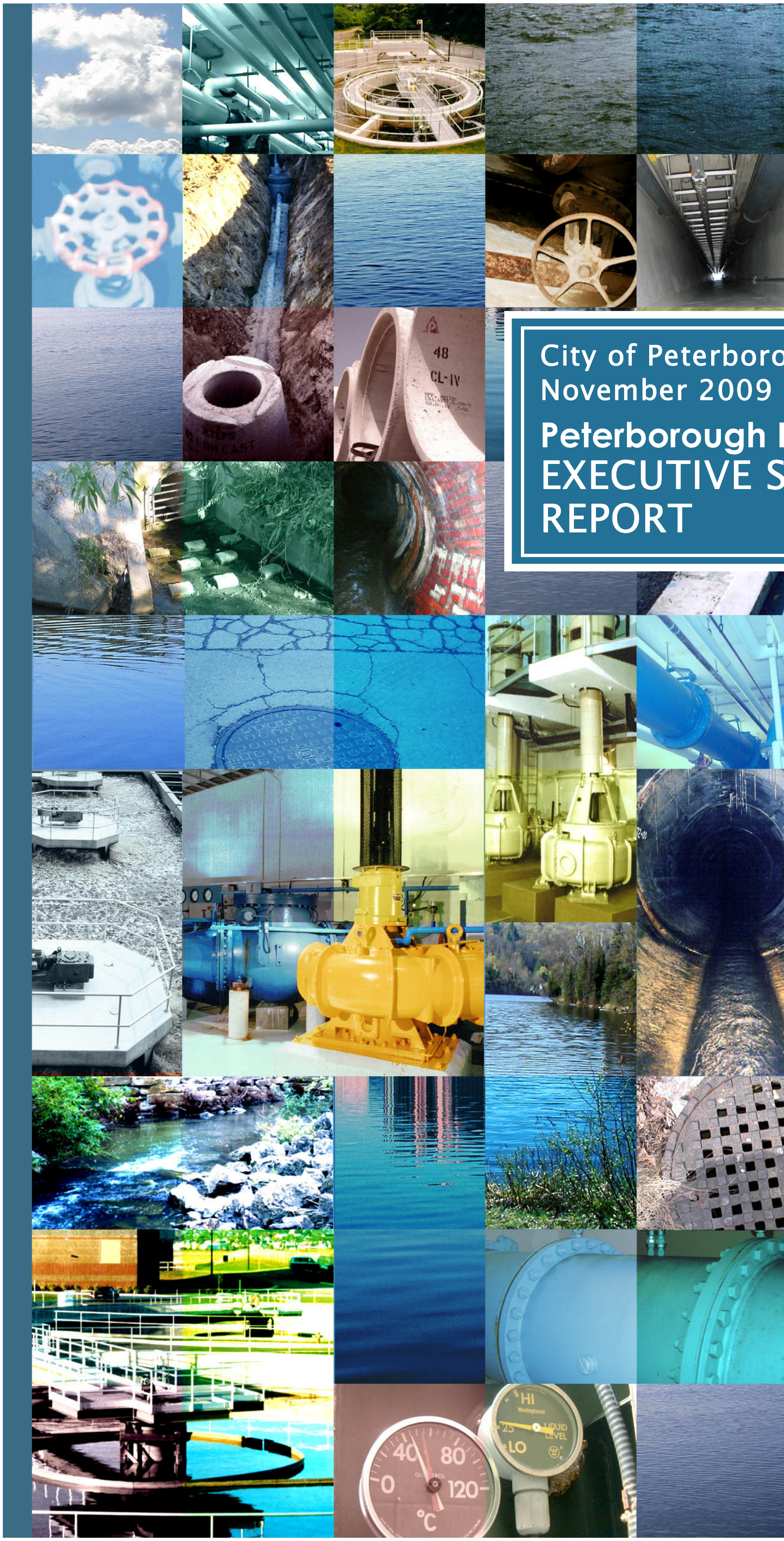


City of Peterborough
November 2009

Peterborough Biosolids Options EXECUTIVE SUMMARY REPORT

R.V. Anderson Associates Limited
engineering · environment · infrastructure
2001 Sheppard Avenue East Suite 400
Toronto ON M2J 4Z8 Canada
Tel 416 497 8600 Fax 416 497 0342

EXECUTIVE SUMMARY REPORT

PETERBOROUGH BIOSOLIDS OPTIONS STUDY

FINAL EXECUTIVE SUMMARY REPORT

Prepared for:

The City of Peterborough

R.V. Anderson Associates Limited
environment - infrastructure

RVA Job # 091864

November 2009

PETERBOROUGH BIOSOLIDS OPTIONS STUDY

TABLE OF CONTENTS

Page

1.0 INTRODUCTION AND BACKGROUND

The City of Peterborough operates one waste water treatment plant (WWTP), which is located on the banks of the Otonabee River. The WWTP treats raw sewage generated from the residential, industrial, institutional, and commercial developments within the City. The Peterborough WWTP services a population of approximately 75, 000 residents. The plant also receives and treats hauled waste from industries and the surrounding rural communities in the County of Peterborough as well as leachate from the landfill, which is jointly operated by the City and County. The leachate is pumped into the collection system upstream of the plant. This serves to dilute the highly concentrated pollutant load before it reaches the treatment process.

Peterborough's WWTP uses a conventional activated sludge process to provide secondary treatment of wastewater. The primary and secondary sludges that are generated are stabilized using anaerobic digestion, which produces a Class B biosolid. Currently all biosolids from the plant are dewatered and disposed of at the City/County landfill, as per the "Addendum to the Class EA Assessment for Waste Water Treatment Strategy and Plant Expansion," issued in April 2005.

1.1 OBJECTIVES OF STUDY

Disposal of Peterborough's biosolids at the landfill is a recommendation of the EA that was prepared for the City. However, due to operational difficulties in handling the material at the landfill, the Waste Management Committee through County Council Resolution, requested the City to investigate other disposal options that could include recovery of the nutrient value of the biosolids and minimization of disposal at the landfill as a standard practice.

The objectives of the study were to:

1. Maximize diversion of Peterborough's biosolids away from the landfill, and
2. Attempt to develop a plan that facilitates nutrient recovery from the biosolids on local farmland for the benefit of local farmers.

1.2 STUDY METHODOLOGY

The Biosolids Options Study was originally intended to be conducted in three phases as follows:

1. A presentation and short-listing of all currently available biosolids disposal/processing technologies,

2. A presentation of a detailed analysis of the short-listed technologies,

3. Completion of a Public Information Centre (PIC), with subsequent preparation of a final report.

As a result of developments described in section 5, the study would not have resulted in definite technology selections and it was decided by the Steering Committee that a PIC would have been premature. Contact with the public, however, is recommended as part of the future master plan study which is to be conducted under the EA process.

The first phase, which is documented in Technical Memorandum #1 (TM1), was an investigation into technologies available for processing/disposal of biosolids and the subsequent creation of a long-list of these technologies. A set of screening criteria was developed, based on Peterborough's specific requirements, and used to short-list the options. A study of the practices of other Ontario municipalities was also carried out; a summary of which provided an understanding of commonly employed biosolids management strategies.

The second phase of the study was a detailed analysis of the technologies or biosolids management scenarios that were developed in TM1. A separate set of evaluation criteria was used for this detailed analysis. Weightings were applied to each criterion to reflect its relative importance. Preliminary, comparative, life-cycle cost analyses were developed for the short-listed technologies.

Each scenario was ranked based on technical score and Net Present Value. A Final Overall Ranking was achieved by combining the technical merit scores with the Net Present Valve scores to create one ranking.

2.0 SHORT-LISTING OF AVAILABLE TECHNOLOGIES

2.1 PETERBOROUGH'S CURRENT BIOSOLIDS MANAGEMENT PROGRAM

The Peterborough WWTP currently dewaters and disposes of its biosolids at the local landfill. The previous practice was land application of liquid biosolids, which was terminated due to the following issues:

- Regulatory requirements for the provision of 240 days of storage for biosolids could not be met,
- Difficulties experienced in securing a land bank large enough to spread the amount of biosolids produced at the facility. In the past three to five years a significant reduction in the land bank occurred as farmers began to opt out of the program. (Records kept at the plant show that the land bank had reduced by 60%, jeopardizing the viability of the program)
- Protracted delays in obtaining Certificates of Approval for application sites,
- Susceptibility to inclement weather periods, during which it is not permitted to land apply biosolids,
- Negative community perception of land application.

