Grand River Conservation Authority

Fall 2012

The GRAND

Watershed Report

Environmental news for the residents of the Grand River watershed • Distribution 210,000 copies

A better future for the Grand

People want to know if the Grand River is improving. Lorrie Minshall says the answer is 'Yes'

Lorrie Minshall in the dam control room at the GRCA headquarters in Cambridge. She's leading the effort to develop a Water Management Plan for the Grand River watershed.

For more than 30 years, Lorrie Minshall has been at the centre of some of the most important work done by the Grand River Conservation Authority: managing floods, protecting water quality, environmental planning.

Now, as she nears retirement, she's looking at what water managers will need to do over the next 30 years to make the watershed a healthier, safer place.

Minshall, a water resources engineer, is director of the team developing an updated Water Management Plan for the Grand River Watershed. The plan will establish goals for an improved watershed and outline the work to be done to get there.

Her goal is to have a preliminary version of the plan ready to hand over when she walks out the door of the GRCA head office for the last time next spring.

To Minshall, the plan is about "getting out of the weeds and dealing with the issues."

She likes to quote her husband Ron, who works at a Cambridge business: "People want to know if the river is fishable, drinkable and swimmable. If it isn't, who is doing something about it?"

'An asset for communities'

"This river has gone from being an open sewer to an asset people and communities appreciate," she says. "But there's still work to be done and these are the next steps that will see it improve further."

The Water Management Plan is the latest in a string of studies dating back to the 1930s. The most recent was completed in 1982 and most of its recommendations on water quality, water supply and flood protection were implemented.

But there are some differences between the new plan and those that preceded it, says Minshall.

Many of the earlier plans focused on infrastructure — sewage treatment plants, dikes, reservoirs and other physical assets.

They're still critical to maintaining a healthy, safe watershed. Sewage treatment plant upgrades will improve water quality, and reservoirs will be needed to reduce flood damages and protect water supplies. In fact, their significance will be magnified in a time of climate change and population growth.

However, the Water Management Plan is also looking at "soft" solutions that involve changes in the way people think about and manage water resources.

For example, one of the big pieces of the plan is water conservation, also called "water demand management."

The idea is that instead of hunting around for new sources of

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The GRCA

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A Message
From the Chair


Jane Mitchell
Chair

Recently I visited the notorious Well Number 5 in Walkerton that in 2000 sickened citizens of the city with E. coli. I also visited the state of the art Walkerton Clean Water Centre where municipal water plant operators are trained so such a tragedy can never happen again. Well Number 5 is now decommissioned and is a memorial to the victims of the tragedy.

The well became contaminated by farm run-off. The GRCA works to prevent run-off with our Rural Water Quality program that helps farmers build manure storage and fence streams to prevent cows from wading.

Cities are upgrading their wastewater plants. The GRCA works with municipalities to create best practices for treatment plants. These help our water while saving millions through efficiencies.

What can the average person do to help keep our rivers and groundwater clean?

If you are on a well, get it tested three times a year. Your water may look and taste wonderful but coliform and E. coli can be lurking. In many areas, your water can be tested for free. Check with your local health department.

Pick up after your dog. There are thousands of dogs in the watershed. It is not simply a case of keeping sidewalks and trails clean; their feces become part of the runoff into streams and aquifers.

Don't flush leftover pills or medicines down the drain. Hormones and antibiotics in particular can hurt wildlife. Take medicines back to the pharmacy. My drug store gives away free bags for excess.


Well Number 5 at Walkerton

The Grand is in good shape. You can swim and canoe in the river. Trout fishing is some of the best in North America. But nitrogen and phosphorus in particular still need to be reduced.

Working together we can keep the Grand grand.

A Message
From the CAO


Joe Farwell
Chief Administrative Officer

This year's weather conditions have been a challenge for water managers. The light snow pack last winter was not sufficient to fill the major reservoirs. The low rainfall over the summer has made it necessary to rely on the reservoirs to supply most of the flow to the Speed, Conestogo, and Grand rivers. Couple this with the higher temperatures, and there is a real challenge maintaining the health of the rivers.

This issue of The Grand draws attention to some of those things that are happening to improve our rivers. Municipalities are investing in improved sewage treatment. The GRCA is working to finalize a Water Management Plan which examines water quality, water supply and opportunities to reduce flood risk. We are also evaluating different scenarios that may result from climate change, and considering how these changes might impact our water management activities.

Understanding how the Grand River watershed will respond to changing climate and population growth is a critical part of the work we do here at the GRCA. The Water Management Plan will provide us with guidance to do our part to keep the Grand River watershed as a healthy and sustainable community.

Who speaks for you?

The municipality where you live appoints one or more representatives to the GRCA board to oversee the budget and activities of the conservation authority.

Townships of Amaranth, East Garafraxa, Melancthon, Southgate; Town of Grand Valley: Tom Nevills

Townships of Mapleton and Wellington North: Pat Salter

Township of Centre Wellington: Joanne Ross-Zuj

Town of Erin, Townships of Guelph/Eramosa and Puslinch: John Brennan

Regional Municipality of Waterloo (Cambridge, Kitchener, North Dumfries, Waterloo, Wellesley, Wilmot and Woolwich): Les Armstrong, Todd Cowan, Jan d'Ailly (GRCA 2nd vice-chair), Rob Deutschmann, Jean Haalboom, Ross Kelterborn, Geoff Lorentz, Claudette Millar, Jane Mitchell (GRCA chair), Warren Stauch

City of Guelph: Bob Bell, Maggie Laidlaw

Municipality of North Perth, Township of Perth East: George Wicke

Regional Municipality of Halton (Halton Hills and Milton): Barry Lee

City of Hamilton: Jeanette Jamieson

County of Oxford (Blandford-Blenheim, East Zorra-Tavistock, Norwich): Bruce Banbury

City of Brantford: Robert Hillier, Vic Prendergast (GRCA 1st vice-chair)

County of Brant: Brian Coleman, Steve Schmitt

Haldimand and Norfolk Counties: Lorne Boyko, Fred Morison

Minshall has been at centre of many key GRCA programs

After graduating from the University of Guelph with a degree in water resources engineering, Lorrie Minshall landed a job with the GRCA running its first computer.

It was not long after the May 1974 flood and the GRCA wanted to use the new tool to develop a computer program to predict floods.

The computer, remembers Minshall, was "way less powerful than a Commodore 64."

But, despite being megabyte challenged, the computer turned out a model that was the forerunner of the much more powerful and sophisticated program used today.

Lorrie Minshall in the early days of her career.

Helped manage dams

Since then she has been involved in some of the most important work done by the GRCA.

Early in her career she became involved in the day-to-day management of the GRCA's network of seven dams that are critical to reducing flood damages and maintaining water quality.

She supervised the resource planning department which promotes ways to minimize the impact on the environment of new development.

Along the way she earned a Master of Business Administration from McMaster University.

In the 2000s she was deeply involved in source water protection planning. Minshall helped put together a presentation for the inquiry into the Walkerton tainted water tragedy. The presentation suggested that conservation authorities should take the lead in developing watershed-based drinking water protection plans.

