BIOSOLIDS MASTER PLAN FOR THE REGIONAL MUNICIPALITY OF HALTON

Prepared for:

Regional Municipality of Halton
1151 Bronte Road
Oakville, Ontario
L6M 3L1

Prepared by:

XCG Consultants Ltd.
820 Trillium Drive
Kitchener, Ontario N2R 1K4

With:

Tetra Tech
(Formerly Hydromantis, Inc.)

And

D.C. Damman and Associates

July 18, 2012

XCG CONSULTANTS LTD.
T 905 829 8880 F 905 829 8890 | toronto@xcg.com
2620 Bristol Circle, Suite 300, Oakville, Ontario, Canada L6H 6Z7

XCG File No.: 3-595-47-01
July 18, 2012

BIOSOLIDS MASTER PLAN FOR THE REGIONAL MUNICIPALITY OF HALTON

Prepared for:

REGIONAL MUNICIPALITY OF HALTON
1151 Bronte Road
Oakville, Ontario
L6M 3L1

Prepared by:

XCG CONSULTANTS LTD.
2620 Bristol Circle
Suite 300
Oakville, Ontario
L6H 6Z7

In Association with:

TETRATECH
(FORMERLY HYDROMANTIS, INC.)
420 Sheldon Dr.
Cambridge, Ontario
N1T 2H9

ES 1. EXECUTIVE SUMMARY

ES 1.1 Background

In 2009, the Regional Municipality of Halton (Halton Region) initiated the development of a comprehensive Master Plan for the management of biosolids generated at the Region's seven wastewater treatment plants (WWTPs). Biosolids are a nutrient-rich, organic by-product of the wastewater treatment process, which is currently provided to the agricultural community for beneficial reuse in crop production.

The purpose of the study was to develop a long-term, environmentally sustainable, reliable, and cost effective biosolids management program that responds to current and future program challenges. Specifically, the purpose was to evaluate biosolids Management Methods, and to recommend a Strategy that ensures the program's long-term sustainability to the year 2031. It was recognized that there were a number of challenges to be considered in the development of the strategy, including:

- Population increases (projected to double by 2031);
- Less available agricultural land;
- Finite off-season storage capacity;
- Regulatory constraints; and
- Public sensitivity.

Halton Region retained a consulting team consisting of XCG Consultants Ltd. (XCG), Hydromantis Inc. (now Tetratech), and D.C. Damman and Associates, along with selected biosolids management experts, to undertake the preparation of the Halton Region Biosolids Master Plan .

ES 1.1.1 Objectives of the Biosolids Master Plan Study and Problem Definition

The following were the objectives of the Biosolids Master Plan study:

- To complete Phases 1 and 2 of the Municipal Class Environmental Assessment (Class EA) (Municipal Engineers Association, October 2000 as amended in 2007 and 2011) process;
- To allow for public, stakeholder, and agency consultation to satisfy the requirements of the Class EA process;
- To determine and recommend preferred Biosolids Management Methods for detailed investigation and potential implementation; and
- To identify follow-up projects required to confirm the viability of the preferred Biosolids Management Methods.

Halton Region faces significant growth in a number of communities. The increase in population will have a direct impact on the amount of biosolids produced and the biosolids handling method. A long-term strategy for biosolids management must be developed to ensure proper management of biosolids and to protect human health and the environment.

ES 1.1.2 Class Environmental Assessment and Master Planning Process

The Municipal Class EA (Municipal Engineers Association, 2000, as amended in 2007 and 2011) outlines an approved planning process for municipal infrastructure projects, including wastewater projects. Municipal proponents can use the Class EA process to meet the requirements of the Ontario *Environmental Assessment Act* (EAA). Individual projects subject to the Municipal Class EA process are categorized as Schedule A, A^+, B, or C, depending on the type of project and its potential environmental effects. The Master Plan provisions of the Municipal Class EA allow municipalities to develop long range plans for integrated infrastructure requirements.

The Biosolids Master Plan was completed as a Master Plan, fulfilling the requirements of Phases 1 and 2 of the Municipal Class EA. Projects that result from the Master Planning process will be subject to the requirements of the Municipal Class EA process which may include further assessment for Schedule B activities. In addition, Phase 3 and Phase 4 requirements may need to be carried out for any Schedule C activities related to the Master Plan.

ES 1.1.3 Public, Agency, Stakeholder, and Aboriginal Consultation

Public and agency consultation is an important element of the Class EA process. A vital component of the Halton Region Biosolids Master Plan involved consultation with interested stakeholders, including regulatory and review agencies, the public, and Aboriginals. As such, a Consultation and Engagement Strategy that outlined key opportunities for participation in the Biosolids Master Plan Class EA Study was developed and followed during the Master Plan process.

A Regional Project Committee (RPC), consisting of Halton Region staff from various departments, was formed to participate and provide input to the Master Plan process. A Biosolids Master Plan Stakeholders Advisory Committee (BMPSAC) was formed to participate in the Master Plan process. Membership was by invitation, with the BMPSAC consisting of representatives from a diverse selection of agencies and stakeholders with experience in the biosolids industry.

A project mailing list was maintained throughout the Master Plan process. The mailing list was developed at the Notice of Commencement stage and names were added to the project mailing list in response to requests. In addition, key project information such as notifications, Public Information Centre (PIC) materials (i.e. display boards, comment sheet, handout) and the Master Plan Report were posted on Halton Region's web site at http://www.halton.ca/biosolids.

ES 1.2 Current and Future Quantities of Biosolids in Halton Region

Halton Region currently operates seven WWTPs that produce biosolids. There is also a Biosolids Management Centre (BMC) that provides for storage of liquid biosolids prior to land application. In 2011, 79,724 cubic metres of liquid biosolids and 13,851 tonnes of dewatered biosolids (cake) were land-applied by Halton Region's biosolids land application contractor. Liquid biosolids are primarily stored at the BMC while the dewatered biosolids are transported to the Terratec Environmental Ltd. Power-Grow facility in Niagara Region prior to land application.

The volume of anaerobically digested liquid biosolids produced in Halton Region is projected to reach 366,754 cubic metres by 2031. The amount of dewatered biosolids produced at the two WWTPs, which dewater biosolids on-site (Skyway and Mid-Halton), is expected to reach 44,298 Wet Tonnes by 2031.

ES 1.3 Development of Halton Region's Biosolids Management Strategy

ES 1.3.1 Evaluation Process

The evaluation of biosolids management methods and the development of Halton Region's Biosolids Management Strategy was a step-wise process. The process is illustrated in Figure ES1.

Key considerations in the development of the Biosolids Master Plan were Halton Region's current and future infrastructure requirements, the current biosolids management program, the commitment to organics recycling, and program diversification requirements to ensure flexibility and sustainability over the long-term. The selected methods must be proven, cost effective, protective of human health, and respectful of the environment.

The evaluation process involved a three-step process that included:

- Pre-Screening and Short Listing of Management Methods for Evaluation;
- Detailed Evaluation of Short Listed Management Methods; and
- Identification of the Preferred Strategy.

ES 1.3.2 Long List of Biosolids Management Alternatives and Methods

A large number of Biosolids Management Methods are available but there are only three end use alternatives; namely:

- Utilization on Land;
- Thermal Processes; and
- Disposal to Land.

Figure ES2 shows the three Biosolids Management Alternatives and the Management Methods that were considered for each Alternative.

Figure ES.1 Evaluation Process for Biosolids Management Methods

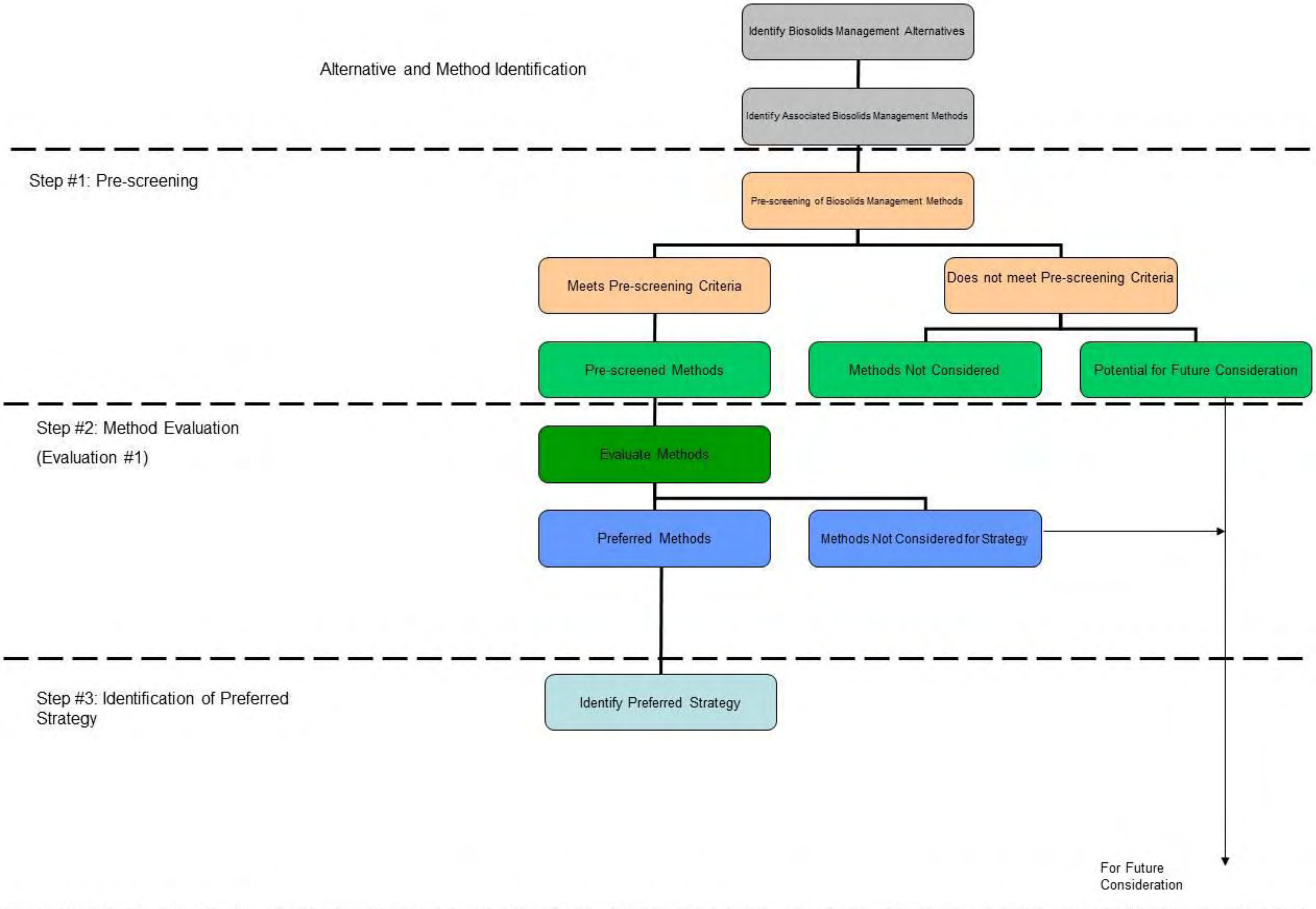
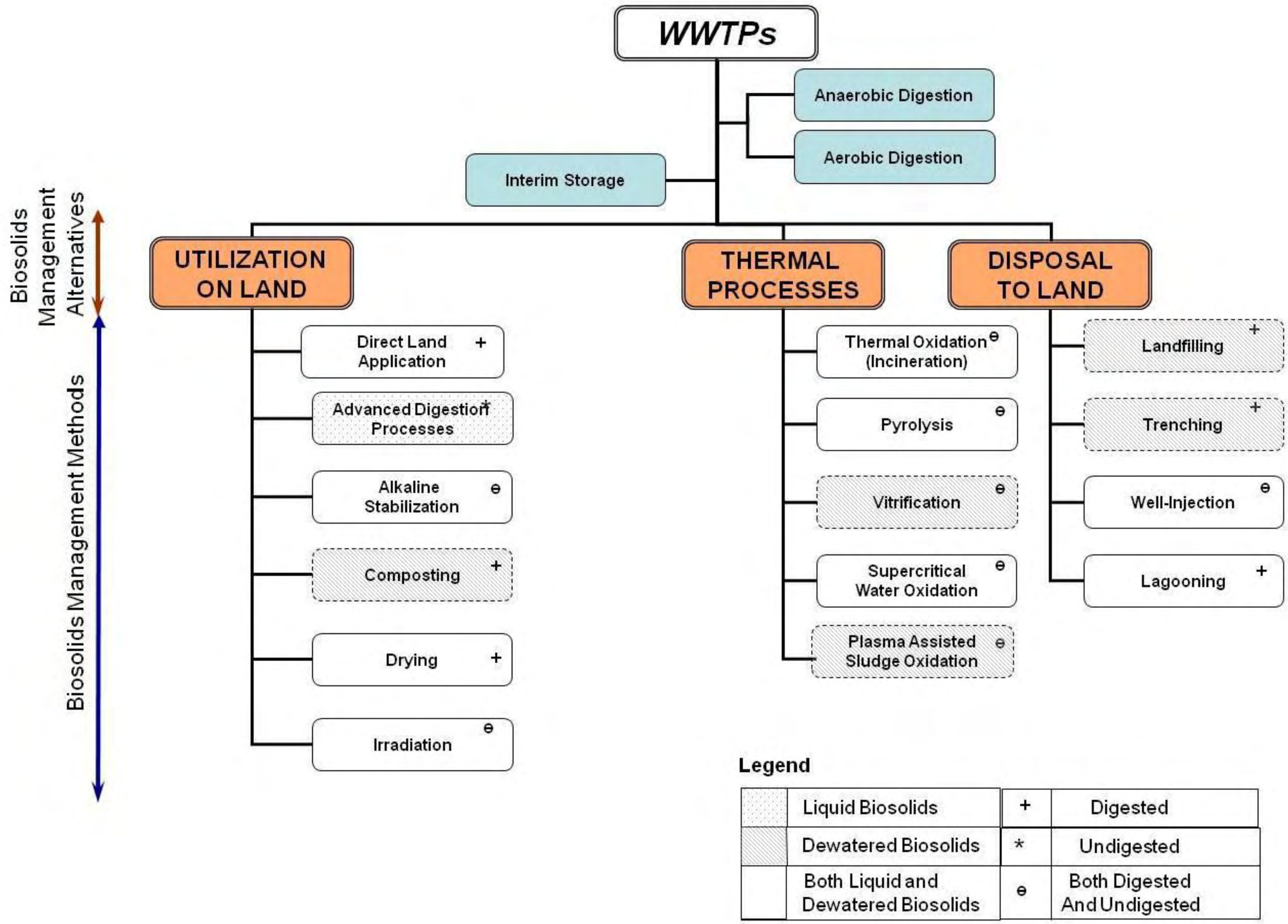


