Conservation & Demand Management Plan

Utilities Kingston's Water and Wastewater Treatment Operations

Utilities Kingston

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1 Message from Senior Leadership

Utilities Kingston continues to work with our Shareholder, the City of Kingston, in its vision to become Canada's most sustainable city. On March 4, 2019, the City of Kingston officially declared a climate emergency that "requires an urgency and strategic response". Part of that response is to set energy and water conservation targets and greenhouse gas reduction targets for our water and wastewater treatment operations.

Utilities Kingston operates the City of Kingston's water and wastewater treatment plants, and all associated pumping stations located throughout the city. These facilities are some of the City's largest energy consumers and it is for that reason Utilities Kingston recently hired an Energy Analyst in May of this year to help us track our energy usage, and help identify potential energy conservation measures that will help Utilities Kingston attain their reduction goals.

Year after year, Utilities Kingston works to improve our water and wastewater systems. Currently we are in the process of some major infrastructure upgrades including our wastewater treatment plant at Cataraqui Bay, a major sewage pumping station on Days Road, and a water booster station on Third Avenue. As we look to replace aging equipment we strive to keep energy efficiency in mind. This year our team will continue their efforts of detecting and repairing leaks within our distribution system, as well as identifying and repairing extraneous flows that enter our sanitary system. These improvements help to reduce the amount of energy required to move water and wastewater throughout our systems. All of our conservation measures, including water conservation measures in our community, help to reduce the demand on our systems delaying the need for expensive expansions of our treatment facilities and ultimately saving energy while reducing costs.

Ontario Regulation (O.Reg) 507/18 requires that all public sector organizations report on the environmental impact of their facilities and buildings, and produce a plan that demonstrates how they will reduce the impact that their facilities and buildings have on the environment. Our Senior Leadership Team approves and supports our CDM Plan for Water and Wastewater Treatment Operations and we will continue to make energy efficiency and greenhouse gas reductions a priority.

Sincerely,

James Miller
Director Utilities Engineering, Treatment and Human Resources

2 Executive Summary

Ontario Regulation 507/18 (Broader Public Sector: Energy Reporting and Demand Management Plans) requires broader public sector (BPS) organizations like the City of Kingston, to develop a Conservation and Demand Management (CDM) plan, and update it every five years.

The CDM plan is composed of two parts:

i. A summary of annual energy consumption and greenhouse gas emissions for Utilities Kingston's Water and Wastewater Treatment Operations.

ii. A description of previous, current, and proposed measures for conserving and otherwise reducing the amount of energy consumed and demanded by Utilities Kingston's Water and Wastewater Treatment Operations, including a forecast of the expected results of current and proposed measures with regards to energy and greenhouse gas reductions.

Utilities Kingston's (UK) Water and Wastewater (W&WW) Treatment Operations hired an Energy Analyst in May of 2019. Part of the Energy Analyst's role will be to: help identify energy saving opportunities, secure financial incentives when available, create an Energy Management Plan, and to help Utilities Kingston's overall goal to reduce the energy consumption, cost, and environmental impact of their water and wastewater treatment operations. Where possible this goal will be achieved through:

i. Continuing to improve the efficiency of our treatment, collection and distribution systems; reducing both operational expenses and environmental impacts.

ii. Incorporating energy conservation and demand management into operations and planning; and integrating life cycle cost and climate impact analyses into decision making processes.

iii. Development of energy baseline models for each facility involved in water and wastewater treatment operations which will serve as starting points for setting energy efficiency targets and comparison points for previous, ongoing and future energy conservation measures.

iv. Monitoring and tracking energy consumption of water and wastewater treatment operations to evaluate how well each facility is performing.

v. Establishing a green team with members from across water and wastewater treatment operations.

vi. Staff awareness programs and furthering a culture of conservation.

vii. Energy conservation and demand management training and support.

In 2018, annual energy usage of Utilities Kingston's Water and Wastewater (W&WW) Treatment Operations was 32,767,480 ekWh*; 23,998,190 kWh of electricity and 825,129 m3 (8,769,290 ekWh) of natural gas.

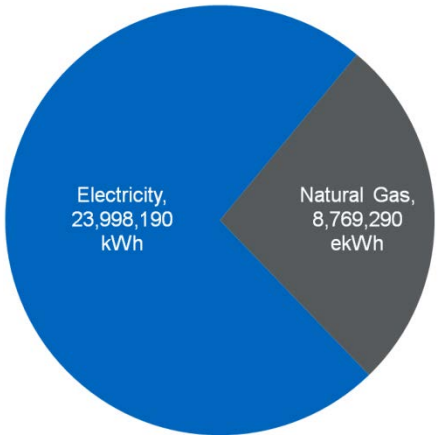

Figure 1 - Annual Energy Use, Utilities Kingston Water and Wastewater Treatment Operations, 2018

In 2018, Utilities Kingston's Water and Wastewater Treatment Operations were responsible for approximately 2,413 tonnes of greenhouse gases related to energy consumption.

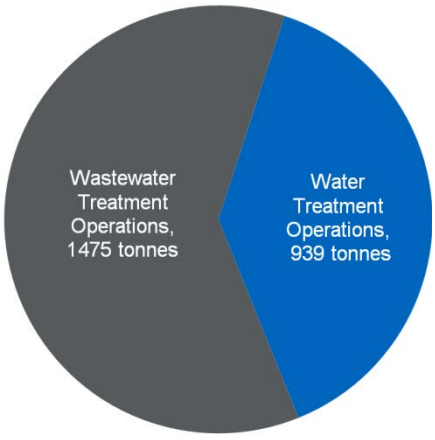

Figure 2 - Annual GHG Emissions, Utilities Kingston Water and Wastewater Treatment Operations, 2018

* ekWh – equivalent kilowatt hours.

