

Duffin Creek Water Pollution Control Plant Environmental Sustainability

A Progress Report



Who we are

Duffin Creek Water Pollution Control Plant is on the north shore of Lake Ontario in the City of Pickering. It's operated as a partnership between The Regional Municipality of York

and The Regional Municipality of Durham. The Plant is capable of treating 630 million litres of wastewater each day and serves the booming communities of York Region, the Town of Ajax and

the City of Pickering in Durham Region. Proudly ISO 14001 certified, the Plant operates to ensure the environmentally responsible treatment of wastewater.





Water is a precious commodity and we Ontarians enjoy amazing lakes, rivers and waterways.

It is incumbent upon all of us to protect this resource with strict environmental policies and enforcement. At the Duffin Creek Water Pollution Control Plant, we embrace our role as environmental stewards with a special obligation to the people of Durham and York Region.

We are pleased to present our Environmental Sustainability Report for the Duffin Creek Plant. With the capacity to be the second largest wastewater treatment plant in Ontario, we have a dual responsibility: to operate a disciplined wastewater facility, as well as to protect the surrounding environment and water quality of Lake Ontario. We're committed to leading the way by demonstrating leadership in sustainability and addressing climate change.

We view our local contributions as playing a part in combating the challenges of climate change.

Sustainability in the wastewater sector can be divided into four key strategies:

- **Clean Operations:** How we handle the wastewater flows. By deploying best practices and state-of-the-art technology, our goal is continued excellent performance metrics.
- **Aggressive Recycling efforts:** How we recycle nutrients and use energy efficiently.
- **Avoiding Contamination:** Protecting the air, the water, and the land by meeting or exceeding provincial and federal regulations.
- **Safety for all Stakeholders:** For staff, the community and the environment.

We invite you to read more on the progress and performance of the Duffin Creek Plant.

John Presta
Commissioner of Works
Region of Durham

Erin Mahoney
Commissioner
Regional Municipality of York,
Public Works

From the archives ...

The Plant's history goes back to the 1960s when Ontario faced declining quality in the rivers and streams in the Greater Toronto Area (GTA). Coupled with a growing population and a booming economy, the challenge was clear. Invest in a major, central facility to serve the Regions and meet the requirements of the Canada-U.S. Great Lakes Water Quality Agreement. Since the Plant's opening in 1969, all levels of Government have invested \$850 million to meet the area's service requirements while protecting the environment.

A unique partnership thrives to protect the environment

The Plant's ownership was transferred from the Province of Ontario, to the Regional Municipalities of York and Durham in 1997. This unique partnership continues to thrive and ensures the Plant delivers leading environmental performance.

Today the Plant holds an impressive ISO 14001 Environmental Management System certification. This globally recognized registration system monitors and accredits progressive organizations that take quantifiable actions to protect the environment and continually improve.

Our Duffin Creek Plant is classified a Class 4 conventional activated sludge treatment plant, under the auspices of the Ministry of the Environment, Conservation and Parks (MECP). The facility has expanded over the years to accommodate the Regions' growth, with the third stage completed in 2014.



Today's snapshot ...

Prudent handling of wastewater is a highly sophisticated process. Think of it as a complex engineering system of tanks, pipes, specialized equipment and facilities covering the equivalent of 400 football fields. It is a massive operation with a vital job. Serving York and Durham Regions, the Plant treats wastewater from homes, businesses and industry. Once treated, the clear water, known as effluent, is returned back to Lake Ontario.

Working for people, business and industry

It all starts with wastewater – a catch-all word for water that ends up in the sewer system from our homes, businesses and industries. Sources are toilets, sinks, laundry and rinse water from various industrial and commercial processes.

You may be surprised by the multi-pronged approach we take to treat the wastewater so the community and our neighbours remain friendly. Many processes are required to remove solid material, nutrients such as phosphorus and bacteria, all while making sure the water being released into Lake Ontario is clean and respectful of the natural environment.

The effluent or clean water leaving the Plant meets the robust environmental protection requirements of the MECP and Fisheries and Oceans Canada. MECP sets limits on the amount and type of various substances in the water released into Lake Ontario through an Environmental Compliance Approval (ECA). Our Duffin Creek Plant removes more solid material, nutrients and bacteria from the wastewater than is required, thereby bettering these compliance limits.

The Plant also runs a leading odour control program that takes advantage of world-class technology and upgrades to ensure it meets the standards set by the MECP.

The result has been a good neighbour policy with zero reported complaints since 2018.



Fast Facts about Duffin Creek





Location:

City of Pickering, on the shores of Lake Ontario.

Number of employees:

105, including staff at the Regional Environmental Laboratory.

Hours of Operation:

24 hours a day, 365 days a year.