Figure ES.2 Schematic of Biosolids Management Alternatives and Methods



ES 1.3.3 Short Listed Management Methods

From the long list of Management Methods, a short list of viable Methods was developed based on the following evaluation criteria:

- Ability to meet current and potential future regulatory requirements;
- At least three known systems in full-scale operation;
- System is operating at a similar scale as potentially required for Halton Region; and
- A minimum of three years of successful operating experience at full-scale.

Each Method had to meet all of the pre-screening criteria to proceed to the detailed evaluation stage. The pre-screening process resulted in a pass or fail rating for each Method. As this is a long-term strategy, some Methods that do not qualify for detailed evaluation at this time may be of particular interest to Halton Region and may be considered in the future as more experience becomes available.

Table ES1 presents the short-list of Management Methods that met the pre-screening requirements.

Table ES1 Short-Listed Management Methods

Alternative	Method
Utilization on Land	Mesophilic Anaerobic Digestion
	Thermophilic Digestion
	Staged Anaerobic Digestion
	Alkaline Stabilization (N-Viro)
	Open Composting
	Composting Under Gore^{TM}
	In-Vessel Composting
	Heat Drying
Thermal Processes	Thermal Oxidation (Incineration)

The short list of Methods was expanded and/or refined to include additional options available to Halton Region for implementation of a particular Method. This refined list of Methods for evaluation is presented in Table ES2.

Table ES2 Refined Short-Listed Management Methods

Alternative	Method
Utilization on Land	Land Application of Liquid and Cake (Conventional Digestion)
	Land Application of Cake Only (Conventional Digestion)
	Land Application of Liquid and Cake (Advanced Digestion)
	Land Application of Cake Only (Advanced Digestion)
	Alkaline Stabilization (Regional Facility)
	Alkaline Stabilization (Shared Facility)
	Open Composting
	Composting Under Gore^{TM}
	In-Vessel Composting
	Heat Drying (Regional Facility)
	Heat Drying (Shared Facility)
Thermal Processes	Thermal Oxidation (Incineration, Regional Facility)
	Thermal Oxidation (Incineration, Shared Facility)

ES 1.3.4 Detailed Evaluation of Biosolids Management Methods

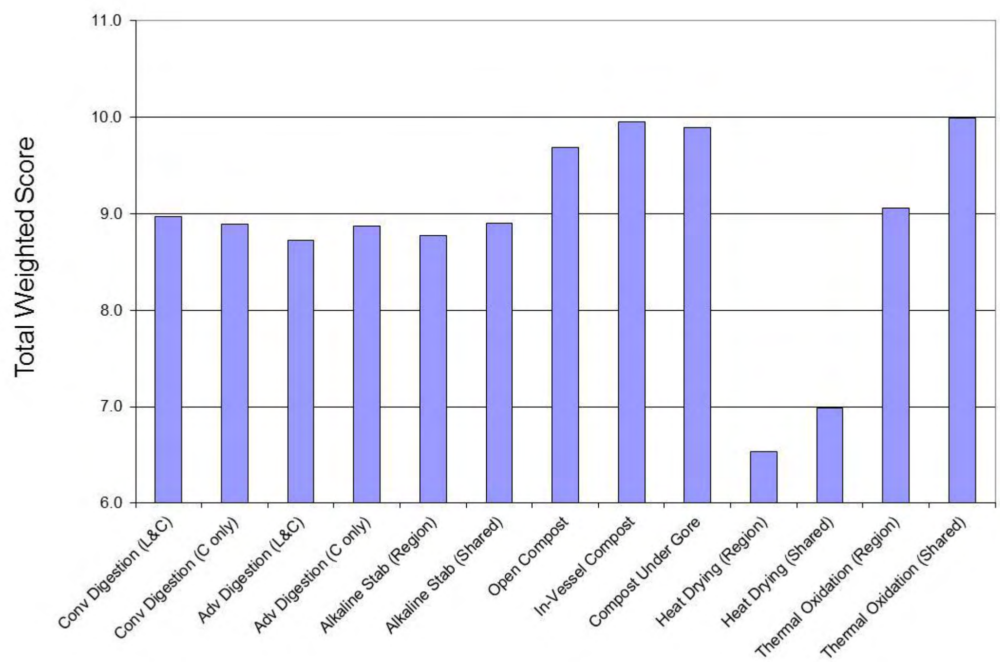
The refined short list of Biosolids Management Alternatives and Methods was evaluated based on a set of evaluation categories, criteria and weightings. The results of the detailed evaluation of the Biosolids Management Methods is shown graphically in Figure ES3.

Based on the detailed evaluation of the Methods, Thermal Oxidation (Incineration) as a partnership in a shared facility outside of Halton Region scored higher than the other Methods and is therefore ranked first.

The In-Vessel Composting, Composting Under Gore^{TM} and Open Composting Methods ranked 2, 3 and 4, respectively. As a group, these Methods ranked second and will be collectively referred to as Composting.

The next highest ranked Method was Thermal Oxidation (Incineration) as a Regional facility. However, since Thermal Oxidation (Incineration) as a partnership at a shared facility is the preferred Method, this Method in a Regional facility will not be considered further for the strategy as there is no benefit to Halton Region to include both a Regional Thermal Oxidation (Incineration) and a Shared Thermal Oxidation (Incineration) facility within the Biosolids Management Strategy. Therefore, Land Application of Liquid and Cake (Conventional Digestion) was considered to be ranked third.

Figure ES.3 Results of Detailed Evaluation of Biosolids Management Methods



In summary, Thermal Oxidation (Incineration) as a partnership in a shared facility outside Halton Region, Composting, and Land Application of Liquid and Cake (Conventional Digestion) are considered to be the preferred Methods.

ES 1.3.5 Development of a Biosolids Strategy

Inclusion of Land Application of Liquid and Cake (Conventional Digestion) as a preferred Method and an element of Halton Region's Biosolids Management Strategy continues a long and successful program in Halton Region that has resulted in a long standing relationship with the agricultural community. However, recent changes in regulations along with the development of agricultural land in Halton Region has shown that this Method as the only element of a Strategy is not sustainable in the long-term as land availability will decline and costs will increase as biosolids must be land applied at greater distances from the source. In addition, a significant increase in biosolids storage would be needed to accommodate a Land Application only strategy.

Composting was the second ranked Method and its use in Halton Region as part of the Strategy would augment and diversify the existing land application program by diversifying the market and providing a higher quality product to other potential users outside of the agricultural community. Inclusion of composting in Halton Region's Biosolids Management Strategy satisfies two of the key strategy considerations by continuing the Region's relationship with the agricultural community while diversifying with an enhanced product that may attract new agricultural users and new end users such as landscapers. However, the new Composting Guidelines are still in draft form and the market in Ontario for a biosolids compost product is uncertain at this time; therefore, considerable additional effort will be needed to determine the optimum biosolids composting process, the preferred product, and the marketability of a compost product containing biosolids.

Thermal Oxidation (Incineration) as a partnership in a shared facility outside Halton Region was the first ranked Method based on the evaluation process. Thermal Oxidation (Incineration) effectively diversifies Halton Region's Biosolids Management Strategy as it is the only Method that does not depend on land application in some form as the final end use. Further, Thermal Oxidation (Incineration) reduces the risk associated with the other two elements of the Strategy as it is not sensitive to weather conditions, product acceptability, or market issues that challenge the other two Methods of the strategy. Current Thermal Oxidation (Incineration) technologies comply with all recent stringent emission regulations and can produce recoverable energy.

ES 1.3.6 Preferred Biosolids Management Strategy

Halton Region's Preferred Biosolids Management Strategy involves:

- Continued Land Application to the extent that costs are controlled and reasonable, and vulnerabilities are minimized;
- Investigation of Composting opportunities to enhance Halton Region's land application program; and
- Investigation of Thermal Oxidation (Incineration) partnership opportunities at a facility outside of Halton Region to diversify the Strategy.

