



**Utilities Kingston**  
**Information Report to the Environment, Infrastructure and**  
**Transportation Policies Committee**  
**Report Number EITP-19-011**

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**To:** Chair and Members of the Environment, Infrastructure and  
Transportation Policies Committee

**From:** Jim Keech, President and CEO, Utilities Kingston

**Resource Staff:** Allen Lucas, Manager, Research and Projects

**Date of Meeting:** October 8, 2019

**Subject:** Kingston Biosolids and Biogas Master Plan

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**Executive Summary:**

In 2015, Utilities Kingston undertook work to examine the feasibility of optimizing biogas production as part of the planned upgrade to the existing solids treatment process at the Cataraqui Bay WWTP. Using a holistic approach for both Cataraqui Bay and Ravensview Wastewater Treatment Plants, a range of options were examined to potentially increase biogas production and also decrease the residual biosolids. The increased biogas production was identified as a benefit in reducing greenhouse gas (GHG) emissions which may qualify for funding through the then Cap and Trade regime being embarked upon by Ontario. This report summarizes the findings of the Master Plan work which started in 2017 for biosolids and biogas, and the next steps.

**Recommendation:**

The report is for information at this time.

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**Authorizing Signatures:**

ORIGINAL SIGNED BY PRESIDENT & CEO, UTILITIES KINGSTON

**Jim Keech, President and CEO,  
Utilities Kingston**

ORIGINAL SIGNED BY CHIEF ADMINISTRATIVE OFFICER

**Lanie Hurdle, Interim Chief  
Administrative Officer**

**Consultation with the following Members of the Corporate Management Team:**

Peter Huigenbos, Acting Commissioner, Community Services

Desirée Kennedy, Chief Financial Officer & City Treasurer Not required

Sheila Kidd, Commissioner, Transportation & Public Works

Deanne Roberge, Acting Commissioner, Corporate Services Not required

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### Options/Discussion:

Utilities Kingston manages the water and wastewater infrastructure for the City of Kingston. Through long range planning and identification of operational efficiencies, customers are assured of safe, reliable services at a fair price. A holistic approach to managing the water supply and treatment ensures protection of this valuable resource minimizes greenhouse gas emissions and protects the natural environment.

The main processes used, at the Ravensview and Cataraqui Bay Wastewater Treatment Plants (WWTP), to clean waste water prior to discharge back to the environment are:

- Screening and grit removal to take out untreatable materials;
- Settling of organic solid materials;
- Biological treatment to remove dissolved carbon and nutrients;
- Disinfection and discharge.

The settled organic solid material and material from the biological treatment process are further stabilized in anaerobic digesters to reduce odour, pathogens and mass. Anaerobic digestion (AD) is a biochemical process where microorganisms convert organic compounds into methane and carbon dioxide. The end products of the AD process are the methane and carbon dioxide gases and a nutrient and carbon rich solid soil amendment that can be applied to farm fields as fertilizer. The methane produced by the process is a potent greenhouse gas (GHG) which can either be flared to reduce its GHG potential or collected and further refined for use as a renewable natural gas or biogas fuel.

During planning and design of current upgrades for Cataraqui Bay WWTP, construction logistics and budget constraints resulted in upgrades to the solids treatment phase being deferred.

In 2015, Utilities Kingston undertook work to examine the feasibility of optimizing biogas production as part of the planned upgrade to the existing solids treatment process at the Cataraqui Bay WWTP. Using a holistic approach for both plants a range of options were examined to potentially increase biogas production and also decrease the residual biosolids. The increased biogas production was identified as a benefit in reducing greenhouse gas (GHG) emissions which may qualify for funding through the then Cap and Trade regime being embarked upon by Ontario.

In order to comply with the Environmental Assessment Act, Utilities Kingston determined the best approach would be to undertake a Master Plan for biosolids and biogas. Through a qualification based request for proposal issued in 2017, TetraTech Canada Inc. was retained to undertake the project.

Exhibit 1 summarizes the work completed to date to assess potential sites at the WWTPs and the different technology options. During the detailed assessment, consideration was given to the inclusion of other organic material, such as the source separated organics (SSO) from the City

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of Kingston's curbside Green Bin program to further increase gas production and address Ontario's direction to reduce or eliminate organics sent to landfill.

Based on the work funded by the City's \$60,000 contribution to the Kingston Biosolids and Biogas Master Plan, the most feasible and beneficial scenario for renewable natural gas production at this time would be an upgrade to the bio-solids process at Cataraqui Bay WWTP that would include the addition of other organic material, such as the source separated organics from the City's residential Green Bin program and potentially other organic materials collected from other sources.