For a time she worked with the provincial government to help it develop the source protection planning process which is now being implemented under the Clean Water Act. Once the Act was passed and the process began, she was the source protection program manager for the Grand River, Long Point Region, Catfish Creek and Kettle Creek watersheds.

She left that position in 2010 to take the lead on development of the Grand River Water Management Plan. That job will come to an end in spring 2013 when she retires.

Lorrie and her husband Ron live in a riverfront home in Caledonia.

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water, municipalities can get more out of existing supplies.

They can use tools such as lawn watering restrictions, pricing mechanisms, incentives for low-flow fixtures or grey water reuse.

It means bending the curve on water consumption, explains Minshall: reduce the overall amount of water consumed even as population rises.

A similar process can be applied to the way sewage is treated, says Minshall. Municipalities know they have to improve the quality of the effluent they're putting into the Grand River and its tributaries.

In the past that would have automatically meant investing millions of dollars to expand sewage treatment plants or upgrade equipment.

While that's still necessary in many cases, sewage plant operators are learning that improving day-to-day operations can also make a big difference.

Called "wastewater optimization," it's a quality control system that involves giving staff the training and opportunity to improve plant processes to turn out the highest quality effluent. Some municipalities that have gone down the optimization road have been able to avoid spending millions on plant upgrades.

> "This watershed is at the leading edge of water protection and innovation."
> *Lorrie Minshall*

That's another way the process of developing the new Water Management Plan is different from the ones of the past, says Minshall.

'What we are going to do'

She doesn't want the plan to be a big long list of recommendations that may or may not be implemented.

"There's no good just talking about what needs to happen," she explains. "Nothing will move unless the people at the table say: 'This is what we're going to do about it.'"

So for Minshall, having water managers from all levels of government sitting at the table together has led to a cross-fertilization of ideas about what can be done.

"Actions are starting even before the plan is written down," says Minshall.

"Municipalities are at different places when it comes to demand management," she explains. So some have picked up new ideas – and identified ways to work around barriers – to make their communities more water efficient.

She says the idea of partners working together to reach shared goals is the "Grand tradition" that has been behind the push for watershed improvements from the earliest days of the GRCA.

To Minshall, it's a better way to get results than a system that is heavy with laws and regulations.

"This watershed is at the leading edge of water protection and innovation," she says, because there is a collaborative approach to problem solving that "gets things done without coming in with regulations."

Grand River Watershed
Water Management Plan

About the Water Management Plan

The Water Management Plan is a collaborative process involving all three levels of government, First Nations and water experts to develop a plan to manage water resources for the next 30 years.

Goals

The goal is to develop an action plan that all of the partners will implement to address these issues:

- ensuring a sustainable water supply for communities, economies and ecosystems,
- reducing potential flood damages,
- improving water quality to improve river health and reduce the Grand's impact on Lake Erie, and
- increasing resiliency to deal with climate change.

Issues

The plan is being developed against the backdrop of 21st century issues of climate change, population growth and extensive agriculture.

- Climate change could have an impact on the frequency of floods and droughts, water quality and water supply.
- The Grand River watershed is one of the fastest growing regions in Ontario. Its population, currently about 960,000, is expected to hit 1.4 million by 2041, putting pressures on existing water supply and sewage treatment systems.
- Close to 70 per cent of the watershed is farmed, with hundreds of thousands of cattle and hogs and millions of poultry. The use of manure and chemical fertilizers has to be managed to minimize the impact on ground and surface water quality.

The partners

The work is overseen by a steering committee made up of representatives of agencies with responsibility for water issues including municipalities, provincial ministries (Environment, Natural Resources, Agriculture) and federal departments (Environment, Agriculture and Agri-Food, Fisheries and Oceans) and the Six Nations of the Grand River.

Timeline

The partnership was launched in early 2010. The plan is expected to be ready by March 2013.

Cost

The work is being financed largely by the GRCA and the Ontario government which provided a grant of $903,000 under the Showcasing Water Innovation Program. The GRCA is contributing a similar amount on behalf of watershed municipalities.

The shape of things to come?

By Katherine Balpataky
GRCA Communications Specialist

From drought to floods, climate change could mean more extreme weather

Trevor Herrle-Braun parks his truck next to the surface pond he uses to irrigate a 10 hectare (25 acre) field of sweet corn in St. Agatha, west of Waterloo.

The water levels are down more than a metre. There's a wide ledge of cracked, dry soil, an exposed road culvert and water lilies wilting on the shoreline as proof.

"We don't usually start irrigating until July, but this year we started in May," says Herrle, who grows and sells vegetables as part of his 242 hectare (600 acre) operation.

"I've got a diesel generator running 24 hours a day pumping water from a well," he says. "The pumping has doubled my costs for the season."

The lack of snow last winter followed by an early spring and long, dry summer made 2012 a challenging season.

Farmers in Ontario have suffered through droughts in the 1920s and 1930s and, more recently, between 1997 and 2002.

However, climate change may make these kinds of conditions more common.

Help develop plan

To prepare for these changes, research is being done as part of the Water Management Plan to get an idea of what climate change may mean for the Grand River watershed.

The knowledge gained in the studies will be used to develop the Grand River Water Management Plan scheduled to be completed in 2013.

There is still some uncertainty about how climate change will affect the watershed. It is a relatively small piece of the Earth and computer models developed to simulate climate change don't provide enough detail at that scale.

So the researchers used several climate models to get a sense of the range of potential changes in rain and snowfall patterns, stream flows, water temperature and other factors.

For example, they looked at what would happen if annual average temperatures rose anywhere between 1.8°C and 4°C. For precipitation, they looked the impact of changes ranging from a drop in annual precipitation of six per cent to an increase of 12 per cent.

Warmer winters ahead

The analysis provided some broad, overall forecasts for the future of the Grand River watershed:

- warmer winters with more frequent snow melts,
- earlier springs,
- longer, drier summers,
- higher precipitation overall with more soaking into the ground in winter, replenishing groundwater aquifers, and
- higher air temperatures resulting in more evaporation in the summer.

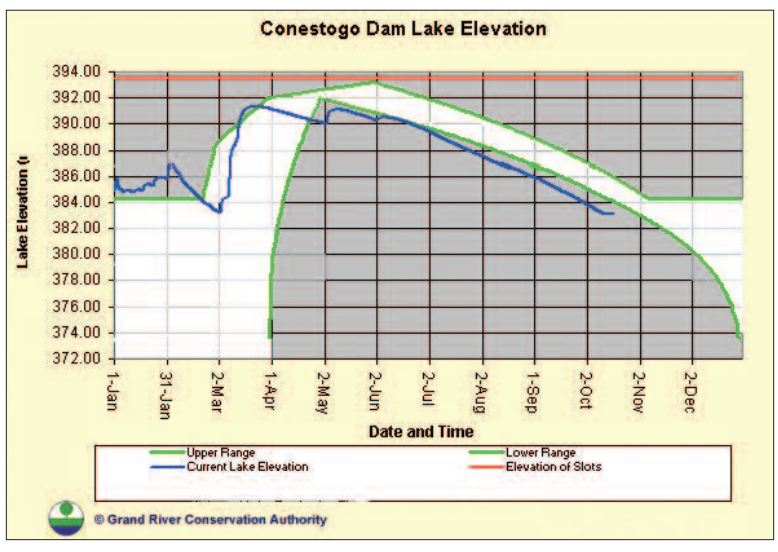
Put these factors together and the result is "the frequency of intense events — both floods and droughts — will increase," says Stephanie Shifflett, water resources engineer for the GRCA.