Maximum amount of water the Plant is built to treat: 630 million litres of water each day (enough to fill 252 Olympic-sized swimming pools¹).

Size of property: 166 hectares, almost two square kilometres which is roughly the size of 400 football fields.

The discharge pipe into Lake Ontario is over a 1 kilometre long, with 63 diffusers in use.

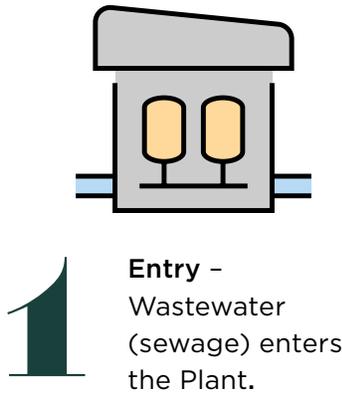
The water's quality is tested daily by the on-site laboratory, 365 days a year.

The facility offers a free liquid waste unloading site for recreational vehicles (RVs) as a convenience to the community.

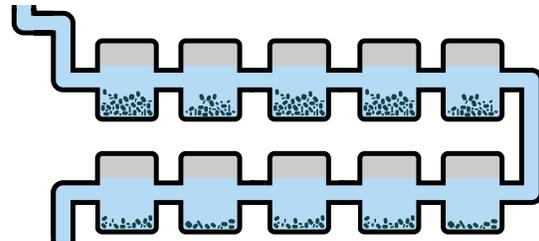
¹ It takes 2.5 million litres of water (2,500 m³) to fill an Olympic-sized swimming pool.

How Wastewater is Cleaned

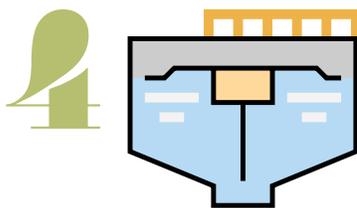
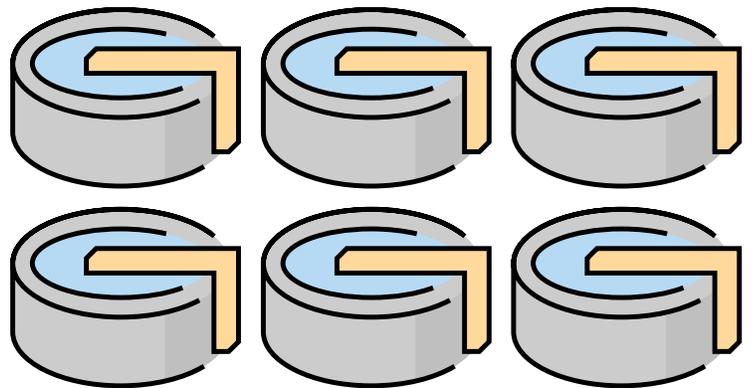
From the entry into the Plant to the release of clear treated water into Lake Ontario, here's the process ...



2 **Screening (Physical)** - Large solid objects such as garbage, branches, plastics, stones, sand and silt are removed using screens and grit tanks.

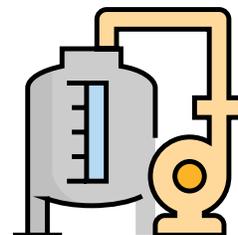


3 **Primary Treatment (Physical)** - Organic materials (food bits and human waste) are removed using settling tanks. Gravity and time are used to let the material fall to the bottom where it is collected. A skimmer removes fat, oil and grease floating on the surface of the tanks. Chemical treatment is used to assist in removing phosphorus.



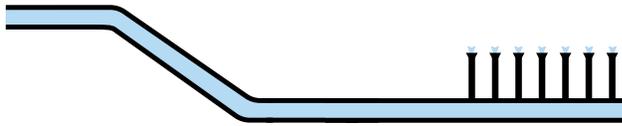
Secondary Treatment (Biological) - Small organic materials and nutrients are extracted. Air is pumped into the wastewater to give helpful bacteria the oxygen they need to break down the organic material and absorb nutrients. Settling tanks are used with chemical treatments to help the material and bacteria settle to the bottom where they are collected.

5 **Disinfection** - Sodium hypochlorite is added to kill off any remaining harmful bacteria such as *E.coli*. A second chemical (sodium bisulphite) is used to take out the chlorine before the clear treated water is released into the Lake, reducing potential harm to aquatic life.

