



City of Toronto BIOSOLIDS MASTER PLAN UPDATE

Executive Summary

Prepared for the City of Toronto
by:

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City of Toronto

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1. Introduction

All aspects of water production, transmission and distribution, wastewater collection and treatment, and stormwater collection, transmission and treatment in the City of Toronto are the responsibilities of Toronto Water. The division manages and operates a large number of facilities. Just a few of these facilities include four water treatment plants and four wastewater treatment plants.

Two major services that result from managing these facilities include:

- Providing high quality drinking water to consumers
- Treating the wastewater that flows from residences and industry to remove contaminants and discharge a clean effluent back to the environment

The City owns and operates four water treatment plants (TPs), which treat water from Lake Ontario. Toronto's water treatment process meets or exceeds all standards set for drinking water by the provincial and federal environmental ministries. As a result of the process to treat water, a solids residue, referred to as *residuals*, is generated. The residuals are mostly inorganic in nature. The City treats over 1.4 million cubic metres of water every day and generates approximately 2,600 tonnes (reported as dry solids) of water residuals every year.

The City also owns and operates four wastewater treatment plants (TPs). Treated effluent from the three largest plants is discharged through long outfall pipes into Lake Ontario. Effluent from the smallest plant, North Toronto Treatment Plant, is discharged into the Don River, which eventually flows into Lake Ontario. The treatment of wastewater generates a residue, referred to as sludge. The sludge is mostly organic in nature, with high nutrient value, in terms of phosphorus and nitrogen. Currently at the City's wastewater treatment plants, sludge is further processed to stabilize the organics and reduce pathogen content. The stabilized sludge is referred to as *biosolids*. The City treats over 1.3 million cubic metres of wastewater every day and generates approximately 54,500 tonnes (reported as dry solids) of wastewater biosolids every year.

As part of the City's mandate to provide water and wastewater services, it is responsible for planning and providing for the management of wastewater biosolids and water residuals.

In the fall of 2002, the City of Toronto initiated a Biosolids and Residuals Master Plan (BRMP) to provide direction on the future management of biosolids and water residuals generated by the City's water and wastewater treatment plants to the year 2025. The BRMP was undertaken to fulfill planning requirements defined in Ontario's Environmental Assessment Act, and according to the Municipal Engineers Association Class Environmental Assessment (EA) process (MEA, 2000).

A draft of the BRMP was released for a 30-day public comment period on September 16, 2004. As a result of some public comments about the recommended biosolids management options, the City of Toronto undertook a Peer Review of the draft BRMP. The peer review results focused on the decision-

making model and the scoring criteria used to establish the recommendations related to biosolids management, and made recommendations for improving the Master Planning process.

In light of these recommendations, and changes to the biosolids management opportunities, regulations, costs and constraints since the draft BRMP was issued in 2004, the City of Toronto initiated the Biosolids Master Plan (BMP) Update in 2008. The planning completed under this update project follows the Class EA Master Planning process, including consultation with the public and project stakeholders.

The goal of this project is to deliver an updated BMP report that the City will use as a guide to plan for future projects and activities for biosolids management.

Since the BRMP was released in 2004, the City has proceeded with separate planning studies and design projects for the management of residuals from each of its water treatment plants. As such, this BMP Update only provides an update of the status of those projects and focuses upon biosolids management planning for the City's four wastewater treatment plants.

2. Purpose

The purpose of the Biosolids Master Plan (BMP) Update study is to plan for the future management of biosolids from each of the four wastewater treatment plants in the City of Toronto in a manner that is sustainable, reliable, environmentally sound, cost-effective and flexible.

The development of the Master Plan had the following objectives:

- To document the status of the existing biosolids program at each treatment plant, in terms of process capacity, availability and reliability
- To prepare a Problem/Opportunities statement, which identifies the limitations in the existing program at each of the City's wastewater treatment plants and opportunities and constraints related to future management of biosolids
- To complete a comprehensive review of a broad range of biosolids management options available locally and globally and identify those feasible for each individual wastewater treatment plant
- To develop a decision-making process, that reflects the priorities and goals of the City, public and other stakeholders, to be used in selecting preferred options for each plant
- To identify a biosolids management strategy for each plant, that includes one or more of the preferred options and to define a plan for implementing the strategy
- To fulfill the requirements of Phases 1 and 2 of the Municipal Engineers Association Class Environmental Assessment Master Planning (MEA, 2000 as amended in 2007) process in the preparation of the Biosolids Master Plan Update.