Water levels won't necessarily be more extreme, but the spring melt and its high flows will occur earlier and summer low flows will be much lower than now.

"What we're learning is that we can no longer count on stream flow or water levels fluctuating within the historical range all the time," says Linda Mortsch, a Senior Climate Change Researcher with Environment Canada and adjunct professor at the University of Waterloo. She provided advice on the Grand River study and is an ongoing contributor to reports prepared by the International Panel on Climate Change.

"It really forces us to look at potential changes in our water

Driest year in decades took its toll on the Grand River watershed



This has been the driest year since 1958 which has resulted in low flows in the river system and low water levels in GRCA reservoirs.

Usually, the reservoirs are filled with water from the spring runoff, but this year some of reservoirs, such as Conestogo, were never filled.

On the graph at left, reservoir operators try to keep water levels (blue line) somewhere in the white area between the two green lines. But this year Conestogo reservoir was low most of the year.

As a result the GRCA adjusted the amount of water it released from the reservoirs in late summer to ensure adequate flows through the end of the year.

Old stumps and roadways can be seen at the bottom of Guelph Lake.
Photo by Chris Seto, Guelph Mercury

availability, " says Mortsch.

The cycle of frequent spring floods and a dried-up river in the summer is not a new one in the Grand River watershed. That's what life was like in the early 20th century as a result of changes to the land when the landscape was cleared of trees and wetlands to make way for farms and cities.

Back then, the Grand River suffered devastating floods many springs and became a foul, polluted gutter in the summer. The solution was to build a series of reservoirs that store water from the spring runoff which is released gradually through the summer and fall to maintain flows.

Those reservoirs were built by the Grand River Conservation Authority (and its predecessor) between 1942 and 1976.

Delicate task

Managing the reservoirs is a delicate task. The GRCA's engineers must make sure there is enough room left in the reservoirs in the spring to accommodate the next major rainfall or snow melt, while holding back enough water to last the summer.

They have refined their operating procedures over the years and learned some important lessons from Hurricane Hazel in October 1954 and the May 1974 flood.

Farmer Trevor Herrle-Braun has been experimenting with different land management techniques to adapt to dry conditions. Testing different irrigation methods and irrigating at night are some of them.

Now climate change is creating the need to revisit the standards once more.

The situation this summer is a good example of these challenges.

This has been the driest year since 1958. There wasn't enough snow melt and rain to fill all seven reservoirs to the required level. By August, the GRCA was faced with cutting back the rate of water flowing out of the reservoirs.

This has implications for municipalities that count on the reservoirs to supply water for their drinking water system and their sewage treatment plant operations.

The GRCA met with municipal water managers to revise their flow targets for the rest of the year. They agreed to adjust their flow targets, operating the day-to-day release of water below normal operating levels — like water rationing — in preparation for more dry weather.

"There are always some risks when you adjust water targets away from optimal levels," says Dwight Boyd, Director of Engineering for the GRCA. "You can put aquatic species under stress. So it's important to plan ahead for such situations."

In Whitemans Creek, in western Brant County, the low water levels this summer led the Grand River Low Water Response Team to call for a voluntary 20 per cent reduction in water use.

Used for irrigation

The creek is heavily used by cash crop farmers who rely on this water for irrigation in summer. In the future, longer dry spells in areas like Whitemans could lead to water conflicts if they aren't managed properly. Drought management plans with measures that involve water users will be needed. Water managers will need a careful evaluation of the risks involved.

The GRCA's Stephanie Shifflett says adapting to these changes will require water managers to do what they've always done — but differently. It may also require more weather data on which to base their decisions.

The climate models provide guidance on the range of challenges the watershed may experience. The study points to the need to modify the way dams and reservoirs are managed to recognize the new conditions.

Build resiliency

"Things like restoring wetlands, planting trees and putting more water storage on the landscape are other adaptation measures that will help build resiliency in the watershed. The good thing about these actions is that they will also help us with the other objectives of the Water Management Plan," says Shifflett.

Of course, there are others who can make use of the climate change study to improve adaptation measures.

Trevor Herrle-Braun is already adapting, by dedicating fields for straw that he uses as mulch to reduce evaporation off his strawberry fields. Other farmers have opted to select drought-tolerant crops or store additional water by digging new storage ponds.

Finding the best top (climate) models

The Water Management Plan climate change study uses the output of global climate models, made available by the Ontario government, to test how different scenarios of climate change may affect local weather and availability of water in the watershed.

Climate models are computer programs that are built using known physical laws and chemical interactions based on the earth's system. These models are useful for testing how one kind of change affects another.

In the Grand River climate study, the output of global climate models based on different scenarios of future greenhouse gas emissions in the atmosphere is used to develop climate change scenarios for the watershed. Then, the projected changes from the regional models are inputted into a computer model that simulates the way water flows through the Grand River system.

Mortsch

The modelling has limitations.

For example, the models work on such large scales that they don't pick up the local weather effects caused by the Great Lakes. The modeling also doesn't show whether there will be more or fewer days of rain and snow. That's because the study uses historical frequency of daily rain and snowfall and then adjusts the amount of precipitation that will fall based on the output of the climate models.

"If you were to pick any one climate change scenario and say 'this is our best guess of what the future will hold' you would probably be wrong. By running multiple climate change scenarios, water managers can get a sense of the types of challenges they may be facing, even if they don't decide to adapt to all of them all," says Linda Mortsch, a Senior Climate Change Researcher with Environment Canada and adjunct professor at the University of Waterloo.

Climate change and water use

Water use is an important dimension of climate change adaptation because some water uses will likely increase as temperatures rise. Dry spells and increased evaporation may make irrigation necessary for some crops where it was not needed before. As well, households that water lawns or refill pools may be inclined to use more water.

As part of the Grand River Water Management Plan and Source Protection Planning, work is being undertaken to develop water use forecasts for sectors in the watershed that use the most water. This work will evaluate whether there are any potential shortfalls in water supply to be concerned about. This information will help municipalities develop their long-term water supply and conservation strategies.

Investing in a cleaner river

More than $750 million is going into better sewage treatment

For more than a century, the residents of the Grand River watershed treated the Grand River system as their sewer.

From the first days of settlement until well into the 20th century, raw or barely treated sewage was dumped into rivers and creeks.

By 1956 the situation across Ontario, and particularly in the Grand River watershed, was so serious that the province created the Ontario Water Resources Commission to build new sewage plants or upgrade existing ones.

'Fast becoming useless'

The Grand was "among the first watercourses to be attacked by the OWRC" because it was "fast becoming useless for most human uses because of increasing pollution," says a history of the commission.

A decade later, after an investment of millions of dollars, the Grand was on the mend.

"Thanks to a network of OWRC municipal water pollution control plants and other control measures, its waters generally are within water quality objectives," said a 1967 news release.