As of the writing of this document, annual energy and greenhouse gas reduction targets have been set for 2019 and 2020, with the following three years in a "to be determined" state.

Annual savings target for 2019 to 2020 are:

i. A reduction in electrical consumption of 2,000 MWh, approximately 6.1% of Utilities Kingston's Water and Wastewater Treatment Operations annual energy consumption in 2018.

ii. A reduction in greenhouse gas (GHG) emissions of 71 tonnes, approximately 2.9% of Utilities Kingston's Water and Wastewater Treatment Operations annual GHG emissions in 2018.

If Utilities Kingston's electrical reduction targets are met the company could expect to see avoided cost of energy savings of approximately $160,000* in 2019, and $320,000† by 2020.

* Calculated using a blended cost of electricity of approximately 16¢/kWh.
† Calculated using a blended cost of electricity of approximately 16¢/kWh. Includes persistent savings from 2019.

Figure 3 - Point Pleasant Water Treatment Plant, Kingston, Ontario*

3 Introduction

Ontario Regulation 507/18 (Broader Public Sector: Energy Reporting and Demand Management Plans) requires broader public sector (BPS) organizations like the City of Kingston, to develop a Conservation and Demand Management (CDM) plan, and update it every five years.

The plan includes Utilities Kingston's Water and Wastewater Treatment Operations:

i. Energy consumption and greenhouse gas (GHG) Emissions,

ii. Energy conservation goals and objectives,

iii. Conservation measures, (previous, on-going and future),

iv. Renewable energy facilities.

The objectives of the Energy Conservation and Demand Management (CDM) plan are to:

i. Meet the requirements of Ontario Regulation (O.Reg) 507/18

ii. Promote energy efficiency in all of Utilities Kingston's Water and Wastewater Treatment Operations,

* Photo by Kingston Aerial Imaging.

Utilities Kingston is responsible for:

i. Providing safe and reliable water services to approximately 38,000 homes and businesses.

ii. Providing safe and reliable wastewater services to nearly 37,000 homes and businesses.

As part of their water treatment operations Utilities Kingston maintains and operates: three water treatment plants, four booster stations, and nine water storage facilities. As part of their wastewater treatment operations Utilities Kingston maintains and operates: three wastewater treatment plants, and over thirty sewage pumping stations. Pumps, motors, drives, and other equipment are in operation 24 hours a day and a significant amount of energy is required to treat and move water and wastewater to and from homes and businesses.

The rising concentration of greenhouse gases (GHG) in the atmosphere is leading to an increase in average global temperatures. The energy Utilities Kingston's Water and Wastewater Treatment Operations consumes generates GHG emissions associated with the consumption of electricity and natural gas. As well, GHG are produced through the biological processes of treating wastewater. Water and wastewater conservation measures reduce the demand for treated water and treating wastewater, and thus reduce the energy requirements involved with both processes.

As new efficient technologies become available, unplanned conservation and demand management opportunities emerge, and data is analysed, the need to update this document will arise. As such Utilities Kingston will treat this CDM plan as a "living document", updating and revising our commitments as required.

Figure 4 - Ravensview Wastewater Treatment Facility, Kingston, Ontario[*]

4 Background Information

On December 12th, 2018, the Government of Ontario enacted Ontario Regulation (O.Reg.) 507/18[†], made under the Electricity Act, 1998. This regulation requires public agencies or municipal service boards to:

i. Prepare, publish, make available to the public, and implement an energy conservation and demand management plan every five years.

ii. Report annually on energy use and greenhouse gas (GHG) emissions.

4.1 Energy Conservation and Demand Management (CDM) Plan

The CDM plan is composed of two parts:

iii. A summary of annual energy consumption and greenhouse gas emissions for Utilities Kingston's Water and Wastewater Treatment Operations.

iv. A description of previous, current, and proposed measures for conserving and otherwise reducing the amount of energy consumed and demanded by Utilities Kingston's Water and Wastewater Treatment Operations, including a forecast of the expected results of current and proposed measures.

[*] Photo by Kingston Aerial Imaging.
[†] O. Reg. 507/18: Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans.

4.2 Energy Conservation and Demand Management Measures

Utilities Kingston's Water and Wastewater (W&WW) Treatment Operations will make the following information publicly available:

i. Annual energy consumption for the last year for which complete information is available for a full year,

ii. Goals and objectives for conserving and otherwise reducing energy consumption and managing its demand for energy,

iii. Proposed measures under its energy conservation and demand management plan,

iv. Cost savings and estimates for its proposed measures,

v. A description of any renewable energy generation facility operated by Utilities Kingston's W&WW Treatment Operations, and the amount of energy produced on an annual basis by the facility,

vi. A description of:

   I. The ground source energy harnessed, if any, by ground source heat pump technology,

   II. The solar energy harnessed, if any, by thermal air or thermal water technology,

   III. The proposed plan, if any, to operate heat pump, thermal air, or thermal water technology in the future.

vii. The estimated length of time the energy conservation and demand management measures will be in place, and

viii. Confirmation that the energy conservation and demand management plan has been approved by the senior management.

