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TO:	CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON MONDAY, SEPTEMBER 9, 2013
FROM:	JOHN LUCAS, P.ENG. DIRECTOR – WATER AND WASTEWATER
SUBJECT:	BIOSOLIDS DISPOSAL ASSESSMENT

RECOMMENDATION

That, on the recommendation of the Director – Water and Wastewater, with respect to biosolids management:

a) the following report **BE RECEIVED** and reported to the Municipal Council for its information; and,
b) the Civic Administration **BE DIRECTED** to report back on a strategy to implement an Organic Rankine Cycle engine that to generate electricity from waste heat at the Greenway Wastewater Treatment Plant.

PREVIOUS REPORTS PERTINENT TO THIS MATTER

CWC Report of 2013-02-25, Item 3, Timeline for major Environmental and Engineering Reports

CWC Report of 2012-05-14, Item 14, Renewable Energy Production from the Greenway Fluidized Bed Incinerator

BACKGROUND

Purpose

A staff proposal to review London's Wastewater Biosolids Management program was approved in April, 2013 in light of emerging technologies and energy recovery. The goal is to ensure that the most cost efficient and effective processes are in place and that beneficial uses are explored.

London's existing residuals management method involves trucking biosolids to a central location for dewatering and incineration followed by ash disposal. There are other approaches to managing residuals from wastewater treatment that involve different processes and infrastructure. Alternative approaches may also have energy recovery or beneficial end use products. For the purpose of this report, London's current biosolids disposal method has been benchmarked against other approaches to guide future optimization and energy recovery projects.

Introduction

This report summarizes the existing London residuals processing methods as a base case for comparison to other options. Recent efficiency measures and future opportunities are also described.

Other technologies are described and evaluated in a Technical Memorandum "London Biosolids Management Options Study" prepared by RV Anderson (July, 2013). The RVA report establishes a benchmark for London's current biosolids processing methods in comparison to common and proven alternatives. The following areas of comparison include economic environmental and social elements. This report also highlights opportunities to improve upon the existing processing system.

London's Existing Situation

In 2012, the City of London treated 67,770 megalitres (15 billion gallons) of wastewater at its six Wastewater Treatment plants. Approximately 17,000 dry tonnes (DT) of solids, commonly referred to as biosolids, were removed from the wastewater stream. Biosolids are removed through similar processes at all plants. Our processing results in an increase in the percentage of solids from 0.025% to 26% (a factor of 1000) in the waste stream. A description of these processes and their effect on the volume and quantity of biosolids is provided in Appendix "A".

Two parts of the process, dewatering and incineration, have recently been improved with an investment of $12M. Benefits received from this investment include:

- reduction of operating costs by $700,000 per year,
- improved containment and treatment of odour
- increased capacity (20 years)
- reduced natural gas consumption
- reduced staff complement

From a performance perspective, London has been benchmarked against others from across Canada. Prior to the above noted improvements, London was:

- at the median for cost per megaliter treated;
- at the median for odour complaints per 1000 population;
- at the median for energy consumed (kWh per megaliter) and resulting GHG emissions;
- above the median for cost of purchased energy;
- below the median for cost of sludge processing and disposal

The recent investment will have a dramatic positive impact on cost and energy, and at the same time maintain our excellent benchmark figure for treatment quality; London's effluent criteria is at1/3 of the median for treatment quality (BOD discharged per capita).

A significant amount of waste heat is generated through the incineration process. While a small portion of this is recovered and currently used to heat the plant during the winter months, most has not been recovered for a beneficial end use. There is significant opportunity to further reduce operating costs, reduce GHG emissions and improve public perception about the operation.

Energy Recovery -- Opportunity to Generate Electricity

As reported to the Civic Works Committee in May 2012, City staff, in conjunction with London Hydro, have reviewed the addition of an Organic Rankine Cycle (ORC) engine to the incineration process at Greenway. The ORC engine would scavenge waste heat from the incinerator process to generate up to 600kW of electricity worth approximately $633,000 annually. Once paid for, it will reduce sludge management operating costs by 35%. By comparison, electricity generation potential for alternative sludge processing methods involving digestion / biogas is estimated at $300,000 per year, not including process infrastructure cost.