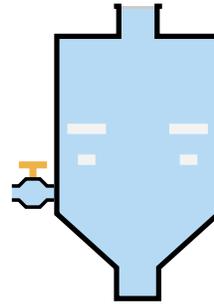


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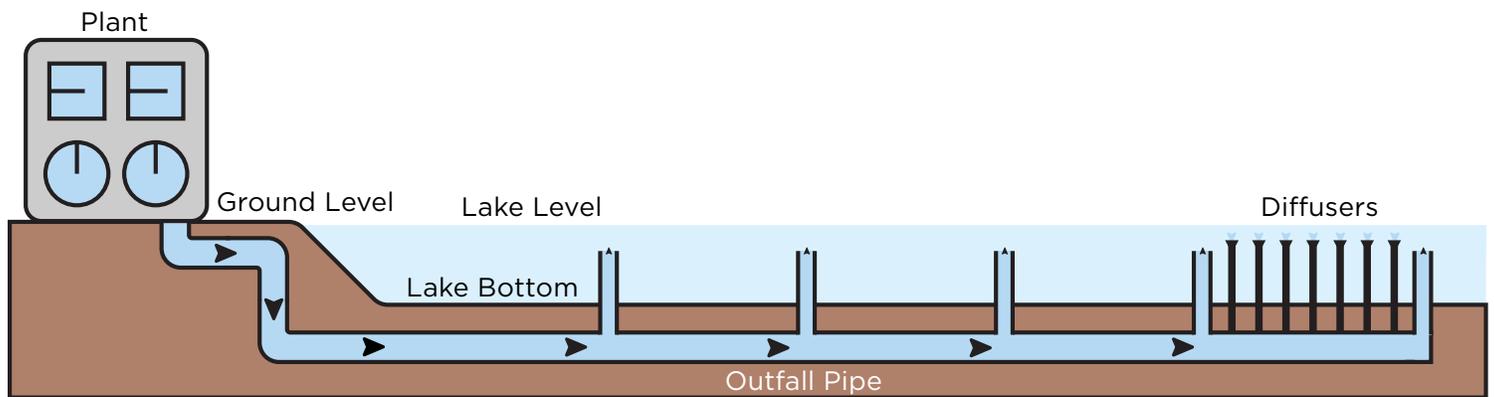
Release - Clear treated water is sent down a discharge pipe, known as the outfall, about one kilometre into Lake Ontario and flows out through 63 diffusers or outlets spaced over a length of 180 metres.



Effluent is the term used for the clear treated water released into lakes, rivers or streams after processing at a wastewater treatment plant.



Biosolids Treatment - Recovering Energy - A portion of the solids that settled out of the tanks enter the anaerobic digestion process where bacteria break down the material further and produces biogas for use as a natural gas energy source..



Big wins spell success

Meet the Sludgehammers ...

This proud group of wastewater operators won the Operations Challenge at the Water Environment Association of Ontario conference in 2022.

Their skills were further tested in a virtual competition in Denmark against international competitors. In time-tested challenges, this crew displayed quick responses

and ingenuity in solving wastewater issues. The Association brings together top specialists to discuss the issues facing global water services.



Upgrades from input to output to support sustainability

Outfall Diffuser Upgrades – The Plant has successfully installed variable port diffusers as warranted by increased flows through the Plant. Variable port diffusers increase the effluent flow through the outfall allowing the rated capacity of the Plant to increase to 630,000 metres cubed per day from 520,000 metres cubed per day.

These also allow for better effluent mixing and improves dilution to meet regulations (20:1 ratio) (1 part volume (m³) of effluent is mixed with 20 parts of lake water).

Digester Mixing Upgrades (Linear Motion Mixers)

Each primary digester at the Plant is currently installed with five draft tube mixers to circulate sludge. These mixers are being replaced with linear motion mixers, which provide a 33 per cent energy reduction compared with the current draft tube mixers – a game changer in reducing corporate and community greenhouse gas (GHG) emissions.



Studies bring about tangible change

In order to optimize the Plant and meet the challenges of higher volumes, studies are regularly undertaken.

A Phosphorous Reduction Action Plan (PRAP) study has been completed by independent, globally-recognized experts. In addition to the core project team, the Regions retained Dr. David Jenkins, Professor Emeritus, University of California, Berkeley, as an independent expert to provide an external peer review.

This Study provided a detailed evaluation of the existing Duffin Creek Plant and options for reducing total phosphorus (TP) and soluble reactive phosphorus (SRP) in the Plant effluent.

The Regions, along with the community, have a shared interest in maintaining the health of Lake Ontario, and in protecting Durham's extensive shoreline.

The final recommendation was to implement optimization of chemically enhanced phosphorus removal in the existing primary and secondary treatment processes at the Plant. This is a technically viable and cost-effective solution to improve TP removal at the Plant.

The good news is this revision to the phosphorus concentration is more stringent than the limit of 0.5 mg/L set by the Great Lakes Water Quality Agreement.

Committing to do better than the objectives outlined by the Agreement demonstrates the Regions' priority on environmental stewardship and continuous improvement. In fact, the Plant's discharge limit for phosphorus is one of the lowest in Ontario for plants discharging to the Great Lakes.

