSERC) Industrial Research Chair (IRC) program, the funding will allow the long-time researcher and fixture of Canadian water science to continue his work and collaborations. With the support of the NSERC-IRC, Huck leads a group of researchers, graduate students, and postdoctoral fellows addressing challenges in

water treatment and supply.

“We actively collaborate with our partners,” said Huck. “They don’t just fund the projects—we work with them directly. We work in their facilities and use their water in our research.”

The program is funded jointly by NSERC and 17 Canadian industry partners, including municipal organizations responsible for water treatment and supply, consulting companies, and manufacturers in the water treatment space. Huck and his team will be funded over a five-year period.



**TANYA  
MCQUEEN**

The Water Technology Acceleration Project (WaterTAP) board of directors recently announced that **Tanja McQueen** has been elected to the role of board chair, succeeding Rick VanSant, who remains an active director and becomes vice chair. McQueen joined the board in 2016, drawing on experience in business leadership and organizational change with private sector, public sector, and not-for-profit roles. She is an ICD.D certified board director and has been actively engaged in WaterTAP’s board as both a member and committee chair.

The board also welcomes four new directors: **Helge Daebel**, **Paul Gibson**, **Rita Theil**, and **John Walker**. Together with five incumbent directors, they will guide the organization in its mandate to promote and strengthen Ontario’s water sector. “We are delighted to welcome Helge, Paul, Rita, and John to the board,” said McQueen. “They represent a broad spectrum of private and public-sector experience. They will help guide WaterTAP’s mandate to connect Ontario’s water technology companies to resources that accelerate their commercialization, market adoption, and growth.”

The new directors will assume their board duties immediately. Full biographies for all directors are available at [WaterTAPontario.com](http://WaterTAPontario.com).



Canadian companies discussed emerging solutions at the water-food nexus on a panel at the WEFTEC Global Center. From left to right: Dr. Peter Gallant, WaterTAP; Dr. Patrick Kiely, Island Water Technologies; Karen Schuett, Livestock Water Recycling Inc., and, James Dunbar, Lystek International.

## WEFTEC New Orleans, LA

The Water Environment Federation’s 91st Annual Technical Exhibition and Conference, known as WEFTEC, was held in New Orleans, Louisiana from September 29 to October 3, 2018. More than 20,000 water professionals and 1,000 water companies attended, including Water Canada Associate Publisher **Jane Buckland**, to learn, connect, and work toward a better future for water. Known as the world’s largest water event, WEFTEC showcases some of the latest developments, technologies, and services for the water sector.

“We are thrilled to be in New Orleans as it honors the past, present, and future with its Tricentennial anniversary,” said **Eileen O’Neill**, executive director of WEF. “The resilience and fortitude of this city and its people—and their unique relationship with water—is something that we can all learn from, aspire to, and, in the full spirit of New Orleans, celebrate.”

The opening session unveiled the first-ever data on how much North American water utilities are recovering resources, including the areas of water reuse, energy generation, and nutrient recovery. It also featured the relaunch of “Water’s Worth It,” a messaging campaign to raise public awareness about the importance of water and the work of the water sector. **Kevin Brown**, author of *The Hero Effect*, shared his ideas and strategies to inspire water professionals to recognize they are everyday heroes in their communities.

The WEF Awards and Presidential Celebration honoured those who have made outstanding contributions to the water environment profession, WEF, and its Member Associations. 2017-18 WEF President **Jenny Hartfelder** also passed on her leadership role to Tom Kunez. For further information, visit [weftec.org](http://weftec.org).



## 8th Annual Maintenancefest at the Walkerton Clean Water Centre

Walkerton, Ont.

The Walkerton Clean Water Centre (WCWC) hosted the eighth annual Maintenancefest in Walkerton on August 28 and 29, 2018. Maintenancefest is a unique hands-on training event that provides an opportunity for up to 100 drinking water system operators from across Ontario to rotate through six training modules of their choice, each led by industry experts.

Training modules included: basics of utility locates, continuous chlorine monitoring, fire flow testing, leak detection, ultraviolet absorbance and transmittance, and more.

This year, 99 participants attended the event and the feedback was excellent. **John Bender**, from the Durham Mobile Home Park, has attended every year and appreciates that he can continue

to learn new information. “It’s continuously good. Every time I’ve come, I’ve always taken something home with me,” said Bender.

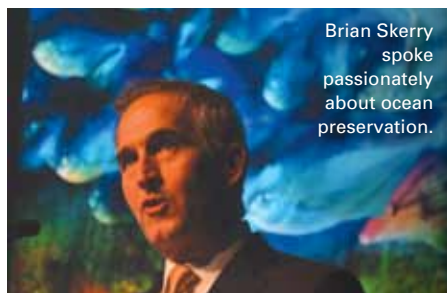
WCWC is an agency of the Government of Ontario, established in 2004, to ensure clean and safe drinking water for the entire province. WCWC coordinates and provides education, training and information to drinking water system owners, operators, and operating authorities, as well as the public, to safeguard Ontario’s drinking water. Through partnerships, WCWC also provides training for the 133 First Nations communities in Ontario. To date, high-quality training has been provided to more than 78,000 participants across Ontario. For further information, visit [wcwc.ca](http://wcwc.ca).



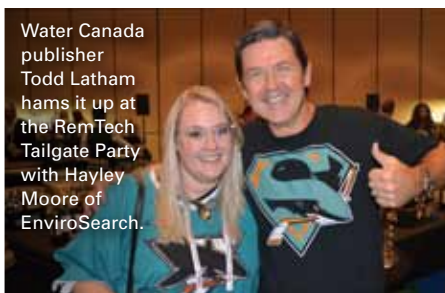
Participants work through an activity during the Continuous Free Chlorine Monitoring module.