3. The Class Environmental Assessment Master Planning Process

The BMP Update has been completed following the Master Plan process defined in the Municipal Class Environmental Assessment (EA) for water, wastewater and road projects, prepared by the Municipal Engineers Association (October 2000, as amended in 2007). The Master Plan satisfies the requirements of Phases 1 and 2 of the Class EA process, described as follows:

- Phase 1 Problem Definition
- Phase 2 Identification and Evaluation of Alternative Solutions to Determine a Preferred Solution

The Master Plan must document public and agency consultation at each phase of the process and a reasonable range of alternative solutions must be identified and systematically evaluated. Public consultation activities completed as part of the BMP Update included:

- A Project Initiation notice
- A letter informing stakeholders of next steps in the BMP Update
- A project web site at www.toronto.ca/biosolids_masterplan
- A project mailing list
- Two project newsletters for the BMP Update, in addition to 5 newsletters issued as part of the draft BRMP
- City staff contact: A Public Consultation Co-ordinator, who is available to respond to comments or questions about the project, at (416) 392-4390, TTY (416)-397-0831, Fax: (416) 392-2974
- Project email address, biosolids@toronto.ca
- Public information sessions at two points during the BMP update, in addition to the two sets of public information sessions held as part of the draft BRMP. In total, four sets of public information sessions were held, for a total of 18 events.
- Notice of Completion

In addition to the above noted public consultation activities, there was significant public consultation undertaken as part of the draft BRMP process, including the formation of an Advisory Committee, and input from that program was used in the completion of the BMP Update as well.

This report has been prepared to document the City of Toronto Biosolids Master Plan (BMP) and its development. A Notice of Completion has been published in local newspapers and has been distributed to those on the project contact list. A 30-day public review period commenced October 1, 2009.

The City's Project Team will work to resolve all outstanding issues prior to the close of the 30-day public review period. It may be noted that the BMP is not eligible for a Part II Order request to the Minister of the Environment, since it is being developed as a municipal Master Plan under the Class EA process. Furthermore, it can be noted that all projects being recommended in this BMP Update document fall into the category of Schedule A projects, as described above; and therefore, once approved by Council, the

City can proceed to implement recommendations with no further planning under the Class Environmental Assessment Act.

4. Development of Master Plan Update

As discussed in Section 1, the City of Toronto initiated a Biosolids and Residuals Master Plan (BRMP) in 2002 to provide direction on the future management of biosolids and water residuals generated by the City's water and wastewater treatment plants to the year 2025. As a result of some public comments about the recommended biosolids management options, the City of Toronto undertook a Peer Review of the draft BRMP. The peer review results focused on the decision-making model and the scoring criteria used to establish the recommendations related to biosolids management and made recommendations for improving the Master Planning process.

In light of these recommendations and changes to the biosolids management opportunities, regulations, costs and constraints since the draft BRMP was issued in 2004, the City of Toronto initiated the Biosolids Master Plan (BMP) Update in 2008.

The BMP Update was developed in the following steps:

1. The decision-making methodology used to evaluate biosolids management options for each treatment plant was reviewed and updated. In addition, the City retained Ipsos Reid, a marketing research firm, to complete a public opinion survey to identify the values of residents as related to factors affecting biosolids management. The information obtained from this survey was used in the update of the evaluation methodology.
2. The operational status of the City's wastewater treatment plants and biosolids management program was updated based on recent data.
3. The review of biosolids management options available in Canada and around the world, completed for the draft BRMP, was updated based on the most recent regulations, markets, technologies and experience.
4. The long list of biosolids management options was reviewed for each plant, considering plant needs and constraints, to identify those options feasible for each plant.
5. Information on each biosolids management option presented in the draft BRMP was updated. This information includes capital and operation costs, greenhouse gas impacts and pollutant emissions.
6. The updated decision-making methodology was used to complete a comparative evaluation of options for each plant and to identify those that ranked highest, indicating they best met the

evaluation criteria. Information from the Ipsos Reid survey regarding public opinion about the management options was considered in the evaluation.

7. Implementation considerations and strategies for each wastewater treatment plant were developed.

Several related studies were referenced in the preparation of the BMP update, including:

- BRMP Peer Review
- Ipsos Reid Public Opinion Research Study
- Toronto Public Health Studies
- Wet Weather Flow Management Master Plan

5. Source and Characteristics of Biosolids

Biosolids may be described as a nutrient-rich material that results from the biological treatment of municipal wastewater. Biosolids are generated in liquid form and typically have a solids content of approximately 2 to 4%. The material may be further mechanically processed to remove water, to make the remaining dewatered biosolids into a cake like material containing about 25 to 30% solids, making it amenable to a number of management methods.

- Biosolids contain nutrients important to plant growth, including nitrogen and phosphorus compounds at levels suitable for use as fertilizers
- Biosolids used as a soil amendment improves pH buffer capacity and water retention capacity
- The volatile solids portion of biosolids offer a fuel value that is approximately half that of natural gas
- When dewatered to a solids content greater than 20%, biosolids resemble a soil-like cake. This significantly reduces their volume and weight
- Anaerobic digestion significantly reduces the pathogen content and vector attractiveness of biosolids
- The levels of metals and trace contaminants in biosolids can be reduced through appropriate control of industrial discharges to the wastewater collection system. Toronto biosolids readily meet the metals standards for application to agricultural land and for use as fertilizers.