2.1.1 Current Production

In 2008 the Peterborough WWTP produced approximately 4.33 dry tonnes/d (20 wet tonnes/d) of sewage sludge. The plant's average solids peaking factor between 2005 and 2008 was 1.5. In 2008, from September to December, a total of 1,056 wet tonnes of dewatered biosolids (cake) were disposed of at the landfill. Approximately 3,000 m^3 of liquid biosolids, produced in 2008, was applied to agricultural land in the spring of 2009, which marked the end of the liquid land application program.

Tipping weights at the landfill over the first eight months of 2009 indicated that the amount of biosolids disposed of at the landfill is approximately 5,000 wet tonnes per year.

The plant produces Class B biosolids, which are suitable for land application under the current Nutrient Management Act (NMA). In addition, the metals content of Peterborough's biosolids is in compliance with the NMA and Canadian Food Inspection Agency Standards for Metals in Fertilizers and Supplements.

2.1.2 Projected Production

A process audit to re-rate the WWTP's capacity from 60,000 m^3/d to 68,000 m^3/d is currently underway. Projections of solids production in this study were calculated using 68,000 m^3/d as the plant's total treated flow. A sludge generation rate of 0.085 (kg sludge)/(m^3 treated influent) and peaking factor of 1.5 were used as parameters in the solids production calculations. The projected solids production, anticipated after 2020, for a flow of 68,000 m^3/d is 2,110 dry tonnes/yr (9,200 wet tonnes/yr), with a peak production of 3,200 dry tonnes/yr (13,900 wet tonnes/yr).

2.2 PRACTICES IN OTHER JURISDICTIONS

The use of biosolids by way of land application is a common practice in North America, Europe, and the UK. In terms of global practice, 42% of the biosolids produced in Canada, USA, and Europe is land applied, 38% is disposed of at landfills, 13% is incinerated, and the remaining is managed by other methods.[1]

In Canada, 43% of the biosolids produced is land applied, 4% is landfilled, 47% is incinerated, and the remaining is handled by other methods.[2]

[1] International data taken from the United Nation Environment Program, Newsletter of Technical Publication, Freshwater Management Series No.1 (Biosolids Management: An Approach for Managing Sewage Treatment Plant Sludge – An Introductory Guide to Decision Makers)

[2] Based on data from Apedaille (2001), Nazareth (2008)

The biosolids Master Plans (BMPs) for the following Ontario municipalities were reviewed:

Regional Municipalities:

- Niagara,
- Waterloo
- Durham

Cities

- Hamilton
- Kingston

Table 2.1 presents a chart form summary of the practice of each region/city. The review showed that three of the five regions use land application as their primary biosolids disposal method. Four of the five regions rely on landfilling as a contingency. Hamilton and Durham's primary disposal method is incineration. Kingston is in the process of choosing composting or lime stabilization as their primary biosolids management technology.

The practices of these jurisdictions show that no single method is appropriate for every municipality. Most municipalities employ a combination of methods, along with a contingency method to provide a full solution.

Table 2.1: Biosolids Disposal Strategies of Selected Ontario Municipalities and Cities as Reported in Their BMP's

Municipality	Agriculture	Landfill	Incineration	Other	Other Contingency
Hamilton		Contingency			Duplicate Incineration Unit
Kingston		Contingency		Composting or Lime Stabilization	
Region of Niagara *		Port Colborne Only		N-Viro^{TM}	
Region of Waterloo					Storage in Kitchener WWTP lagoon
Region of Durham		Contingency		Cement Kilns	

*Since the completion of their Master Plan in 2001, the Region of Niagara only uses landfilling as a contingency measure. The Region is in the process of updating its Master Plan

Legend

Primary method used for biosolids disposal under normal conditions

Contingency method used for biosolids disposal under emergency situations where normal disposal method(s) cannot be used.

2.3 AVAILABLE TECHNOLOGIES AND END USES

Currently, Peterborough's Class B biosolids could be used in the following ways:

- land applied as cake on agricultural land (when available),
- processed or incinerated at another facility, or
- disposed of (as cake) in a landfill.

The City, recognizing the importance of diversity within its program and future impacts on capital and operating costs, has therefore embarked on this study to develop a program that is environmentally and economically sustainable in the long-term as well as acceptable to the public.

2.3.1 Technology Categories

The technologies available for biosolids treatment are classified under the following categories:

- Digestion
- Alkaline stabilization (including N-Viro™, Bioset™, Lystek™)
- Thermal processes
- Composting
- Volume minimization
- Other / Embryonic

Provided below is a listing and a short description of each technology. A more detailed description is contained in Technical Memorandum #1.

2.3.1.1 Digestion Technologies

Anaerobic Digestion: The natural breakdown of organic matter in the absence of oxygen. There are two main types of anaerobic digestion: Mesophilic and Thermophilic. Mesophilic Anaerobic Digestion occurs in a digester whose temperature is controlled between 35°C – 38°C and is the digestion technology currently employed by the Peterborough WWTP. Thermophilic Anaerobic Digestion is carried out at an elevated temperature between 46°C – 60°C, which increases the digestion rate.

Aerobic Digestion: The digestion of sludge in the presence of oxygen. This method has longer residence times compared to anaerobic digestion and significantly higher energy requirements.

Auto-thermal Thermophilic Aerobic Digestion (ATAD): Autothermal thermophilic aerobic digestion is primarily an aerobic digestion process operating without external heat input at thermophilic temperatures (from 50°C to 65°C).

Vertad™: A trademarked aerobic thermophilic digestion process claimed to produce Class A biosolids. Vertad™ is similar to ATAD except that a vertical, in-ground, constant pressure aeration reactor is used.

Dual Digestion (Two-Stage Aerobic-Anaerobic): A digestion process consisting of two stages: an aerobic thermophilic reactor followed by an anaerobic reactor.

Staged Mesophilic Digestion: Staged mesophilic is a multi-staged anaerobic digestion process at mesophilic temperatures that produces a more stable and less odourous product, which is easier to dewater.

Staged Thermophilic: Staged thermophilic digestion can involve 2, 3 or 4 reactors in series where all reactors operate as methane reactors. The flow from reactors can be a continuous flow or can involve batch generation to eliminate pathogen short-circuiting

Temperature Phased Anaerobic Digestion (TPAD): A trademarked two-stage reactor, where the first reactor operates at thermophilic temperatures (49-60°C) and the second at mesophilic temperatures (35-38°C). Claimed to produce a Class A biosolids.

Torpey Process: Mesophilic anaerobic digestion with sludge recirculation to increase sludge retention time without increasing the hydraulic retention time.

Anaerobic Baffled Reactor: A digester that uses baffles (alternating and standing) to modify and separate the residence time of the liquid from the solids, which accomplishes digestion in shorter time frames. This technology is still evolving.

Aerobic / Anoxic Digestion: Aerobic digestion cycle with on/off operation sequence so that anoxic conditions for denitrification are provided thus an enhanced pathogen destruction effect takes place. This technology is still being investigated.

Columbus Thermophilic Treatment: A 3-stage process which consists of thermophilic digestion followed by a long narrow plug flow reactor and mesophilic digestion for odour control. Only one facility is currently in operation.

BioTerminator: Anaerobic baffled reactor that involves the addition of a carbon supplement in a plug flow digestion process through five different sections in a thermally insulated vessel. This technology would need to be implemented in Peterborough's existing digestion tanks and does not guarantee a Class A product.

ThermoTech™: Fermentation of biosolids in an auto-heated aerobic digester at thermophilic temperatures. This technology was originally designed for converting food wastes into high protein animal feed and then adapted for municipal sludge applications.

2.3.1.2 Sludge Volume Minimization Technologies:

Volume minimization technologies are not stabilization technologies and therefore cannot be a solution on their own. They have the ability to increase the available biodegradable matter, which enhances volatile solids reduction. The end result, when used with anaerobic digestion, is more methane production and less biosolids to handle. All volume reduction technologies require thickening of the Waste Activated Sludge (WAS).