5 Summary of Energy Consumption and GHG Emissions

As part of the *Electricity Act, 1998*, Utilities Kingston's Water and Wastewater (W&WW) Treatment Operations are required to include in their Energy Conservation and Demand Management (CDM) Plan a summary of their annual energy consumption and greenhouse gas (GHG) emissions.

Utilities Kingston Water and Wastewater Treatment Operations voluntarily make available to the public their energy consumption and greenhouse gas emissions. This information can be found at the following web address: https://utilitieskingston.com/Pages/CDMReporting

5.1 Energy Consumption

In 2018, annual energy usage of Utilities Kingston's Water and Wastewater (W&WW) Treatment Operations was 32,767,480 ekWh*; 23,998,190 kWh of electricity and 825,129 m3 (8,769,290 ekWh) of natural gas.

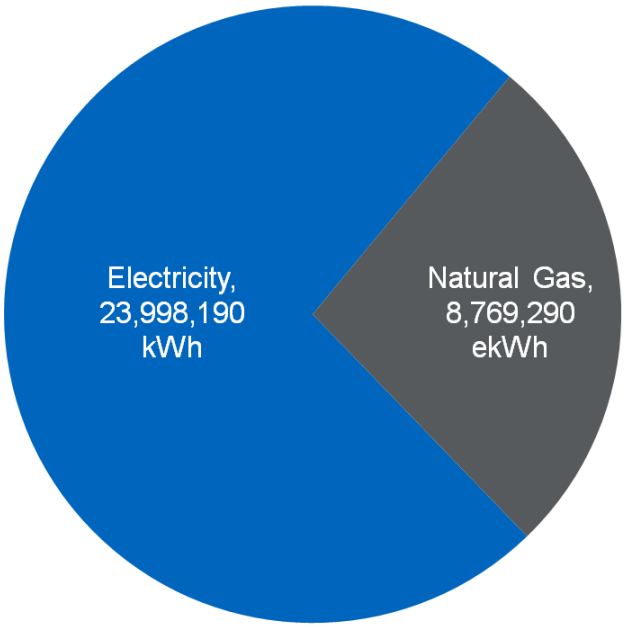

Figure 5 – Annual Energy Use, Utilities Kingston Water and Wastewater Treatment Operations, 2018

* ekWh – equivalent kilowatt hours.

In 2018, 9,772,235 kWh of electricity and 312,658 m^3 of natural gas were used by Water Treatment Operations, and 14,225,954 kWh of electricity and 512,471 m^3 of natural gas were used by Wastewater Treatment Operations.

	electricity (kWh)	natural gas (m3)
Water Treatment Operations	9,772,235	312,658
Wastewater Treatment Operations	14,225,954	512,471
Total	23,998,190	825,129

Table 1 - Annual Water and Wastewater Treatment Operations Energy Consumption, 2018.

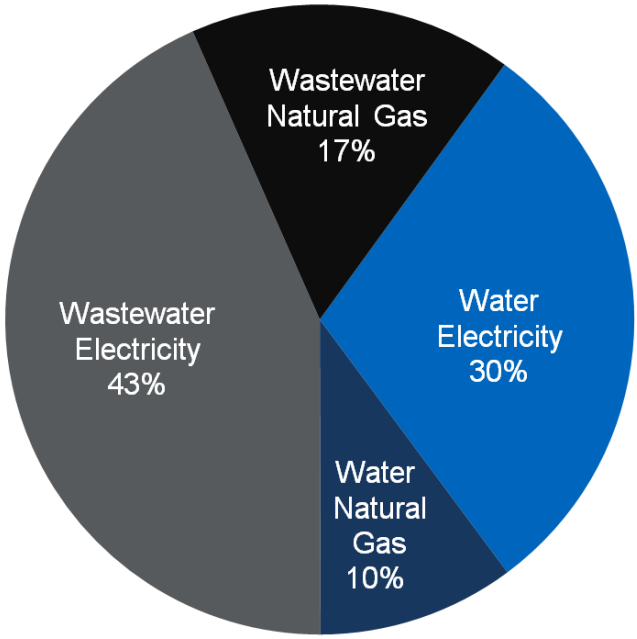

Figure 6 - Breakdown of Energy Usage, Water and Wastewater Treatment Operations, 2018.

A more detailed breakdown of energy consumption for Water and Wastewater Treatment Operations can be found in Appendices A and B.

5.2 Greenhouse Gas Emissions

In 2018, Utilities Kingston's Water and Wastewater Treatment Operations were responsible for approximately 2,413 tonnes of greenhouse gases related to energy consumption, with 61% of those emissions attributed to Wastewater Treatment Operations.

	GHG (tonnes)
Water Treatment Operations	939
Wastewater Treatment Operations	1,475
Total	2,413

Table 2- Annual GHG Emissions, Utilities Kingston W&WW Treatment Operations, 2018.