6. Biosolids Status Review

Wastewater generated in the City of Toronto is treated in one of four treatment plants (TP):

- Ashbridges Bay TP
- Humber TP
- Highland Creek TP

- North Toronto TP

The four plants use conventional activated sludge (CAS) processes that generate biosolids through anaerobic digestion. Ashbridges Bay TP and Highland Creek TP both mechanically dewater their biosolids to generate a biosolids cake with 26-28% solids content, while Humber TP and North Toronto TP generate liquid biosolids with 2-4% solids content.

Biosolids Management at Ashbridges Bay TP

Currently, biosolids from Ashbridges Bay TP are managed in the following manner:

- Pelletization for use as a fertilizer product
- Beneficial use of biosolids in cake form, including:
 - Beneficial use on agricultural land
 - Alkaline stabilization
 - Degraded site reclamation
- Municipal solid waste landfill

Pelletization

Following a fire in August 2003, the reconstruction of the pelletizer facility commenced in 2005 and was completed in 2008. The pelletizer facility is now operated under an agreement with Veolia Water which includes the operation and maintenance of the facility as well as the marketing of pellets. In 2008, during commissioning, the pelletizer facility processed 9,000 dry tonnes of pellets.

Beneficial Use on Agricultural Land

The City has a contract for the agricultural land application of biosolids cake with Terratec Environmental, who has been the contractor since the program commenced in 1996. The terms of the contract require that Terratec take responsibility for all necessary approvals and permits for both the hauling operations and the agricultural sites receiving biosolids. The City is responsible for ensuring that the biosolids quality meets all regulatory requirements to be suitable for agricultural land application in Ontario. In addition to the Terratec contract, the City has entered into several other short-term biosolids management contracts, including GSI Environmental Inc. (GSI), who also manages a portion of biosolids by beneficial use on agricultural land in Eastern Ontario.

Approximately 6,200 dry tonnes of biosolids was applied to agricultural land during 2008, representing approximately 14% of the biosolids generated at Ashbridges Bay TP.

Alkaline Stabilization

Integrated Municipal Services (IMS) is currently contracted to manage a minimum of 2,700 dry tonnes per year of biosolids at their N-Viro technology site in New York State. The N-Viro technology involves adding

an alkaline material to the biosolids in order to further stabilize it. The resulting material is used as a fertilizer. The services provided by IMS include transport and haulage to the site and marketing of the fertilizer produced. In 2008, 2,720 dry tonnes of biosolids was managed using this alkaline stabilization process.

Degraded Site Reclamation

A portion of the biosolids managed by GSI is currently managed using land application at mine degradation and rehabilitation sites in Quebec. In 2008, 2,217 dry tonnes of biosolids was managed by application to degraded sites.

Landfill

The City has contracts in place with Terratec Environmental, GSI and IMS to provide haulage of the City's biosolids to various approved landfill sites, including the City's recently purchased Green Lane landfill site. In 2008, 22,544 dry tonnes of biosolids were disposed of in landfills, representing approximately 53% of the biosolids generated at the Ashbridges Bay TP.

Biosolids Management at Humber TP

Liquid biosolids and some waste activated sludge is discharged to the Mid-Toronto Interceptor (MTI), where it is blended with wastewater from other parts of the City before entering the Ashbridges Bay TP for management.

Biosolids Management at Highland Creek TP

Biosolids generated at the Highland Creek TP are incinerated onsite by multiple hearth incinerators. There are two incinerators available for this purpose, each with reported capacity for about 35 dry tonnes of biosolids per day. One incinerator is intended to operate as duty, with the second in stand-by and contingency mode. Incinerator ash is stored in on-site ash storage lagoons. Ash is removed from the lagoons once a year and hauled off site to be disposed of at Green Lane landfill.

Biosolids Management at North Toronto TP

Liquid biosolids from the North Toronto TP are discharged to the Coxwell Trunk Sewer and combined with raw wastewater collected in this sewer, for treatment with incoming raw wastewater at Ashbridges Bay TP.

Table 1 summarizes information for all four of Toronto's wastewater treatment facilities for comparative purposes.

Table 1 Summary of City of Toronto Wastewater Treatment Plant Biosolids Management Status

Feature ¹	Facility			
	Ashbridges Bay TP	Humber TP	Highland Creek TP	North Toronto TP
Wastewater treatment process	All facilities are conventional activated sludge plants with chemically assisted phosphorus removal and effluent disinfection.			
Approved plant wastewater capacity (m ³ /d)	818,000	473,000	219,000	45,500
Biosolids processes following anaerobic digestion	Centrifuge dewatering	None	Centrifuge dewatering	None
Current biosolids management approaches	Beneficial use of biosolids cake: <ul style="list-style-type: none"> – Agricultural land application – Alkaline stabilization – Land reclamation Drying/ pelletization and product distribution Municipal waste landfill (contingency)	Discharge to Mid-Toronto Interceptor sewer for co-management at Ashbridges Bay TP	Multiple hearth incineration Ash storage in lagoons Ash disposal at Green Lane landfill	Discharge to Coxwell Trunk Sewer for co-management at Ashbridges Bay TP
Current Average Biosolids (dry tonnes of solids/d)	106.1 ² 57.4 ³	58.5 ⁴	29.2	1.2
Biosolids generation estimates – at rated capacity (dry tonnes of solids/d)	138.1 ² 76.6 ³	73.7 ⁵	31.5	1.8
Notes: <ol style="list-style-type: none"> 1. m³/d – volumetric raw wastewater flow rate measured in cubic metres per day 2. Includes amounts generated as a result of treating solids discharged from Humber TP and North Toronto TP. 3. Excludes Humber TP management at Ashbridges Bay TP. 4. Current estimate includes unprocessed WAS discharged to Ashbridges Bay TP. 5. Future is based on digestion of all raw sludge and WAS at Humber TP. 				