Ultrasonication: Pre-treats the sludge prior to digestion, by using ultrasonic waves, which seems to increase soluble solids and the biodegradability of sludge as well as improve dewaterability and biogas generation by up to 25%.

Cambi Process: A patented process that involves high-temperature and high-pressure hydrolysis of organics prior to mesophilic digestion to improve digestion and facilitate dewatering up to 30% to 35% solids. This process produces a Class A product.

Microsludge (followed by Anaerobic Digestion): A chemical treatment at high pressure to enhance cell disruption prior to digestion.

Lystek™ (applied to thickened WAS then anaerobic digestion): A process that shears the cell walls through the addition of potassium hydroxide and heat from steam. This system is still under development.

Cannibal™: A process that treats a portion of the WAS in a side-stream bioreactor to create facultative bacteria. The aerobic bacteria are destroyed and this mixed liquor is returned to the main process, where the outnumbered facultative bacteria are broken down. This results in a significant reduction in WAS feed to digestion and up to 50% reduction in total solids, which would require handling, processing and disposal.

2.3.1.3 Alkaline Stabilization Technologies

Alkaline Stabilization of biosolids involves the addition of an alkaline agent (usually containing lime) to raise the sludge pH, which inactivates pathogens and controls odours.

Alkaline Stabilization (N-Viro): A process that employs the addition of alkaline chemicals such as cement kiln dust (CKD), lime kiln dust (LKD), and lime materials to raise sludge pH to 12. The sludge is kept at a temperature above 52°C for 12 hours and subsequently air-cured to achieve a minimum 50% solids reduction.

In Vessel Lime Pasteurization: A patented process that produces a Class A biosolids via the addition of lime additives. This process has high operating requirements, large chemical demands, and a high potential for odours.

Bioset Process: A patented process that combines alkaline additives and sulfamic acid with sludge under pressure to produce Class A biosolids additives and liquid ammonium fertilizer.

Lystek™: This system produces a Class A biosolids via the use of potassium hydroxide and heat from steam on Class B biosolids that is produced via digestion and dewatering.

2.3.1.4 Thermal Conversion Technologies

Thermal conversion technologies dry biosolids via mechanical drying systems to a solids concentration of 60 to 95%.

Heat Treatment (e.g. ZIMPro™): The heating of sludge for short periods under pressure to achieve stabilization and conditioning, which reduces the water affinity of sludge solids thus producing a readily dewatered sludge.

Incineration: The thermal destruction of organic content in biosolids and conversion of some inorganics to the gas phase to achieve biosolids volume reduction. Incineration requires a minimum 25% cake biosolids feedstock.

Incineration at Duffin Creek: The Duffin Creek Incineration Facility converts biosolids cake to ash by processing through a fluidized bed incinerator at 900℃. No nutrient recovery is achieved by this process.

Minergy's GlassPack™: A process that melts the mineral content of sludge using an enriched oxygen fed high temperature furnace (1600℃) and produces an inert glass aggregate end-product with potential marketability as a construction material.

Sludge to Oil ™– High Temperature Pyrolysis: Enhanced pyrolysis of sludge under specific pressures and the addition of catalysts to produce a usable fuel. There are currently no pilot studies that have produced an end-product that is suitable for diesel engine combustion.

Slurry Carb™- Modified Low Temperature Pyrolysis: Dewatered cake is macerated, heated to 232℃ then pressurized inside a vessel where cells are broken thus releasing carbon dioxide and removing the affinity of solids towards water. This process produces a highly concentrated, difficult to treat side-stream, which would affect the main treatment process at Peterborough's WWTP.

Liberty Energy™: A process that produces electricity in a standard steam cycle using steam created from the combustion of biogas that is obtained via a fluidized bed gasifier. A cogeneration project is underway in Hamilton, Ontario, but the implementation timing is unknown.

2.3.1.5 Composting Technologies

Composting is a process whereby organic material undergoes biological degradation, thus generating a stable end product. Most composting operations consist of the following steps:

- Mixing dewatered sludge or biosolids with a carbon-based amendment and /or bulking agent (usually wood chips, straw or sawdust)
- Aerating the compost pile either by the addition of air, by mechanical turning, or by both
- Recovery of the bulking agent (if practicable)

- Further curing and storage
- Product marketing and beneficial use

Composting – Open: The composting of a mixture of biosolids, bulking agents, and finished compost in an environment open to the atmosphere to achieve a solids content of 40% to 50%. Two common types of open composting are aerated static pile and windrow composting. Aerated static pile composting places the dewatered sludge/bulking agent mixture over a grid of aeration piping for unmixed composting over 21 to 28 days. Curing occurs over 60 to 90 days. Windrow composting achieves composting in a few weeks to several months and involves mixing of the compost piles (windrows) during composting. Curing times depends on the end use of the compost.

Composting – In-Vessel: Composting that occurs in an enclosed container or vessel, typically a plug flow or dynamic (agitated bed) system. Composting times are between 10 and 21 days with a 12 to 16 week unaerated curing period.

Composting Under Gore™: The Gore™ Cover system utilizes a geotextile membrane, which is permeable to oxygen but impermeable to large molecules, to cover the composting piles. This helps to reduce odour emissions. Composting is accomplished in six weeks and curing occurs over 2 weeks to several months for long term curing.

Vermicomposting: The use of worms to break down the organics into castings or vermicompost (soil additive). Vermicomposting has not been proven on a large scale. This type of composting cannot occur in the winter (unless enclosed in a heated facility). The ammonia concentration in anaerobically digested sludge would need to be reduced since high ammonia would be toxic to the worms.

2.3.1.6 Newer or "Embryonic" Technologies

Liquid A: The production of a Class A product through a batch process of heating a sludge/granular lime mixture for one hour and using recirculated air for mixing in the reactor. The end-product is highly alkaline and not suitable for Peterborough.

Micronair™: A sludge pre-treatment system that proposes to significantly decrease solids production. A recirculation loop feeds underflow from an aerobic digester through a compressed air system that generates micron-sized bubbles. The aerated underflow is returned to the digester, where it tends to lift sludge in the digester to the tank surface, creating a high solids blanket at the top of the digester. This recirculation increases solids retention time and solids degradation. This process has not been validated as of yet.

Brinecell™ Process: Electrolytically activated sodium chloride solutions are used to disinfect sludge or digested biosolids. This process does not enhance the destruction of volatile matter and is essentially a pathogen reduction process that is still being developed.

Ozone Treatment: A proprietary process whereby thickened sludge is acidified and mixed under pressure with ozone gas and further processed by removal of the ozone, addition of polymer and lime, dewatering, and pelletizing to produce a product suitable for land application or use as a fuel. While there are two pilot systems being tested, this process is no longer being marketed.

Long-Term Lagooning: Storage and long-term anaerobic digestion of sludge in earthen lagoons. Detention times vary from a few months to a several years. The land requirements would be significant for Peterborough.

Seasonal Air Drying: Seasonal air drying after lagoons can potentially help provide Class A biosolids. This process has potential for significant odours and requires a large area of land. The process is highly weather dependent, and considered unsuitable for use in Ontario.

Irradiation: The inactivation of pathogens using high radiation energy, either beta or gamma. However, due to potential risks to operator safety, public perception, and potential remaining odours, no full-scale operations exist.

Plasma Assisted Sludge Oxidation: The heating of dewatered sludge cake (>20% solids) in a vacuum reactor where the organic content of the sludge is used as a heat source for plasma generation. The end product is an inert ash. This process is generally a refinement of incineration technologies.

During the Biosolids Options Study the option of using Peterborough's biosolids at an Ethanol Plant in Havelock was presented. The Ethanol Plant proposes the digestion of sewage sludge in an on-site digester to produce methane gas, which would act as a fuel in the ethanol production process. The stabilized biosolids would then be converted to fertilizer and marketed. Construction of the plant is under way and it is expected to be in operation in October 2009.

While the use of biogas as a fuel source is not a new technology, the Ethanol Facility option was carried through as a possible end-use technology and as a potential component in Peterborough's biosolids management plan.

2.4 SCREENING CRITERIA

The following criteria were used in TM1 to screen the long-list of technologies described above to a short list:

- Public acceptance
- Health and safety (public)
- Health and safety (operator/worker)
- Proven successful performance
- Potential for significant odours
- Risk assessment
- Regulatory compliance
- End-use compatibility
- Feasibility

These screening criteria were considered crucial to the success of the program; accordingly, any option receiving a "FAIL" score for any one of these criteria was removed from the list and dropped from further consideration.