But population growth has continued to put a strain on the river system which is expected to deal with an ever-growing flow of treated effluent.

When the OWRC issued its congratulatory news release in 1967, the watershed population was about 400,000. Now it is more than twice that (about 960,000) and is projected to hit 1.4 million in 2041.

Governments are constantly under pressure to invest in new and expanded plants to protect water quality.

So now, in the early years of the 21st century, another massive infusion of cash holds the promise of another step forward in the battle to improve the Grand River system.

Municipalities, with the support of the senior levels of government, are spending more than $750 million in sewage treatment plant upgrades.

The Kitchener sewage treatment plant is undergoing a $326 million upgrade.
Photo courtesy Region of Waterloo

Region of Waterloo: The Region has an ambitious plan to upgrade 6 of its 13 sewage treatment plants over a decade at a cost exceeding $700 million. Work is already underway on the Kitchener and Waterloo plants. Ahead is work at the Hespeler, Wellesley, Baden-New Hamburg and St. Jacobs plants.

Town of Grand Valley: A new sewage treatment plant worth $16 million opened last spring to serve the community in Dufferin County.

Township of Centre Wellington: Work has started on a new $21 million sewage treatment plant for Elora. In 2002 the township completed a $2.6 million upgrade of its Fergus plant.

City of Guelph: A major expansion of its treatment plant, worth $18 million, was completed in 2002.

City of Brantford: A major upgrade worth about $20 million has been planned for 2014 but city officials are conducting a study of plant operations to see if they can be made more efficient and so reduce the size of the upgrade or delay it.

Some of the work is to cope with population growth, but more significantly, a lot of the money is going into new technology to improve the quality of the effluent going into the river system.

Going after nutrients

The targets are nutrients – chemicals such as phosphorus and nitrogen – that are found in human and animal waste. The plants are designed to take most – but not all – of the nutrients out of the sewage. While the output of nutrients from each plant may be relatively small, the cumulative impact of the nutrient loads from 30 sewage plants in the watershed can harm river health.

In the river, are fertilizer for algae and aquatic plants.

A healthy river ecosystem needs a certain level of nutrients. But an overload can destroy a river. If there are too many aquatic plants, they remove too much oxygen from the water, depriving fish and other aquatic organisms of the oxygen they need.

High nutrient levels in the Grand are also a concern because of the effect they have on Lake Erie. The plume of nutrient-loaded water and sediment entering the lake at Port Maitland contributes to algae growth and other water quality issues in the eastern Lake Erie basin.

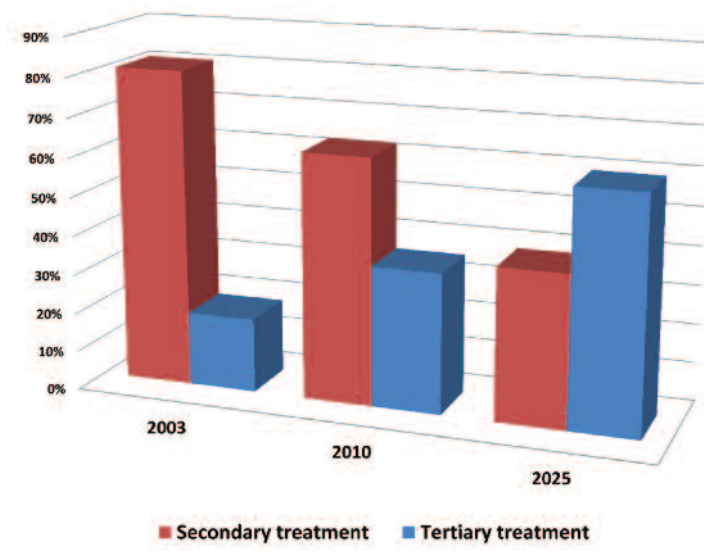
"The Grand River sediment plume can be detected up and down the coast for a distance of 12 km (seven miles) and up to three km (two miles) offshore depending on weather," says the Lake Erie Binational Nutrient Management Strategy.

The Grand River is one of several rivers that "urgently need reductions in total phosphorus concentration," it concluded.

The sewage treatment plant upgrades that have just been completed or are in the works will help with that. Many more of the plants will provide what's known as "tertiary" treatment in which a third step is added to the treatment process to remove even more phosphorus.

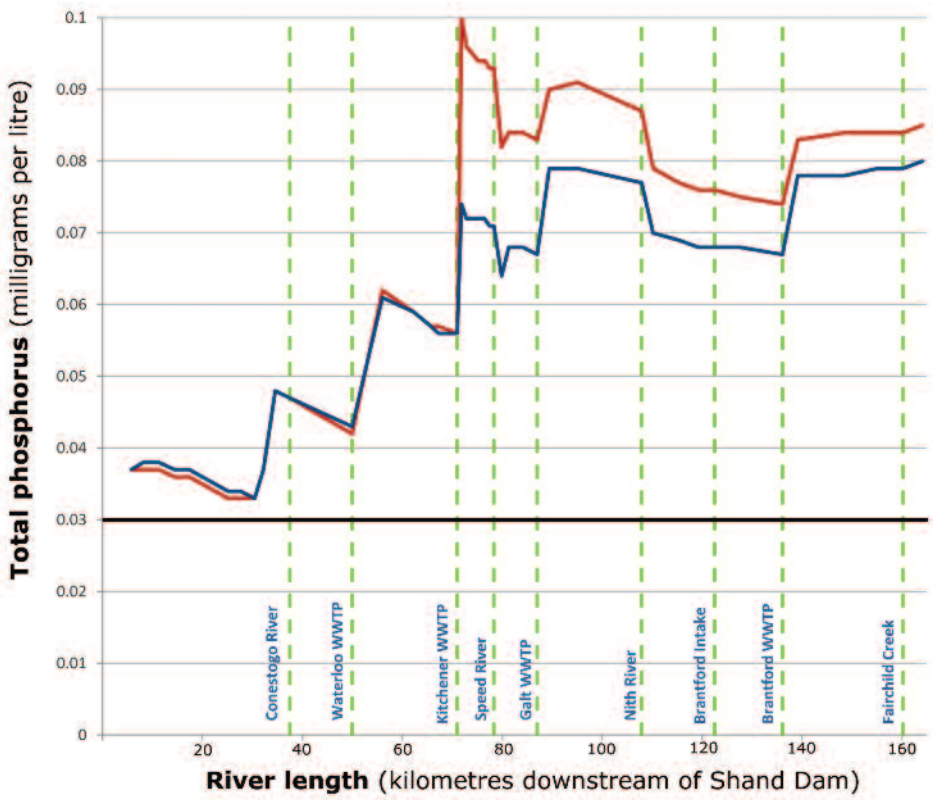
As part of the work on the Water Management Plan for the Grand River, a team of water quality experts looked at the potential impact of the plant improvements. The work is summarized in the report "Assessment

Level of sewage treatment



More municipal wastewater treatment plants are moving to a higher level of treatment, called "tertiary," which reduces the nutrients in the effluent. This chart shows the change in the volume of sewage getting higher levels of treatment as the sewage treatment plants in the watershed as plant are upgraded.