Table 2 summarizes problem and opportunities for each facility in order to develop biosolids management options specific to each facility.

Table 2 Summary of Problems, Opportunities and Constraints for Each Treatment Plant

Feature	Facility			
	Ashbridges Bay TP	Humber TP	Highland Creek TP	North Toronto TP
Existing management strategy	<ul style="list-style-type: none"> Beneficial use program (agricultural land application) Drying/pelletization and product distribution Several short-term contracts (alkaline stabilization, land reclamation, landfilling) 	<ul style="list-style-type: none"> Discharge to Mid-Toronto Interceptor for co-management at Ashbridges Bay TP 	<ul style="list-style-type: none"> Multiple hearth incineration Ash storage in lagoons Ash disposal in municipal waste landfill 	<ul style="list-style-type: none"> Discharge to Coxwell Trunk Sewer for co-management at Ashbridges Bay TP
Problems	<ul style="list-style-type: none"> Agricultural land availability is limited, and capacity for only approximately 15% has been provided in the last several years Pelletizer has capacity for approximately 25-30% of the biosolids generated at the plant Short-term contracts to manage biosolids that exceed the capacity of the pelletizer or land application program can result in an increase in costs and do not provide a reliable or sustainable solution 	<ul style="list-style-type: none"> Ashbridges Bay TP, where Humber TP biosolids are managed, does not currently have sufficient capacity to manage all biosolids 	<ul style="list-style-type: none"> Based on operation of one incinerator as duty and the other as standby, the existing incinerators do not provide adequate capacity for current and projected peak month solids generation rates. 	<ul style="list-style-type: none"> Ashbridges Bay TP, where North Toronto TP biosolids are managed, does not currently have sufficient capacity to manage all the biosolids

Feature	Facility			
	Ashbridges Bay TP	Humber TP	Highland Creek TP	North Toronto TP
Opportunities	<ul style="list-style-type: none"> Utilize pelletizer to its maximum capacity to take advantage of City's capital investment and operating agreement Maintain beneficial use program to the extent possible Develop a sustainable plan for future management of biosolids to provide contingency and ensure reliable operation 	<ul style="list-style-type: none"> Develop a sustainable plan for future management of biosolids to provide contingency and ensure reliable operation 	<ul style="list-style-type: none"> Develop a sustainable plan for future management of biosolids to replace capacity of multiple hearth incinerators, to provide contingency and ensure reliable operation 	<ul style="list-style-type: none"> Continue to manage biosolids at Ashbridges Bay TP because North Toronto TP generates a small amount of biosolids that do not affect processes at Ashbridges Bay TP
Constraints	<ul style="list-style-type: none"> Existing incinerators at the Ashbridges Bay TP site are no longer operational and cannot be readily replaced with newer incinerators unless an Individual Environmental Assessment is completed, as required by the Ashbridges Bay TP Mediation Agreement 	<ul style="list-style-type: none"> There is very limited space available at the Humber TP site, especially in view of the close proximity of residential properties. Space for dewatering and truck loading facilities is available; however, further on-site processing is not feasible at the Humber TP site 	<ul style="list-style-type: none"> The existing incinerators at the Highland Creek TP are currently undergoing repairs and upgrades; however remaining reliable service life is estimated at 5 to 10 years with these upgrades 	<ul style="list-style-type: none"> The smallest of Toronto's wastewater treatment plants with limited opportunity to benefit from economies of scale Plant location and access makes any increase in the facility footprint or traffic volume problematic

7. Project Decision-Making

In overview, project decision-making for the BMP Update followed these steps:

1. *Identify Long List of Biosolids Management Options*

A long-list of options was identified following a review of biosolids management practices in North America, Europe, Japan and Australia.

2. *Identify Feasible Options for Each Wastewater Treatment Plant*

Management options unique to each treatment plant were identified to address the limitations and take advantage of the opportunities identified in the problems/opportunities statement for each treatment plant.

3. *Identify the Highest Ranking Management Options for Each Wastewater Treatment Plant*

Using the decision-making tool selected for the project, each feasible management option was evaluated to identify the management option(s) that best met the selection criteria for each wastewater treatment plant.

4. *Assess Decision Making Process and Results*

Both the decision-making process and results of the evaluation were assessed against the principles of good governance.