The final phase of the Master Plan project will include additional assessment of renewable natural gas demand scenarios at east and west locations and a public consultation where Council, staff and the public will be invited to participate by providing comments on the proposed plan which includes the renewable natural gas production scenario. Once completed, the Master Plan will provide a biosolids management approach that includes a preferred option for renewable natural gas production for Council's consideration that support Kingston's Climate Emergency Declaration and a number of Council priorities:

- Demonstrate leadership on climate action;
- Strengthen economic development opportunities; and
- Foster healthy citizens and vibrant spaces.

The Canadian Clean Fuel Standard, currently under development by the federal government, sets targets to reduce the carbon intensity of fuels, which is creating a market for clean biogas or renewable natural gas. As recommended in TetraTech's Detailed Assessment Report, Utilities Kingston proposes to undertake early discussions with potential purchasers of the biogas, including determining the benefit to the City of Kingston's natural gas system.

**Existing Policy/By-Law:**

Not applicable

**Notice Provisions:**

Not applicable

**Accessibility Considerations:**

Not applicable

**Financial Considerations:**

Not applicable

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**Contacts:**

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**Other City of Kingston Staff Consulted:**

Heather Roberts, Director, Solid Waste Services

Paul MacLatchy, Environment Director

**Exhibits Attached:**

Exhibit A - Kingston Biosolids and Biogas Master Plan

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# Kingston Biosolids & Biogas Master Plan

## UPDATE 2019-10

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### **Background**

In 2015, in response to then Ontario government actions with respect to a Cap and Trade program for greenhouse gas emission reductions, Utilities Kingston (UK) undertook initial investigations to assess opportunities which may benefit from the programs under development.

One of the activities took an holistic approach to wastewater treatment plant solids management. Improving the solids treatment phase could increase gas production at the plants, creating a beneficial biogas which could be used or sold, and reduce the biosolids currently land applied as a beneficial soil amendment. The combined benefits would be to generate a carbon neutral fuel along with a direct reduction in anthropogenic greenhouse gas emissions from less biosolids to handle, transport and field apply.

Following initial investigations by staff, a decision was made to work within the existing provincial Environmental Assessment framework by undertaking a Master Plan. To complete the Master Plan, a Request For Proposal for professional engineering services was issued in early 2017 and a contract subsequently awarded to TetraTech Canada Inc. (TetraTech). The work includes developing a plan to guide future works specific to biosolids processing with options for the biogas produced at the wastewater treatment plants (WWTP).

### **Operation Assessment**

The study is comprised of three phases.

- Phase 1 was completion of a preliminary assessment of alternative technologies and processes to identify a short list for further investigation.
- Phase 2 entailed the completion of a detailed assessment of the short-listed technologies and processes, including a financial feasibility evaluation of biogas utilization.
- Phase 3, to be undertaken late 2019, will entail completion of the Master Plan in compliance with the Municipal Engineers Association Class Environmental Assessment. The steps for the Master Plan include public notice, public consultation (meeting), receive comments and prepare the final plan.

The following details TetraTech’s activities for Phase1 and Phase 2 in order to develop a list of potential technologies which could be used. Sites evaluated included Ravensview WWTP, Cataraqui Bay WWTP and a potential generic new location which for cost assessment was assumed to be located adjacent to the municipal snow storage site on Perth Road North of Highway 401. This site was selected due to its location adjacent to a main natural gas feed to the city, proximity to major transportation and the previous use as a waste transfer site during dredging of the Cataraqui River in the early 2000’s.

Changes to provincial regulatory regime; including the cancellation of Ontario’s Cap and Trade and discussion on banning organics from landfill, as well as the Canadian Clean Fuel Standard (pending) warranted a more detailed assessment for inclusion of additional organics to increase gas production. The assessment was generic and considered that organics could come from a number of areas, potentially Kingston’s current or expanded municipal source separated organics (SSO) program.

## Summary

The scope of this study and assessment continues to evolve. The City of Kingston’s climate emergency declaration, along with federal and provincial governments’ desires to reduce greenhouse gas generation and develop a greater amount of renewable natural gas (RNG) has shaped the current focus.