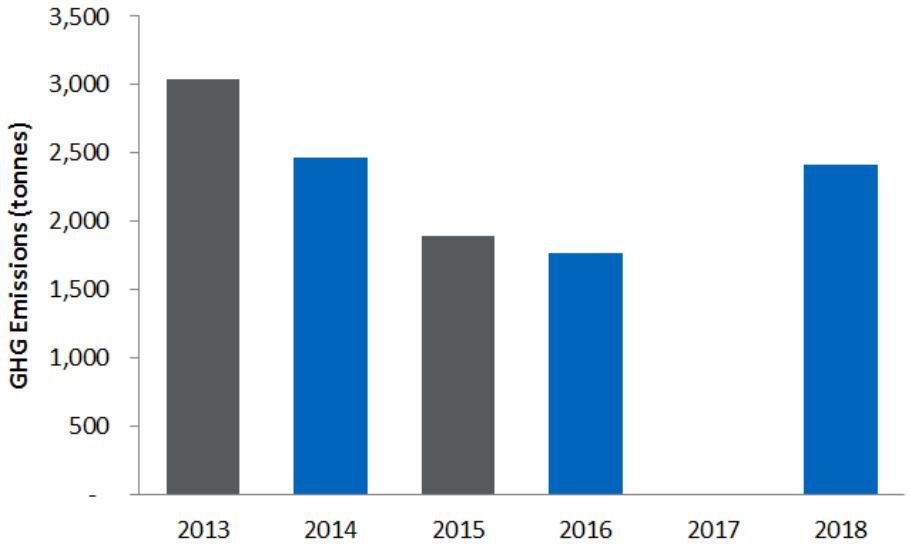

Figure 7 - GHG Emissions, Utilities Kingston W&WW Treatment Operations*

A more detailed breakdown of GHG emissions for Water and Wastewater Treatment Operations can be found in Appendices A and B.

* At the time of this writing the data for 2017 was unavailable. The graph will be updated when the data becomes available.

6 Goals and Objectives

The treatment of water and wastewater is essential to human health, however removing contaminants from water and wastewater comes with a significant energy cost. Utilities Kingston aims to reduce the energy consumption, cost, and environmental impact of their water and wastewater treatment operations. Where possible, this goal will be achieved through:

i. Continuing to improve the efficiency of our treatment, collection and distribution systems; reducing both operational expenses and environmental impacts.

ii. Incorporating energy conservation and demand management into operations and planning; and integrating life cycle cost and climate impact analyses into decision making processes.

iii. Development of energy baseline models for each facility involved in water and wastewater treatment operations which will serve as starting points for setting energy efficiency targets and comparison points for previous, ongoing and future energy conservation measures.

iv. Monitoring and tracking energy consumption of water and wastewater treatment operations to evaluate how well each facility is performing.

v. Establishing a green team with members from across water and wastewater treatment operations.

vi. Staff awareness programs and furthering a culture of conservation.

vii. Energy conservation and demand management training and support.

6.1 Energy and Greenhouse Gas Reduction Targets

As of the writing of this document, annual energy and greenhouse gas reduction targets have been set for 2019 and 2020, with the following three years in a “to be determined” state. In May 2019, Utilities Kingston hired an Energy Analyst for their water and wastewater treatment operations (see Section 6.2.1). As part of their role the Energy Analyst will create an Energy Management Plan by the end of 2019. Potential energy conservation measures will be identified in the Energy Management Plan and will serve to guide Utilities Kingston in setting future targets. This CDM Plan will be updated regularly as new information becomes available.

Annual savings target for 2019 to 2020 are:

i. A reduction in electrical consumption of 2,000 MWh, approximately 6.1% of Utilities Kingston's Water and Wastewater Treatment Operations annual energy consumption in 2018.

ii. A reduction in greenhouse gas (GHG) emissions of 71 tonnes, approximately 2.9% of Utilities Kingston's Water and Wastewater Treatment Operations annual GHG emissions in 2018.

	Reduction Targets		
	electricity (kWh)	natural gas (m3)	GHG (kg)
2019	1,000,000	0	35,548
2020	1,000,000	0	35,548
2021	TBD	TBD	TBD
2022	TBD	TBD	TBD
2023	TBD	TBD	TBD
Total	TBD	TBD	TBD

Table 3 - Utilities Kingston's W&WWTO Annual Energy and GHG Reduction Targets, 2019-2023

6.2 Cost Savings

As of the writing of this document, annual cost savings targets have been estimated for 2019 and 2020, with the following three years in a "to be determined" state. Cost savings have been determined through the avoided cost* of energy if Utilities Kingston's W&WWTO reduction targets (Table 3) are realised.

	Cost Savings
2019	$ 161,532.70
2020	$ 161,532.70
2021	TBD
2022	TBD
2023	TBD
Total	TBD

Table 4 - Utilities Kingston's W&WWTO Annual Cost Savings Targets, 2019-2023

The cost savings outlined do not include any incentives Utilities Kingston may be eligible for through the electricity conservation programs offered by the Province, or natural gas efficiency programs offered by Utilities Kingston and Union Gas.

* Calculated using a blended cost of energy of ~16.15¢/kWh.

7 Conservation Measures

An energy conservation measure (ECM) is any measure implemented that will reduce energy consumption and/or energy demand. The aim of an ECM is to achieve energy and cost savings, and to reduce greenhouse gas (GHG) emissions.

7.1 Previous Measures

7.1.1 Combined Sewer Overflow (CSO) Storage Tanks

A CSO is an overflow of diluted sewage from the combined sewer system. Overflows occur when the combined sewer is full and the pipes no longer have the capacity to move the contents to the treatment plant. This happens when more storm and groundwater enters the collection system than the pipes were designed for. Combined sewers are meant to accommodate some storm water runoff, but not large amounts. The sewage is diluted to some degree by storm water.

CSO storage tanks have been placed strategically throughout the city. These tanks limit the inrush volumes seen by the pumping and treatments plants by restricting the flow rate of the sewage. A reduction in the inrush volumes creates an overall reduction in the electrical demand of the sewage system.