Decision-Making Principles

The world of biosolids management presents many complex choices. *Management options* (such as beneficial use, landfill, etc.) and *processing technologies* (such as dewatering, pelletization, alkaline stabilization, incineration, etc.) should be optimally combined to meet the needs of each individual treatment plant and community. This involves the consideration of a range of biosolids management and process technology combinations for each of the four treatment plants in the development of the Master Plan for the City of Toronto.

To this end, two important principles guided the development of the BMP Update:

- Decision-making must follow internationally recognized principles of good governance, such as participation, transparency and accountability
- The decision-making tool adopted must be appropriate to this study and to the assessment of sustainability

For the draft BRMP and this BMP Update, the multi-criteria analysis (MCA) decision-making model was utilized. The project team acknowledged the need to develop and weight the criteria through consultation with stakeholders. Members of the general public, the Biosolids and Residual Master Plan Advisory Committee and City staff were consulted during development of the draft BRMP. Public opinion research and additional public input received during public information sessions was used to augment this information in this BMP Update. A reasonable, reproducible and robust decision-making process, as required by Ontario's Class Environmental Assessment Master Planning process, was ensured by:

- Seeking a broad range of opinion
- Attempting to build consensus in the development of the decision-making process
- Considering input from an extensive consultation process with a broad range of stakeholders

During the peer review and the February 2009 public consultation sessions, a number of suggestions for improvement in the model were tabled. As a result, the model has been revised for this BMP Update with the overall objective being to make the evaluation process more easily understood by stakeholders. Specifically, the objectives were to:

- Eliminate overlap among criteria
- Reduce the number of criteria
- Provide clear definitions for the criteria
- Explain how options are to be evaluated relative to one another
- Establish the relative importance of the criteria (i.e., weights) based on information available from the draft BRMP as well as public opinion research and public consultation undertaken during this BMP Update

In order to make the decision-making process more easily understood, this BMP Update has adopted the 'Triple Bottom Line' approach, which is represented by three performance indices: an Environmental Index, a Social Index and an Economic Index. The Environmental Index reflects risks and impacts to the natural environment of each biosolids management option, the Social Index reflects the human social environment, while the Economic Index reflects cost and risks and impacts to the fiscal environment. All evaluation criteria in the BMP Update fall under one of these three major categories.

Although in this type of model, weightings are usually evenly distributed between the three indices, for the BMP Update, the Environmental Index was weighed more heavily, followed by the Social and Cost indices. This is to reflect the level of importance of each criteria group to the public and consulted stakeholders.

It was this model that was used to evaluate the biosolids management options considered for each of the City's wastewater treatment plants.

8. Description of Biosolids Management Options

One of the first steps in the Master Planning process was to review local and global technologies and experiences of other municipalities to develop a broad list of potential ways to manage the City of Toronto's biosolids.

The purpose of the management options assessment was to gather and analyze sufficient information regarding each of the long list of biosolids management options to be able to make rational and transparent decisions regarding the feasibility of each option for use by each Toronto wastewater treatment plant.

Table 3 presents the long list of biosolids management options considered in the development of the Master Plan Update.

Table 3 Long List of Biosolids Management Options

Management Option	Processing and Resulting Material Requiring management	Markets/End Use
Beneficial Use	<ul style="list-style-type: none"> • Liquid biosolids • Biosolids cake (dewatered) • Enhanced digested biosolids cake • Thermally dried biosolids (to pellets) • Alkaline Stabilized biosolids (addition of basic material such as lime) • Composted biosolids 	<ul style="list-style-type: none"> • Agricultural land application • Land rehabilitation • Silviculture (tree farming) • Fertilizer blending (specialty horticultural market)
Thermal Reduction	<ul style="list-style-type: none"> • Incineration of biosolids cake, resulting in inorganic residual ash <ul style="list-style-type: none"> – Multiple hearth incineration – Fluidized bed incineration • Emerging thermal technologies for biosolids cake, resulting in residual ash <ul style="list-style-type: none"> – Steam reformation/pyrolysis – Plasma assisted sludge oxidation – Sludge Total Energy Recuperator Module (STERM™) 	<ul style="list-style-type: none"> • Municipal waste landfill • Incorporation into cement
Landfilling	<ul style="list-style-type: none"> • Biosolids cake (dewatered) 	<ul style="list-style-type: none"> • Municipal landfill and landfill cover • Monofill (dedicated landfill)
Co-management with Municipal Solid Waste	<ul style="list-style-type: none"> • Biosolids cake (dewatered) 	<ul style="list-style-type: none"> • Management with source separated organics

Management Option	Processing and Resulting Material Requiring management	Markets/End Use
Feed to Industrial Process	<ul style="list-style-type: none"> Biosolids cake (dewatered) 	<ul style="list-style-type: none"> Fertilizer manufacturing Direct feed to cement manufacturing Feed to fuel production

Based on the review of available technologies and end uses of biosolids, as well as the current practices in Ontario and worldwide, the following summary of biosolids management options has been provided to document the feasible options considered for the City of Toronto.