Phase 1, the Preliminary Assessment provided a comparative evaluation of relative “advantages” and “disadvantages” of technologies and processes associated with the various treatment stages with the co-digestion of biosolids and SSO. This considered alternatives in the following categories:

- *Sludge pre-treatment*: thickening, hydrolysis, conditioning and stabilization.
- *Solids stabilization*: digestion, co-digestion, post-treatment/composting, chemical stabilization, and thermal stabilization.
- *Biogas utilization*: on-site combined heat and power, boilers, vehicle fuel, and local or regional natural gas pipeline injection.
- *Dewatering*: centrifuge, belt-filter press, drying beds, rotary vacuum filters, and enhanced solar.
- *Side-stream treatment*: phosphorus recovery and ammonia reduction.
- *Biosolids management*: land application, landfill, and utilization as construction material.

Three sites noted were reviewed for available space and treatment capacity for inclusion of these various options in order to fully screen each option being considered.

The scope of the work undertaken for Phase 2, the Detailed Assessment, included:

- Evaluation of existing wastewater treatment facility data including plant capacity, population served, annual influent and treated effluent, natural gas consumption, biogas generated, and electricity consumption.
- Scenario development of options for improving biogas generation and quality, while decreasing biosolids.
- Management requirements for Utilities Kingston.
- Overview of potential end-use options for biogas and biosolids.
- Business case development and cost benefit analysis for each developed scenario.
- Review of funding opportunities available.

The outcome of the Detailed Assessment provides a framework for Phase 3, a Master Plan. Key factors for success of the next stage include determining viable end-use options for biogas and biosolids based on current market and incentive programs, as well as cost benefit analysis for capital and operating expenditures, and conceptual phasing for any operational changes.

### **Preferred Option**

From the current evaluation the most feasible and beneficial scenario at this time is to upgrade the solids process at Cataraqui Bay WWTP.

This would include:

- transfer raw sludge from Ravensview WWTP to Cataraqui Bay WWTP,
- combine and pretreat the sludge through a process called biological hydrolysis,
- include additional organics, such as source separated organics program from the City of Kingston Green Bin program,
- upgrade anaerobic digesters (AD),
- generated biogas is to be cleaned of impurities and injected into the adjacent natural gas pipeline on Front Road as renewable natural gas (RNG), and
- continue land application of dewatered biosolids as a soil amendment on agricultural land.

Biological Hydrolysis (BH) takes the first three stages of the digestion process, Hydrolysis, Acidogenesis and Acetogenesis,<sup>1</sup> into separate tanks before the final stage, Methanogenesis, within the digester. This method is a more effective preparation of sludge for digestion, resulting in a decrease in biosolids for management and an increase in biogas produced. Due to a number of factors renewable natural gas is increasing in value. Therefore, the current analysis identified cleaning impurities from the biogas generated and injection into the adjacent natural gas pipeline creates the greatest financial benefit.

Inclusion of other organics, such as Green Bin material collected currently from Kingston residential properties provides the potential to increase renewable natural gas production. Using the current 4000 tonne per year of SSO collected in Kingston, gas production is calculated to increase from 3881 m<sup>3</sup>/day to 5969 m<sup>3</sup>/day. The Net Present Value (NPV) for this scenario ranges from -\$12.5 million to +\$1.9 million, primarily due to the value of the renewable natural gas, and a capital cost of \$21.9 million.

In reviewing with the City's Director of Solid Waste Services, increased SSO tonnage may be possible from the greater community, especially given other initiatives being driven by the Province to eliminate organics from landfills. The Province is expected to continue pursuing landfill bans in the future. Regulatory changes will require the diversion and management of organics from landfill to other processing technologies for recovery. This will create a need and greater market for organics from the Institutional, Commercial and Industrial (ICI) sectors which may no longer be able to dispose of organics at landfills. As shown in the next section, increased organic input will result in greater gas production, resulting in more favourable NPV, for the same capital cost.

It should be noted that currently the Province of Ontario does not recognize the production of RNG from SSO as a form of diversion from landfill.

Additional work is required to further define the preferred location due to potential land requirements, adjacent site impacts, markets/end-use of RNG and an injection point for pipeline connection.

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<sup>1</sup> Hydrolysis: A chemical reaction where particulates are solubilized and large polymers converted into simpler monomers; Acidogenesis: A biological reaction where simple monomers are converted into volatile fatty acids; Acetogenesis: A biological reaction where volatile fatty acids are converted into acetic acid, carbon dioxide, and hydrogen; and Methanogenesis: A biological reaction where acetates are converted into methane and carbon dioxide, while hydrogen is consumed.

### Scenario Description and Financial Analysis

The scenarios evaluated are briefly described in the table on the following page.

These were assessed based on capital costs, operating costs, the resulting solids and gas that could be generated. A number of options were considered for biogas utilization, which in all cases the most benefit was to clean the gas for pipeline injection as RNG, which was carried forward as the assumption for all scenarios.