Sewage plant upgrades will cut phosphorus levels



This chart shows phosphorus levels in the Grand River as the river goes downstream from Shand Dam to Six Nations. Levels tend to go up when water from tributaries and effluent from wastewater treatment plants (WWTP) enters the Grand.

Current phosphorus levels

Projected phosphorus levels after plant upgrades are complete

Provincial Water Quality Objective

of Future Water Quality Conditions in the Grand and Speed Rivers" and is available at *www.grandriver.ca*

The team used a computer program called the Grand River Simulation Model. The computer model simulates the water quality in the Grand River from Fergus to south of Brantford, and the Speed River from Guelph Lake to its end in Cambridge.

The users of the model can plug in projections on the effluent loads coming out of the sewage treatment plants in those reaches. They can look at different scenarios involving river flows, water temperature and other variables.

Levels change

The concentration of phosphorus in river water rises and falls as the Grand moves downstream. It's highest immediately downstream of sewage treatment plants and where streams and rivers enter the Grand. But the concentration drops off as the phosphorus is taken up by aquatic vegetation, or in places where clean groundwater enters the river.

"Significant improvements to water quality will result from the implementation of planned wastewater treatment plant upgrades," said the report.

They found, for example, that there will be a sizeable drop in phosphorus levels downstream of the Kitchener sewage treatment plant, the largest in the watershed. The phosphorus load would drop to about 0.07 milligrams per litre (mg/L), a reduction of about one-third.

The experts did several other model runs to see what would happen if, in addition to the physical upgrades, there were some improvements in the way the sewage plants were operated.

The process is called "optimization" and essentially it involves stepping up quality controls in the sewage plant to focus on turning out the cleanest effluent possible.

The City of Guelph went through the process a few years ago and found that it could meet its effluent quality targets without a planned $20 million sewage plant expansion. The City of Brantford has embarked on a project to optimize its plant.

> "Significant improvements to water quality will result from the implementation of the planned wastewater treatment plant upgrades
> *Water Management Plan study*"

Optimizing the operation of other sewage treatment plants could reduce phosphorus levels 10 per cent or more in the southern Grand River.

"The adoption of wastewater treatment process optimization as a best practice by watershed municipalities is a win-win for river water quality and for municipalities, given its proven cost-effectiveness," said the study.

More oxygen

The result of the drop in phosphorus levels will be a rise in dissolved oxygen – a fact that is critical to the health of the river, particularly the fish and other aquatic species that live there.

"Dissolved oxygen levels in the summer are predicted to improve in heavily impacted reaches of the Grand and Speed rivers," said the report. "The greatest improvement will occur in the Grand River at Blair."

Researchers Gerald Tetreault (left), Keegan Hicks and Meghan Fuzzen

Tiny fish provide big clues to water quality changes

Meghan Fuzzen wades into the Grand River just upstream of the Kissing Bridge at West Montrose with an electrofishing pack on her back and a wand in her hand.

The University of Waterloo researcher is surveying darters – a type of small fish — as part of a study to see how water quality affects fish populations.

Fuzzen's study is one part a much larger national research project, funded by the Canadian Water Network, that's bringing together scientists and water managers from across the country to find ways to measure changes in river health.

In five watersheds across Canada, researchers who study chemistry, aquatic insects, plants, river flows and fish are collecting samples and identifying survey sites to decide what species and conditions are most important for measuring watershed-wide changes. In the Grand, this research will be used to develop monitoring programs and improve water management decisions.

"Over the next three years, we hope to get a more complete picture of the processes going on in the river," says Adam Yates, a principal investigator from Western University of London, Ont.

"Traditionally, researchers tend to focus on one aspect of the natural system – like fish," says Gerald Tetreault of the University of Waterloo, who is coordinating the field work. "This is a really unique opportunity to build off one another."

The GRCA, municipalities and other agencies are involved to make sure the research will have a direct impact on water management decisions.

Improve monitoring

"The Grand River Conservation Authority and its partners will use this research to improve monitoring programs and guide decisions made as part of the Grand River Water Management Plan," says Barbara Veale, Coordinator of Policy and Partnerships for the GRCA.

"It's been really useful to work with (GRCA) staff because we gain their knowledge about how wastewater treatment plants operate and why river flows are maintained as they are," says Jason Venkiteswaran, a researcher from the University of Waterloo who is studying the fate of nutrients in the Grand.

"We draw on the experience and long-term monitoring data of municipalities and GRCA and we test each other's assumptions about how the river works," he says.

The Canadian Water Network has provided $600,000 over three years.

Farmers work to keep nutrients out of water

Watershed faces challenges dealing with all that manure

The Grand River watershed is blessed with some of the best farmland and most productive farmers in the country.

Close to 70 per cent of the watershed – about 4,500 hectares – is farmed.

However, this agricultural richness also brings some challenges. One of the biggest is the handling of manure and commercial fertilizers, which are sources of nutrients such as phosphorus, nitrates and ammonia.

It's a big challenge. For example, 20 dairy cows or 60 beef feeder cattle can produce as much solid waste as 1,000 people.

With more than 250,000 head of cattle in the watershed, that's a lot of manure to be stored, handled and applied to cropland to keep it out of groundwater and surface water. There's also the manure generated by hundreds of thousands of hogs and millions of chickens and turkeys.

Top five for manure

In a report issued in 2002, the office of the Environmental Commissioner of Ontario said "the Grand River watershed (is) among the top five manure producing areas in the country, at over 5,000 kilograms per hectare."

The report identifies two issues of general concern for Ontario, which also apply to the Grand River watershed:

- Phosphorus levels "tend to be higher in areas of more intensive cropping systems, higher livestock production densities and clay soils."
- "Nitrate concentrations appear to be trending upward" with implications for both human and aquatic life.

Nutrients such as phosphorus and nitrates (a form of nitrogen) have two primary sources: "point sources" such as sewage treatment plants and septic systems, and "non-point sources" such as runoff from rural or urban land.

Some preliminary work has been done as part of the Water Management Plan to try to identify the proportion of nutrients coming from "point sources" versus "non-point sources."

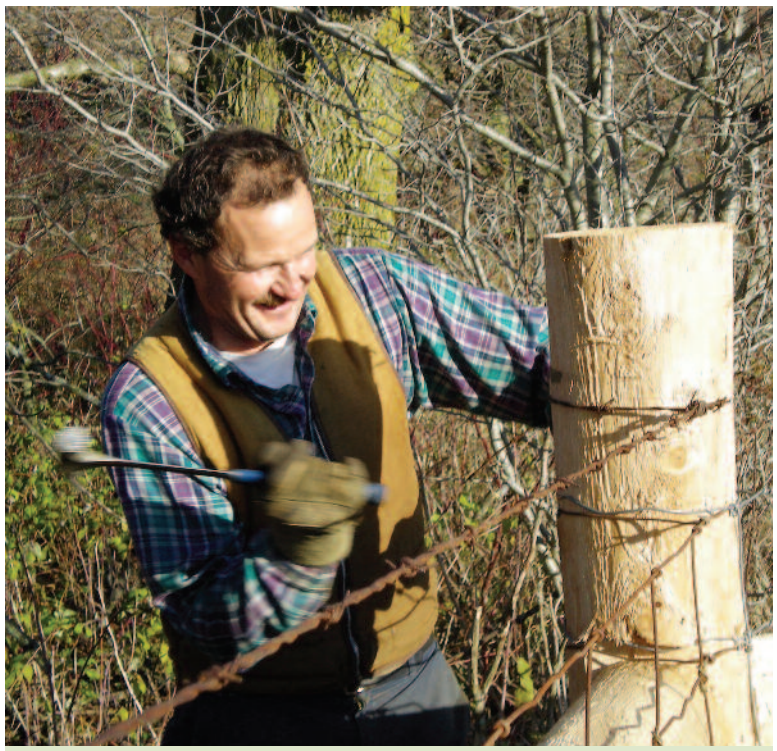
The analysis is contained in a report done by a group of water quality experts from the GRCA, municipalities, provincial and federal ministries and other agencies. ("Summary of Activities to Determine Sources of Nutrients and Sediment in the Grand River Watershed and their Relative Importance.")