The ORC is projected to have a 10 year payback on a $7.5 million investment. This assumes low operating cost increases, along with some funding from the saveONenergy Process & Systems initiative, as a "behind-the-meter" load displacement project. Heat recovery projects of this nature are viewed very favourably as a resource is captured that would otherwise be lost. This project would be a show piece for the International Water Centre of Excellence and Southern Ontario Water Consortium research centre currently under construction at Greenway. The ORC project will also be important as part of the Mayor's Sustainable Energy Council that strives to promote sustainable energy projects in London.

The road to a successful project goes through the Technical Safety Standards Authority (TSSA), which is responsible for legislation governing ORC engine operations. In June 2013, representatives from London Hydro and City staff met with the TSSA and learned that any updates to the regulations will not likely be completed within the next two years. To make the ORC engine cost effective, there will need to be a favourable interpretation of, or changes to, operator licensing requirements to reflect those requirements used in other provinces of Canada and countries where ORC engines are currently used. Staff recommends that the project be pursued, notwithstanding these preliminary discussions, to accelerate the project. London Hydro is very supportive of the project and will assist in overcoming any challenges to it.

Biosolids Disposal Systems -- Alternatives

The existing sludge processing methods used in London are not unique; 40 to 50% of the biosolids produced in Ontario are incinerated. There are also other tried and proven alternative methods successfully used in Ontario and Canada. The following processes are compared.

- A baseline scenario (i.e., the existing system)
- Option 1: Anaerobic Digestion-Dewatering-Incineration
- Option 2: Dewatering-Anaerobic Digestion-Land Application
- Option 3: Dewatering-Lystek-Land Application
- Option 4: Dewatering-Sludge Drying-Beneficial Use
- Option 5: N-Viro-Land Application

Each are further described in Appendix “B”.

Alternative Biosolids Management -- Criteria

Alternative disposal methods are evaluated based on three criteria:

Economic:	Total Life Cycle Cost: A net present value for capital (excluding land) and operating (including revenues). Comparison is in dollars per dry tonne of sludge.
Environmental:	Carbon Footprint: An equivalent emission rate based on a computer model used for this purpose. Comparison is in tonnes of CO_2 per year (can be positive or negative)
Social:	Public Perception: Four factors covering nuisance, odours, land use and “doing the right thing” perspectives of the public. Comparison is a points system relative to the base case (existing process)

More detail on each of these is included in Appendix “C”.

Biosolids Disposal Systems – Total Lifecycle Cost Comparison Results

Table 1, below, provides a summary of total costs associated with the Base Case and alternatives. Please note that the base plus ORC engine options were not specifically identified within the consultant’s evaluation. The distinct cost advantage of the Base Case is evident, and is due to the use of existing infrastructure that has capacity for the future. Alternatives require new and different infrastructure, in most cases at a different site because of land constraints at Greenway. Another location adds transportation costs. Alternatives would require a Sewer Rate increase of between 2.6 and 6.2%. The Base Case is already included in the Sewer Rates and forecasts.

Table 1. Present Value Disposal Cost Comparison

Disposal Method	Present Value Cost / Dry Tonne *(see note a.)*	Annual Cost in Millions	Effect on Sewer Rate
Base (Dewatering-Incineration)	$88	$1.6	0.0%
Base plus ORC engine - optimistic	Lower than the Base	Lower than the Base	same
Base plus ORC engine – pessimistic (see note b.)	same	same	same
Alternatives:			
1. Anaerobic Digestion-Dewatering-Incineration	$294	$5.4	4.7%
2. Dewatering-Anaerobic Digestion-Land Application	$289	$5.3	4.6%
3. Dewatering-Lystek-Land Application	$207	$3.8	2.6%
4. Dewatering-Sludge Drying-Beneficial Use	$249	$4.5	3.5%
5. N-Viro-Land Application	$358	$6.5	6.2%

a. Based on 18,250 DT/yr
b. The Base plus ORC engine – optimistic *means no requirement for full time stationary engineer, pessimistic means full time stationary engineers are required by* TSSA