Attendees complete a hands-on exercise during the Pressure Control Valves module.



Brian Skerry spoke passionately about ocean preservation.



Water Canada publisher Todd Latham hams it up at the RemTech Tailgate Party with Hayley Moore of EnviroSearch.



Jonathan Gee, manager of Great Lakes Areas of Concern for Environment Canada presents on the Randle Reef project in Hamilton.

## RemTech 2018 Banff, Alta.

On October 10 – 12, 2018, environment professionals from across the country attended the Remediation Technologies Symposium 2018 (RemTech 2018) at the scenic Fairmont Banff Springs. Now in its 17th year, the Environmental Services Association of Alberta (ESAA) has been hosting this leading event to showcase the latest innovations in soil and groundwater remediation.

**Brian Skerry**, the prolific underwater photographer for National Geographic, was one of the keynote speakers. His talk on “Luminous Seas” provided insight into his incredible work over the past

three decades, with more than 10,000 hours underwater, photographing marine wildlife and underwater environment. Skerry has shot over 25 feature stories for National Geographic and this year was awarded the prestigious National Geographic’s Explorer of the Year. He immersed the audience in his cover stories and shared some of his favourite moments underwater including snorkeling with former president **Barack Obama** on Midway Island after the protected ocean area of the Papahānaumokuākea Marine National Monument World Heritage site was expanded to over 1,510,000 km<sup>2</sup>.

Over 600 delegates from government, academic institutions, and industry attended the conference to network and learn about leading edge technologies involved in site remediation and groundwater research. The three-day technical program included 55 exhibits and 80 technical presentations which covered topics such as: in-situ and ex-situ treatment methods, biological (and non-biological) treatment, thermal desorption, encapsulation, multi-phase extraction, and environmental management. For further information, visit [esaa.org/remtech](http://esaa.org/remtech).



## Sustainable water security for the greatest lakes and beyond. BY CONNIE VITELLO

**IT'S A PROFESSIONAL AND PERSONAL PLEASURE** to work with the Water Canada team while they firm up the replacement of a new full-time editor. This Great Lakes edition has special meaning for me. I'm fortunate enough to live in the Toronto Beach, a cozy community by Lake Ontario. As anyone who lives, works, or plays near the water will tell you, it's wonderful all year long. The mood of the waves makes for a different experience daily. My golden doodle loves to dive right in, and I'm happy that she can.

Toronto has some of the best beaches in the world. Their water quality is verified by an internationally recognized and regularly monitored program that is committed to maintaining high standards for water quality. We've come to expect world class lake water management and reporting. (For further information about Blue Flag Canada, visit [environmentaldefence.ca/blue-flag](http://environmentaldefence.ca/blue-flag).)

While conditions have improved in recent years, they're still not perfect. There are still high E. Coli days and ongoing contamination concerns, and much like previous Water Canada editor Katherine Balpataky mentioned in a recent edition, I tend to pick up trash on the ground before it has a chance to pollute the water.

On October 22, 2018, the Beaches-East York Ward elected Councillor Brad Bradford, who was endorsed by Toronto Mayor John Tory, and who pledges to make the ward and Toronto a leader in

reducing plastic waste. Many of us who live near the water are acutely aware of the correlation between our behavior and the health of the water ecosystem, and how it is connected to other ecosystems and human health.

But we can all do better. The 2017 Royal Bank of Canada (RBC) Water Attitudes Study confirms how much Canadians value water but also reveals a troubling carelessness with our number one resource. (To read the study, visit [rbc.com/community-sustainability/environment/rbc-blue-water/water-attitude-study.html](http://rbc.com/community-sustainability/environment/rbc-blue-water/water-attitude-study.html))

Compared to the rest of the world, Canadians are quite fortunate. Water is highly visible and available in Canada. The Great Lakes make up the largest surface area of freshwater found in one place anywhere in the world. In fact, Natural Resources Canada has assessed Canada as a freshwater-rich country. On an average annual basis, Canadian rivers discharge close to nine per cent of the world's renewable water supply, while we have less than one per cent of the world's population.

Meanwhile, many countries and many people across the globe are suffering. According to a recent report from the British Broadcasting Corporation (BBC), over the past 40 years, the world's population has doubled and use of water has quadrupled. There are too many people in need of clean water, decent sanitation, and hygiene solutions.

In a recent survey of senior level

representatives in the Canadian water industry there was a clear consensus that there's a direct correlation between successful business practices and sustainable business practices. Most participants had established corporate social responsibility or sustainability goals. They and many others are beginning to look beyond the walls of their own operations to make a more meaningful impact in their communities, watersheds, and increasingly, globally.

The Canadian government and several Canadian organizations are poised to play increased roles in helping the global community attain greater confidence in water sustainability. I've recently become familiar with a dynamic organization, WaterAid Canada (WAC), a charity focused on making essential strategic shifts toward achieving sustainable improvements in the water industry. Word to the wise: they are actively searching for Canadian partners. (For further information about WAC, visit [wateraid.org/ca](http://wateraid.org/ca).)

Let's not be humbled by our own arrogance about the Great Lakes and our water sustainability. Sure, we have great expectations, but they must be backed by responsible efforts, locally and globally. **wc**



Connie Vitello is the interim editor of Water Canada.



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