Based on the Plant's official annual average flow projections, meeting or doing better than the effluent objectives will result in decreasing the Plant's actual TP loading by about 40 per cent over the next 25 years compared to the current ECA objectives approved by MECP. Work is well underway in constructing of PRAP upgrades with completion in 2024.





Nearshore monitoring protects the ecosystem

Together with the Toronto and Region Conservation Authority (TRCA), Duffin Creek Plant has been vigilant in monitoring the water quality from Lake Ontario since 2006. Officially known as the Western Durham Nearshore Water Quality Monitoring program, the data collected is vital so governments can make sound decisions and policy for the local environment.



Think of the nearshore as the meeting place where humans interact with the natural environment. The 'nearshore' includes the shoreline or lake edge and the area of the lake out to a depth of approximately 30 metres. This area shows us the effects stormwater and watershed activities can have on the lake. Activities on land can impact our streams that empty into the lake, affecting the conditions of the shoreline and local beaches.

By better understanding the overall health of the lake, we can find ways to improve its water quality and protect the ecosystem. For more information visit: trca.on.ca/nearshore.

Water Quality Metrics:

- An average of 94 per cent of phosphorus is typically removed from wastewater entering the Plant before the clean treated water is released into Lake Ontario.
- Water leaving the Plant regularly has less than 100 counts of *E.coli* per 100 millilitres of water – entirely safe for swimming.²

² For more information see TRCA Lake Ontario Nearshore Monitoring – Ajax and Pickering website at: trca.on.ca/the-living-city/watersheds/lake-ontario-waterfront/western-durham/lake0comparison.dot

Finding the right balance of Phosphorus

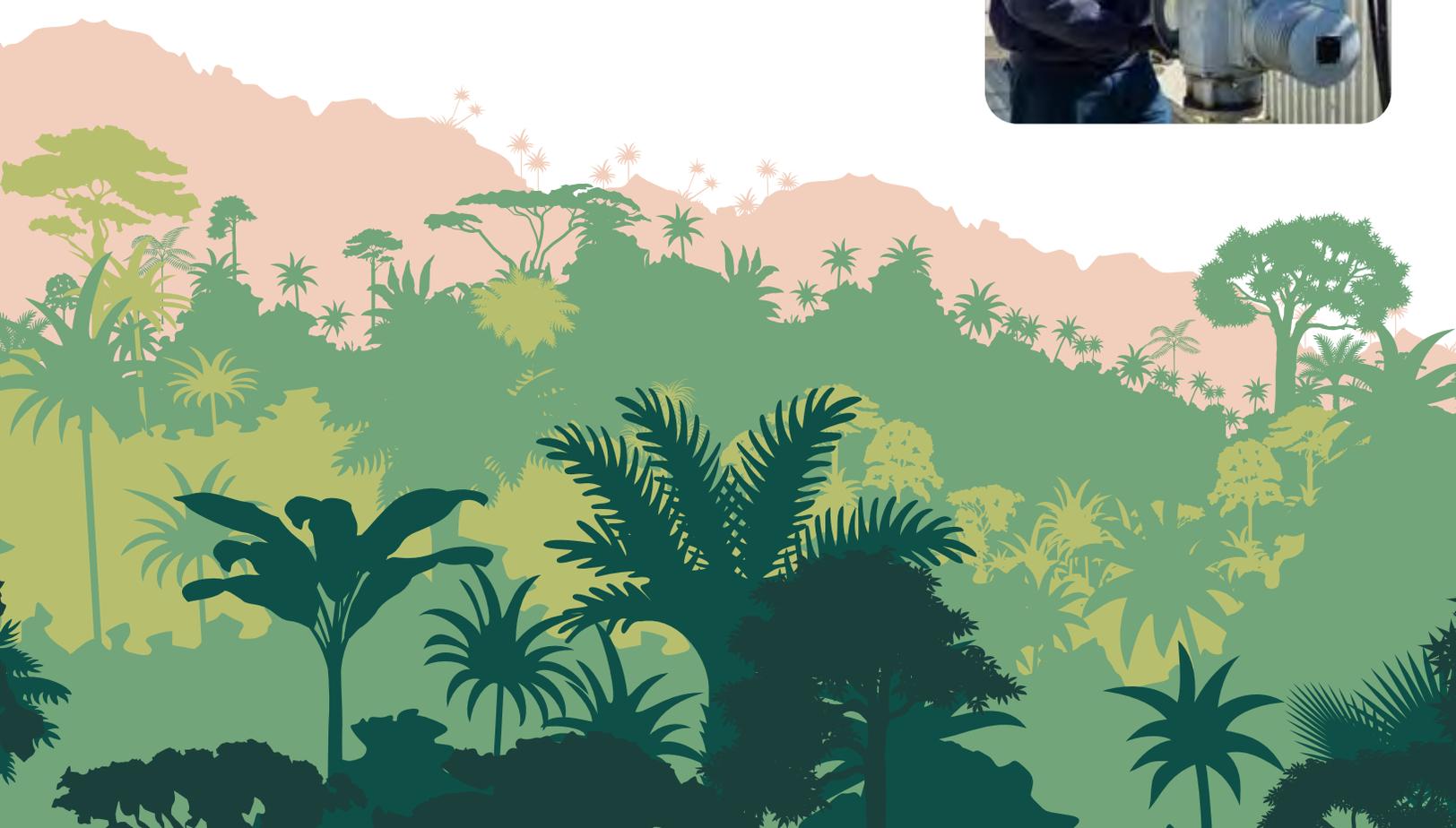
Phosphorus is a nutrient essential for life. All plants and animals need phosphorus to grow, but too much of it can lead to algae blooms that are harmful to humans and animals. Phosphorus occurs naturally in the environment, originating from soils and rocks. It's also found in animal and human waste, rotting plants, and in common household cleaning products. Higher levels in rivers and lakes also come from water that has run off from farms and urban areas, stormwater, discharge from septic systems, and wastewater treatment plants. The Plant uses technology to ensure the cleaned water released into Lake Ontario achieves or better regulatory requirements.