2.5 SHORT-LISTING OF TECHNOLOGIES

A “Technologies Screening Matrix” was created to capture the preliminary screening of the technologies, based on the above nine criteria. All technologies were scored on a PASS/FAIL basis. The technologies that received a PASS on all nine criteria were used to form the short list of options.

The following categories of technologies were not considered suitable for Peterborough’s situation:

- Volume Minimization – minimization is not a solution in itself but a possible refinement in the overall process.

- Alkaline Stabilization – this stabilization produces an alkaline biosolid which is compatible with non-alkaline soils only. Peterborough’s soil ranges from neutral to alkaline and is generally above 7.5, which makes it unsuitable for the addition of alkaline biosolids.

- Other Process Technologies (embryonic technologies) - these technologies have not been proven, their results cannot be guaranteed at this time, and Peterborough is looking for a solution with a proven track record for reliability.

The short-listed technologies are:

- Mesophilic Anaerobic Digestion
- Heat Drying
- Incineration at Duffin Creek
- Composting with Gore™
- Use at Havelock’s Ethanol Facility

It should be noted that composting with Gore™ is currently not a viable option. It came to light late in the study that use of sewage biosolids as a composting feedstock is not consistent with Ontario regulations. However, the regulations are currently under review and if they change to permit the use of sewage biosolids as composting feedstock, then composting would be reintroduced as a feasible option. Nonetheless, this summary report presents the findings of the evaluation protocol for composting as the considerations were completed before the anomaly came to light.

2.6 SCENARIOS FOR DETAILED EVALUATION

Based on the results of the short-listing of technologies, four scenarios were developed for detailed evaluation in Technical Memorandum #2.

Base Scenario: Landfill Only (current practice)

Scenario 1:
a) Land Application and Landfill
b) Incineration at Duffin Creek with Landfill as contingency
c) Use at proposed Ethanol Facility with landfill as contingency

Scenario 2: Drying at the WWTP, with landfill as contingency

Scenario 3: Gore™ Composting at the landfill, with landfill as contingency

3.0 DETAILED EVALUATION OF SHORT- LISTED TECHNOLOGIES

3.1 CRITERIA AND WEIGHTINGS

Ten criteria were chosen for the detailed analysis of the four scenarios developed. Nine of the criteria were given a weighting from 1 to 10 to indicate its relative importance in the decision making process. The nine non-monetary criteria and their respective weightings are shown in Table 3.1.

Table 3.1: Criteria and Weightings

Criteria	Weighting
Public health and safety	10
Public acceptance	8
Operator/worker health and safety	8
Protection of the environment	7
Ease of operation & maintenance	4
Reliability/Proven performance	5
End use compatibility	7
Risk assessment & market factors	3
Regulatory compliance and Sustainability	9

The tenth criterion was Net Present Value (NPV), which considered the capital and operating/maintenance costs for each scenario over its expected lifespan. The Net Present Value was calculated using a 20-year life cycle, 5% interest rate, and 2% inflation rate. Energy costs were calculated using $0.10/kWh for electricity and $0.40/m^3 for natural gas.

The NPV criterion was not assigned a weighting, but evaluated separately from the other criteria. This was done to allow an assessment of value (technical merit) independent of cost (NPV).

3.2 SCENARIO DESCRIPTIONS

3.2.1 Base Scenario

The Base Scenario is the current practice of anaerobic digestion of mixed primary and waste activated sludge (WAS), dewatering, and subsequent disposal at the local landfill. No physical changes would be required at the plant or the landfill. Since the landfill is within 10km of the plant, minimal transportation issues would exist.

Landfilling of biosolids is practiced in Ontario and has been used by the City of Hamilton, the City of Kingston, the Region of Niagara, and Durham Region. However, there are operational difficulties associated with handling this material at the landfill as well as potential for odours, which have resulted in attempts to minimize the practice.

With this scenario, Peterborough would be dependent on a single outlet for biosolids and any interruption to landfill operations or access to the landfill would be problematic.

3.2.2 Scenario 1A – Land Application and Landfilling

Scenario 1A involves sending between 30% to 70% of the biosolids to land application on farmland and the balance to landfill.

This scenario would not require any physical changes at the plant. The services of a contract firm would have to be enlisted to arrange and perform land applications. These services would include securing land for application, assistance with preparation of approvals, biosolids haulage to site, and application of biosolids. In addition, a temporary storage facility would be needed to store up to 120 days of biosolids from where the land application contractor could load their trucks. The 120 days (4 months) worth of biosolids storage would be for biosolids produced in the winter and slated for land application the following summer. All other biosolids produced in the winter would be disposed of at the landfill, under this scenario.

Operational and end-use issues associated with this scenario included public perception of health risks associated with living close to application sites, odour complaints, and difficulties associated with obtaining Certificates of Approval for application sites. However, changes to the regulation have since been enacted to alleviate some of these issues, i.e. the requirement for Certificate of Approvals, which potentially makes it easier to land-apply biosolids. These changes are discussed further in section 4.0.

3.2.3 Scenario 1B – Incineration at Duffin Creek

Scenario 1B entails hauling Peterborough's biosolids to the Duffin Creek Incineration Facility in the Region of Durham, a distance of 95 km. This scenario would not require any physical changes to the plant. However, changes may be required at Duffin Creek since they do not currently have a biosolids receiving station to receive and transfer cake to the incinerators. Construction of this station may involve cost sharing with Peterborough.

The tipping fee for incineration was estimated at $115/WT ($500/dry tonne) based on informal discussions with Durham. Transportation costs to Duffin Creek were estimated at $33/WT ($145/dry tonne), giving a total handling and disposal cost for incineration of $148/WT ($645/dry tonne). In comparison, the current tipping fee at the landfill was estimated as $127.50/WT ($554/dry tonne) and haulage was estimated as $3/WT ($13/dry tonne). Total handling and disposal fee for landfill is $130.50/WT ($567.50 per dry tonne). (The $127.50 cost of tipping incorporates a surcharge on the standard tipping fee to offset operational difficulties and consumption of landfill capacity.)

Due to the travelling distance to Duffin Creek, transportation costs are naturally higher than other options. Additionally, public perception of incineration is poor and an option that does not involve nutrient recovery may not be well received by the public. Difficulties are also expected in obtaining public acceptance from the community in the vicinity of the Duffin Creek Plant.

In this scenario landfilling was considered as a contingency in the event that haulage to Duffin Creek was not possible due to weather, etc. It is likely that there would be strong political and public objection to this scenario.

3.2.4 Scenario 1C – Use at Ethanol Facility

This scenario involves trucking dewatered cake to the Ethanol Plant being constructed in Havelock, where it would be used to generate biogas for use as a fuel in the production of ethanol. This scenario was favourable since the Ethanol Facility is designed to accept and use biosolids, no physical changes would be required at the WWTP, and the Ethanol Plant is fairly close to Peterborough (34 km).

There would be few operational and end-use concerns associated with this option. The biosolids would be hauled an additional 24 km to Havelock rather than to the landfill. This item may not be an issue as the possibility of a railroad into Havelock is being discussed. A railroad to the Ethanol Facility would significantly reduce haulage costs for this option.

It was thought that this option would be well received by the Peterborough community, as it appeared to be the most environmentally friendly of the options (all of the plant's inputs are converted to usable products and spent biosolids are converted to fertilizer). This option would need to have public consultation with Havelock stakeholders, who may be reluctant to receive biosolids from another municipality.

3.2.5 Scenario 2 – Thermal Drying

Scenario 2 proposes the construction of a thermal drying system at the Peterborough WWTP. The end-product of this process is a 90-95% solids content, marketable fertilizer. The major pieces of equipment required for a thermal drying system are dryers, boiler(s), air emissions control, conveyor, and a storage silo.

This option would require substantial physical change at the plant at significant capital cost. However, transportation costs would be reduced since the biosolids would be transported as dried pellets rather than dewatered sludge.

In addition to space constraints at the plant site, operation and end-use issues associated with this scenario included operational challenges associated with a thermal drying system, which is quite complex. This new system may require additional staffing at the plant and a 24-hour oncall operator to handle any system upsets such as excessive heat generation, which has been known to lead to fires.