There isn't enough data available to provide hard numbers on the relative weight of different sources of nutrients.

However, some broad trends were identified:

- In the spring, melting snow and rain wash soil off the land, carrying high levels of phosphorous. During the runoff period, almost all of the phosphorus entering the river system is coming from non-point sources. A similar thing can happen following a big summer rainstorm.
- During the winter and spring, high nitrate levels in the middle section of the Grand River in Waterloo Region is suspected to come from groundwater which enters streams and rivers through springs or seeps. The nitrates in the groundwater were built up over decades of manure and fertilizer use.
- During the summer, sewage treatment plants account for much of the phosphorus and ammonia entering the river system.

> "The Grand River watershed is among the top five manure producing areas in the country."
>
> *Environmental Commissioner Gord Miller*



A farmer builds a stream fence in Wellesley Township.

Water experts have long understood the impact that farm runoff can have on water quality.

That's why so much effort – and money – has been put into programs to keep water clean on the farm.

The provincial government passed the Nutrient Management Act in 2002 to establish province-wide standards for manure.

Many farmers have nutrient management plans which outline how they will handle, store and apply manure on their land.

There are also many well-established "beneficial management practices" (BMPs) that can be implemented by farmers, whether or not they have Nutrient Management Plans.

Rural investments

For more than a decade, the Grand River Conservation Authority has operated the Rural Water Quality Program. Municipalities provide the bulk of the money for the program, which is given to farmers as grants to pay part of the cost of implementing BMPs. The farmer is also required to provide labour, materials or cash to cover his share of the cost.

By the end of 2011 more than 1,100 projects were carried out with a total value of more than $31 million, including grants of $11 million.

The money has gone into hundreds of manure storage facilities, fencing of more than 125 kilometres of streams, dozens of erosion

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Before and after

An effective way to protect water quality is to install fences and greenery along streams.

The fences reduce soil erosion caused by cattle when they wander into a stream for a drink of water.

Trees and shrubs along a stream will soak up nutrients that would otherwise go into the stream.

More than 115 kilometres of stream fences have been built through the Rural Water Quality Program.

Hunting groundwater from the sky

By Janet Baine
GRCA Communications Specialist

To a groundwater specialist, seeing is believing.

They know that groundwater comes into a river, but infrared technology allows experts to see exactly where the groundwater hot spots are located.

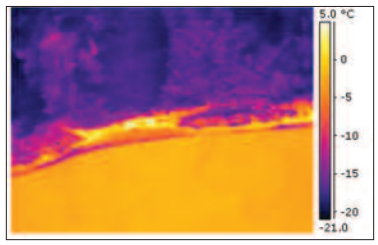
At dawn on a cold day in January 2012, Gregg Zwiers and Brewster Conant flew in a helicopter above part of the "recovery stretch" of the Grand River — an 11.5 km section between Glen Morris and Paris. They used Conant's infrared camera, which measures radiation and makes the temperature difference visible.

The sun was coming up and the helicopter door was off, so it was frigid. This day was chosen carefully — a cold day when rain or snow had not fallen in quite a while so there wasn't much other than groundwater entering the river, allowing it to be more visible.

Conant teaches earth and environmental science at the University of Waterloo. Zwiers is the senior hydrogeologist with the GRCA

They flew over the section of the river twice —once taking still photos and then video with the $20,000 infrared camera, while a standard video camera was also shooting the river.

Hot water



Above: The pale yellow is the location along the east bank of the Grand River where groundwater is entering the river.
BELOW: The same area is shown in the video capture.

Constant temperature

On this day, the air temperature was -19C and water in the river would have been close to zero. However, groundwater is a fairly constant 9C to 11C throughout the year.

During the winter, the groundwater is warmer than the river water, so it prevents ice from forming. During the summer, the groundwater can be 20C cooler than the river water, so it cools off the river, which makes it a better habit for some organisms that need cool water.

And, the groundwater is usually cleaner than the river water, so water quality improves where a lot of groundwater enters.

More information on where groundwater enters a river and how much can be an important step toward a greater understanding of river health.

That's particularly true of the section that Zwiers and Conant flew that day. The GRCA has known for a long time that this small stretch of river improves water quality in a really big way. There are about 720,000 people living upstream and many communities, wastewater facilities and farms.

This is the area where the river passes through the Galt-Paris Moraines.

The camera doesn't measure temperature, but can show where the water is warmer than the surrounding land and water, based on the colour differences in the infrared photos and video. Then it's possible to match these spots with a map and still photos.

A helicopter travels along the Grand River in search of groundwater entering the river.

Shows 'hot spots'

The report includes infrared images showing "hot spots" where lots of groundwater is entering the river. It identified more than 500 of these locations.

Researchers estimate that an average of 30 to 60 litres per second per kilometre of groundwater flows into the Grand River in this section. This is enough water to fill one or two Olympic-sized swimming pools per day per kilometre.

The research was funded by a donation from S.C. Johnson and Son Ltd. of Brantford that came through the Grand River Conservation Foundation.

"I learned most of the groundwater is coming in along the west bank, which is discharging a lot more water than the east bank," Zwiers says. "It confirmed for us what we suspected and we can look in greater detail to learn more. So many ways we measure groundwater are indirect, but this is a way you can see it."

"This is one step in a multi-step process of trying to understand your river. You are going to see the biggest discharges by doing this, so you are not going to miss anything big," says Conant.

> "This is one step in a multi-step process of trying to understand your river."
>
> *Researcher Brewster Conant*

Water temperature facts

- The more groundwater seeping into the river at a given stretch, the cooler the river will be during the summer.
- Water released from reservoirs, such as Shand and Conestogo, has a cooling impact on the rivers.
- In a laboratory setting, water that is 15C will hold about one-third more oxygen than water that is 30C.
- After the sun goes down, the air and water temperature goes down as well, so cool nights help improve temperature.
- Shade from trees and vegetation beside the river cools the water down.
- Shade from boulders and trees create cool spots where fish can rest and stay cool on hot summer days.
- Rain hitting hot pavement and then entering the river can be very hot and even deadly for fish.
- Engineered streams that have been straightened also provide very poor habitat and warm the water
- Effluent from wastewater treatment plants can warm the river in winter but can cool the water in summer.