What we do to protect Water Quality

Every drop of water flowing from the Duffin Creek Plant into Lake Ontario is treated. Unlike many other treatment plants, untreated or partially treated wastewater cannot be released by the Duffin Creek Plant. Most other plants are built with what is called an 'overflow' or 'by-pass'. During heavy rain or snow melt, the amount of water that comes into those plants is higher than average and can result in sewage by-passing a plant's treatment process and releasing directly into a lake or river. The Duffin Creek Plant has no overflow or by-pass. A standby power system makes sure the minimum number of pumps and equipment are always working so that no untreated sewage is released into Lake Ontario.

Water quality is tested multiple times a day by the on-site laboratory. Instruments continually monitor flow and processes in the Plant using a Supervisory Control and Data Acquisition (SCADA) system.

Whenever possible, water used by one process is recycled for use in another. This means a minimal amount of drinking water is used in the wastewater treatment process.



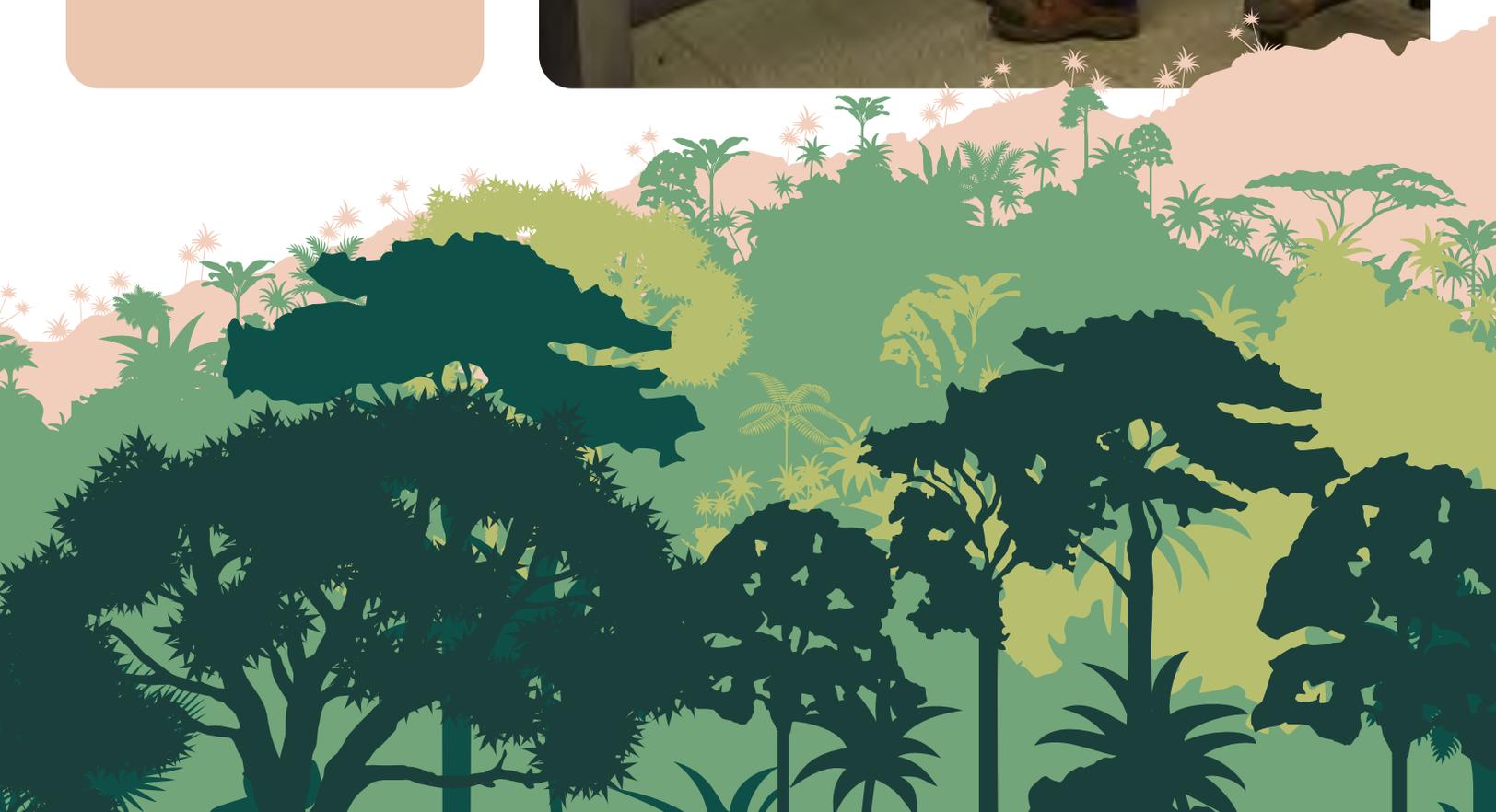
Stopping potentially Harmful Substances at Source