Beneficial Use Options:

- Liquid biosolids
- Dewatered biosolids and dewatered Class A biosolids
- Thermally dried pellets
- Alkaline stabilized material
- Compost (from biosolids)

The following beneficial use destinations/markets were assessed:

- Agricultural land application
- Land rehabilitation (at mine tailings areas)
- Silviculture (tree farming)
- Specialty agricultural and horticultural products

Other Biosolids Management Options:

Based on the review of other biosolids management options, the following conclusions were summarized:

- Incineration is a proven, feasible option for managing biosolids. Incinerator ash may be disposed in municipal landfills or recycled, with demonstrated experience in cement and brick manufacturing. While both multiple hearth and fluidized bed incineration technologies are used, nearly all new incinerators installed in the last 20 years have been fluidized bed incinerators due to improved performance and emissions control.
- Emerging thermal technologies, such as gasification, while showing future potential, are not adequately demonstrated to the point that their applicability for biosolids management can be confirmed.
- Biosolids as a waste feed to the municipal solid waste program now and in the future, is not generally compatible with municipal waste management options being planned by the City of Toronto.
- There are a number of proven and emerging management options where biosolids would be a feedstream to an industrial process. These options include:

- Dewatered biosolids as feed to cement manufacturing
- Biosolids/sludge as feed to fertilizer manufacturing
- Biosolids/sludge as feed to fuel product manufacturing, where fuel would be primarily used in cement manufacturing

9. Detailed Evaluation of Management Options and Development of Preferred Management Strategies

The purpose of this section is to present the detailed results from the evaluation of the long-list of biosolids management options being considered for each City of Toronto wastewater treatment plant.

Detailed information was used in the evaluation and scoring of management options for each wastewater treatment plant. In order to complete a comparative evaluation of all management options using the decision-making process, technical and cost information on each option was required. To that end, additional data were compiled and information was generated to support the evaluation of biosolids management options and the basis of their development.

Ashbridges Bay Treatment Plant

For Ashbridges Bay TP, there were eleven feasible management options evaluated, in addition to the “do nothing” alternative that compares the existing situation to those options being considered.

Table 4 presents a summary of the final scores for each of the environmental, social and economic indices used in the decision making process for each of the twelve management options considered.

Table 4 Total Weighted Scores for Ashbridges Bay TP Biosolids Management Options

Biosolids Management Option	Environmental Index	Social Index	Economic Index	Final Weighted Score
A0: “Do nothing” - Short term contracts for beneficial use and landfilling	28.2	29.3	12.6	70
A1: Beneficial use of biosolids cake	32.7	28.6	19.2	80
A2: Thermal Drying (pelletization) On-site	26.3	31.2	11.4	69
A3: Thermal Drying (pelletization) Off-site	25.1	29.7	10.9	66
A4: Alkaline stabilization On-site	30.9	27.8	11.0	70
A5: Alkaline stabilization Off-site	30.7	26.3	10.4	67
A6: Composting (including Vermiculture) On-site	31.0	28.6	12.3	72
A7: Composting (including Vermiculture) Off-site	30.7	25.5	12.2	68

Biosolids Management Option	Environmental Index	Social Index	Economic Index	Final Weighted Score
A8: Thermal reduction On-site	27.1	31.2	17.8	76
A9: Thermal reduction Off-site	26.3	30.5	16.6	73
A10: Landfilling (and landfill cover)	32.9	27.0	17.9	78
A11: Feedstream to off-site private sector industrial process	27.6	30.1	9.4	67

Based on the results, the recommended strategy includes the following:

1. **Maximizing the program for beneficial use of biosolids cake.** This will include dedicating City staff time to marketing and sourcing new opportunities for beneficial use such as land rehabilitation and tree farming, and will require expanding the City's program to establish long-term, competitively-bid contracts for management of the biosolids in a diverse range of beneficial use applications.
2. **Using landfill as a contingency measure** to backstop the program as well as dispose of varying quantities of biosolids that cannot be beneficially used at any given time. This will include hauling biosolids cake for disposal in the City's Green Lane landfill, and potentially other landfills, as established through competitively-bid long term contracts.

The primary benefits of this program over the existing 'do-nothing' solution are:

1. **Lower cost:** Existing short-term contracts were not competitively-bid and therefore potentially represent an increase in cost to the City.
2. **Better long term cost predictability:** With long term contracts, the City can negotiate pricing and be less exposed to price increases due to frequent renewals.
3. **Reliability:** Entering into long term contracts will ensure the City has a more reliable management program.
4. **Fastest implementation schedule:** Both beneficial use and landfilling options are operating now and can continue without any additional capital investments by the City.

While on-site thermal reduction scored third among the options, it is not recommended as part of the program for the Ashbridges Bay TP, for the following reasons:

1. **Delayed implementation:** Given that additional studies and environmental assessment would be required and the timelines and costs associated with the required capital investment, this project would take a minimum of 6 years to be commissioned – assuming funds were available for an immediate start.
2. **Capital budget:** The Ashbridges Bay TP has significant and pressing upgrade needs, to maintain reliable wastewater treatment and on-site solids processing. As well, anticipated new regulatory changes are expected to require that significant capital investment be made in order for the facility to remain in regulatory compliance.