ES 1.3.7 Proposed Implementation Plan

Each of the three Methods (Land Application of Liquid and Cake; Composting; and Thermal Oxidation) could be an integral part of the Region's Biosolids Management Strategy, depending on the outcome of further investigations. Further investigations will be needed to define the specific details of each element of the Strategy [e.g. composting method, allocation of biosolids to each method, partnership options for Thermal Oxidation (Incineration), etc.].

Key decisions that will need to be made by Halton Region regarding the Preferred Biosolids Management Strategy include:

- The quantities and sources of liquid and dewatered biosolids that can be accommodated in a sustainable land application program (including storage requirements);
- The feasibility of composting biosolids;

- The details of a partnership agreement for Thermal Oxidation (Incineration) of biosolids;
- The approximate quantity of biosolids that should be allocated to each element of the Strategy to minimize risk and optimize the cost of the program; and
- The need for and location of additional dewatering.

These decisions will allow the final costs and details of the Biosolids Management Strategy to be defined.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1. INTRODUCTION AND PURPOSE

In 2009, the Regional Municipality of Halton (Halton Region) initiated the development of a comprehensive Master Plan for the management of biosolids generated at the Region’s seven wastewater treatment plants (WWTPs). Biosolids are a nutrient-rich, organic by-product of the wastewater treatment process, which is currently provided to the agricultural community for beneficial reuse in crop production.

The purpose of this study was to develop a long-term, environmentally sustainable, reliable, and cost effective biosolids management program that responds to current and future program challenges. Specifically, the purpose was to evaluate biosolids management alternatives and methods, and to recommend a strategy that ensures the program’s long-term sustainability to the year 2031. It was recognized that there were a number of challenges to be considered in the development of the strategy, including:

- Population increases (projected to double by 2031);
- Less available agricultural land;
- Finite off-season storage capacity;
- Regulatory constraints; and
- Public sensitivity.

Halton Region retained a consulting team consisting of XCG Consultants Ltd. (XCG), Hydromantis Inc. (now Tetratech), and D.C. Damman and Associates, along with selected biosolids management experts, to undertake the preparation of the Halton Region Biosolids Master Plan.

1.1 Background

Halton Region is located in South West Ontario on 967 square kilometres of land including 25 kilometres of waterfront on Lake Ontario. Halton Region includes the City of Burlington and the Towns of Oakville, Milton, and Halton Hills. The approximate population of Halton Region in 2008 was 467,200.

Halton Region currently operates seven WWTPs and a Biosolids Management Centre (BMC). The following are the WWTPs currently operating in Halton Region:

- Burlington Skyway WWTP located in Burlington on Lakeshore Road in between Burlington Bay (Hamilton Harbour) and Lake Ontario;
- Mid-Halton WWTP located in Oakville just north of the QEW Highway between Bronte Road and Third Line;
- Oakville South East WWTP located in Oakville on Lakeshore Road between Ford Drive and Winston Churchill Boulevard;
- Oakville South West WWTP located in Oakville on Lakeshore Road between Third and Fourth Line;

- Georgetown WWTP located on Mountainview Road South in Georgetown;
- Milton WWTP located in Milton on Fulton Street; and
- Acton WWTP located in Acton on Churchill Road South.

Additionally, the W.A Bill Johnson BMC is located on Regional Road 25, north of Highway 407 in Oakville.

In 2011, 79,724 cubic metres of liquid biosolids and 13,851 tonnes of dewatered biosolids (cake) were land applied by Halton Region's biosolids land application contractor. Liquid biosolids are primarily stored at the BMC while the dewatered biosolids are transported to the Terratec Environmental Ltd. Power-Grow facility in Niagara Region prior to land application.

1.2 Objectives of the Biosolids Master Plan Study

The following were the objectives of the Biosolids Master Plan study:

- To complete Phases 1 and 2 of the Municipal Class Environmental Assessment (Class EA) (Municipal Engineers Association, October 2000 as amended in 2007 and 2011) process;
- To allow for public, stakeholder, and agency consultation to satisfy the requirements of the Class EA process;
- To determine and recommend preferred Biosolids Management Methods for detailed investigation and potential implementation; and
- To identify follow-up projects required to confirm the viability of the preferred Biosolids Management Methods.

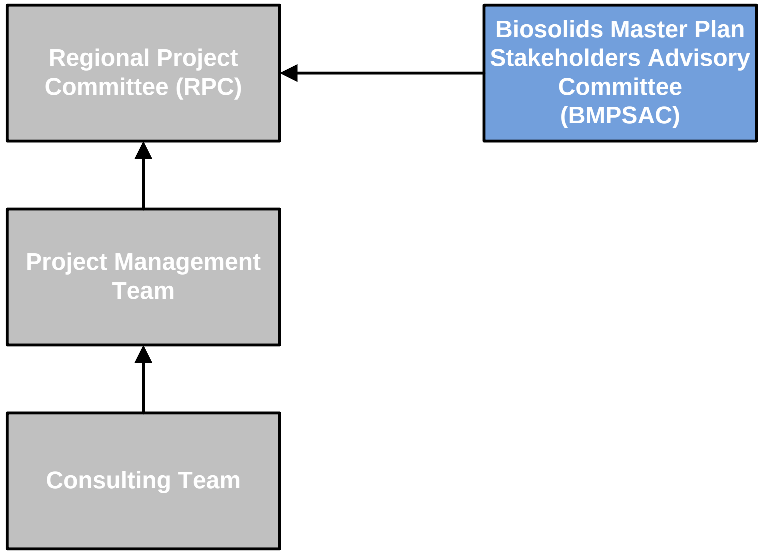
1.3 Problem Definition

Halton Region faces significant growth in a number of communities. The increase in population will have a direct impact on the amount of biosolids produced and the biosolids handling method. A long-term strategy for biosolids management must be developed to ensure proper management of biosolids and to protect human health and the environment.

1.4 Project Organization and Approach

Figure 1.1 illustrates the Project Organization. A Regional Project Committee (RPC), consisting of Halton Region staff from various departments, was formed to participate and provide input to the Master Plan process. Further details on the RPC are found in Section 9.2.

Figure 1.1 Project Organization



In addition, a Biosolids Master Plan Stakeholders Advisory Committee (BMPSAC) was formed to participate in the Master Plan process. Further details on the BMPSAC are found in Section 9.3.

Figure 1.2 illustrates the overall study approach.

1.5 Class Environmental Assessment and Master Planning Process

The Municipal Class EA (Municipal Engineers Association, 2000, as amended in 2007 and 2011) outlines an approved planning process for municipal infrastructure projects, including wastewater projects. Municipal proponents can use the Class EA process to meet the requirements of the Ontario *Environmental Assessment Act* (EAA). Individual projects subject to the Municipal Class EA process are categorized as Schedule A, A^+, B, or C, depending on the type of project and its potential environmental effects. The Municipal Class EA planning and design process is illustrated in Figure 1.3.

The Master Plan provisions of the Municipal Class EA allow municipalities to develop long range plans for integrated infrastructure requirements. The Biosolids Master Plan was completed as a Master Plan, fulfilling the requirements of Phases 1 and 2 of the Municipal Class EA.

Projects that result from the Master Planning process will be subject to the requirements of the Municipal Class EA process which may include further assessment for Schedule B activities. In addition, Phase 3 and Phase 4 requirements may need to be carried out for any Schedule C activities related to the Master Plan.

Figure 1.2 Overall Study Approach

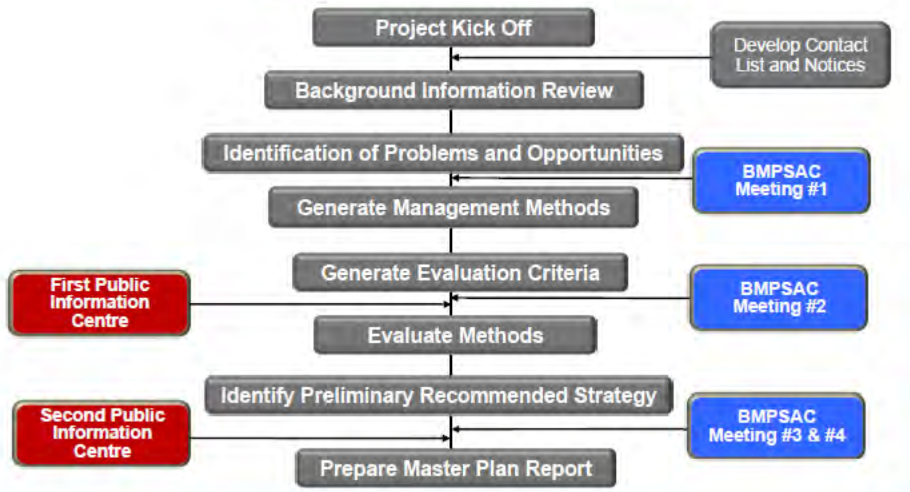
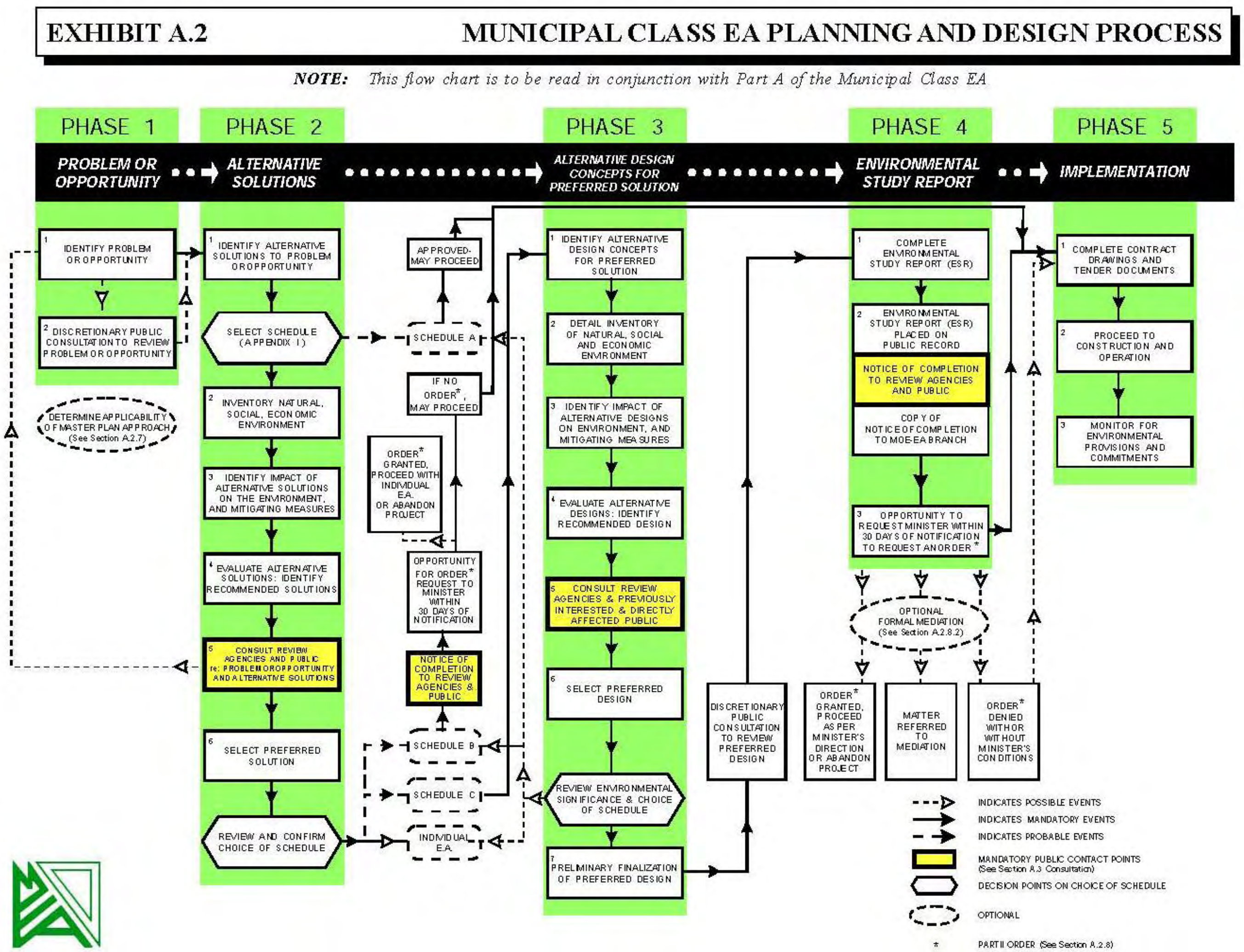