Rural water quality

Continued from Page 8

control projects and other projects that help keep nutrients and sediment out of waterways.

A report from the George Morris Centre, an agricultural think tank at the University of Guelph, pointed out that best management practices "act as barriers to prevent or decrease the contamination of water by nutrients, pesticides and pathogens."

In 2011 the centre carried out a study to analyze the costs and benefits of various BMPs to determine which had the greatest impact on water quality at the lowest cost.

It concluded that farm BMPs "are environmentally effective and can protect groundwater sources from nitrogen contamination."

"Using practices such as planting vegetation strips along shorelines, constructing wetlands, rotating crops, using low nitrogen fertilizer and repairing older septic systems are examples of beneficial management practices that help prevent contamination of private and public drinking water sources from nitrogen," said the study.

Waste not, want not

Municipalities are coming up with innovative ways to encourage conservation

By Katherine Balpataky
GRCA Communications Specialist

Spend any time in the cities or towns of the Grand River watershed and you're likely to see a construction site where steel beams are being hoisted, concrete foundations being laid and pipes being stacked – the signs of urbanization.

Over the next 25 to 50 years, many of the municipalities in the Grand River watershed will experience significant population growth.

To ensure that municipalities are able to meet water needs without stressing the river or groundwater systems, municipal water managers are working on long-term water supply strategies. They are looking at ways to manage the demand for water to get more out of less.

By sharing their experiences and research, the water managers are making Grand River watershed one of the most progressive in the nation.

Guelph

Grey is green

Mike Darmon steps into the basement of his Guelph home to check the water levels in his greywater system. The 150-litre tank is more than half-full of water collected from their showers and baths. He can flush freely today.

"It comes down to making water work as hard as it can before you flush it away," says Darmon. "The average person in Guelph uses 187 litres per day. We're now down to 60."

Mike and his wife Louise installed the greywater system in their 80-year-old home in 2009 as part of a pilot project by the City of Guelph. By evaluating the users' experiences, the city hopes to learn if water recycling could be promoted more broadly among residents, and if so, how.

Match source to use

Greywater systems are based on the premise that water quality should be matched to its use: you don't need drinkable water for gardens or flushing toilets.

Most household greywater systems reroute water from the bath and shower into a tank where it is filtered and recycled for use in the toilet. This alone reduces the demand on municipal supplies by an average of 83 litres per person per day, since flushing is one of the largest water uses in the home.

When water managers at the City of Guelph began to evaluate the opportunities for conserving water among household users, they discovered that low-flow showerheads and water-efficient appliances would only get them so far. A public survey indicated that certain residents were motivated to experiment with greywater. So Guelph launched a pilot study and offered rebates to encourage the installation of greywater systems in 30 new and existing homes.

"The main goal was to see how effective greywater systems are at reducing water and energy use," says Wayne Galliher, Water Conservation Project Manager for the City of Guelph.

The study also collected information on how satisfied participants were with the new systems, how well they were able to maintain them, what motivated them to enroll and how their behaviour changed.

"It was surprising how little information exists about the technologies and building codes and standards across Canada," says Galliher. "We've been getting calls from across Canada and North America from communities that want this information."

> "It's also important to connect the people who are using the greywater system so they can share what they've learned."
>
> *Project Manager Wayne Galliher*

Mike Darmon and wife, Lois Cherry use a high-efficiency washer and hang-dry laundry to reduce water and energy use. Lois says her mother grew up during the Depression, so she was brought up this way.

After three years, the average water savings from participants was 22.6 litres (5.97 gallons) per capita per day or about 30 per cent savings per household. To put this in perspective, if every household in Guelph saved this much, you could fill two of the world's largest oil supertankers (over 1 million cubic metres) with the water saved in one year.

The study showed that the $1,500 incentive was critical to getting homeowners and builders to participate. Saving on water and energy bills was another important factor.

The majority who signed up because of their "green attitude" said they had already done some research on greywater systems.

More satisfied

As a result, the green keeners were generally more satisfied with the greywater systems. Those who participated to save money were less satisfied. Most said the unexpected maintenance work was the reason.

"I don't think these systems will work for everyone," says Darmon. "It's a good idea to take a look at your lifestyle and reduce water use in every other way you can first. Then determine whether you have the need," he says.

We learned a lot about our residents' needs," says Galliher. "Other municipalities that are considering greywater should consult the public to understand the opportunities and challenges specific to your community," he says.

"It's also important to connect the people who are using the greywater system so they can share what they've learned and support one another."

For its next phase of work, Guelph will explore the feasibility of a communal system that would connect greywater use between a mix of residential and industrial users.

For more information regarding Guelph`s Residential Greywater Field Test, visit: *www.guelph.ca/greywater*

Oxford

Whale of a price

When Oxford County amalgamated 21 water systems and nine wastewater facilities that serve almost 30,000 customers in 2008, there was a need to create a single water rate structure to simplify administration and cover operating costs.

Designing a new rate system was also an opportunity to encourage water conservation.

Now that the rate system has been in place across Oxford for three years, it is time to evaluate whether water is truly being saved.

So the county is embarking on a study to examine how their pricing system is encouraging people to conserve.

"Most residents have been supportive of the new system, once they know how it works," says Deborah Goudreau, Manager of Water Services for Oxford County. "Because they have some control over the cost of their water."

"But, it has been a challenge to communicate how the new rate system works," she says.

Goudreau says the various utilities serving the county prior to 2008 had different rate structures. Some utilities charged by volume while others had flat rates. Some utilities had reserve funds for capital costs while other ran a deficit. Each had its own billing cycle. So in 2008, Oxford staff began to research water rate options.

Water price tied to use

Oxford chose a structure known as a "humpback system." In this pricing scheme, the cost per cubic metre rises and then falls in blocks. So, initially, the more water you use, the more you pay per cubic metre — to a point. After a certain threshold (in this case, 850 cubic metres per month), the rate per cubic metre decreases in blocks. The rate structure is designed to encourage households to conserve water to save money, yet keep things affordable for industrial water users in the area.

Oxford County water manager Deborah Goudreau works high above Tavistock.

"The main goal was to develop a single rate system that would cover the costs of providing water and wastewater services to the county," says Goudreau. "But we also wanted a water rate system that would encourage residential water conservation without penalizing industrial and commercial users," she said.

The new system may not encourage water conservation if people are confused how it works or aren't interested enough to ask questions about saving money. That's why the next step is to evaluate whether the rates are actually promoting water conservation.

"Per capita water use was dramatically different among communities when the program started," says Goudreau. "So it will be really interesting to see where we land once we get a look at the analysis."

Oxford hopes to complete the study by the end of 2013.

For more information on Oxford County's humpback water rate structure, visit *http://www.oxfordcounty.ca*

Region of Waterloo

The water information age

If home owners from Chicago, San Diego, Miami and Waterloo each tallied up the amount of water used on their lawns in one year, who would come out on top for water use? Which one would make the greatest effort to conserve water?