Sewer-use by-laws play a role in the wastewater process. By enacting by-laws that set limits of what industry can put down the drain, harmful substances are eliminated at the source. Data collection is imperative in making these changes. There are also public education campaigns that divert items from wastewater plants, such as taking your unused pharmaceuticals to a drugstore for proper disposal.

Not sure where stuff goes?

York region residents can check out The bindicator (<https://www.york.ca/environment/garbage-and-recycling/bindicator>)

Durham residents have the Know Before You Throw App (durham.ca/KnowBeforeYouThrow).





Managing Wastewater in a Changing Climate

Energy Recovery leads the way

Wastewater treatment is energy and Greenhouse Gas (GHG) emissions intensive. Yet at the same time, treatment plants have the potential to generate renewable energy in the form of biogas, electricity, and heat which can offset fossil fuel consumption and related GHG emissions. Managing facility energy demand through energy efficiency measures, while also increasing renewable energy generation at the Plant, provides opportunities to contribute to meeting net zero GHG reduction targets set by both Durham and York Regions.

Since 2014, the Plant has participated in numerous energy conservation and demand management programs and funding opportunities, including the Embedded Energy Manager program and the Retrofit program. These initiatives avoided energy use of over 14,000 MWh representing a cost avoidance of over \$1.3M.

On a day-to-day basis, the Plant harnesses energy recovered from the wastewater and uses it to help meet the energy needs of the Plant. Gas (biogas) and solids (biosolids) are by-products of the wastewater process. Instead of burying biosolids at a landfill, they are used as fuel to generate steam. The steam is then used to heat onsite buildings and drive large power turbines and offset electricity needs. This fuel source means less natural gas and electrical power is required to operate the Plant.

Operation staff are constantly looking at ways to improve resource recovery and reduce GHG emissions.

The Plant also participates in the Industrial Conservation Initiative (ICI) program offered by the Independent Electricity System Operator (IESO). Participants pay Global Adjustment (GA) charges based on their percentage contribution to the top five peak Ontario demand hours over a 12-month period. When feasible, the Plant responds to predicted peak hours by reducing electrical demand which has resulted in significant cost avoidance. Since joining the program in 2015, the Plant has achieved annual avoided costs of over \$2.4 million, and up to and including August 2022, a cumulative total cost avoidance of over \$17 million.

As a result of these initiatives annual GHG emissions related to energy use at Duffin Creek Plant have decreased by 46 per cent over the past decade. Even more impressive, GHG emissions per litre of wastewater treated have declined by 50 per cent which is an indicator of increasing efficiency of Plant operations. As we look forward to the next decade and beyond, the race to net zero will pick up speed. Both regions will be looking to implement recommendations from the recently completed comprehensive Integrated Resource Recovery (IRR) study which examined the sector's current best practices and evaluated their applicability to Duffin Creek Plant.

The professional team at the Plant, with the Regions' support, make energy efficiency a cornerstone of every decision.

Energy Highlight Reel

- The Dewatering Process Building – used in processing biosolids – achieved **LEED Gold Certification (Leadership in Energy and Environmental Design)**. This remains the only wastewater plant process building to be LEED Gold designated in Canada.
- The Duffin Creek Plant received the Conservation Champions award in 2013, 2014, 2015 and 2017 for outstanding electricity conservation. This annual award, sponsored by energy provider Exelion Energy, is bestowed to a select few business customers.