7.1.2 Embedded Energy in Treated Water and Wastewater

Utilities Kingston collaborated with St. Lawrence College's Sustainable Energy Applied Research Centre (SEARC) to find the embedded energy in each cubic metre of water that travels full circle in Kingston's water service and sanitary sewer systems. The study concluded that the average embedded energy in a cubic metre of water and wastewater for Kingston was 0.46595 kWh/m^3. The energy associated with each cubic meter represents the energy that is saved when combined water and wastewater conservation efforts are realised. Separated out, the energy embedded in a cubic metre of treated water is 0.234 kWh m^3. Using these numbers, Utilities Kingston is able to quantify energy savings from water and wastewater conservation measures.

7.1.3 Reduced Thermostat Setpoints at Remotely Monitored Facilities

In the last CDM plan it was noted that some of our remotely monitored facilities temperature settings were set to provide ideal temperatures for manned facilities. These buildings are generally small and electrically heated. These facilities have since had

their temperature setpoints lowered by a few degrees, enough that equipment can still operate without negative consequences.

7.1.4 Ravensview Wastewater Treatment Plant Upgrade

Ravensview WWTP was built in 1957 as Kingston's first sewage treatment plant. Just shy of 50 years later the facility began a transformation into a world-class institution employing cutting edge treatment technologies. This transformation was completed in 2009. The two primary objectives of this upgrade were to implement secondary treatment while also increasing the capacity by roughly 30%. These objectives were to be accomplished with efficiency and minimal environmental impact as greatest importance. Some of the energy efficiency upgrades installed were:

i. A 394 kW dual fuel Co-generator (co-gen) was implemented into the system in order to generate both heat and up to 33% of the facility's electrical needs.

ii. Thermophilic Digestion (temperature at 55°C instead of 37°C) was chosen primarily to achieve "Class A" bio solids, but a much welcomed by-product is an increase in the amount of biogas generated. This in turn feeds the co-gen and ultimately produces more electrical and thermal energy

iii. And High Speed Neuros Blowers were installed. These units are close to half the size of typical blowers and boast up to 40% less energy consumption. Aeration blowers are typically the largest energy consumers at a treatment plant.

These and many smaller efficiency measures make Ravensview one of Canada's most environmentally friendly sewage treatment facilities.

7.1.5 River Street Sewage Pumping Station

River Street Sewage Pumping Station (SPS) is the largest SPS in Kingston's wastewater service area. It receives inflow from all the other stations in Kingston Central and pumps the wastewater under the Cataraqui River and up a hill before being gravity fed to the Ravensview Wastewater Treatment Plant. In 2012, the facility underwent a complete renovation. Improvements were made to the building envelope by: adding three inches of polystyrene insulation, and replacing windows and doors. Ventilation fans and lighting systems were upgraded, and variable frequency drives (VFD) were installed on the four main pumps.

7.1.6 James Street Water Booster Station Upgrade

This booster station conveys treated water to the system east of the Cataraqui River and is located in the Barriefield Heritage Conservation District. The upgrades were needed to replace aging infrastructure and ensure adequate supply of water for the East Water System. The upgraded facility now accommodates 20-year population growth projections. Included in the work were a building extension to house new pumps, electrical equipment and other associated infrastructure.

7.2 Ongoing Measures

7.2.1 Energy Analyst

Utilities Kingston's Water and Wastewater (W&WW) Treatment Operations hired an Energy Analyst (EA) in May of 2019. Funded through the SaveOnEnergy Embedded Energy Manager program, part of the EA's role will be to: help identify energy saving opportunities, secure financial incentives when available, create an Energy Management Plan, and to help Utilities Kingston's overall goal to reduce the energy consumption, cost, and environmental impact of their water and wastewater treatment operations.

7.2.2 Cataraqui Bay Wastewater Treatment Plant Upgrade

Cataraqui Bay (Cat. Bat) WWTP was built in 1962. In 2002, the plant went through a major upgrade, and is currently undergoing its second upgrade. The work will see the plant rated treatment capacity increase from 38,800 m^3 per day to 55,000 m^3 per day to meet projected population growth. The resulting treatment processes will be similar to those at Ravensview WWTP. Some of the energy efficient upgrades being installed are:

i. New natural gas boilers and new dual fuel boilers that use both natural gas and digester gas.

ii. Energy efficient lighting in the new addition.

7.2.3 Active Leak Detection (ALD)

Utilities Kingston maintains 560 kilometres of municipally-owned water mains. Over time, cracks can form, allowing water to leak out of the pipe. Cracks can develop for a number of reasons, e.g. corrosion, the freeze-thaw cycle, and material defects. Unreported breaks in the water system can persist in the system for lengthy period of times, wasting energy and having a negative financial impact.

Active Leak Detection (ALD) is used to seek out leaks that haven't surfaced. The leaks are detected using engineering studies, surveys, camera inspections and acoustic analyses with geophones, data loggers and correlaters. Active Leak Detection was started in 2012 in order to reduce non-revenue water losses in the system.

Utilities Kingston has calculated the amount of energy embedded in each m^3 of water it treats and pumps to customers within both Kingston Hydro and Hydro One's territories. These energy values have been used to link water conservation and the reduction of system leaks directly to energy savings.

In 2018, ALD resulted in energy savings of 264,156 kWh, and avoided cost of energy savings of approximately $42,670[*]. An incentive of $26,416 was provided to Utilities Kingston through the Save On Energy Retrofit program offered by the Ontario government through the Independent Electricity System Operator (IESO).