The processing of hot, dried pellets in a dusty environment introduces risks to worker health and safety, which were considered higher than in the other scenarios. A number of pelletizing facilities have suffered fires or explosions and there are concerns in regard to the proximity of residences to the north-east of the WWTP.

3.2.6 Scenario 3 – Gore™ Composting

In the Gore™ Composting Scenario Peterborough's biosolids would be trucked to a composting facility, which was considered to be located at the landfill site. The Gore™ composting system entails mixing biosolids with a bulking agent (i.e. woodchips), followed by a 3-phase composting process. The composting piles are covered with the Gore™ geotextile membrane (designed to minimize odours and control pile moisture and temperature). The Gore™ process provides mechanical aeration of the biosolids during composting, which, when complete, is followed by screening and storage for long-term curing.

A large area of land would be required to set up mixing, composting, and for buildings to house the composting equipment. The preliminary estimate of the amount of land required was 3,100 m^2.

Operation and end use issues associated with this scenario include a potential for odours when cake is delivered from the WWTP and is waiting to be mixed with the bulking agent before being transferred to a compost pile.

Two operators may be needed at the composting facility to perform the required tasks of receiving biosolids, mixing, operating the equipment, relocating the piles, etc.

3.3 EVALUATION & SCORING

The scenarios were first ranked based on technical scores and Net Present Value (NPV) as shown in Table 3.1

The cost per technical point was calculated for each scenario's capital cost, annual cost, and NPV. The results for each type of cost were ranked, which produced three sets of rankings. The average of the three rankings was calculated. The Final Overall Ranking was obtained by ranking the average. This approach was used in order to obtain a fair assessment of VALUE (technical score) and COST (NPV, Capital and Annual). The Final Overall Rankings are shown in Table 3.1 below.

Table 3.1: Technical, NPV, and Overall Rankings

Scenario	Technical Score Ranking	NPV Million $	NPV Ranking	Final Overall Ranking
Base: Landfilling	6	13.9	4	4
1(a): Landfilling and Land Application	4	12.3	3	3
1(b): Incineration at Duffin Creek	5	15.2	5	5
1(c): Fuel for Ethanol Plant	1	2.0	1	1
2(a): Thermal Drying	3	18.7	6	6
2(b): Gore™ Composting	2	11.9	2	2

The Final Overall Ranking indicated that the option of using the biosolids as a fuel source at the Ethanol Plant was the most favourable and Gore™ Composting was the second most favoured scenario. The least favourable options were Incineration at Duffin Creek and Thermal Drying. The option to continue with landfilling ranked fourth.

Regardless of what option is chosen, Peterborough would need to implement an Environmental Assessment (EA) process, to assess environmental impacts and consult with stakeholders. This process requires consultation with the public of any region or county that may be affected by biosolids from Peterborough. The acceptability of each option would be dictated through the EA process.

4.0 ANTICIPATED FUTURE REGULATIONS & TRENDS

Through contact with MOE officials it was determined that current regulations governing composting in Ontario (Interim Guidelines for the Production and use of Aerobic Compost in Ontario – 2004) restrict the copper content of compost feedstock to 100mg/L maximum[3]. This is a very stringent limit that biosolids material is unlikely to meet. This requirement effectively prohibits the use of biosolids as feedstock in composting operations, which means that Gore™ Composting is not a feasible option for Peterborough. Accordingly, it would be screened from the long list of technologies during the EA process, along with all composting technologies.

An amendment to the NMA was enacted in October 2009, which is geared towards improving the regulatory framework that governs the application of biosolids on agricultural lands in an attempt to encourage land application of biosolids rather than disposal at landfills. The key changes are:

- Non-Agricultural Source Materials (NASM) generators are no longer required to prepare a Nutrient Management Strategy,
- Sewage biosolids generators are no longer mandated to have 240 days of storage, but must have arrangements in place to avoid winter spreading and cope with inclement weather,
- Management of NASM, including sewage biosolids, as a nutrient instead of a waste when land applied. This redefinition eliminates the requirement for a Certificate of Approval under the EPA for land application sites, <u>provided</u> that pathogen and metal levels in the biosolids are within the limits set out in the proposed regulation,
- Materials that do not meet the prescribed level of quality, dictated by the regulation, would be prohibited from land application,

[3] The Compost Guidelines are currently under review.

- Application of sewage biosolids at any land application site requires preparation and approval of a NASM plan under the new regulatory framework.

- Farmers are no longer required to test both the biosolids being applied and the soil where it is to be applied. They are responsible for soil testing only and biosolids generators are responsible for biosolids testing. This change means that the regulatory responsibility would be shared rather than lie solely with the farmer.

- A “NASM Framework Odour Guide” has been developed by OMAFRA, which categorizes NASMs into three odour categories (OC1, OC2, and OC3), based on the level of odour produced. OC3 NASMs are those having the strongest odours. Odour categories are as follows:

Odour Category	**Biosolids Qualification**
OC1 (odour detection threshold less than 500 ou/m^3)	Liquid, anaerobically digested, sewage biosolids from a municipal WWTP
OC2 (odour detection threshold between 500 and 1500 ou/m^3)	Biosolids that have been dewatered by any method, excluding a centrifuge operating at less than 2000 rpm, then stored for 30 days or less.
OC3 (odour detection limit between 1500 and 4500 ou/m^3)	Biosolids that have been dewatered by a centrifuge at 2000 rpms or higher. **OR** Biosolids that have been dewatered then stored for a minimum of 30 days

NASM must not be applied to agricultural land if their odour exceeds the OC3 limit. For biosolids that do not fall into one of these categories an independent odour assessment, per regulation guidelines, would have to be performed to determine the odour level.

The regulatory amendments are intended to simplify the administration of land application of NASM and to encourage beneficial use of materials through land application. The odour categories impose restrictions on set-back limits from neighbouring properties. Peterborough’s biosolids fall into category OC3, only by virtue of the centrifuge rotational speed criterion.

5.0 PROJECT REDIRECTION

Technical Memorandum #2 was presented to and discussed with the Waste Management Committee (WMC). At that time the general consensus of the WMC members was that the scenarios proposed in TM2 for detailed investigation under the EA process are acceptable. However, developments following that meeting have made it apparent that there may be significant, unforeseen challenges associated with the top ranked options.

The following are the major changes or new constraints that have impacted the outcome of this study:

1. Information that the composting guidelines prohibit the use of sewage biosolids as composting feedstock,
2. Notable opposition to the use of Peterborough's landfill for any purpose related to biosolids management,
3. Indication that potential for local public opposition to transporting biosolids from Peterborough to Havelock is high.

The compost guidelines have had a major impact on the result of the study. Gore™ Composting was ranked as the second most desirable option for Peterborough, but in view of the compost guidelines, composting is no longer a viable option and will not be considered further at this time.

The unanticipated opposition to use of the landfill for handling biosolids affects the technical scoring for this option and means the scoring would need to be revised to capture the effects of this development.

The potential for opposition to processing Peterborough's biosolids at the Ethanol Facility in Havelock is an issue that may change this option's technical score. The scoring for this option would need to be revisited to take into consideration this potential opposition.

In light of these developments and the significant impact they have on the options evaluations/scoring, it was decided not to pursue further evaluation of the short-listed options presented in TM2 but to produce an updated long-list for evaluation under a Master Plan EA. In view of this, incineration at Duffin Creek would be brought back to the table as a potentially viable option for biosolids disposal, subject of course to full stakeholder consultation.

6.0 RECOMMENDATIONS

It is recommended that Peterborough undertake the preparation of a Biosolids Master Plan (BMP) under the Municipal Class EA process, following Phase 1 and Phase 2 of the process as soon as possible. There are different approaches available when preparing a master plan under the EA process.

In Approach #1 of the Master Plan process, the Master Plan is prepared after Phases 1 and 2 of the Municipal Class EA process have been completed. This Master Plan would form the basis for future investigations for Schedule B and C projects that are identified in the Master Plan. This Master Plan approach is done on a broad level and more detailed investigations would be needed on each project to satisfy EA requirements when that project is initiated. This approach is not recommended for Peterborough.