Figure 1.3 Municipal Class EA Process



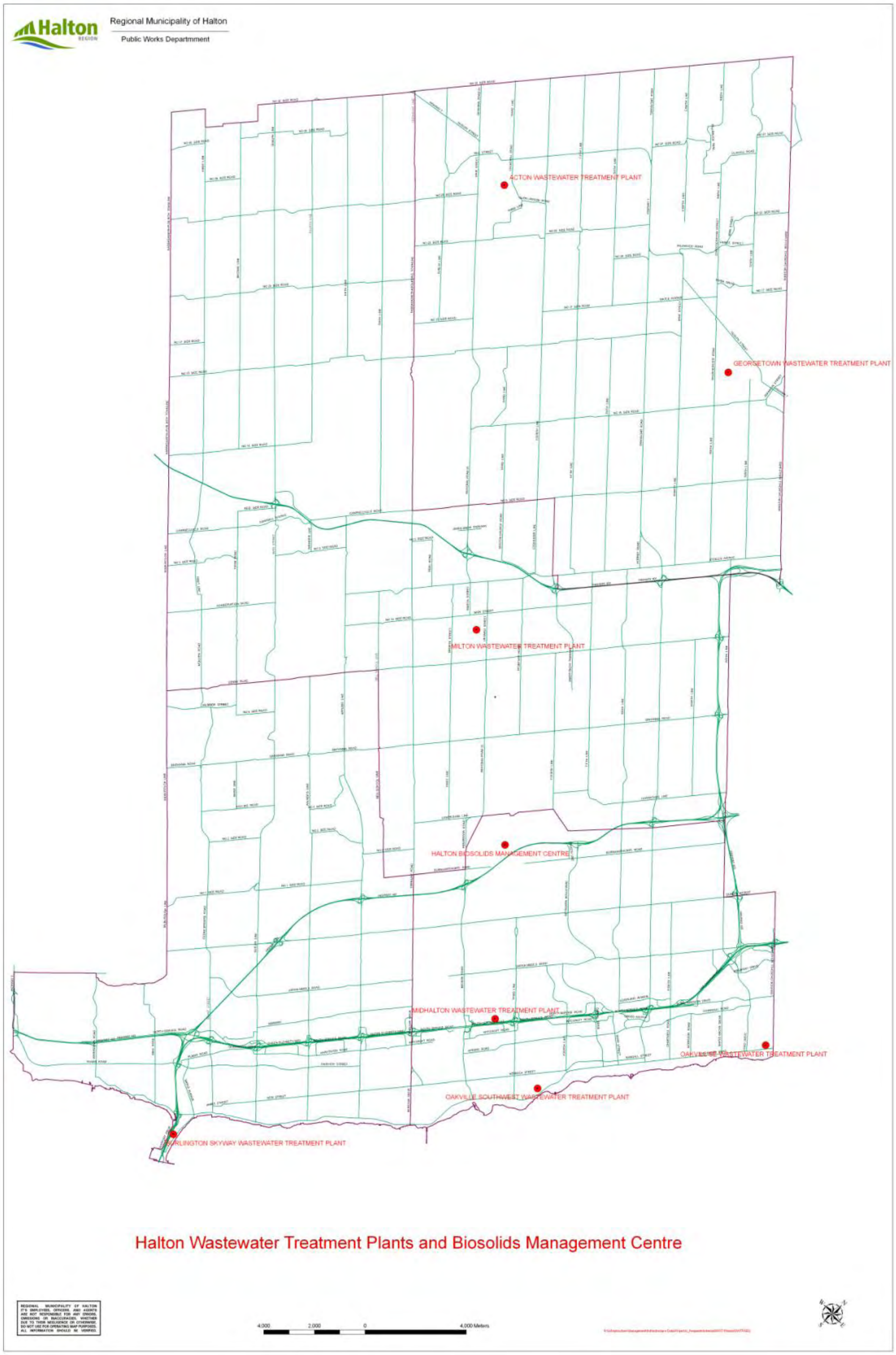
2. CURRENT STATUS OF BIOSOLIDS MANAGEMENT IN HALTON REGION

Halton Region currently operates seven WWTPs and the BMC as summarized below:

- Burlington Skyway WWTP;
- Mid-Halton WWTP;
- Oakville South East WWTP;
- Oakville South West WWTP;
- Georgetown WWTP;
- Milton WWTP;
- Acton WWTP; and
- W.A Bill Johnson BMC.

The locations of the wastewater treatment operations are illustrated in Figure 2.1. The current biosolids management practices in the Halton Region are described in detail in Technical Memorandum (TM) TM1A (Current Status of Biosolids Management Programs in Halton) that is included in Appendix A of this report. In TM1A, the WWTPs and the BMC are described in detail and information is provided on the quality and quantity of biosolids generated at each WWTP and the current management practices.

Figure 2.1 Location of Halton Region WWTPs and BMC



2.1 Halton Region WWTP's and Biosolids Stabilization Process

A general description of the Halton Region WWTPs and the biosolids treatment processes used at each WWTP is presented in Table 2.1.

Table 2.1 General Description of WWTPs in Halton Region

Facility	Current ADF[(1)] (m^3/d)	Rated ADF Capacity (m^3/d)	Type of Plant	Biosolids Management
Burlington Skyway WWTP	122,090	118,000	CAS	WAS is thickened in three DAF units followed by digestion utilizing two-stage mesophilic anaerobic digestion (two primary digesters and one secondary digester). Primary sludge pumped directly to the two-stage anaerobic digestion. Dewatering is completed by two centrifuges and two standby belt filter press (BFPs).
Mid-Halton WWTP	47,200	50,000	CAS	WAS is thickened in rotary drum thickeners, followed by two-stage anaerobic digestion (two primary digesters and one secondary digester). The secondary digester can operate as a primary digester if needed. Dewatering is completed by two centrifuges (one duty and one standby).
Oakville South East WWTP	26,450	31,800	CAS	Co-thickening of primary sludge and WAS in primary clarifiers, two-stage anaerobic digestion (three primary digesters and one secondary digester).
Oakville South West WWTP	34,620	45,400	CAS	Co-thickening of primary sludge and WAS in primary clarifiers, two-stage anaerobic digestion (two primary digesters).
Georgetown WWTP	17,500	22,727	CAS	Anaerobic digestion in one primary and one secondary digester.
Milton WWTP	12,200	18,500	CAS	Gravity thickened of sludge and aerobically stored.
Acton WWTP	4,610	4,545	CAS	Anaerobic digestion in one primary and one secondary digester.
W.A Bill Johnson BMC	n/a	n/a	BMC	Ten storage tanks with total volume of 81, 000 m^3. Mobile dewatering unit utilizes two of the storage tanks. One tank for dewatering feed storage and one tank for centrate storage until transported to WWTP for treatment.

Notes:

1. Based on 2008 flow data.

Each WWTP in Halton Region performs some level of biosolids management on-site, with the exception of the Milton WWTP where sludge is gravity thickened and stored before transport off-site to the Burlington Skyway WWTP, Mid-Halton WWTP, or Oakville South East WWTP for further digestion and dewatering.

On-site biosolids dewatering occurs currently at the Burlington Skyway and the Mid-Halton WWTPs. Dewatered biosolids from the Burlington Skyway WWTP and the Mid-Halton WWTP are currently transported to the Terratec Environmental Ltd. Power Grow Facility in Niagara Region, land-filled, or land applied. Stabilized liquid biosolids from Burlington Skyway WWTP, Mid-Halton WWTP, Oakville South East WWTP, Oakville South West WWTP, Georgetown WWTP, and Acton WWTP have either been land applied directly or hauled off-site to the W.A. Bill Johnson BMC for storage and/or dewatering.

The BMC contains 10 storage tanks with a total capacity of 81,000 cubic metres. This facility provides storage for liquid biosolids produced by the Halton Region's WWTPs. Currently, one of the storage tanks at the BMC is utilized as a feed tank for dewatering by a mobile dewatering unit and one provides storage for the centrate before it is transported to another WWTP for treatment. Thickened biosolids are sent to sites for land application.

2.2 Quantity of Biosolids Production

The average biosolids production and disposal/usage for each WWTP in Halton Region is summarized in Table 2.2.

Table 2.2 Average Annual Biosolids Production and Haulage Rates (2004 to 2008)

Facility	Liquid Biosolids (m^3)			Dewatered Biosolids (W.T.)			
	Biosolids Transported to BMC	Biosolids to Land Application	Total Liquid Biosolids	Biosolids Hauled to Power-Grow Facility	Biosolids Hauled to Landfill	Biosolids to Land Application	Total Dewatered Biosolids
Burlington Skyway WWTP (2)	59,159	5,712	64,870	11,914	3,040	2,106	17,060
Mid-Halton WWTP (2)	26,882	1,406	28,288	2,467	3,009	47	5,523
Oakville South East WWTP (2)	36,732	4,965	41,697	n/a	n/a	n/a	n/a
Oakville South West WWTP	13,048	927	13,975	n/a	n/a	n/a	n/a
Georgetown WWTP	25,816	5,812	31,627	n/a	n/a	n/a	n/a
Milton WWTP (1)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Acton WWTP	4,014	646	4,661	n/a	n/a	n/a	n/a
Total for Halton Region	**165,651**	**19,468**	**185,118**	**14,381**	**6,049**	**2,153**	**22,583**

Notes:

n/a - Not Applicable

W.T. - Wet Tonnes

1. Sludge is hauled to Burlington Skyway WWTP, Mid-Halton WWTP, or Oakville South East WWTP for further digestion and dewatering.
2. Includes contributions of sludge produced at other Halton Region WWTPs.

The percentage of the total liquid biosolids and dewatered biosolids produced by each of the Region's WWTPs is illustrated in Figure 2.2 and Figure 2.3, respectively.