Biosolids Disposal Systems – Carbon Footprint Comparison Results

A standard industry model was used to assess greenhouse gas emissions for the base case and alternatives. The model produces an equivalent CO_2 emission for direct comparison. Table 2, below, provides a summary of emission estimates. Positive figures are GHG created and negative are GHG credit figures. Results favour methods that involve land application of nutrients or generate electricity.

Table 2. CO_2 Emission Comparison

Disposal Method	CO_2 Emissions In tonnes per year
Base Dewatering-Incineration	987
Base plus ORC engine - optimistic	Much lower than the Base
Base plus ORC engine - pessimistic	Much lower than the Base
Alternatives:	
1. Anaerobic Digestion-Dewatering-Incineration	5817
2. Dewatering-Anaerobic Digestion-Land Application	-5074
3. Dewatering-Lystek-Land Application	-4302
4. Dewatering-Sludge Drying-Beneficial Use	6815
5. N-Viro-Land Application	*-10971*

Biosolids Disposal Systems – Public Perception Comparison Results

All steps in the processes were considered under four elements: hauling sludge; odour potential; storage requirements; and, beneficial use (method of stabilization). Methods that involved more hauling than the base case, Class B product storage and higher potential for odours scored worse than the base case. However, beneficial use is weighted high. Table 3, below, provides a summary of four measures.

Table 3. Public Perception Comparison

Disposal Method	Hauling (1000 m3/day)	Potential for Odour Increase	Long Term Storage Required	Beneficial Use based on Class of Product (see note a.)
Base Dewatering-Incineration	*155.8*	*low*	*no*	n/a
Base plus ORC engine - optimistic	same	same	same	Much better than the Base
Base plus ORC engine - pessimistic	same	same	same	Much better than the Base
Alternatives:				
1. Anaerobic Digestion-Dewatering-Incineration	977.9	med	no	*A*
2. Dewatering-Anaerobic Digestion-Land Application	1818.8	high	yes	B
3. Dewatering-Lystek-Land Application	285	low	yes	*A*
4. Dewatering-Sludge Drying-Beneficial Use	253.8	med	yes	*A*
5. N-Viro-Land Application	321.7	med	yes	*A*

a. ***Class A** biosolids must not have detectable levels of fecal coliforms and some other pathogens. Class A biosolids can be applied to all types of land, including lawns and home gardens. **Class B** biosolids are of lower quality since they have detectable levels of pathogens and are worse from a public perception perspective.*

Experience Elsewhere

There are few instances of a municipality converting to an entirely new biosolids management process. There is one recent case derived from unique circumstances; it is summarized below and compared to the London situation.

The City of Greater Sudbury produces approximately 7900 DT per year of biosolids, less than one half of the quantity produced in London. The disposal method has been to haul thickened (3%) biosolids to tailings ponds at a local mine, but in 2008 the City of Greater Sudbury received notice from the Ministry of Environment that this process was no longer acceptable. The City of Greater Sudbury completed the required Environmental Assessment (EA) Study to consider this problem and subsequently selected a preferred option. Sudbury does not have any facilities for biosolids dewatering, so this was included in the scope of the project. Sudbury decided to go with a Design, Build, Finance, Operate and Maintain contract with N-Viro Systems Canada, LP.

The preliminary estimates for the facility were in the range of $30-40 million but the final price came in at $62 million due to technology costs, odour control and the passage of time. The City will finance 75% of the cost less $11 million contributed through the Federal Government Public-Private Partnership (3P) program. The remaining 25% will be financed by the contractor/technology provider and recovered from the City through the $2.8 million annual operating fee over 20 years. The annual requirement for the wastewater budget will be $6.2 million or a present value cost/dry tonne of $785.