3. **Community:** While the technical evaluation shows that thermal reduction on-site would have minimal community impacts, the City has plans to make significant investment in a 20-year program to improve the waterfront in the Ashbridges Bay TP area.

Humber TP

For Humber TP, there were nine feasible management options evaluated, in addition to the “do nothing” alternative that compares the existing situation to those options being considered.

Table 5 presents a summary of the final scores for each of the environmental, social and economic indices for each of the ten management options considered.

Table 5 Total Weighted Scores for Humber TP Biosolids Management Options

Biosolids Management Option	Environmental Index	Social Index	Economic Index	Final Weighted Score
H0: “Do nothing” Discharge liquid biosolids for treatment at ABTP via Mid-Toronto Interceptor (MTI)	39.2	30.9	17.9	88
H1: Discharge liquid biosolids for management at ABTP via new dedicated forcemain direct to dewatering	36.3	29.0	17.9	83
H2: Land application of liquid biosolids	30.8	24.0	16.3	71
H3: Beneficial use of biosolids cake	32.7	28.6	19.2	80
H4: Thermal Drying (pelletization) Off-site	24.9	29.3	10.7	65
H5: Alkaline stabilization Off-site	30.6	26.3	10.4	67
H6: Composting (including Vermiculture) Off-site	30.7	25.5	12.2	68
H7: Thermal reduction Off-site	23.9	30.5	16.5	71
H8: Landfilling (and landfill cover)	32.7	26.7	17.9	77
H9: Feedstream to off-site private sector industrial process	27.6	30.1	9.4	67

Based on the results, the recommended strategy for biosolids management at the Humber TP includes the following:

- Maintain the existing strategy of discharging liquid biosolids and waste activated sludge to the MTI where they are co-managed with biosolids at the Ashbridges Bay TP.**

The primary benefits of maintaining the existing ‘do-nothing’ solution are:

1. *No capital cost:* Discharging biosolids to the MTI does not require any capital investment by the City for implementation.
2. *Site capacity:* The Humber TP site is very small and has limited space for new facilities.
3. *Reliability:* The existing practice ensures that the wastewater treatment processes at the Humber TP will not be disrupted due to any construction at the Humber TP site required for all options related to independent management of Humber TP biosolids.

Highland Creek TP

For Highland Creek TP, there were eleven feasible management options evaluated, in addition to the “do nothing” alternative that compares the existing situation to those options being considered.

Table 6 presents a summary of the final scores for each of the environmental, social and economic indices for each of the twelve options.

Table 6 Total Weighted Scores for Highland Creek TP Biosolids Management Options

Biosolids Management Option	Environmental Index	Social Index	Economic Index	Final Weighted Score
HC0: “Do nothing” Existing multiple hearth incinerators	25.7	35.4	7.8	69
HC1: Beneficial use of biosolids cake	31.4	27.8	19.2	78
HC2: Thermal Drying (pelletization) On-site	26.0	32.0	11.4	69
HC3: Thermal Drying (pelletization) Off-site	24.9	30.5	10.9	66
HC4: Alkaline stabilization On-site	30.6	27.8	11.0	70
HC5: Alkaline stabilization Off-site	30.4	26.3	10.4	67
HC6: Composting (including Vermiculture) On-site	30.7	27.8	12.3	71
HC7: Composting (including Vermiculture) Off-site	30.5	25.5	12.2	68
HC8: Thermal reduction On-site	27.9	36.6	17.8	82
HC9: Thermal reduction Off-site	26.0	30.5	16.6	73
HC10: Landfilling (and landfill cover)	32.6	27.0	17.9	78
HC11: Feedstream to off-site private sector industrial process	27.3	30.1	9.4	67

Based on the results, the recommended strategy for biosolids management at the Highland Creek TP includes the following:

1. **On-site thermal reduction.** Replacement of existing multiple hearth incinerators with new modern fluidized bed incinerators with state of the art scrubbing technology and energy recovery. An additional incinerator is planned to provide the contingency necessary to ensure reliable biosolids management capacity.

The primary benefits of this program over the existing 'do-nothing' solution are:

1. **Reliability:** Multiple hearth technology is outdated and the existing multiple hearth incinerators at the Highland Creek TP are coming to the end of their useful life and do not provide adequate firm capacity for the current and projected peak month biosolids generation rates. New modern fluidized bed incineration will ensure state of the art technologies for biosolids processing and air emission control.
2. **Public acceptance:** Public opinion research suggested that residents in areas surrounding the Highland Creek TP prefer incineration to truck traffic, which would be far greater for all other management options.
3. **Operator familiarity and acceptance:** The operations staff at the Highland Creek TP are familiar with the incineration process, which provides consistency in operations and decreases operator training requirements.

North Toronto TP

The North Toronto TP discharges digested liquid biosolids into the Coxwell trunk sewer, which ultimately directs these solids with raw wastewater for treatment at the Ashbridges Bay TP. At present the biosolids represent less than 2% of the total loading to the Ashbridges Bay TP.