Figure 2.2 Percentage of Total Liquid Biosolids Produced (2004 - 2008)

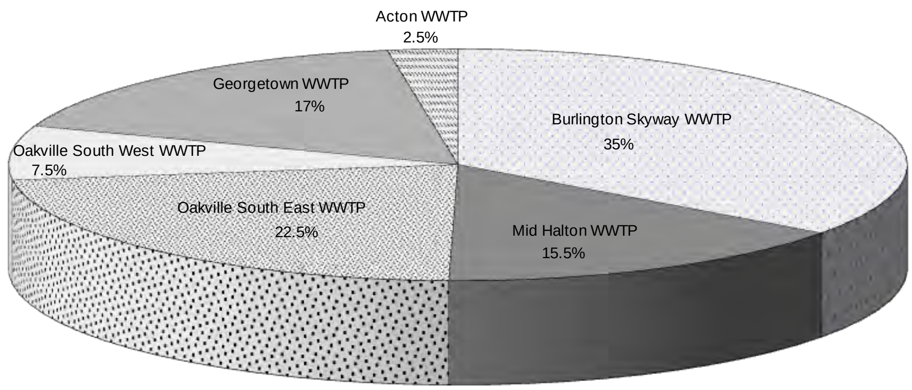
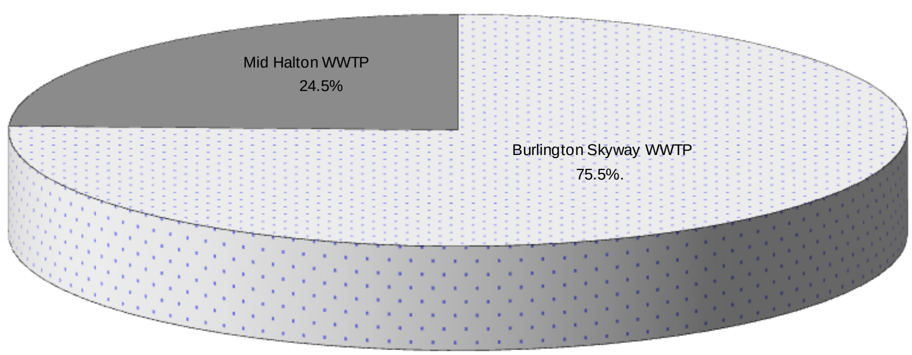


Figure 2.3 Percentage of Total Dewatered Biosolids Produced (2004 - 2008)



The Burlington Skyway WWTP produces the largest quantity of biosolids in Halton Region and represents about 35 percent of the total liquid biosolids production and 76 percent of the total dewatered biosolids production over the period. The total average annual liquid biosolids produced by the Halton Region WWTPs was 185,118 cubic metres. About 89 percent of this total (or 165,651 cubic metres) was sent to the BMC for storage and further dewatering. The remaining 11 percent was applied directly to land.

The Milton WWTP has no sludge stabilization process on-site. Raw and waste activated sludge is hauled off-site to the Skyway WWTP for stabilization. The Mid-Halton, Oakville South East, or South West WWTPs are used as contingency receiving facilities. As a result, biosolids quantities from these plants include the contribution from the Milton WWTP and no quantities for the Milton WWTP are included in Table 2.2 to avoid double counting.

There are only two facilities in Halton Region producing dewatered biosolids: the Burlington Skyway WWTP and the Mid-Halton WWTP. The total average annual dewatered biosolids produced by the Halton Region WWTPs was 22,583 Wet Tonnes (W.T.). About 64 percent of this total (or 14,381 W.T.) was hauled to the Power-Grow Facility for storage, 27 percent (or 6,049 W.T.) was hauled to a landfill, and the remaining 9 percent was applied directly to land.

2.2.1 Power-Grow Systems Inc.

Power-Grow Systems Inc. provides storage for Halton Region's dewatered biosolids. The facility is operated by Terratec Environmental Ltd. and located in Niagara Falls, Ontario. The Power-Grow facility receives dewatered biosolids from Halton Region on a daily basis. Table 2.3 presents the quantities of dewatered biosolids hauled annually to the Power-Grow facility. Table 2.4 presents the breakdown of disposal methods for biosolids at the Power-Grow facility and the annual quantities.

From the Power-Grow facility, dewatered biosolids are land applied when conditions permit or are landfilled. Dewatered biosolids have not been land applied in Halton Region since 2005; however, dewatered biosolids continue to be land applied outside of Halton Region.

Table 2.3 Dewatered Biosolids to Power-Grow Facility from Halton Region

	Units	2004	2005	2006	2007	2008
Dewatered Biosolids from the Skyway WWTP	W.T.	2,347	15,528	15,160	12,980	13,554
Dewatered Biosolids from the Mid-Halton WWTP	W.T.	0	1,889	1,817	2,733	5,898
Dewatered Biosolids from the BMC	W.T.	0	0	0	0	845

Notes:
W.T. – wet tonnes

Table 2.4 Disposal of Dewatered Biosolids from the Power-Grow Facility

Year	Landfill	Land Application Within Halton Region	Land Application Outside Halton Region
2004	n/a	6,654 W.T.	0 W.T.
2005	n/a	0 W.T.	7,600 W.T.
2006	10,296 W.T.	0 W.T.	17,785 W.T.
2007	0 W.T.	0 W.T.	15,520 W.T.
2008	0 W.T.	0 W.T.	19,470 W.T.

Notes:
n/a – not available
W.T. – wet tonnes

In 2004, all of the dewatered biosolids stored at the Power-Grow facility was applied to land within Halton Region. In 2006, approximately 37 percent of the dewatered biosolids stored at the Power-Grow facility was landfilled. The remaining quantities of dewatered biosolids stored at the Power-Grow facility from 2005 to 2008 were applied to land outside of Halton Region.

2.3 Quality of Biosolids

2.3.1 Dewatered Biosolids

Table 2.5 presents the 2008 metal and pathogen content of the dewatered biosolids from each the Halton Region WWTPs.

The Nutrient Management Act (NMA, Bill 81) specifies the maximum biosolids application rate for land application as a function of the concentration of regulated metals. The maximum allowable metals (CM1 and CM2) concentrations associated with two biosolids application rates are included in Table 2.5 for reference. If the NMA CM criteria had been in place for the 2008 year, the following metals would meet CM2 but not CM1 maximum concentrations: copper, molybdenum, selenium, and zinc.

Under NMA, there are also two pathogen classifications, CP1 and CP2. In order to land apply biosolids under the NMA CP1 criteria, the biosolids must have a geometric mean *E. coli* concentration (i.e. CFU per g of total solids) below 1000 CFU per g TS. In addition, the CP1 criterion requires that the Salmonella concentration must be less than 3 CFU per 100 ml, and that both the viable Helminth ova and total culturable enteric virus must be non-detectable in 100 mL. Based on available historical sampling data in 2008 presented in Table 2.5, the historical dewatered biosolids *E. coli* concentration was over the maximum concentration for CP1 criteria but was consistently well below the NMA CP2 compliance limit for land application. No data were available on Salmonella, viable Helminth ova or total culturable enteric virus concentration. Based on available information if the NMA CM and CP criteria were in place during this period, the dewatered biosolids from the Burlington Skyway WWTP and the Mid-Halton WWTP would have met the CM2 and CP2 criteria under NMA standards for regulated metals and pathogens in sewage biosolids.

Table 2.5 Biosolids Metal and Pathogen Content (2008)

Units	Parameter	Burlington Skyway WWTP	Mid-Halton WWTP	Maximum Concentration for Agricultural Land Application	
		Metals		**CM2 (1)**	**CM1 (2)**
mg/kg Dry Solids	Arsenic	12.7	3.9	170	13
	Cadmium	0.5	0.5	34	3
	Chromium	98	82	2,800	210
	Cobalt	5.5	3.8	340	34
	Copper	**708**	**591**	1,700	100
	Lead	30	21	1,100	150
	Mercury	0.7	0.7	11	0.8
	Molybdenum	**10.3**	**8.8**	94	5
	Nickel	20	13	420	62
	Selenium	**2.4**	**2.6**	34	2
	Zinc	**656**	**631**	4,200	34
		Pathogen		**CP2(3)**	**CP1(4)**
CFU per gram TS	E.Coli	**225,309**	**124,487**	2,000,000	1,000
CFU per 4 grams of Total Dry Weight	Salmonella	n/a	n/a	None	3
	Viable Helminth Ova	n/a	n/a	None	0
	Total Cultural Enteric Virus	n/a	n/a	None	0

Notes:

BOLD values indicate metal or pathogen concentrations exceeding CM1 or CP1 standards.

1. Based on CM2 criteria in O. Reg. 338/09 of NMA (2002).
2. Based on CM1 criteria in O. Reg. 338/09 of NMA (2002).
3. Based on CP2 criteria in O. Reg. 338/09 of NMA (2002).
4. Based on CP1 criteria in O. Reg. 338/09 of NMA (2002).

2.3.2 Liquid Biosolids

Table 2.6 presents the 2008 metal content of the liquid biosolids from each the Halton Region WWTPs.

If the NMA CM criteria had been in place for the 2008, copper and zinc concentrations would meet CM2 but not CM1 maximum concentrations for all WWTPs in Halton Region. Biosolids for all WWTPs, with the exception of Acton WWTP, would meet CM2 but not CM1 maximum concentrations for molybdenum and selenium; Acton WWTP would meet both CM1 and CM2 maximum concentrations for both these metals. Biosolids from Oakville South East WWTP and Oakville South West WWTP would meet CM2 but not CM1 maximum concentration for nickel. Only the Oakville South West WWTP exceeded the CM1 but not CM2 maximum concentrations for chromium in 2008. Based on the information presented in Table 2.6, if the NMA CM criteria were in place in 2008, the biosolids from all WWTPs in Halton Region would have met the CM2 criteria under NMA standards for regulated metals in sewage biosolids.

Table 2.6 Biosolids Metal and Pathogen Content (2008)

Units	Parameter	Burlington Skyway WWTP	Mid- Halton WWTP	Oakville SE WWTP	Oakville SW WWTP	Georgetown WWTP	Acton WWTP	Maximum Concentration for Agricultural Land Application	
Metals								**CM2 (1)**	**CM1 (2)**
mg/kg Dry Solids	Arsenic	12.7	3.6	3.7	11.3	3.5	4.8	170	13
	Cadmium	0.6	0.6	2.0	2.6	0.8	0.7	34	3
	Chromium	88	74	90	**505**	70	64	2,800	210
	Cobalt	6.7	3.8	4.0	3.8	2.3	1.9	340	34
	Copper	**301**	**482**	**898**	**1,622**	**528**	**700**	1,700	100
	Lead	28	20	32	60	20	20	1,100	150
	Mercury	0.8	0.7	0.4	0.7	0.5	0.3	11	0.8
	Molybdenum	**9.5**	**8.3**	**11.3**	**9.9**	**5.2**	1.9	94	5
	Nickel	19	11	**75**	**160**	21	10	420	62
	Selenium	**2.4**	**2.4**	**5.0**	**2.8**	**2.4**	1.9	34	2
	Zinc	**557**	**563**	**900**	**709**	**674**	**520**	4,200	34

Notes:

BOLD values indicate metal or pathogen concentrations exceeding CM1 standards.

1. Based on CM2 criteria in O. Reg. 338/09 of NMA (2002).
2. Based on CM1 criteria in O. Reg. 338/09 of NMA (2002).

2.4 Current Biosolids Management Practices in Halton Region

Biosolids produced at the Burlington Skyway, Mid-Halton, Oakville South East and South West, Georgetown, and Acton WWTPs is stabilized on-site in anaerobic digestion processes prior to land application, landfilling, or haulage to off-site biosolids storage at the BMC or Power Grow facilities. The Milton WWTP has no sludge stabilization process on-site. Raw and waste activated sludge is hauled offsite to the Skyway WWTP for stabilization. The Mid-Halton, Oakville South East, or South West WWTPs are used on a contingency basis only.