The process technology in this case is the same as Alternative 5 - N-Viro-Land Application. The cost of $785/DT is higher than the $358/DT estimated in the consultant's report because the City of Greater Sudbury also has to create dewatering infrastructure. In contrast, all alternatives in the consultant's analysis rely on London's built dewatering systems as part of their process steps.

Employment Opportunities

Alternative sludge management processes would require increased labour costs varying from $0 to $315,000. These systems are not labour intensive and do not create much in the way of new jobs. By comparison, recent improvements in the dewatering process at Greenway has resulted in significant cost savings, partly due to making seven positions redundant. The alternatives assume additional sludge haulage is provided by contract trucking services which may or may not add jobs to the London market, depending on time of year. Other jobs would be considered short term and derived from construction activities.

Synthesis

Taking all of the analyses and considerations made in this report together as a whole suggests the following with respect to London's biosolids management:

- the existing system has capacity to accommodate the needs for the next 20 years and is performing to MOE criteria. There is no capacity or operational problems that would generate a need for change.

- recent investments have reduced operating costs, reduced GHG emissions and improved odour control.

- the existing operation is extremely cost effective when benchmarked against other municipalities; this is why London can deliver a higher sewage treatment quality on a cost basis.

- alternative solid waste disposal options are burdened with substantial infrastructure cost; new technologies would require from $ 5 to $41 million.

- net present value analysis completed show the existing system has a significantly lower cost, this cost is incorporated into existing operating budgets and capital forecasts; there is opportunity for improvement utilizing the ORC engine.

- conversion to an alternative solid waste technology would add significant cost to the sewer rate structure with increases ranging from 2.6 to 6.2%. Replacing existing capacity is not eligible for Development Charge recovery

- the existing solid waste disposal process is rated in the middle of the alternatives for greenhouse gas comparison; there is opportunity for improvement using the ORC engine.

- in a comparison of public perception factors, the existing process rates in the middle of the alternatives; there is opportunity for improvement

- a successful application of new technology to capture waste heat and generate electricity from it would improve on the cost, GHG emissions and public perception of the existing process; the technology is twice as effective in generating electricity when compared to sludge digestion alternatives.

Report Summary

The potential for energy recovery and newer emerging technologies has prompted an interest to evaluate London's existing biosolids management system. The purpose is to evaluate the most cost effective socially and environmentally acceptable method of disposal of biosolids that may produce energy while saving on overall disposal cost. There is also an interest in determining whether other methods would result in a lower environmental impact and be perceived more favourably.

RV Anderson was hired to work with City staff to prepare a Solids Management Options Study to compare the existing biosolids management system with other proven management options.

It was determined that alternative biosolids management options can best be evaluated in terms of:

- Total Life Cycle Cost
- Carbon Footprint
- Public Perception

An evaluation using the above criteria was conducted on:

- A baseline scenario (i.e., the existing system)
- Option 1: Anaerobic Digestion-Dewatering-Incineration
- Option 2: Dewatering-Anaerobic Digestion-Land Application
- Option 3: Dewatering-Lystek-Land Application
- Option 4: Dewatering-Sludge Drying-Beneficial Use
- Option 5: N-Viro-Land Application

The results of the evaluation have determined:

1. The existing biosolids disposal system is the least expensive with the lowest overall total life cycle cost. All other options are 2 to 4 times more costly per dry tonne. Alternative options are more expensive because of the cost of new infrastructure required, for seasonal storage, and / or increased haulage costs.
2. Implementation of an alternative disposal system would require a sewer rate increase of between 2.6 to 6.2% to cover changes in operating and capital cost. The existing system cost is included within current operating budgets and financial forecasts.
3. The carbon footprint analysis in terms of equivalent CO_2 emissions in tonnes per year ranked the alternatives as Option 5, 2, 3, Base case, 1 ,4.
4. The public perception analysis ranked the options as Option 5, 3 & 4, Base case, 2 and 1.
5. The existing biosolids system ranks best in a cost weighted overall evaluation followed by Options 3, 4, 2, 1 and 5.
6. Options 1 and 2 which include digestion ranked poorly because of the high cost to haul liquid sludge to the digesters and then haul the digested sludge back to Greenway for dewatering. For option 2, land application would involve hauling the digested and dewatered sludge to a storage site or fields for application.
7. Land application options, 2, 3, 4 and 5 all require long term storage since applying treated biosolids to land can only be done on farm fields in accordance with the Nutrient Management Act.