Scenario	Description
Status Quo	Continue to process raw sludge at each plant separately, with operation of Ravensview cogeneration/boilers and Cataraqui Bay boilers, plus flares at both facilities.
Ravensview BH-AD	Transfer dewatered raw sludge from Cataraqui Bay to Ravensview, blend and treat through biological hydrolysis process then existing digesters.
Cataraqui Bay TPAD	Transfer dewatered raw sludge from Ravensview to Cataraqui Bay, blend and treat in new/upgraded thermophillic (high temperature) digesters.
Cataraqui Bay BH-AD	Transfer dewatered raw sludge from Ravensview to Cataraqui Bay, blend and treat through biological hydrolysis process then new/upgraded digesters.
Cataraqui Bay BH-AD include SSO	Transfer dewatered raw sludge from Ravensview to Cataraqui Bay, blend including SSO and treat through biological hydrolysis process then new/upgraded digesters.
New Site BH-AD include SSO	Transfer dewatered raw sludge from Ravensview and Cataraqui Bay to a new site, blend including SSO and treat through biological hydrolysis process, build new digesters.

The most financially viable options include biogas cleaning and pipeline injection to gain the most from clean fuel standards and premiums being paid for RNG as carbon offsets.

The following table is a brief summary of the costs and NPV for the various scenarios, assuming all biogas is cleaned and converted to RNG. The current average day natural gas supplied to the City by Utilities Kingston as measured at the City Gate Regulating Station is 276,700 m<sup>3</sup>/day and is provided as a reference for the amount of RNG that is calculated to be produced under each of the scenarios.

Scenario	Capital Costs +/-15%	Net Present Value Range	Biogas @57% CH <sub>4</sub> m <sup>3</sup> /d	RNG as % of City Avg. Day NG
Status Quo	\$14.6 million	-\$13.8 million to -\$2.9 million	3881	0.79%
Ravensview BH-AD	\$14.0 million	-\$9.4 million to +\$1.8 million	4408	0.91%
Cataraqui Bay TPAD	\$12.9 million	-\$9.5 million to \$0.0 million	4071	0.84%
Cataraqui Bay BH-AD	\$12.9 million	-\$10.8 million to \$0.0 million	4408	0.91%
Cataraqui Bay BH-AD includes 4000 tonne SSO	\$21.9 million	-\$12.5 million to +\$1.9 million	5969	1.23%
Cataraqui Bay BH-AD includes 8000 tonne SSO	\$21.9 million	-\$2.5 million to +\$14.4 million	7530	1.55%
Cataraqui Bay BH-AD includes 10000 tonne SSO	\$21.9 million	\$2.4 million to +\$20.7 million	8311	1.71%
Cataraqui Bay BH-AD includes 12000 tonne SSO	\$21.9 million	\$7.4 million to +\$26.9 million	9091	1.87%
New Site BH-AD includes 4000 tonne SSO	\$27.0 million Note 1	-\$18.5 million to -\$2.7 million	5969	1.23%

Notes:

1. Does not include land costs

**Next Steps**

Following this information update, Utilities Kingston will begin completion of the third phase of the work and develop a Master Plan in accordance with Ontario's Environmental Assessment Act and Regulations. This will include public consultation to

seek input on the options and preferred alternative. The Master Plan will be developed to provide a phased approach and flexibility should regulatory or other factors provide an opportunity to change.

A public meeting is proposed for November to provide the information and request comments. With comments received, a file report will be prepared. This will enable the Notice of Completion to be published which starts the 30 day minimum public comment period. Subject to public comments and no requests for further study, the Master Plan should be completed by early January 2020.

Once the first public consultation has been completed, the Master Plan will enable projects to be streamlined through the remainder of the Environmental Assessment process. Subject to direction from Council, the project could proceed to finalize the Environmental Assessment and proceed to preliminary design.

The financial feasibility of the alternatives for the project are sensitive to fluctuations in the market value of RNG. Therefore changes in policy direction by the government which affects the prices may have a direct impact on the viability of future work. Timelines for the project enable a further detailed evaluation to be completed which could expedite or delay the next phases.

As recommended in the TetraTech report, work will begin in seeking a market for the potential sale of RNG with definitive pricing. Exploring other options for the gas use, such as the value of potential credits to the City of Kingston gas distribution system or using the RNG at a fair market price for City facilities will improve the reliability of calculated Net Present Values. This will also include exploring an alternate gas line connection point identified by TetraTech near Ravensview.