Only two plants in Halton Region dewater sludge: the Burlington Skyway WWTP and the Mid-Halton WWTP. Both facilities are equipped with centrifuges for dewatering biosolids.

Off-site liquid biosolids storage is provided at the W.A. Bill Johnson BMC in ten 8,100 cubic metres biosolids storage tanks. A mobile dewatering unit is available at the BMC for on-site biosolids dewatering.

Dewatered biosolids from the Burlington Skyway WWTP, Mid-Halton WWTP, and the BMC are hauled to the Terratec Environmental Ltd. Power Grow Facility in Niagara Region, land-filled, or land applied. Sludge hauled to the Power Grow Facility is stored and land applied when conditions permit.

2.5 Land Application Sites

Liquid and dewatered biosolids from the Halton Region WWTPs and the BMC are seasonally land applied or landfilled. Table 2.7 summarizes the quantities of biosolids that were land applied and landfilled. Included is the land area to which biosolids were applied within and outside of Halton Region.

Table 2.7 Land Application and Landfilling of Halton Region Biosolids

Biosolids Management	2004	2005	2006	2007	2008
Land Application Within Halton Region					
Liquid Biosolids (m^3)	96,099	69,710	65,123	63,749	58,739
Land Application Area (ha)	701	565	492	469	432
Dewatered Biosolids (W.T.)	1,292	0	0	0.	0
Land Application Area (ha)	40	0	0	0	0
Land Application Outside Halton Region					
Liquid Biosolids (m^3)	0	3,952	11,028	60,908	42,167
Land Application Area (ha)	0	32	82	446	312
Dewatered Biosolids (W.T.)	0	3,954	17,726	19,956	21,941
Land Application Area (ha)	0	278	502	598	768
Liquid Biosolids to Landfill (W.T.)	0	4,287	13,946	3,882	38.9

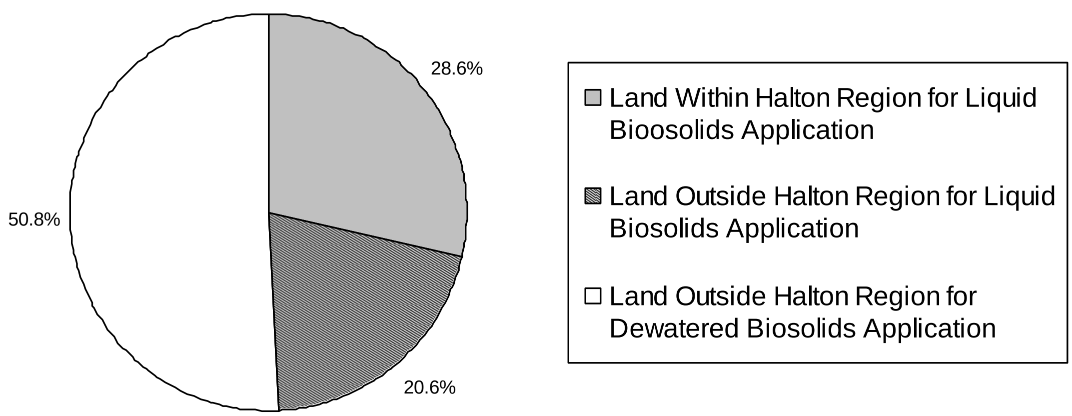
Notes:
W.T. – Wet Tonnes

Approximately 2,324 hectares of land have been approved for biosolids land application within and outside of the boundaries of Halton Region. Of the total approved land area, approximately 47 percent lies within Halton Region.

In 2008, 71 percent of land approved as organic soil conditioning sites outside of Halton Region was used for dewatered biosolids application. Approximately 51 percent of the total land to which biosolids were applied was used for dewatered biosolids outside of the Region. Twenty-nine percent of the total land was used for liquid biosolids within Halton Region, and approximately 21 percent was used for liquid biosolids application on land outside of Halton Region.

Land application of dewatered solids has not been practiced in Halton Region since 2005. From 2005 onward, all land applied biosolids within Halton Region have been liquid biosolids. Outside of Halton Region, the majority of land approved as organic soil conditioning has been used for dewatered biosolids application. Figure 2.4 presents a breakdown of the land application program in 2008.

Figure 2.4 Liquid and Dewatered Biosolids Application in 2008



3. FUTURE QUANTITIES OF BIOSOLIDS IN HALTON REGION

The basis for population projections was population data provided by Halton Region and based on Ontario's Places to Grow Growth Plan (2006), which Halton Region utilized to develop their Best Planning Estimates (Halton Region, 2007) to the year 2031. The Places to Grow plan focuses on intensification by "directing a significant portion of new growth to the built-up areas of the community" (Ontario Government, 2006). The plan also outlines "urban growth centres" in which specific density intensities will be targeted. In Halton Region, downtown Burlington and Milton have been designated as urban growth centres with targets of 200 residents and jobs combined per hectare by the year 2031. The basis for the population projections and the estimates of future biosolids quantities are described in detail in Technical Memorandum TM1B (Projected Future Biosolids Quantities) that is included in Appendix A of this report. It should be noted that the projections presented in this section were current as of the dates of the TMs (May 2010).

Halton Region's wastewater treatment needs are met by seven WWTPs. Population projections for each of the WWTP service areas were developed and used to estimate future biosolids production. Table 3.1 outlines the projected population for the seven WWTP service areas in Halton Region based on information from the Region and maps of each WWTP's service area. It should be noted that the sum of the populations within the WWTP drainage areas does not equal the total population for Halton Region as the total population of the Region also includes residents in rural areas that are assumed to be unserviced.

Table 3.1 Serviced Population Projections to 2031 for Halton WWTPs Catchment Areas

WWTP Drainage Area	2006	2011	2016	2021	2031
Burlington Skyway	160,692	170,220	172,090	175,008	182,039
Mid-Halton	103,480	142,078	193,902	247,197	321,289
Oakville South East	54,758	54,714	54,755	56,376	65,249
Oakville South West	34,514	34,671	35,400	37,278	45,133
Georgetown	35,118	37,859	41,314	42,978	65,848
Milton	19,778	23,057	26,345	29,134	35,312
Acton	10,222	10,084	10,150	11,602	14,398

3.1 Future Biosolids Production

Table 3.2 presents the quantity of anaerobically digested liquid biosolids and dewatered biosolids that are projected to be produced at each of the seven WWTP in Halton Region to 2031. Milton WWTP is shown to produce no biosolids currently due to the current practice of transporting Milton's sludge to the Skyway WWTP for treatment. Based on conversation with Halton Region, the assumption has been made that population growth associated with the Milton WWTP service area will be serviced by the Mid-Halton WWTP to 2031; therefore, the Mid-Halton WWTP's biosolids projections includes the combined annual growth rate for the two WWTP service areas. After about 2013, anaerobic digestion of biosolids produced by the Milton WWTP will take place on-site; hence, from 2016 and beyond, biosolids production will occur at the Milton WWTP as indicated in Table 3.2.

Currently, the liquid biosolids are either directly land applied or transported to the BMC for storage prior to land application. The capacity of the 10 storage tanks at the BMC totals 81,000 cubic metres. Using the assumption that, with supernating, the volume of sludge could be reduced by 50 percent (the BMC is currently supernating at about 45 to 50 percent), the effective storage volume of the BMC for liquid biosolids hauled into the facility is 160,000 cubic metres. The storage capacity recommended by the Ministry of the Environment (MOE) as a best practice is 240 days unless other disposal contingencies are available to manage biosolids during winter months and inclement weather when land application cannot be practised. Figure 3.1 presents the liquid anaerobically digested biosolids expected to be produced within Halton before and after supernating at the BMC to 2031. The volume of anaerobically digested liquid biosolids produced in Halton Region is projected to reach 366,754 cubic metres by 2031.

Skyway and Mid-Halton WWTPs are the only WWTP which dewater biosolids on-site. Currently, dewatered biosolids from the Skyway and Mid-Halton WWTPs are sent to the Power-Grow facility in Niagara and land applied outside Halton Region. From Halton Region's internal projections, it is assumed that Skyway and Mid-Halton's dewatered biosolids production will increase based on the annual growth within the service areas to 2031. The amount of dewatered biosolids produced at the two WWTPs which dewater biosolids on-site (Skyway and Mid-Halton) is expected to reach 44,298 W.T by 2031.

Based on information from Halton Region, it was assumed that by 2012 no liquid biosolids will be directly land applied from the WWTPs. Based on the projected annual anaerobically digested liquid biosolids, the storage capacity of the BMC will be exceeded in 2016 as shown in Figure 3.1. The projected biosolids storage volume required to provide 240 days storage at the BMC would be approximately 117,515 cubic metres in 2031 (assuming 50 percent supernating), which is approximately 1.5 times the current storage capacity at the BMC.

Table 3.2 Biosolids Production Projections to 2031

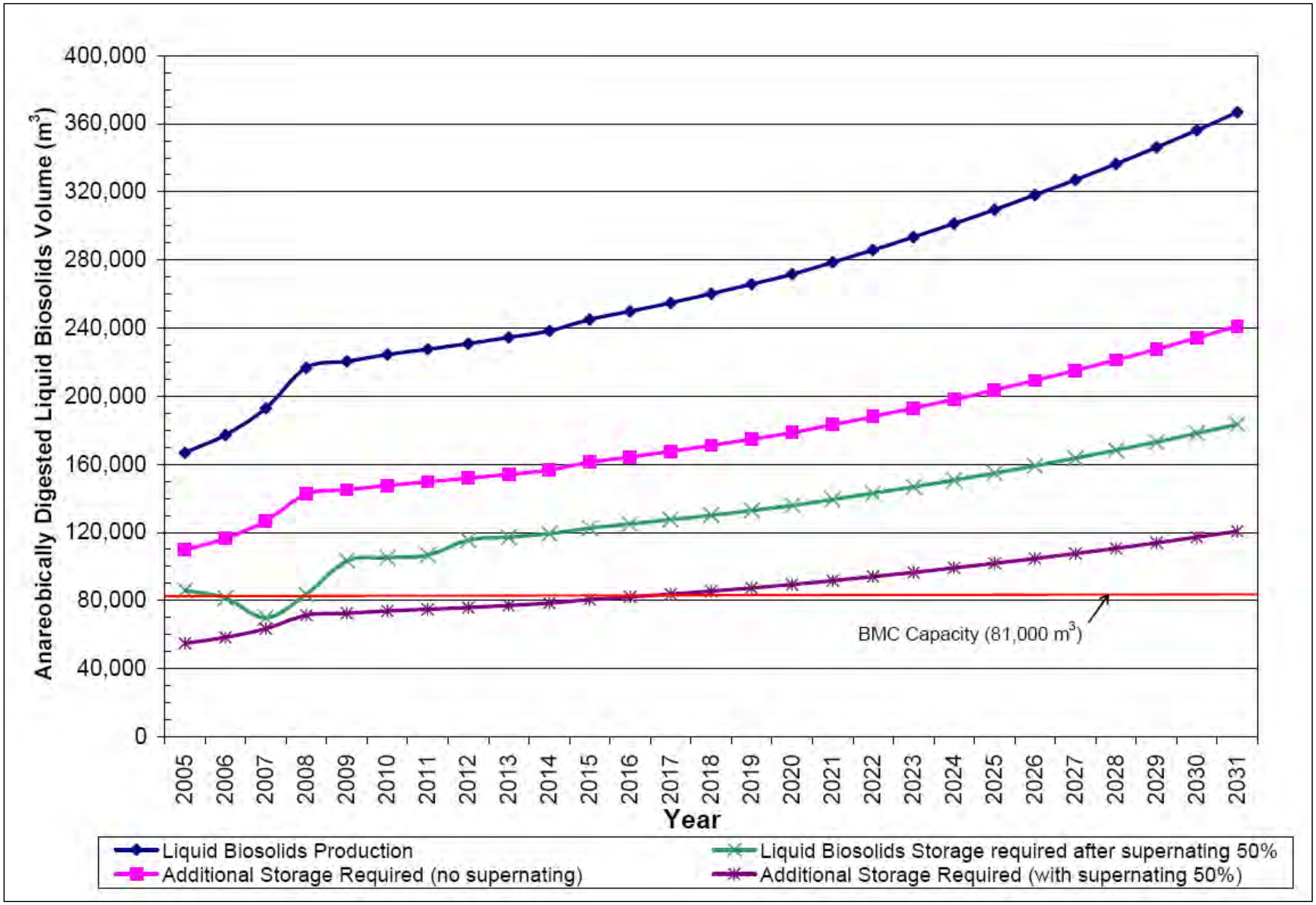
	2006		2011		2016		2021		2026		2031	
	Anaerobically Digested Liquid	Dewatered	Anaerobically Digested Liquid	Dewatered	Anaerobically Digested Liquid	Dewatered	Anaerobically Digested Liquid	Dewatered	Anaerobically Digested Liquid	Dewatered	Anaerobically Digested Liquid	Dewatered
	m3	W.T.	m3	W.T.	m3	W.T.	m3	W.T.	m3	W.T.	m3	W.T.
Skyway	75,729	17,231	42,879	16,125	25,177	16,439	26,354	16,882	28,192	17,573	30,105	18,293
Mid-Halton(1)	29,121	5,467	34,169	7,122	51,369	11,632	70,903	16,055	90,239	20,434	114,846	26,005
Oakville South East	37,476		49,504		49,663		50,961		53,371		55,895	
Oakville South West	0(3)		60,418		61,523		63,949		67,523		71,296	
Georgetown	32,102		31,764		34,419		37,433		48,511		62,867	
Milton(2)	0		0		18,538		18,538		18,538		18,538	
Acton	2,774		8,767		9,079		10,408		11,724		13,206	
Total	177,202	22,702	227,500	23,862	249,788	26,490	278,546	32,937	318,094	31,962	366,754	44,298