The answer to these questions and others will soon be clear thanks to an ongoing study of North American household water use. The study will help the Region of Waterloo evaluate the effectiveness of water conservation programs and to determine future water needs.

Waterloo Region was one of 18 North American municipalities to partner with the American Water Works Association Research Foundation and Aquacraft Inc. to update the 1999 residential water end use study.

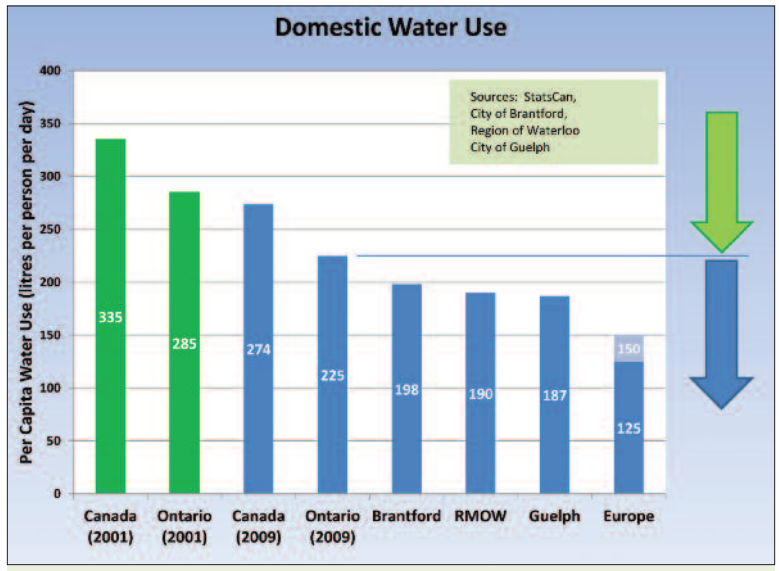
Analyze bills

The researchers will analyze utility bill data from 26,000 households and responses from a 900-household survey to understand how water is used in the home.

"The information goes a long way for forecasting water demands and conservation potential, evaluating conservation programs and to help us understand the factors that influence water use," says Peter Mayer, principal investigator for the study of Aquacraft Inc.

Mayer says the research will help water managers understand how much water has been saved by promoting high-efficiency toilets and low-flow shower heads, water pricing policies and the way information is presented on bills.

> "It's a small percentage of people causing a lot of the water loss when it comes to leakage"
>
> *Water use investigator Peter Mayer*



Per capita domestic water use in Brantford, Region of Waterloo and Guelph is lower than the Canadian and Ontario averages, but still higher than in Europe.

The Waterloo portion of the study will include a detailed household survey and analysis of water bills and will monitor real-time water consumption in the homes over two weeks to measure exactly how much water is beings used by specific appliances, showers and taps. For 10 homes, the analysis will also look at hot water use.

Mayer says that some of the early results show that managing leaks could be the next big thing for household water conservation.

"We're finding that it's a small percentage of people causing a lot of the water loss when it comes to leakage," says Mayer.

Survey users

Water managers would need to survey water use billing information to get at these kinds of water losses.

Although toilet leaks may go unnoticed by homeowners, they are easily detected by the researchers because they create consistent patterns of water use both day and night. If these patterns were detected, the water loss could be flagged to bill payers, saving them money on their water bill and saving the municipality the costs of pumping and treating it.

"We know there has been a significant reduction in per capita household water use overall," says Steve Gombos, Water Efficiency Manager for the Region of Waterloo.

"But this research gives us a much better picture of why. We will also see how the region stacks up against other municipalities.

"For example, if we find out that Peel Region is doing better, we can take a look at their conservation programs and see what we can learn from them," he says.

Waterloo Region will also use the research to evaluate how much water demand there will be in the future, to be used in the Water Efficiency Master Plan update.

Results from the study will be available in 2013.

The Region of Waterloo will share what they have learned from this process with other watershed municipalities through the Grand River Water Management Plan.

The Grand River Conservation Foundation

Innovative partnerships boost conservation projects

By Janet Baine
GRCA Communications Specialist

An innovative partnership with the Grand River Conservation Foundation and the Ontario Stone, Sand & Gravel Association will help build a new hydro facility planned at the Parkhill Dam in Cambridge (Galt).

The project is in the planning phase and is expected to cost between $7 and $8 million to build. It will double the GRCA's hydro production capacity.

The association has offered to help raise money to pay some of the capital costs of the project.

Already the association and its member companies have raised $205,000 during the first months of their five-year commitment to this project. This doesn't include the funds raised at a gala dinner at the Cambridge Mill restaurant Oct. 18, as the final tally isn't in yet.

"We think it is fabulous that an entire industry has come to the table so generously to support this project," said Sara Wilbur, executive director of the Grand River Conservation Foundation. The foundation is the GRCA's charitable partner, supporting projects which have few or no other sources of public funding.

"Members of the OSSGA have been generous supporters of GRCF for years, and this new project will be a model for other projects of this kind throughout the province. The project is also going to be a showpiece for everyone in Cambridge to see," said Wilbur.

"The industry sees real value in creating green solutions to put more resources into the conservation stream," said Moreen Miller, Chief Executive Officer of OSSGA. "This project will create perpetual funding for the work that the GRCA does."

The GRCA already operates three hydro generating facilities at Shand Dam, Conestogo Dam and Guelph Dam. During the summer when water flows are low, the new Parkhill hydro facility will produce about 600 kwh of power, about the same as the existing Shand Dam site. But in the spring when there is far more water passing by the dam, it will produce about 1.2 megawatts of power. This is enough electricity for about 575 homes.

Project partners

- Lafarge Canada Inc.
- Holcim (Canada) Inc.
- Cox Construction Ltd.
- Steed and Evans
- MHBC Planning/Ian and Sandie MacNaughton
- CBM Aggregates
- Tri City Equipment

Representatives of the OSSGA and the GRCF at the Parkhill Dam (from left): Moreen Miller (OSSGA Chief Executive Officer), Malcolm Matheson, Ruth Prior, Dan O'Hara, Sara Wilbur (GRCF Executive Director) and Tony Iacocca.

Rallying for the Grand River

Another new Grand River Conservation Foundation partnership is with the BMW/MINI Grand River dealership.

The Kitchener dealership held a car rally in October with the unique combination of raising more than $1,700, increasing awareness of river management and enjoying a day on the roads along the river.

"The Grand River watershed has some fantastic drives and this event was a great opportunity to showcase them. Our dealership looks out onto the Grand, so it's only natural that we would partner with GRCF to promote conservation of our river.," said Scott Quinn, managing partner and general manager.

During the rally, the cars stopped at several places along the river with a GRCA guide.

The participants learned about river management while they enjoyed lunch. Proceeds went to the GRCF for the protection of water and natural areas.

"We work with diverse partners who all have different skills to bring to the table. What they share is a common interest in conservation and the willingness to do something about it," said Sara Wilbur, foundation executive director.

"We are really pleased to broaden our base of partners because we expect that these are long-term relationships that will strengthen conservation initiatives."

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You can help, too!

For more than 40 years, the Grand River Conservation Foundation has improved our quality of life by enriching the natural values of the Grand River watershed and encouraging people to enjoy, and to learn from, the great outdoors.

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