Overall, the existing biosolids system in London offers the best value and is mid-rank for GHG emissions and public perception. There is an opportunity to improve upon all factors (cost, GHG emissions and public perception) with the use of an Organic Rankine Cycle engine to produce electricity from waste incinerator heat. The value of electricity (revenue) estimated at $633,000 would result in a 10 year payback. Staff recommends that a strategy be prepared on how to advance this opportunity.

Conclusion

The current City of London Biosolids disposal system has sufficient capacity to meet the City of London's needs for the next 20-30 years. There are no immediate capacity, operational or financial performance needs driving an alternate biosolids disposal method for the City of London.

The existing system is extremely cost effective when compared to alternative methods. A portion of the existing facilities have been paid through development charges to accommodate growth. Converting to an alternative system would be entirely rate funded as replacement capacity.

In a comparison to other methods, the existing system is:

- best in class for cost by a factor of 2 to 4 times;
- middle of the class for GHG emissions; and,
- best in class for three of four public perception factors, but overall is middle of the class because there is not a beneficial use end product.

Can the existing system be better? Yes.

There is a significant opportunity to improve upon cost, GHG emissions and public perception through the generation of electricity from incinerator heat. There are technical operating details which will influence cost savings, with a range from zero to $633,000 per year. GHG emissions and public perception will improve with the use of an ORC engine. Staff recommend that this opportunity by pursued, starting with a report on a strategy about how to do so that would maximize benefits to the City.

Acknowledgements

This report was prepared by Geordie Gauld, Division Manager, Wastewater and Treatment Operations.

RECOMMENDED BY:	CONCURRED BY:
JOHN LUCAS, P.ENG. **DIRECTOR – WATER AND WASTEWATER**	**JOHN BRAAM, P.ENG.** **MANAGING DIRECTOR – ENVIRONMENTAL & ENGINEERING SERVICES** **AND CITY ENGINEER**

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Appendices:

Appendix "A" -- Existing Sludge Management Process

Appendix "B" -- Biosolids Disposal Systems -- Overview

Appendix "C" -- Alternative Biosolids Management Comparison Criteria

Appendix "A"

Existing Sludge Management Process

Primary Clarification
Primary Clarification tanks reduce the velocity of wastewater allowing heavier solids to settle. These solids (primary sludge) are pumped from the tank at roughly 3.5% solids. This process removes approximately 50% of the solids contained in the waste stream.

Biological Treatment and Secondary Clarification
Following primary clarification, the wastewater undergoes biological treatment using the Return Activated Sludge Process. Bacteria and Protozoa assimilate the remaining organic matter into microbial biomass. Large amounts of air are supplied to this process to maintain an aerobic environment and to ensure adequate tank mixing. From the aeration tanks the wastewater enters the secondary clarifiers where the biomass flocculates and settles to the bottom where it is collected and pumped back to the head of the aeration tanks. A clear supernatant flows out over surface weirs in the clarifier and undergoes disinfection before discharge to the river.

Thickening
Excess biomass is removed from the biological treatment process and is thickened from 0.5% to 5% solids using thickening equipment. Polymers have the ability to bind sludge particles together and are used as an aide in the thickening process. Thickening can also be used to increase the solids content of primary sludge to reduce storage and trucking costs.

When combined, the mixture of primary and thickened biosolids averages approximately 3.5% solids. Annually this translates to 486,000 wet tonnes of solids requiring further processing. All biosolids generated within the City of London are trucked to the Greenway Plant for dewatering and incineration.