The Greening of Duffin Creek

For those who enjoy the waterfront, the Duffin Creek Plant is a quiet neighbour with a major footprint. Surrounded by woodlands, marshes and ponds on almost two square kilometres of land, the Plant overlooks Lake Ontario. Over the years, the greenery and tree planting has blossomed into a natural habitat for wildlife and native plants. The walking trail and bike path are well used and enjoyed year-round.



Points of interest

- Duffin Creek Plant is part of a water monitoring project, in concert with Toronto and Region Conservation Authority. Water quality data is collected and used so government can make informed decisions on environmental policy.
- In 2021, the Wildlife Habitat Council awarded Duffin Creek Plant certification for its commitment to conservation.
- The green buffer between the Plant and the Waterfront Trail has matured into a pleasing landscape of trees, meadows, wetlands and ponds.
- The Linton House - a stone farm house from the 1800s - was relocated and preserved onsite. Managed by the City of Pickering, it provides washroom facilities for trail visitors.
- A stormwater pond collects rain and snow melt to improve water quality before it flows back into Lake Ontario. It does this by allowing dirt and other solids in stormwater runoff to settle at the bottom of the pond.
- Almost 12 per cent of the Plant's site includes wooded and wetland habitats. Work continues with the TRCA to enhance the greening and biodiversity of the area with such initiatives as bee boxes and nesting boxes, raised poles and platforms for birds of prey and planting native trees and shrubs.

Odour control is more than a good neighbour policy

The Plant runs a leading odour control program that takes advantage of world-class technology and constantly upgrades to ensure it meets (or exceeds) the standards set by the MECP.

Odour control technology is carefully selected to tackle the exact source of the air stream. Certain technologies are better than others at removing specific odours. For example, odours from the initial liquid phase of the treatment process tends to contain more hydrogen sulfide gas ($H_2S_{(g)}$) and need filters to deal with that type of odour.

The solids management portion of the process contains reduced sulphur organic-based compounds such as methyl mercaptan and dimethyl

disulfides. These are best treated with heat or combustion. In other words, all smells are not created equal – targeting the source of odour is critical.

The Plant deploys three main systems to remove odour-causing compounds from the air. They are incinerators, biofilters and activated carbon units. Each has a unique job to do and, in concert, they work towards an Environmental Compliance Approval (ECA), issued by MECP. Ensuring compliance with this approval involves a rigorous process of testing, reporting and monitoring.

Don't forget about algae

Our beautiful Lake Ontario is also home to algae – a naturally occurring organism found in almost all bodies of water.

These microscopic organisms grow near the water's surface and often build up along the shorelines. Algae give off a pungent smell when they decay and die which can sometimes be confused with the wastewater treatment plant. Algae, while not toxic, is often the smelly culprit at the water's edge.

Odour control and the overall efficiency of the Duffin Creek Plant go hand in hand. Environmental concerns top the list with new sulphur dioxide limits coming into effect from the MECP. Equipment upgrades and new technologies are regularly examined. As the Regions grow and prosper, the Plant will continue to scale up to meet the demand with a disciplined approach to wastewater treatment.



Leadership in sustainability

With new technology, minimal waste from the Plant is sent to landfill

Waste Reduction Highlights:

- None of the solid by-products (sludge or biosolids) at the Plant are sent to landfill. The exception is an emergency situation, such as mechanical or electrical breakdown.
- Other wastewater plants in the Regions transport their sludge or biosolids to Duffin Creek Plant for final disposal, reducing their dependency on landfills. This demonstrates the Plant's best practices in biosolids management.
- Only one daily truck load of grit, gravel and other large particles collected in the sewer system is transported to landfill.



What We Do to Reduce Waste

All biosolids are treated on site. Enhanced technology has enabled the Plant to process organic solids removed from wastewater treatment into biosolids. Biosolids produced at the Plant (and smaller plants) are now burned in the Plant's incinerators as fuel. There is enough energy in the biosolids that they burn without having to add any additional burning agents.

The facility strives to operate 80 per cent of the time with no supplementary fuel. By avoiding the extra fuel, we reduce GHG emissions.

Burning biosolids creates ash which is recycled in the cement making process at the St. Marys Cement Plant in Durham Region. This resourceful recycling avoids landfills which is an environmental bonus.