Approach #2 also puts the Master Plan preparation at the end of Phase 1 and 2 of the EA process. However, the level of investigation, consultation, and documentation in this approach are sufficient to satisfy the requirements for Schedule B projects and no further investigations would be required when such projects are initiated. If any project requires a Schedule C process then Phases 3 and 4 of the EA process must be undertaken prior to implementing the project. Approach #2 is recommended for preparation of Peterborough's Master Plan.

6.1 CONSIDERATIONS UNDER THE BMP PROCESS

During the Master Plan process a detailed analysis of all potentially viable options for Peterborough will be conducted. Key factors that will be considered in this investigation include:

1. Environmental impacts at the site of any biosolids processing facilities as well as any sites that may receive the biosolids for nutrient recovery or other purposes,

2. Public opinion of all parties that may be affected by the chosen BMP, e.g. near Duffin Creek or in Havelock,

3. Cost implications, both capital and operating, to the Peterborough community, as the costs for the BMP will impact the cost of treating wastewater. This cost increase will in the future have to be recovered once the Sustainable Water and Sewage Act is in effect. As such, user fees for connected users, hauled waste, and leachate will need to increase to achieve full cost recovery.

4. Development of more than one level of contingency, which would avoid diverting biosolids to the landfill except in dire emergencies and only after all other provisions have been exhausted.

Other key issues that need to be addressed or taken into consideration during the Master Plan process are:

- If the Ethanol Facility is considered, the consultation process must include the Havelock public through public meetings, direct mailings, etc. At least one public meeting should be held in Havelock to obtain feedback directly from the Havelock community.

- When incineration at Duffin Creek is investigated York Region should be considered a stake-holder since they are co-owners of the facility. The City of Pickering would be a stakeholder as the host of the facility. In light of this dual ownership, both the York public and Pickering public would need to be consulted about any plans to transport Peterborough biosolids to Duffin Creek. However, in the first instance, the BMP team would need to determine if the political arm of the two Regions (York and Durham) would be willing to entertain the proposal to incinerate Peterborough's biosolids at the Duffin Creek WPCP.

- The long-listed technologies described in TM1 and summarized previously in this report would be augmented with options generated through the EA process.

- The tipping fee that the landfill will levy needs to be determined. For the purposes of this study, the value used was $127.50/wet tonne. However, this is only an estimate and the correct value needs to be calculated using a life-cycle cost analysis of the landfill and its operations.

- The plant's biosolids production should be revisited to determine production based on a complete year of operation. At the time of writing, the yearly biosolids production was estimated at 7000 wet tonnes. This value was obtained by prorating the available data, (last three months of 2008 operation), in which all the biosolids produced were hauled to the landfill. In the months following, the data indicated that the actual yearly amount hauled to the land fill may be closer to 5000 wet tonnes per year rather than the prorated 7000 wet tonnes. During the BMP, projected sewage flows to the plant and corresponding solids production will need to be assessed.

- Peterborough should proceed with an RFP process to obtain competitive bids from proponents who are able to provide contracted Biosolids Management Services. This contract should be aimed at diverting all of Peterborough's biosolids away from the landfill until the selected management strategy, as determined by the Master Plan, is implemented. The RFP process should incorporate changes made to the NMA regulations. The contractor would be responsible for approvals, storage that may be required, and securing end-use sites (in the case of land application). The RFP should include provisions for contingencies, with the landfill coming into use only in dire emergencies.

  It is recommended that this RFP be released as early as possible in 2010 and the contract started in Spring 2010 in order to facilitate decommissioning of the existing landfill (SFA), as described in Section 6.2 below. The estimated annual cost for the interim biosolids management services contract is approximately $500,000 to $1,000,000.

- Although composting has been removed from the list of feasible options, it may be re-listed if, during the EA process, the regulations change to allow sewage biosolids to be a feedstock for aerobic composting. If this occurs, composting should be reintroduced as a possible option in Peterborough's biosolids management plan.

6.2 ANTICIPATED CHANGES TO LANDFILL OPERATIONS

Construction of a second landfill area to the north of the existing site is underway. The second area is referred to as the NFA (North Fill Area) and is slated to become operational in

September of 2010. Landfill staff have indicated that once the new North Cell is ready to receive waste it would only be able to receive municipal solid waste for an interim period, during which time biosolids would not be introduced for fear of impeding leachate percolation in the future.

The exact length of this restriction on biosolids is not clear. However, in light of current Certificates of Approval, some alternative plan for disposal of the biosolids must be in place during this period to avoid potential non-compliance with regulations. Alternative method(s) would be captured in the Interim Contract for Biosolids Management Services as described in the previous section.

Additionally, it has been recognized that the introduction of biosolids to the Peterborough landfill would impact the landfill's active lifespan[4], and for this reason the WMC wishes that it not be considered as an option except in extreme emergencies.

6.3 TIME CONSTRAINTS

As previously mentioned, NFA operations are expected to commence in September 2010, however, it has been recommended that the landfill not receive biosolids for approximately twelve to eighteen months of initial operation[5]. The Interim Biosolids Management Contract needs to be in place during this transition period.

The Interim Biosolids Management Contract would need to remain in place during preparation of the Master Plan, which is expected to start in May 2010 and last approximately one year. The RFP process to choose a contractor for this Short Term contract is slated for early 2010.

The attached schedule shows the expected duration of key activities of the NFA construction and performance of the Biosolids Master Plan. Some key dates in the process are:

[4,5] Memorandum from Urban and Environmental Management Inc (UEM). to The City of Peterborough, *"Peterborough Landfill & Biosolids Disposal Recommendations for Additional Biosolids Processing and/or Diversion from Landfill*," November 10, 2009, pg 4.

- Bid Interim Biosolids Management Contract – January 2010
- Selection of engineering services for BMP/EA – February 2010 to April 2010
- Start of Interim Biosolids Management Contract – May 2010
- Start of BMP/EA Process– May 2010
- Start of NFA operations - Sept 2010
- End of BMP/EA Process– May 2011
- Design/Procurement of BMP Selected Solution – June 2011 to May 2012
- Earliest Start of Long Term BMP Contract – Fall 2012 (assumes service type contract implemented)

Biosolids Management Long Term Solution Implementation (Service-Contract Based Option)

This time line for implementation of the Long Term BMP solution applies to a BMP solution that contracts biosolids management to an outside party. The timeline also assumes that the proponent has a licensed, operational facility with the capacity to handle Peterborough's biosolids production.

- Contract Provider Procurement Process – October 2011 to December 2011
- Negotiation and Award – December 2011 to March 2012
- Earliest Operational Date – April 2012

Biosolids Management Long Term Solution Implementation (Technology Based Option)