7.2.3.1 Rezatec Pilot Project

In 2018, Utilities Kingston partnered with Rezatec, a provider of geospatial data analytics, to run a three month pilot project which aims to optimize the Utilities Kingston's leak detection activities across a section of the municipal water system. Rezatec technology combines artificial intelligence and satellite data with historic leak event data to identify sections of the water network at higher risk of failure. This technology has the potential to reduce the time and cost of detecting leaks by more than 60%.

7.2.4 Extraneous Flows

Extraneous flow, also known as Inflow and Infiltration (I&I), is when storm water or groundwater enters the sanitary system. The extraneous flows enter the sewer through cracks, unsealed joints or other defects, cross connections, private-side sources including downspouts and foundation drainage. Reducing the amount of I&I into the sanitary system reduces the amount of energy required to pump and treat wastewater.

7.2.4.1 Separation of Combined Sewers

There are three types of sewers in the City of Kingston:

i. Sanitary Sewer System – collects sewage, e.g. from bathrooms, sinks, kitchens etc. and carries it to a wastewater treatment plant (WWTP).

[*] Calculated using a blended cost of energy of ~16.15¢/kWh.

ii. Storm Sewer System – collects rain runoff (and other runoff throughout the city, e.g. roadway pollutants, fertilizers, pesticides etc.) and carries it to the nearest body of water, e.g. Lake Ontario.

iii. Combined Sewers – part of the Sanitary Sewer System, collects both sewage and runoff in a single pipe and carries it to the WWTP.

Combined sewers are no longer constructed in the City of Kingston and the City has established a long term goal of separating Kingston's existing combined sewers. At the end of 2018 there are 18,528.3m of combined sewer pipes in the system. The inflow of rainwater into Kingston's sanitary system during heavy downpour forces the pumping and treatment facilities to increase their electrical demand in order to address these high volume incidents.

7.2.4.2 Preventative Plumbing Program

The preventative plumbing program (PPP) provides homeowners with financial assistance for work on their home that will protect against flooding. Part of the program helps to finance the disconnection of sump pumps and foundation drains that are connected to the sanitary system. These systems are meant to direct groundwater and rainwater away from the house but are not, by law, allowed to be connected to the sanitary system. Helping to finance our customers in this way encourages compliance with City of Kingston By-Law No. 2008-192, but also reduces the total sewage volume in the system.

Between 2012 and 2018, the program was able to help finance the disconnection of 142 sump pumps from Utility Kingston's sanitary system. It is estimated that disconnections may have resulted in removing 146,000 m^3 of water the sanitary sewer system, helping to reduce the potential of backups and eliminate unnecessary energy consumption as those flow volumes are no longer being pumped or treated in the wastewater system.

7.2.4.3 Portsmouth Sewershed Inflow and Infiltration Reduction Project

In 2010, it was noted that the Portsmouth Pumping Station located in Aberdeen Park, was subject to abnormally high levels of inflow and infiltration (I&I) from groundwater and other otherwise clean water sources. These excessive extraneous flows results in additional flow in to the sanitary sewer that must be collected, conveyed, pumped and treated. It also contributes to other problems including surcharging sewers, basement sewage backups and increased bypassing of sewage to the environment during heavy rainfalls or rapid snowmelts.

This project involves identifying the sources of I&I, prioritizing, and completing the necessary repairs to the sewer to reduce the amount and severity of the leaks.

7.2.5 Commercial Water Incentive Programs

In 2016, Utilities Kingston water incentive programs funded $97,480 worth of water projects resulting in 22,797 m^3 of treated water and sewage saved annually.

7.2.5.1 Commercial and Multi-Residential Toilet Replacement Program

In many commercial and multi-residential properties, landlords and tenants face structural barriers that make investments in water efficiency less cost effective. To help overcome these barriers, Utilities Kingston offers incentives to help with the cost of replacing toilets that use 13 litres per flush (lpf) or more with toilets that use 6 lpf or less.

7.2.5.2 Water Efficiency Retrofit Incentive Program (WERIP)

Utilities Kingston Water Efficiency Retrofit Incentive Program helps commercial customers improve their water efficiency, reducing water demand and removing load from Utilities Kingston's wastewater systems. Projects that save more than 80m^3 per year are eligible for the program. The project provides a financial incentive of $5 per m^3 of annual, permanent combined water and sewer savings, up to a cap of 20% of eligible project costs.

7.2.6 Behavioural Measures in Our Community

Since 2010, Utilities Kingston have been offering water conservation programs aimed at educating members of our community with regards to water conservation.

7.2.6.1 Water Buggies

Utilities Kingston water buggies are mobile water distribution systems that operate at local events during the summer months. Each unit has eight water fountains and eight bottle fill stations. Holding up to 1400L of water, each buggy could potentially divert 2,800 plastic bottles from the solid waste stream. The buggies are powered by solar panels, which provide electricity to the water pump and on-board water treatment system.

7.2.6.2 Rain Barrel Program

Each spring, Utilities Kingston offers rain barrels for sale to customers who receive municipal water and wastewater services in the City of Kingston. Rain barrels help protect the environment by reducing the amount of treated lake water used for watering

plants and lawns and diverting rainwater from the sewer system during storms. Rain barrels help conserve energy by reducing the amount of water and wastewater that needs to be treated and pumped. Since 2006, the program has sold over 10,000 rain barrels.

7.2.6.3 Water Conservation Garden

In 2010, Utilities Kingston opened its "Water Conservation Demonstration Garden". Formerly a drainage ditch, this space has been turned into an award winning, hands-on water conservation education facility. The garden incorporates drought tolerant and native plant species suited to a variety of micro-environments, and showcases the use of bioswales*, rain barrels and water-smart landscaping. During the summer months the garden is used to host conservation workshops, guided tours and educational activities for children.