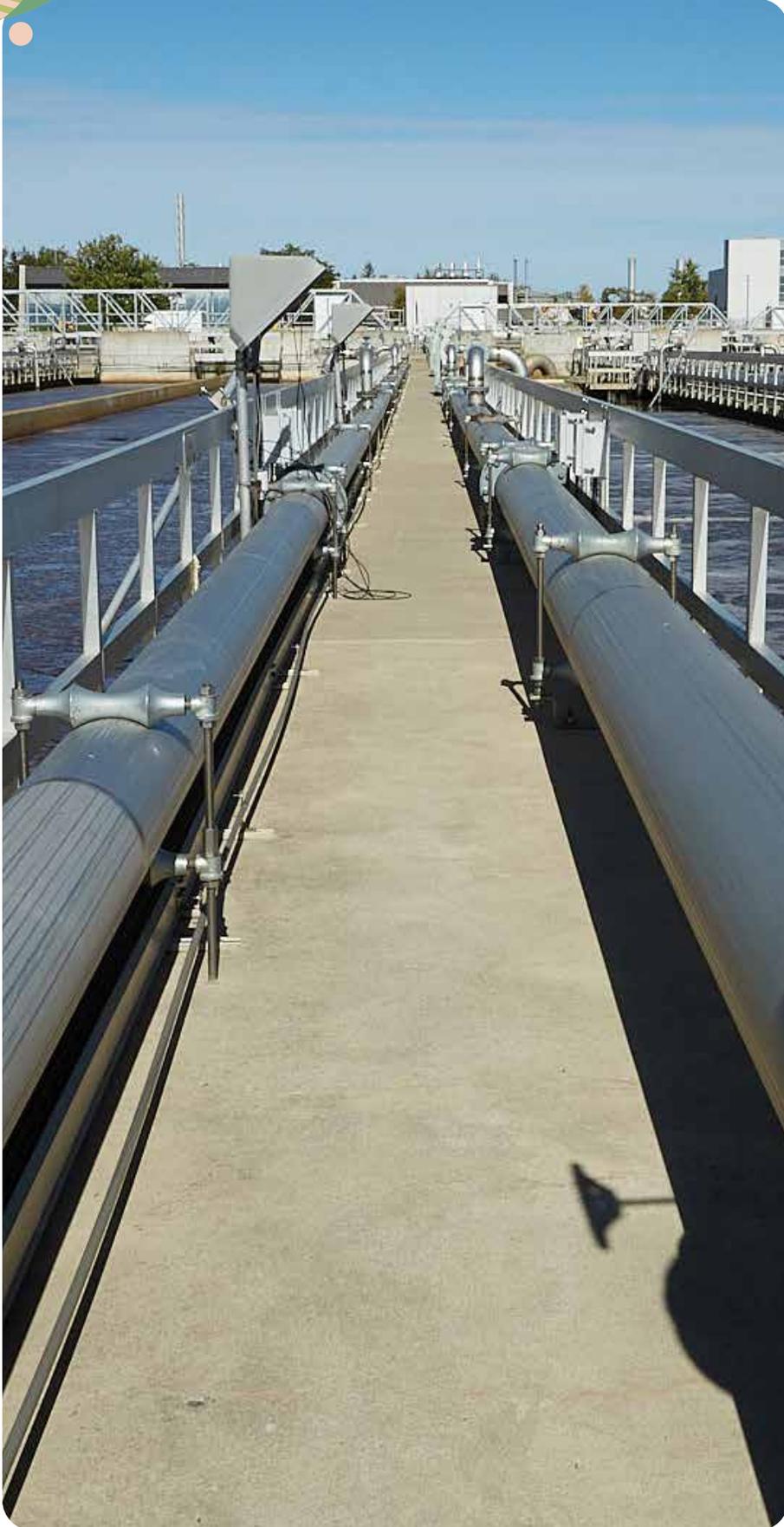
What are Biosolids?

Think of them as organic solids - solids that originate from a living being - settling out of the wastewater during the treatment process. They are treated in enclosed digesters using bacteria and other natural processes to break them down, resulting in biogas and fuel. This process is technically referred to as anaerobic digestion. Biosolids are full of nutrients and can be reused in creating heat and energy.





Continuous improvement ...



When you look at the strategic plans for York and Durham Regions, you get a clear picture that the Regions will grow - not just in population - but in economic expansion and prosperity. As a vital part of the infrastructure, servicing both Regions, the Duffin Creek Plant will continue to scale in size and capacity to meet these needs. Both regions continue to invest in the Plant in order to serve our communities and protect our natural resources.

Duffin Creek Plant staff, as members of the wastewater sector, are part of a collegial community of operators in Ontario, across Canada and internationally. New technologies and best practices are constantly shared with the singular goal of doing things better.

While the Duffin Creek Plant has an excellent report card, it will not be complacent. Work continues on the facility and equipment upgrades, partnering with stakeholders on research and monitoring and investing in the people who make the Plant run safely and efficiently.





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