Dewatering
Biosolids are dewatered at Greenway using centrifuges which spin the solids at high speed, separating the solids from the liquid, again with the aid of polymers. This is new technology recently constructed. Dewatering biosolids increases the solids content from 3.5% to 27% and reduces the weight from 486,000 to 63,000 tonnes. This is the equivalent of reducing 24,000 truck-loads to 2,900.

Incineration
The dewatered biosolids are then incinerated at the Greenway plant site. Dewatered biosolids at 26% solids will burn without the need for supplemental fuel (natural gas). Ash is the only product remaining and has been used in the manufacture of cement products and disposed in the landfill. From the original 17,000 dry tonnes (DT) of biosolids processed in the City of London in 2012, 3500 DT (175 loads) of ash were produced. The dewatering and incineration processes run 24 hours per day, 7 days per week. Recent dewatering upgrades are expected to produce an annual net operational savings of $700,000 across the dewatering and incineration system or 25% of the total cost of dewatering and incineration, including a reduction of seven full time staff.

Bioset
Bioset is an alternative disposal system used to process dewatered biosolids at Greenway when the incinerator is undergoing maintenance. The Bioset process mixes lime with the dewatered biosolids in a self contained vessel. An exothermic reaction occurs between the lime and dewatered biosolids, heating the combined product to 50 degrees Celsius and stabilizing* the biosolids. The end product is less odorous and easier to handle than raw dewatered biosolids. Currently the Bioset material is disposed in the landfill but could be land applied with proper approvals and the construction of offsite storage.
* *Biosolids stabilization reduces the level of pathogens prior to final end use and is usually coupled with a dewatering process in larger installations, especially when haulage costs are a consideration. Unstabilized solids can only be disposed in a landfill site while incineration does not require stabilization.*

Supernatant/Centrate Processing
Sludge thickening and dewatering processes produce liquid waste streams (i.e., supernatant, filtrate, centrate etc.) which must be returned to the wastewater treatment process. The

rejected liquid side streams are highly concentrated and odourous, and must be reintroduced into the treatment process.

Odour Control

The operation of the old belt presses resulted in air contamination of the entire building making odour containment an issue and dramatically increasing the size of the HVAC and air scrubbing systems. The old scrubbers were also prone to failure due to the corrosive nature of the chlorine solution used and the age of the equipment, some of which was installed in the 1970's. The recently completed dewatering upgrades at Greenway included an entirely new odour control system based on ozone technology. Ozone offers lower capital and operating costs as well as increased reliability. The centrifuges are an enclosed process which significantly reduces the volume of odorous air requiring treatment while minimizing the potential release of odours from the process and buildings.

Appendix "B"

Biosolids Disposal Systems -- Overview

<u>Existing-Base Case</u>

In the existing disposal system, thickened biosolids are hauled from the satellite plants to Greenway for dewatering and incineration. The dewatering system was upgraded to centrifuges in June 2013 and the incinerator has been in service since 1988. Continuing with this method of biosolids disposal has several inherent advantages including:

- The systems are fully paid for and have sufficient capacity for the next 20-30 years
- These systems are proven over time and offer little risk in comparison to constructing a new process
- Individual components of the system have been optimized to improve the overall efficiency of the system as a whole.
- Greenway services 60% of London, and is a central location for the remaining 40%. This minimizes the distance biosolids are trucked within the City. Trucking all of London's biosolids for offsite disposal would be a major expense, considering that it would include Greenway, the source of 60% of generated biosolids.
- Greenway is a large plant and the liquid train can easily handle the high strength process side streams associated with biosolids processing.

<u>Alternatives</u>

1. Anaerobic Digestion-Dewatering-Incineration

Anaerobic digestion takes place in oxygen deficient digesters which stabilizes the sludge. A by-product is biogas which can be used as an energy source for heating or electricity generation. Through this process up to 40% of the volatile suspended solids contained in the biomass may be converted to biogas significantly reducing the amount of residual requiring disposal. Anaerobic digestion requires 20-30 days to complete and as such, a large footprint is occupied by the digesters. There is not enough space to place anaerobic digesters at Greenway – it is encumbered by the Thames River floodplain. For the comparative analysis, a general site south of Hwy 401 was used for land costs and truck haulage calculations.