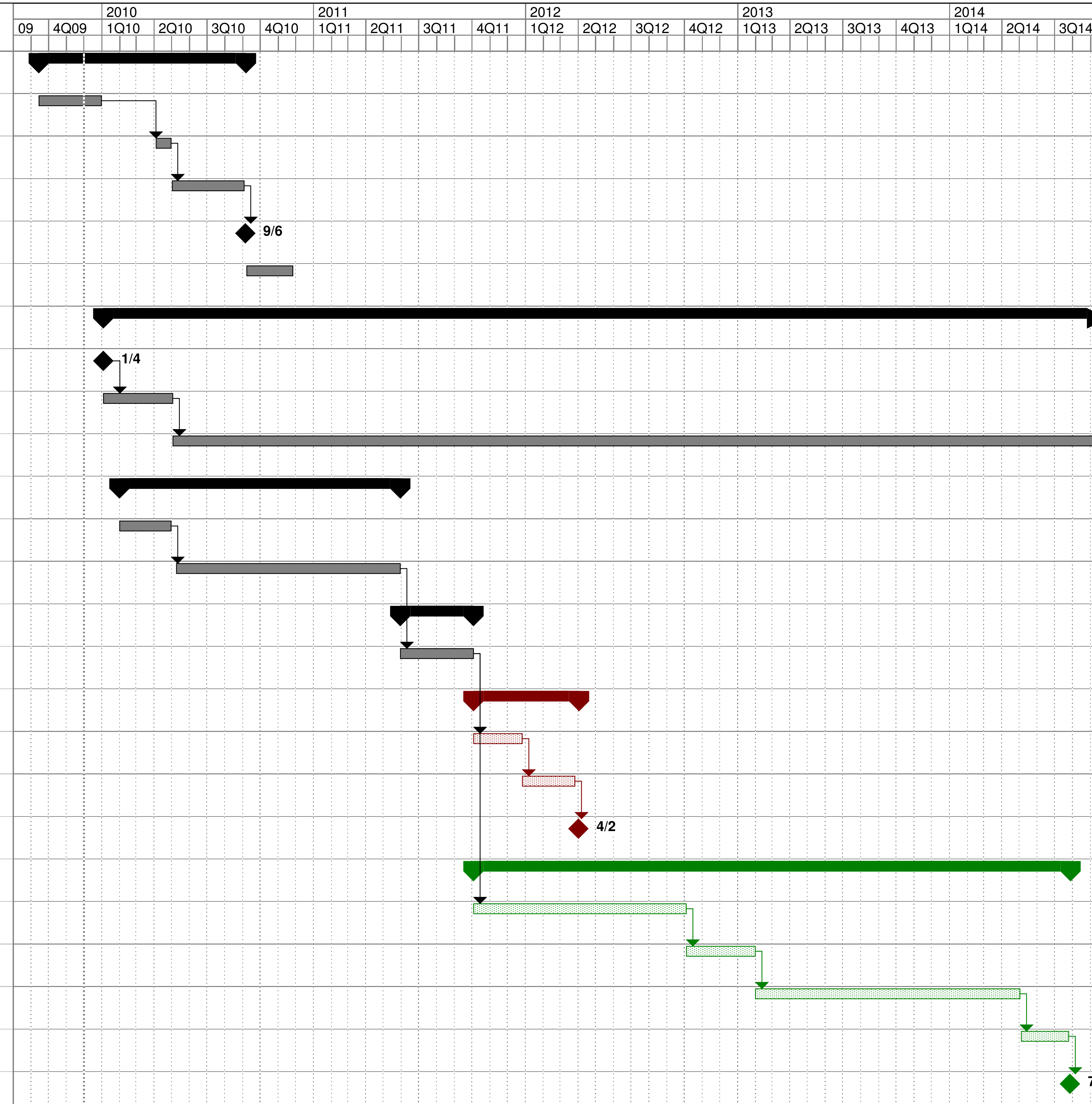
This time line for implementation of the Long Term BMP solution applies to a BMP solution that requires a technological solution rather than contracting to a biosolids management service provider.

- Design – October 2011 to October 2012
- Tender and Award - October 2012 to January 2013
- Construction – February 2013 to May 2014
- Commissioning and Testing – May 2014 to July 2014
- Earliest Operational Date – July 2014

Figure 6-1

TIMELINE FOR NFA CONSTRUCTION & THE BIOSOLIDS MANAGEMENT PLAN PROCESS

Task No.	Meetings	Task /Activity	Start	Finish
		Construction of North Fill Area	**Tue 9/15/09**	**Mon 9/6/10**
		Construction of NFA Utilities	Tue 9/15/09	Thu 12/31/09
		Landscaping and Hydro Seeding	Mon 4/5/10	Fri 4/30/10
		Construction of Cell 2	Mon 5/3/10	Fri 9/3/10
		Start of North Fill Operations	Mon 9/6/10	Mon 9/6/10
		Phasing out of Operations in South Fill Area	Wed 9/8/10	Fri 11/26/10
		Interim Biosolids Management Contract	**Mon 1/4/10**	**Mon 9/29/14**
		Bid Interim Biosolids Management Contract	**Mon 1/4/10**	**Mon 1/4/10**
		Selection of Short-Term Biosolids Management Contractor	Mon 1/4/10	Mon 5/3/10
		Performance of Biosolids Management Contract	Tue 5/4/10	Mon 9/29/14
		BMP/EA Process	**Mon 2/1/10**	**Mon 5/30/11**
		Select Consultants	Mon 2/1/10	Fri 4/30/10
		BMP/EA Process	Mon 5/10/10	Mon 5/30/11
		Design/Procurement of BMP Selected Solution	**Tue 5/31/11**	**Mon 10/3/11**
		Engineering Procurement	Tue 5/31/11	Mon 10/3/11
		Biosolids Management Long Term Contract (Service Based Option)	**Tue 10/4/11**	**Mon 4/2/12**
		Procurement of Contractor	Tue 10/4/11	Mon 12/26/11
		Negotiation and Award	Tue 12/27/11	Mon 3/26/12
		Earliest Operational Date for Long Term Service Contract	Mon 4/2/12	Mon 4/2/12
		Biosolids Management Long Term Contract (Technology Based Option)	**Tue 10/4/11**	**Mon 7/28/14**
		Design	Tue 10/4/11	Thu 10/4/12
		Tender and Award	Fri 10/5/12	Thu 1/31/13
		Construction	Fri 2/1/13	Fri 5/2/14
		Commissioning and Testing	Mon 5/5/14	Fri 7/25/14
		Earliest Operational Date for New Technology	Mon 7/28/14	Mon 7/28/14



R.V. Anderson Associates Limited
environment · infrastructure

APPENDIX A

Urban and Environmental Management Inc., *"Peterborough Landfill & Biosolids Disposal Recommendations for Additional Biosolids Processing and/or Diversion from Landfill*," November 10, 2009.

UEM URBAN & ENVIRONMENTAL MANAGEMENT INC. PROFESSIONAL CONSULTING SERVICES

Memo 08-107

To: Craig Simmons, Melanie Kawalec
City of Peterborough

From: Paul Flood, M.Eng., P.Eng., DCE

Date: November 10, 2009

Re: Peterborough Landfill & Biosolids Disposal Recommendations for Additional Biosolids Processing and/or Diversion from Landfill

---

We have reviewed the October 2009 biosolids option study executive summary report by RVA. This memo is based on our discussions with Peterborough Landfill operations staff, the design and current operation of the Landfill, and experience with biosolids processing and landfilling.

1. Initial Review Comments

a. It needs to be appreciated that the Landfill can no longer, at least not in the near future, accept the quantities and characteristics of biosolids currently being generated by the City of Peterborough wastewater treatment plant. If the small remaining capacity at the top of the existing South Fill Area (SFA) receives any more biosolids, the final surface of the SFA will be too weak to support the heavy equipment required to install the final cover or maintain proper vegetation and drainage to support the long term needs of the final contours. Similarly, the new North Fill Area (NFA) should not receive any biosolids at least until the base of the Landfill is covered by at least 3 to 4 m of waste to protect the integrity of the leachate collection system.

b. If biosolids must continue to be landfilled, they should be more dewatered, stabilized, and/or mixed with solid waste that has some structure to achieve any operational success. If there were adequate quantities of construction/demolition and/or leaf & yard waste materials available to mix with the biosolids, the operations might become somewhat manageable. However in that case, those recyclable resource materials would be wasted and use up valuable landfill space.

c. Landfill operations staff is only capable of operating a limited tipping area and working face to allow disposal truck access and minimize daily and intermediate cover requirements. This landfill working space near the top of the SFA is also getting smaller. The quantity and moisture content of the biosolids are too high for the size and location of the working area (within a few metres of the top of waste elevation) and the limited waste quantities available for mixing. Landfill staff is being asked to do something almost physically impossible with the type of waste being mixed with the biosolids i.e. mostly weak and wet refuse, ultimately generating a very soft working surface for continued landfill and final cover operations.

d. In our view, for the biosolids to continue to be landfilled in the SFA or the NFA, additional processing is necessary at the sewage treatment plant and/or the Landfill to further stabilize and dewater the sludge. RVA has this experience in London including fast-tracking the required engineering design, approvals, and construction of such processing equipment during the period when London's incinerator was out of service for a number months.

e. MOE should also take a more accommodating and helpful position. Perhaps the approvals process could be streamlined to add more biosolids processing and storage facilities at the wastewater treatment plant including consideration of the Class EA and C. of A. process.

f. The City of Kawartha Lakes is presently land applying some of their treatment plant biosolids using contract storage and operations. This approach and similar potential partnerships should be further investigated by the City of Peterborough although it is understood that during the last few years many farmers have opted out of the program.

This next part of this memo was prepared based on our site visit of November 5, 2009 for personal observation and discussion with Landfill operations staff to verify our initial review comments noted above.