Notes:

W.T. - Wet Tonnes

1. Milton Area is expected to be re-directed wastewater above current level to the Mid-Halton WWTP and therefore the growth for Milton has been included in the Biosolids projection for Mid-Halton WWTP
2. Milton WWTP is expected to continue to transport raw sludge to Mid-Halton and Skyway WWTP until approximately 2013 at which time anaerobic digestion will take place at on-site.
3. Oakville South West digester were underwent maintenance during 2006 and therefore did not produce digested biosolids

Figure 3.1 Projected Anaerobically Digestion Liquid Biosolids and Storage Requirements to 2031



4. BIOSOLIDS MANAGEMENT PRACTICES

A technical review was conducted to identify the biosolids management practices in municipalities local to Halton Region and globally. The findings of the reviews are presented in TM1C (Biosolids Management Practices of Local Municipalities) and TM1D (Global Trends in Biosolids Management Practices). The full Technical Memoranda are included in Appendix A. The key findings are summarized in this section of the Biosolids Master Plan (BMP) report. It should be noted that these reviews present information that was current as of the dates of the TMs (May 2010). Changes, particularly in the practices of municipalities local to Halton Region, may have occurred since the completion of these reviews.

4.1 Biosolids Management Practices of Local Municipalities

4.1.1 Municipalities Reviewed

A review of selected municipalities in Ontario was undertaken to obtain background information on current and possible future biosolids management practices and costs. The analysis undertaken and decisions made by other municipalities that face similar challenges to Halton Region may assist Halton Region in assessing its options and developing a long-term biosolids management strategy.

The biosolids management practices of the following municipalities were reviewed either based on publicly available information from their websites, direct contact with responsible individuals in the municipality, or both:

- County of Brant;
- City of Brantford;
- Regional Municipality of Durham;
- City of Guelph;
- Haldimand County;
- City of Hamilton;
- City of Kingston;
- City of London;
- Regional Municipality of Niagara;
- Norfolk County;
- City of Ottawa;
- Oxford County;
- Regional Municipality of Peel;
- City of Toronto; and
- Regional Municipality of Waterloo.

4.1.2 Methodology

When available, a municipality's BMP or equivalent was reviewed. Information regarding the current status of the municipality's practices was obtained either from the municipality's website, contact with municipal staff, or both. Attempts were made to obtain the following information from each municipality:

- Availability of a Biosolids Master Plan, or equivalent, for review;
- Number of facilities producing biosolids and the total amount of biosolids produced annually;
- Methods of transfer and storage of biosolids currently used;
- Treatment methods currently used;
- Current disposal methods/end uses;
- Current cost for biosolids treatment and disposal ($ per dry tonne);
- Probable future changes to biosolids management in the municipality; and
- Probable future changes in cost based on changes to biosolids management methods.

The amount of information available in each subject area varied from municipality to municipality. Those municipalities that had recently completed a BMP generally were able to provide more information regarding their current and future biosolids management practices.

4.1.3 Practices in Other Ontario Municipalities

Table 4.1 summarizes the findings of the biosolids management review for the Ontario municipalities identified above. Table 4.2 presents a comparison of the key features of the biosolids disposal strategies for the Ontario municipalities reviewed as well as those of Halton Region.

As shown in Table 4.1, 12 of the 15 municipalities reviewed currently use land application of biosolids as a main disposal practice and two municipalities use land application as a contingency plan. Eight of the municipalities use landfill as a secondary disposal method and two municipalities use landfill as the primary disposal practice. Thermal oxidation (incineration) is practiced as a main disposal method by four municipalities. Composting is practised by only one municipality as the primary treatment method (City of Ottawa). The City of Ottawa's composting is currently conducted in Quebec where the regulations and guidelines are different. Ottawa intends to continue composting in Quebec into the future.

Table 4.3 includes a summary of the probable future practices of the municipalities reviewed, based on available information. No details regarding future biosolids management strategies for Brant and Norfolk County were available. The City of Brantford, the Region of Niagara, the Region of Waterloo, and the City of Toronto are currently updating or planning to review their Biosolids Master Plans.

Table 4.1 Summary of Biosolids Management Strategies in Ontario Municipalities

Municipality	Amount of Biosolids (dry tonnes/year)	Biosolids Treatment		Primary Biosolids Disposal/Use		Approximate Biosolids Management Cost ($/dry tonne)	
		Current	Planned	Current	Planned	Current	Predicted
County of Brant	No data	Dewatering	No data	Land application	No data	No data	No data
City of Brantford	3,120	Anaerobic digestion	Potential implementation of dewatering program.	Liquid land application to sites within County of Brant	Potential land application as cake	\$144 to \$160[1]	No data
Regional Municipality of Durham	5,882[2]	Aerobic digestion at 2 plants and anaerobic digestion at 4 plants Dewatering at Duffin Creek WWTP	Potential for larger facilities at Duffin Creek WWTP to allow for more dewatering. Decommission and rerouting of Pringle Creek WPCP	Land application of liquid biosolids during applicable season Thermal Oxidation (Incineration) of dewatered cake at Duffin Creek WWTP when land application is not available	Potential land application and further Thermal Oxidation (Incineration)	No data	No data
City of Guelph	2,963	Anaerobic digestion, dewatering by BFP, Lystek™ processing,	WAS thickening implementation in full scale	Land application of Lystek™ biosolids	Land application of Lystek biosolids with landfilling as contingency	Anaerobic digestion - \$29 Dewatering - \$112 Land application - \$96 Landfilling - \$31 Total - \$359 Lystek costs unknown	No data

Notes:
1. Cost includes haulage and land application only.
2. Production from all WWTP excluding Duffin Creek.

Table 4.1 Summary of Biosolids Management Strategies in Ontario Municipalities (cont'd)

Municipality	Approximate Amount of Biosolids (dry tonnes/annum)	Biosolids Treatment		Biosolids Disposal		Approximate Biosolids Management Cost ($/dry tonne)	
		Current	Planned	Current	Planned	Current	Predicted
Haldimand County	470	Aerobic digestion, thickening by decanting	Biosolids Master Plan currently being written Optimizing storage facilities to meet demand of biosolid production	Liquid land application to sites within Haldimand County	Biosolids Master Plan currently being written	$297 to $319(1)	No data
City of Hamilton	32,500	Anaerobic digestion, dewatering by centrifuge and BFP	Anaerobic digestion and dewatering	Land application of dewatered biosolids outside the City	Thermal Oxidation (Incineration) with land application contingency	No data	No data
City of Kingston	2,200	Co-thickening, anaerobic digestion Dewatering by centrifuge at the Kingston WWTP	Mesophilic digestion or TPAD Covered drying beds at Kingston West WWTP New cake storage facilities at Ravensview WWTP	Both liquid biosolid and dewatered cake land applied	Dewatered cake land applied.	$60(2)	$106(2)
City of London	18,000	Dewatering without digestion	Dewatering without digestion	90% incinerated, 10% landfilled	Continue with Thermal Oxidation (Incineration) Land application while incinerator is being maintained	Thermal Oxidation (Incineration): $105(3) Bioset: $245(4)	No data

Notes:

1. Cost includes haulage and land application only.
2. Based on $/wet tonne
3. Cost includes operation and maintenance costs for dewatering and Thermal Oxidation (Incineration) facilities.
4. Cost includes operation and maintenance costs for haulage and Bioset processing.

Table 4.1 Summary of Biosolids Management Strategies in Ontario Municipalities (cont'd)

Municipality	Approximate Amount of Biosolids (dry tonnes/annum)	Biosolids Treatment		Biosolids Disposal		Approximate Biosolids Management Cost ($/dry tonne)	
		Current	Planned	Current	Planned	Current	Predicted
Regional Municipality of Niagara	9,800	Anaerobic digestion Dewatering at one facility	Diversification of biosolids management techniques	Liquid land application to sites within Region of Niagara N-Viro Process of dewatered biosolids	Continue with liquid land application program with diversification of management options N-Viro Process	$200 (1) $350 - $450 (2)	$278 (1),(3)
Norfolk County	726	Aerobic digestion at one facility Anaerobic digestion at two facilities	Biosolids Master Plan initiated in 2005	Liquid land application to lands within Norfolk County and periodically in the County of Haldimand	Biosolids Master Plan initiated in 2005	No accurate estimate could be provided by County Staff	No data
City of Ottawa	12,600	Anaerobic digestion and dewatering with centrifuge	Anaerobic digestion and dewatering	63% of biosolids composted in Quebec 24% land applied 13% used as landfill cover	Continued diverse disposal of biosolids	$230 (4)	No data
Oxford County	1,520	Anaerobic digestion and dewatering at 2 facilities Aerobic digestion at 2 facilities	Optimize biosolids stabilization in order to meet land application standards.	Land application of liquid biosolids mainly in Oxford County Land filling of dewatered cake	Land application of dewatered and some liquid biosolids	$211 (5)	$171

Notes:

1. Cost includes haulage, land application and operation of storage facility (haulage of supernatant operation and maintenance)
2. Based On application of N-Viro Process.
3. Based on continued land application.
4. Cost includes haulage and servicing/tipping fees.
5. Based on average annual biosolids production and average annual operations and maintenance costs.