This process would involve trucking thickened sludge from all sites to an alternate site for digestion and then trucking the residual to Greenway for dewatering and incineration. This alternative would also require a system to treat the high strength supernatant liquid by-products. Digesting the biosolids produced within London could produce biogas electricity worth up to $300,000 annually above that needed to heat and sustain the process.

2. Anaerobic Digestion-Dewatering-Land Application

This alternative is similar to Option 1 with the exception the digested sludge will be dewatered offsite then land applied. It eliminates the need to return all of the digested sludge to Greenway but will require new dewatering and digested sludge storage facilities since land application is restricted to seasons when agricultural fields are dry.

3. Dewatering-Lystek-Land Application.

Lystek is a patented process in which dewatered sludge is stabilized using a combination of heat, alkali and high shear mixing. The end product can be pumped using conventional equipment. The process could be located in the Greenway plant with Lyztek-sludge storage and disposal required offsite.

4. Sludge Drying-Beneficial Use

Sludge drying involves heating dewatered sludge which simultaneously kills pathogens and reduces the sludge volume by up to 70%. The process is energy intensive and the product is classified as a fertilizer or can be used as a fuel source for a boiler or direct fired burner. As evaluated, this process would require dewatering all biosolids at Greenway with the drying facility located offsite.

5. N-Viro Alkaline Stabilization-Land Application

The N-Viro process stabilizes biosolids by combining the biosolids with lime (high pH) followed by heat drying. This process would require dewatering all biosolids at Greenway with the N-Viro facility located offsite and land application for biosolids.

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Appendix "C"

Alternative Biosolids Management Comparison Criteria

Evaluation Criteria

Alternative disposal methods have been identified and evaluated based on three criteria: Total Life Cycle Cost; Carbon Footprint; and, Public Perception. A matrix was developed that standardizes all the technologies and criteria to a Present Value per dry tonne disposal cost with a lower figure representing a higher value to City ratepayers.

Total Life Cycle Cost

Capital Cost

The capital costs of an alternative technology include:

- Cost of technology, installation and commissioning
- Cost of new land required
- Cost of building to handle new technology
- Odour control systems if required
- Sludge and biosolids storage facilities as required

A study period of 20 years, a discount rate of 4% and an escalation rate of 1% were used in the capital cost evaluations of all alternatives.

Operations Cost

This covers the additional operating costs associated with the processes including:

- Operation and maintenance costs of the raw sludge receiving and storage facility
- Operation and maintenance costs of the sludge processing technology
- Hauling cost of processed biosolids to the Greenway plant
- Hauling/conveyance and treatment cost of process supernatant/centrate to the Greenway WWTP
- Operations and maintenance cost of any centralized biosolids storage facility/ and or for land application or to landfill.

Any effects the alternatives may have on the existing process efficiencies, if used in the alternative, were included in the evaluations. Tables summarizing the various capital and operations costs are included on pages A1-1 through page A1-6 in the RVA report.

Carbon Footprint

The Biosolids Emissions Assessment Model (BEAM), as developed by the Canadian Council of Ministers of the Environment, (CCME) has been used to compare the processes evaluated. The model can be used to:

- Estimate a program's GHG emissions, including establishing a baseline
- Compare emissions from different biosolids management scenarios within a program
- Estimate the impacts an GHG emissions resulting from changes in a biosolids management program
- Understand the factors that have the greatest impact on increasing or reducing GHG emissions.

A table summarizing the Carbon Footprint Evaluation is contained on page A1-9 of the RVA report.

Public Perception

Biosolids processing systems are comprised of several subsystems with varied Public Perceptions. In an attempt to quantify public perception for this report, each disposal option has been scored relative to the existing operations. Components considered were:

- Nuisance -- Sludge or Biosolids hauling through the City
- Odours - Potential
- Land Use -- Biosolids storage
- Doing the right thing -- Method of stabilization (depending on the class of product for land application)