2. General Observations

1. The landfill appeared to be well operated and maintained. Operations are contracted to WMI with security personnel operating the weigh scale. Proper and sufficient equipment and personnel were on site and working continuously during the site visit. Considerable odour was noticeable with the delivery of biosolids in open dump trucks as well as during and following disposal.
2. Significant visual evidence of previously disposed biosolids was observed (black color at the surface, rutting, differential settlement, wet surface) despite efforts to mix and/or cover the material with other refuse. Clearly, proper compaction and effective use of the remaining capacity of the SFA will be difficult to achieve with the present quantities and characteristics of the biosolids being received.
3. Operating space in the SFA is becoming increasingly limited as the final contours are approached. Much of the SFA (13.5 ha) is already under final cover and only 4.7 ha of the SFA remains to be filled. The thickness of waste to be placed in the active fill area ranges from about 2 m to about 6 m with an average of about 3.5 m.
4. Optimized use of the remaining capacity of the SFA for solid waste and biosolids will be difficult considering that presently, about 5,800 tonnes of solid waste and 550 to 680 tonnes of biosolids are shipped to the site each month. The biosolids have a low solids content and generally should be mixed with about 10 times their weight (rather than 5) of other solid waste for proper stabilization and successful compaction purposes.
5. The limited working area, relative proportions of biosolids and solid waste, together with the limited thickness of material that can be placed from current to final contours, make it necessary to place biosolids over a majority of the remaining fill area to allow for successful landfilling. Wet conditions (snow, rain) will continue to render the landfilling of biosolids increasingly onerous on operating equipment and waste haul vehicles. The chemical characteristics of the biosolids will increase the strength of the leachate.

3. Summary of Discussion Items

3.1 South Fill Area

1. The SFA is approaching its approved capacity. If 70,000 tonnes of waste is landfilled annually and in the SFA only (apparent waste density of 0.63 t/m^3), the SFA will reach its approved capacity by May 2011. However, upon construction of Cell 2 (NFA) in early 2010, most if not all of the waste delivered to the site will be diverted to the NFA to cover the newly constructed liner. To place a minimum of 1.8 m of waste and daily cover over the 3.2 ha Cell 2 liner will take 5 to 6 months. If waste disposal then reverted solely to the SFA, the SFA would reach its approved capacity by December 2011. If more waste is placed in the NFA to better protect the liner and leachate collection system (3 to 4 m total) then the SFA will remain inactive for upwards of one (1) year.

2. The Landfill operator has tried a number of different techniques to tip, spread, mix, and compact biosolids with incoming solid waste, but with generally poor results. For example, trenches have been excavated into the existing waste and biosolids disposed into the trenches followed by placement of solid waste on top. This process reduced odours from the biosolids but significant operational issues continued, including wheel rutting, soft wet surface conditions, vehicles getting stuck, etc., as the biosolids/waste mix is too weak to adequately support landfill equipment and disposal vehicles that continue to travel on the Landfill.

3. Polymers used to increase the solids content of the biosolids to provide more structure break down over time, and the biosolids become more sloppy and odorous, particularly during wet weather.

4. Continued disposal of solid waste and biosolids in their current proportions (too much biosolids relative to quantity of waste) will result in significantly reduced structural integrity of the landfill surface. This will continue to negatively impact the ability of the landfill to support heavy waste haul, cover, and compaction equipment and vehicles during continued waste disposal and final cover placement operations.

5. Continued placement of biosolids/waste so close to the final elevations of the SFA will result in difficulties in final cover placement. This includes the inability to adequately shape the top of the fill area to place final cover soil and topsoil, provide positive surface water drainage ditches, etc. as rutting will occur during material placement, compaction, and grading activities.

6. Over time, significant differential settlement is expected to occur in areas that contain biosolids due to the accelerated waste decomposition process inherent in those areas. This could cause surface water to pond in depressions which would generate higher volumes of leachate and possibly impact the operation of the gas collection system.

7. There is potential for increased gas generation due to landfilling of biosolids, but also potential for biosolids to clog the granular materials surrounding gas collection wells. Soft areas in the final cover (due to underlying biosolids and subsequent differential settlement) could also result in the development of erosion channels and sliding of disposed waste and cover material; potentially exposing waste and allowing air to infiltrate the gas collection system and reduce the quality of collected gas.

8. All of the above will result in increased cell closure and post closure operating and maintenance costs and reduced effectiveness of the final soil and vegetative cover.

9. Landfill workers will continue to struggle with biosolids odour. Workers at other municipal landfills have refused to work under conditions involving the disposal of biosolids due to odour and health & safety concerns.

3.2 North Fill Area

1. Construction of the engineered controls associated with the new NFA is currently underway. The liner and leachate collection system for Cell 2 (the first waste disposal cell in the NFA) will be constructed in early 2010. Waste disposal is expected to start in the NFA by mid 2010.

2. Disposal of biosolids near the base of the NFA will be of even greater concern than continued disposal on top of the SFA. Some landfill sites do not permit the disposal of biosolids within several metres of the liner and leachate collection system. Other landfills do not permit the disposal of biosolids at all except under emergency conditions.

3. Biosolids have a high moisture content and low strength. These materials do not adequately support the weight of construction equipment and waste haul vehicles. This is particularly problematic within close proximity to a newly constructed liner and leachate collection system as rutting of the fill area surface could be deep possibly tearing or damaging the geotextile protecting the leachate collection system.

4. Migration of biosolids toward and into the leachate collection system can cause biologic clogging of the geotextile and stone surrounding the leachate collection system. This could render the leachate collection system less effective and result in localized leachate mounding. A high leachate mound could reverse design hydraulic gradients (from inward to outward gradients) and eventually cause leachate to migrate out through the liner and into the native soil. Care must be taken to ensure leachate mounds do not exceed critical elevations.

3.3 Biosolids Management

1. There are other better biosolids management alternatives available, including resource recovery, however they are more expensive. Class EA and C. of A. requirements could delay the selection and implementation of available alternatives.
2. The Peterborough wastewater treatment facility has some lagoon biosolids storage capacity available. Can it be used again for storage of some of the biosolids quantities, at least until sufficient drying and stabilization has occurred? Can additional processing take place at the plant to decrease water content, increase solids content and reduce odours?
3. Previously, Peterborough biosolids were land applied, as is still the case for some Kawartha Lakes material. Biosolids were also previously hauled away under contract for land application in southwestern Ontario. Can this practice be resumed for some of the biosolids material?

4. Conclusions and Recommendations

1. If the SFA is to continue to accept biosolids without additional dewatering and/or other stabilization methods (e.g. lime addition) the biosolids should only be placed in areas where remaining waste thickness is greatest i.e. near the centre of the fill area. A minimum of 3m of waste should be placed in all areas below the bottom of final cover to support its construction.
2. If the quantity of biosolids cannot be reduced or alternative disposal methods arranged (e.g. land application) the characteristics of the material needs to be improved by decreasing the moisture content and increasing the solids content to provide improved stabilization and structural characteristics.
3. No biosolids should be disposed in the NFA until the entire bottom of the landfill cell is covered by at least 3 to 4 meters of solid waste. This could take about 12 to 18 months to achieve. Disposal of biosolids at present quantities and characteristics should not resume in the SFA for the operational concerns noted above.
4. It may be possible to coordinate solid waste and biosolids disposal over the short term, so that when the NFA is ready to receive waste, all solid waste is disposed of in the NFA and all biosolids are disposed of in the SFA. Operational changes will be required in the SFA to accommodate such activities. This includes mixing the biosolids with compost, wood chips, contaminated soil etc and spreading the material in thin lifts using light or wide track equipment. Operating costs will increase with the operation of two (2) tipping areas.
5. The remaining life of the SFA is about 24 months (end of 2011) assuming that all waste delivered to the site in mid to late 2010 will be diverted to the NFA for at least 6 months to protect the liner that will be constructed at the NFA in early to mid 2010. We recommend that the new NFA, when constructed, not receive any biosolids until at least 3 to 4m of waste and daily cover have been placed on top of the cell bottom liner. This means that significantly reduced quantities of biosolids should be received at the Landfill for the next 2.5 to 3 years unless significant additional processing/stabilization takes place. Ideally, an alternate method for the management of all biosolids should be developed and put in place as soon as possible.

Prepared & respectfully submitted by
Urban & Environmental Management Inc.

P.T. Ford

c Joe Ovcjak, P.Eng., DCE; Senior Landfill Design Engineer