Two approaches to biosolids management were considered for the North Toronto TP. A detailed evaluation was not completed for the North Toronto TP. Based on the small scale of the North Toronto TP and the site and access limitations of the Don Valley location, the preferred management option for the North Toronto TP includes the following:

1. **Continue to discharge into the Coxwell trunk sewer for management at Ashbridges Bay TP.**

The primary benefits of maintaining the existing 'do-nothing' solution are:

1. **Economy of scale:** Due to the size of the North Toronto TP, the incremental increase in costs or impacts at Ashbridges Bay TP for management of the North Toronto TP biosolids will be negligible.
2. **No capital cost:** Discharging biosolids to the Coxwell trunk sewer does not require any capital investment by the City for implementation.
3. **Site Accessibility:** The Don Valley location of the plant makes it not easily accessible and increased truck traffic could potentially be problematic.
4. **Future Uncertainty:** The future of the North Toronto TP is not clear at this time due to the implementation considerations of the Wet Weather Flow Management Master Plan.

Table 7 presents the biosolids management options for each treatment plant that scored highest using the project decision-making process, and which are included in the long-term biosolids management plan for the City of Toronto.

Table 7 Treatment Plant Strategy Alternatives

Alternative	Description
Ashbridges Bay TP	
A1	<p>Maximize existing long-term contracts for pelletization and beneficial use on agricultural land (30 to 35% of required capacity).</p> <p>Maximize the program for beneficial use of biosolids cake using long-term contracts and sourcing new opportunities in a diverse range of beneficial use applications.</p> <p>Use landfill as a contingency measure to backstop the program as well as dispose of varying quantities of biosolids that cannot be beneficially used at any given time.</p>
Humber TP	
H0	Management at Ashbridges Bay TP via Mid-Toronto Interceptor (MTI).
Highland Creek TP	
HC8	On-site thermal reduction using new state of the art fluidized bed incineration technology.
North Toronto TP	
NT0	Management at the Ashbridges Bay TP via Coxwell Trunk Sewer.

10. Implementation Plan

This implementation plan has been prepared to present the activities, studies and projects required to provide reliable, environmentally sound and cost-effective management of biosolids into the future. The implementation strategy presents the following components for each plant:

- Activities for optimizing/maximizing the current biosolids management program
- Activities required to implement the preferred biosolids management options to address existing problems/deficiencies
- Measures recommended for the City to consider to enhance the biosolids processes upstream, that will realize benefits to the City, in terms of reducing biosolids quantities and/or enhancing the energy recovery from biosolids.

In addition, this section also presents an approach to monitoring the success of the biosolids management program to provide information that will enable the City to make continuous improvements to the program.

The implementation plan, summarized in Table 8, proposes how to maximize the use of existing infrastructure and programs in the short-term and what strategies will be used in the interim period while the long-term strategy is implemented.

Table 8 Summary of Implementation Plan for the BMP

Plant	Highest Ranking Strategy	Implementation Plan
Ashbridges Bay TP	Maximize beneficial use of biosolids cake and pellet product distribution Use landfill as contingency capacity	Dedicate staff and resources to enhance and diversify markets for beneficial use Investigate and secure alternative landfill as contingency
Humber TP	Send to Ashbridges Bay TP via MTI for co-management	Continue to send to Ashbridges Bay TP via MTI for co-management Investigate and potentially implement digestion improvements to reduce solids and recover energy
Highland Creek TP	Replace existing multiple hearth incinerators with fluidized bed facility	Continue to operate and maintain the existing multiple hearth units in the interim Since multiple hearth units are being upgraded, phase in new incineration capacity as necessary Investigate and potentially implement heat recovery from incineration process
North Toronto TP	Send to Ashbridges Bay TP via Coxwell Trunk Sewer for co-management	Continue to send to Ashbridges Bay TP via MTI for co-management

Other components of the BMP Update include:

- On-going monitoring to ensure compliance with existing and future regulations, guidelines and standards
- Annual plan development and assessment of the program against the goals set out in the Master Plan, as defined for each biosolids plant strategy and also to identify opportunities for improvements
- 5 to 10 year BMP review

11. Addressing Public Questions and Concerns

The development of the BMP Update included an active public consultation program that sought out the comments and concerns of the public and other stakeholders.

BMP Update comments were received primarily through the two sets of Public Information Sessions.

From the outset of the project, the project team recognized that achieving full consensus on the issues at hand was unlikely, given the controversy surrounding biosolids management in many communities, including Toronto. Nevertheless, a Master Plan was required, and its development considered the full range of comments and concerns received throughout the project. While the BMP Update and its implementation plan will not entirely satisfy all stakeholders, the project team has reviewed it in order to make sure all comments and concerns have been considered.

The City prepared detailed tables to highlight and address comments provided through the public information sessions held as part of the BMP Update. The tables summarize comments and concerns that were raised during the BMP Update study, and the project team's responses, which highlight how these concerns have been addressed. These tables are documented in the public consultation appendix of the main BMP Update report that also outlines all the public consultation activities undertaken during the BMP Update and the drafting of the BRMP.