7.2.6.4 Everything Drainage Workshop

Every summer Utilities Kingston invites homeowners to participate in a free workshop to help them manage excess water on their property, prevent basement flooding and comply with the City of Kingston's Sewer Use Bylaw. Learning how storm water and rainfall should be handled at their property can help our customer's conserve water and reduce the risk of water damage to theirs and surrounding properties.

* Landscaping designed to remove pollution and debris from surface water runoff.

7.3 Future Measures

7.3.1 Energy Management Plan

As part of their role, the Energy Analyst will be responsible for identifying and reporting potential opportunities for energy conservation. An Energy Management Plan (EMP) will prepared by November 2019, and will help guide Utilities Kingston W&WW Treatment Operations as they work towards their reduction targets.

The EMP will provide an overall view of possible measures that will reduce energy use. Budgets, resources, and timelines will be established, and the plan will include tracking and monitoring processes for all energy sources including electricity, natural gas, diesel, cogeneration, renewable energies, or other fuels to help create a complete understanding of energy conservation measures (ECM) and their effects.

7.3.2 Establishing Baselines

Energy baselines create benchmarks for comparing energy performance of our facilities year to year. As part of their role, the Energy Analyst (EA) will be developing an Energy Baseline Model (EBM) of each facility, starting with the largest energy consumers. An EBM will help the EA quantify energy and cost savings of energy conservation measures.

Utilities Kingston has been measuring their energy use and energy intensity at most of their facilities since 2011. By establishing 2011 baselines at each facility the Energy Analyst will be able to determine what effects, if any, previous measures have had on energy consumption and demand. By establishing 2018 baselines, the Energy Analyst will be able to determine what effects, if any, future measures have had on energy consumption and demand.

7.3.3 Days Road Sewage Pumping Station

Age and condition of this facility as well as the anticipated increase in flow from the upstream sewer shed has created the need for an upgrade of the Days Road Sewage Pumping Station (SPS). A Professional Engineering Services firm has been asked to provide an environmental assessment as well as oversee the design and construction of the upgrade. The firm has already determined the electrical baseline of the SPS which will be used to help:

i. Determine potential energy savings of the upgrade,

ii. Identify any energy efficiency incentives that may be available.

7.3.4 Third Ave Water Booster Station Upgrade

Age and condition of this facility has created the need for an upgrade at the Third Ave Water Booster Station. A Request for Proposal (RFP) for professional engineering services for the upgrade was issued in May of 2019. The objectives of the RFP ask for:

i. An energy baseline report of the facility using 2014-2018 data.

ii. Equipment to be selected with energy efficiency in mind.

iii. Expected energy savings pre and post construction.

7.3.5 Organizational Measures

7.3.5.1 Operations and Planning

All future operational and planning considerations will be analysed by Utilities Kingston's Energy Analyst (EA), who will help to determine potential energy and greenhouse gas impacts of each change with an ultimate goal of incorporating energy efficiency into systems and processes. When possible, life cycle costing will be incorporated into purchasing decisions related to building systems and treatment operations. The EA will rely on the W&WW treatment team to help determine operational impacts that an energy conservation measure (ECM) may have. In some cases it may be found that a proposed ECM would have negative impacts on treatment, in which case it would be shelved.

7.3.5.2 Green Team

A Green Team will be established in 2019 with representation from both water treatment operations and wastewater treatment operations. The Green Team will meet monthly to review all new and existing energy conservation and demand management initiatives.

7.3.5.3 Communication Plan

Although the Energy Analyst is responsible in ensuring that W&WWTO are operating efficiently, all staff should be familiar with conservation and demand management (CDM) and their benefits. To increase CDM knowledge among staff a communication plan will be put in place in which Energy Conservation Measures (ECMs) are reported and will include their energy, cost, and environmental impacts.

7.3.6 Behavioural Measures in Our Facilities

7.3.6.1 Building Automation Systems (BAS)

Where BAS systems exist, they will be reviewed bi-monthly to ensure HVAC system schedules and lighting schedules are optimized. Where BAS systems do not exist a temperature set point policy will be put in place.

7.3.6.2 Window Shades

Where window shades exist, encourage staff to shut them in the summer to keep the heat out and raise them in the winter to let the heat in. Where window shades do not exist, consider having them installed.

7.3.7 Future Measure Considerations

At the time of this writing some Energy Conservation Measures (ECM) have been identified and will be fleshed out in the Energy Management Plan (EMP). A high level overview of identified measures can be found in Appendix C.

8 Renewable Energy

8.1 Cogeneration

Cogeneration refers to technology where electricity and heat are created and used jointly.

8.1.1 Ravensview Cogeneration

The methane gas produced by digestion during solids processing at Ravensview Wastewater Treatment Plant is fed into an internal combustion engine running a generator. The generator produces 370 kW of electrical power, which serves approximately 25% of the plant's power consumption. The methane gas is also used in the boiler system for heating the building and digesters.

8.2 Solar Air Heat

Solar air heating refers to technology where the Sun's energy is captured and used to heat air.

8.2.1 Point Pleasant Solar Wall

The Point Pleasant Water Treatment Plant (WTP) has Transpired Solar Collectors (TSC) on the south side of the building. Point Pleasant's TSC's are made of black perforated steel siding which absorbs the sun's energy and heats the surrounding air, which can then be drawn into the building via a fan unit.

9 List of Initialisms

Initialism	Description
BAS	Building Automation System
BPS	Broader Public Sector
BS	Booster Station
CDM	Energy Conservation and Demand Management
CSO	Combined Sewer Overflow
EA	Energy Analyst
EBM	Energy Baseline Model
ECM	Energy Conservation Measure
GHG	Greenhouse Gases
Lpf	Litres per flush
O.Reg.	Ontario Regulation
PPP	Preventative Plumbing Program
SPS	Sewage Pumping Station
SS	Soft Start
TBD	To Be Determined
TSC	Transpired Solar Collector
VFD	Variable Frequency Drive
VSD	Variable Speed Drive
W&WW	Water and Wastewater
WERIP	Water Efficiency Retrofit Incentive Program
WR	Water Reservior
WT	Water Tower
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

10 List of Assumptions:

1.0 m3 of natural gas = 10.627777 ekWh

GHG per 1.0 kWh electricity = 0.035548 kg

GHG per m3 natural gas = 1.890627 kg

Appendix A

Energy Consumption and Greenhouse Gas Emissions for Water Treatment Operations, 2018

Facility	Electricity (kWh)	Natural Gas (m3)	Annual GHG
Cana WTP	42,972		1,528
King St. WTP	5,043,185	80,065	330,648
Point Pleasant WTP	2,960,343	6,842	193,795
O'Connor Dr. WR	806,741	9,552	46,738
Progress Ave. WR	205,200		7,294
Third Avenue WR	188,530		6,702
Creekford WT	72,931		2,593
Innovation Dr. WT	51,313		1,824
Milton WT	4,056		144
O'Connor WT	11,400		405
Tower St. WT	10,649		379
Collins Bay Rd. BS	8,328		296
James St. BS	335,146		11,914
Old Colony Rd. BS	5,193		185
Purdy Court BS	3,008		107
Hwy 15 Valve Chamber	11,740		417
Hwy 2 Valve Chamber	9,183		326
Ravensview Fill Station	2,320	176,199	333,209
Totals	**9,772,235**	**312,658**	**938,504**

Appendix B

Energy Consumption and Greenhouse Gas Emissions for Wastewater Treatment Operations, 2018

Facility	Electricity (kWh)	Natural Gas (m3)	Annual GHG
CANA WWTP	100,268		3,564
Cataraqui Bay WWTP	3,731,573	98,892	319,619
Ravensview WWTP	4,361,871	304,694	731,119
Barrett Ct. SPS	106,546		3,787
Bath Collins Bay Rd. SPS	13,170		468
Bath Lower Dr. SPS	1,326		47
Bath Rd. SPS	40,784	408	2,221
Collingwood CSO	27,195		967
Collins Bay SPS	9,360		333
Coverdale Dr. SPS	17,059		
Crerar Blvd. SPS	55,278	35	2,031
Dalton Ave SPS (266)	751,210		26,704
Dalton Ave SPS (266-2)		3,859	7,295
Days Rd. SPS	686,160		24,392
Emma Martin CSO	16,308		580
Greenview Dr. SPS	42,464	258	1,997
Hillview Rd. SPS	165,000		,865
HWY 15 SPS	,292		828
James St. SPS	71,977		2,559
John Counter SPS	2,329		438
Kenwoods Circle SPS	11,057		393
King - Elevator Bay SPS	18,593		661
King - Lake Ontario Park SPS	1,912		68
King - Portsmouth SPS	176,779	7,653	20,753
King St. SPS and CSO	405,162	16,071	44,786
Lakeshore Blvd. SPS	2,504		1,866
Morton St. SPS	12,377		440
Notch Hill Rd. SPS	156		6
Palace Rd. SPS	11,760		418
Rankin St. SPS	7,297		259
River St. SPS (8)		80,594	152,373
River St. SPS (8-100)	3,267,147	7	6,154
Schooner Dr. SPS	11,200		398
Smuggler's Cove SPS	1,703		61
Westbrook Rd. SPS	14,714		523
Yonge St. SPS	421		15
Totals	**14,225,954**	**512,471**	**1,474,595**

Appendix C

Future Measure Considerations for Water and Wastewater Treatment Operations

Potential Energy Conservation Measure	Opportunity	ECM	electricity (kWh) reductions	natural gas (m^3) reductions	GHG (kg) reductions	Cost ($) savings
Lighting Upgrades	Inefficient, no sensors	LED, occupany sensors	TBD	TBD	TBD	TBD
Electric Air Handling Units	Manual Control	Automatic Control	TBD	TBD	TBD	TBD
High Lift Pumps at King St.	Old, inefficient	Efficient, VFD, soft start	TBD	TBD	TBD	TBD
Portsmouth Sewage Station Redirect	Long run to Ravensview	Shorter run to Cat. Bay	TBD	TBD	TBD	TBD
Building Envelope Improvements	Loose envelope	Tighten envelope	TBD	TBD	TBD	TBD
Demand Response	On-site generation	Shave peak demand	TBD	TBD	TBD	TBD
Dissolved Water Overshoot	Sensors	TBD	TBD	TBD	TBD	TBD
Pump Upgrades	Old, inefficient	Efficient, VSD, Soft start	TBD	TBD	TBD	TBD
Blower Upgrades	Old, inefficient	Turbo blowers	TBD	TBD	TBD	TBD
Motor Upgrades	Old, inefficient	Efficient, VSD, Soft start	TBD	TBD	TBD	TBD
Sub-Metering	Little sub-metering	More useful data	TBD	TBD	TBD	TBD
		Total	TBD	TBD	TBD	TBD