Table 4.1 Summary of Biosolids Management Strategies in Ontario Municipalities (cont'd)

Municipality	Approximate Amount of Biosolids (dry tonnes/annum)	Biosolids Treatment		Biosolids Disposal		Approximate Biosolids Management Cost ($/dry tonne)	
		Current	Predicted	Current	Predicted	Current	Predicted
Regional Municipality of Peel	55,000	Dewatering	Dewatering	Thermal Oxidation (Incineration)	Thermal Oxidation (Incineration)	$124[(1)]	$124 [(1)]
City of Toronto	53,400	Anaerobic digestion and dewatering for biosolids from 3 WWTPs at central WWTP (Ashbridges) Dewatering (no digestion) at Highland Creek WWTP	Anaerobic digestion and dewatering for biosolids from 3 WWTPs at central WWTP (Ashbridges) Dewatering (no digestion) at Highland Creek WWTP	Land application program, drying/pelletization, and several short-term contracts (alkaline stabilization, land reclamation, landfill) from Ashbridges WWTP Thermal Oxidation (Incineration) at Highland Creek WWTP	Targeting 50% land application and pelletization at Ashbridges WWTP. Remaining 50% of biosolids to be disposed of through reliable long-term contracts for beneficial use of biosolids cake. Continue Thermal Oxidation (Incineration) at Highland Creek WWTP with upgrade to more efficient incinerators	Landfill: $177[(2)] Cake land application: $120[(3)] Pelletization & land application: $116[(4)]	Landfill: $192[(2)] Cake land application: $71 to $279[(3,5)] Pelletization: & land application $142 to $202 [(3,4,5)] Thermal Oxidation (Incineration): $88[(4)]
Regional Municipality of Waterloo	12,360	Aerobic Digestion. Anaerobic digestion. Thickening/Lime stabilization.	Upgrades to digesters Addition of dewatering facilities Addition of additional technologies for biosolids treatment and stabilization	Liquid land application of biosolids to lands within the Regional Municipality of Waterloo and other local municipalities	Land application of dewatered cake	$150	Solar dried & land application: $70[(6)] Alkaline stabilized/ thermally dried & land application: $163[(6)]

Notes:
1. Cost includes labour, chemicals, electricity and natural gas.
2. Cost includes haulage and land application fees
3. Cost includes haulage and tipping fees.
4. Cost includes labour, electricity and natural gas for downstream dewatering.
5. Cost dependent on distance travelled for land application.
6. Cost includes operation and maintenance costs for thickening, dewatering, drying, haulage and land application.

Table 4.2 A Comparison of the Current Biosolids Management Strategy of the Region of Halton with Other Selected Ontario Municipalities

	Region of Halton	County of Brant	City of Brantford	Region of Durham	City of Guelph	Haldimand County	City of Hamilton	City of Kingston	City of London	Region of Niagara	Norfolk County	City of Ottawa	Oxford County	Region of Peel	City of Toronto	Region of Waterloo
Land Application	✗	✗	✗	✗	✗	✗	✗	✗	●	✗	✗	✗	✗		●	✗
Landfill	●		●	●	●		●	●	●			✗			✗	●
Thermal Oxidation (Incineration)				✗					✗					✗	✗	
Compost												✗				
Alkaline Stabilization (N-Viro)										✗						
Pelletization															✗	

✗ Indicates primary disposal process

● Indicates secondary or contingency disposal process

* Indicates primary disposal process is currently not operational

Shaded cells indicate that no information is currently available

Table 4.3 Future Planned Biosolids Management Strategies in Selected Ontario Municipalities

	County of Brant	City of Brantford[1]	Region of Durham	City of Guelph	Haldimand County	City of Hamilton	City of Kingston	City of London	Region of Niagara[1]	Norfolk County	City of Ottawa	Oxford County	Region of Peel	City of Toronto[1]	Region of Waterloo
Land Application		✖	●	✖	✖	●	✖	●	✖		✖	✖		✖	✖
Landfill				●				●			✖	●			●
Thermal Oxidation (Incineration)			✖			✖		✖					✖	✖	
Compost							✖				✖				
Alkaline Stabilization (N-Viro)									✖						
Pelletization														✖	
Potential diversification of biosolids management strategies and technologies				✖	✖				✖		✖			✖	✖

✖ Indicates primary disposal process

● Indicates secondary or contingency disposal process

Shaded cells indicate that no information is currently available

Land application of biosolids is proposed as the main management method in the future for nine of the municipalities reviewed. Only one municipality plans to use landfill as a main management method for biosolids and four municipalities plan to use landfill as a contingency plan. Five municipalities plan to use thermal oxidation (incineration) as the main management strategy of biosolids and two municipalities plan to use composting as a main management strategy. Pelletization is expected to be a large portion of one municipality's biosolids management strategy. Six municipalities indicated that possible diversification of management strategies and/or technologies will continue to be investigated.

4.1.4 Summary of Findings

The following points provide a summary of the findings for the review of the current and predicted biosolids management practices of 15 Ontario municipalities.

- Eleven of the 15 municipalities reviewed had Biosolids Management Plans or Strategies (Durham, Guelph, Hamilton, Kingston, London, Niagara, Ottawa, Oxford, Peel, Toronto, and Waterloo). Brant and Brantford currently have no plan in place while Haldimand and Norfolk Regions are currently preparing Biosolids Master Plan.
- Eleven of the municipalities reviewed currently use anaerobic digestion, four municipalities use aerobic digestion, three municipalities use both, and two municipalities do not use any digestion.
- Eleven of the municipalities reviewed currently use dewatering and it was indicated that two of the municipalities that currently do not use dewatering, plan to initiate it the future.
- Twelve of the reviewed municipalities currently use land application as their main biosolids disposal strategy. Based on available information, there is expected to be a decrease in the number of municipalities using land application, but it is still expected to be the predominant method of biosolids disposal.
- The City of Hamilton indicated that it plans to use thermal oxidation (incineration) as a future primary means of biosolids disposal as there are many concerns with continued land application.
- The City of Toronto indicated that it plans to practise more land application of biosolids in the future. As the City has limited land available, most of the application will need to occur in other municipalities. This will create competition for land application between municipalities.
- The Region of Durham has started to expand land application of biosolids to nursery lands to grow trees. This provides an alternative to land application on conventional agricultural land while reducing the transportation and additional processing [dewatering and thermal oxidation (incineration)] normally required of these biosolids.

- Only Ottawa is currently using composting for biosolids treatment as Guelph has discontinued the practice. Ottawa sends its biosolids to Quebec for composting where the regulations are different.

4.2 Global Trends in Biosolids Management Practices

TM2D, entitled Global Trends in Biosolids Management (Appendix A), discussed the options that are available to a municipality to manage the biosolids generated in a wastewater treatment facility namely; land application, landfill, thermal oxidation (incineration), and "other" used to capture those methods that do not easily fit into the first three. Each is describe in detail in the TM and the fate of biosolids in Canada, the United States, and Europe is presented and discussed.

The TM also identifies jurisdictions that have a multiple tiered classification system in which at least a two tier system of biosolids has been formalized in legislation. The TM also provides background on guidelines/regulations in Ontario and compares them to other areas of Canada and the world. These regulations are particularly focused on land application, as this is the area that has had most focus here and in other jurisdictions and that is pertinent to Halton Region at present.

A number of common features and trends have been observed in Canada, the United States, and Europe including the following.

- More biosolids are being produced as treatment facilities upgrade to higher levels of wastewater treatment, although reductions can partially address this through biological nutrient removal and solids enhancement processes.
- The preferred option for biosolids disposal/treatment is highly region/state/country dependent.
- In North America, land application is the preferred option by regulatory authorities as evidenced by their future projections of the legislation they will or are considering to implement.
- Land application of biosolids from one region competes directly with the land application of biosolids from another region, other biosolids sources (e.g. pulp and paper) and increased manure production.
- Landfill is the least preferred option by regulatory authorities.

There are a number of differences in the approach to biosolids management in Canada, the United States, and Europe. These are listed below.

- Relative to Canada and the United States, there is a greater emphasis on the use of thermal oxidation (incineration) in Europe;
- Likely due to greater available lands, Canada and the United States attempt to have a higher fraction of biosolids applied to land relative to Europe; and
- Restrictions on biosolids landfilled will become more restrictive in Europe than they are in Canada and the United States.

From a regulatory standpoint, more restrictions are being placed on many of the biosolids options including landfill, land application and thermal oxidation (incineration). Some of the restrictions are listed below.

- Limiting the type of material than can be put in a landfill (e.g. bans or restrictions of organic material);
- Reducing the allowable metal concentration in biosolids applied to land; and
- Reducing the air emissions allowable from an incinerator.

Sewer use control measures have been effective in improving the quality of biosolids, allowing restrictions to be more easily met.

Predicted future trends for biosolids disposal/utilization that were noted are presented below.

- Future wastewater treatment facilities will be designed and operated in order to minimize biosolids production.
- European countries are increasingly interested in nutrient (phosphorus) recovery/extraction from biosolids. This practice may be adopted in North America, if found viable.
- To increase the number of options available for biosolids utilization/disposal and improve the public's perception of biosolids, biosolids classification may be adopted in regions that face serious biosolids issues.
- According to a 2009 CCME report (CCME, 2009), future biosolids management practices will take into account the presence of micro-constituents (i.e. emerging contaminants of concern) and biosolids treatment strategies may also involve the removal of these contaminants.
- The preferred biosolids disposal/utilization options will remain highly region specific.
- In urban areas, good source control for metal and other pollutants will support all methods of biosolids treatment including the use of thermal oxidation (incineration) and heat/electrical generation and recovery.
- In urban regions where excess landfill space is available, landfill will be the preferred option.
- Utilization of biosolids in land reclamation projects (e.g. expired gravel pits) will increase.
- Regions will consider central biosolids processing facilities in order to provide for economy of scale.
- In rural areas, the focus will remain on land application, although competition from other regions will require local regions to be more aggressive in securing adequate land.
- Municipalities that would like to utilize land application will need to be more proactive with the public in order to secure adequate quantities of land. The amount of available land may be reduced due to new regulations and the conversion of agricultural land to residential use.

5. BIOSOLIDS MANAGEMENT ALTERNATIVES AND METHODS

5.1 Alternatives and Methods

A large number of Biosolids Management Methods are available but there are only three end use Alternatives; namely:

- Utilization on Land;
- Thermal Processes; and
- Disposal to Land.

A comprehensive review of the available Biosolids Management Methods was undertaken as part of the Biosolids Master Plan and is provided in TM2A (Biosolids Management Alternatives and Methods). The full Technical Memoranda is included in Appendix B. The key findings are summarized in this section of the BMP report.

Figure 5.1 shows the three Biosolids Management Alternatives and the Management Methods that could be considered for each Alternative. The Alternatives are described briefly in the subsections below, along with a listing of the Methods that considered for each Alternative. For more detailed information on the Methods, the reader is referred to TM2A in Appendix B.

5.2 Biosolids Management Alternatives

5.2.1 Utilization on Land

Utilization of biosolids on land involves the beneficial use of biosolids through applying it to soil in order to replenish the soil with the nutrients and organics that are available in the biosolids. Depending on the characteristics of the biosolids, land utilization can take place on agricultural land, forests, horticultural operations, or on land in need of reclamation or rehabilitation.

Some of the advantages of utilizing biosolids on land are:

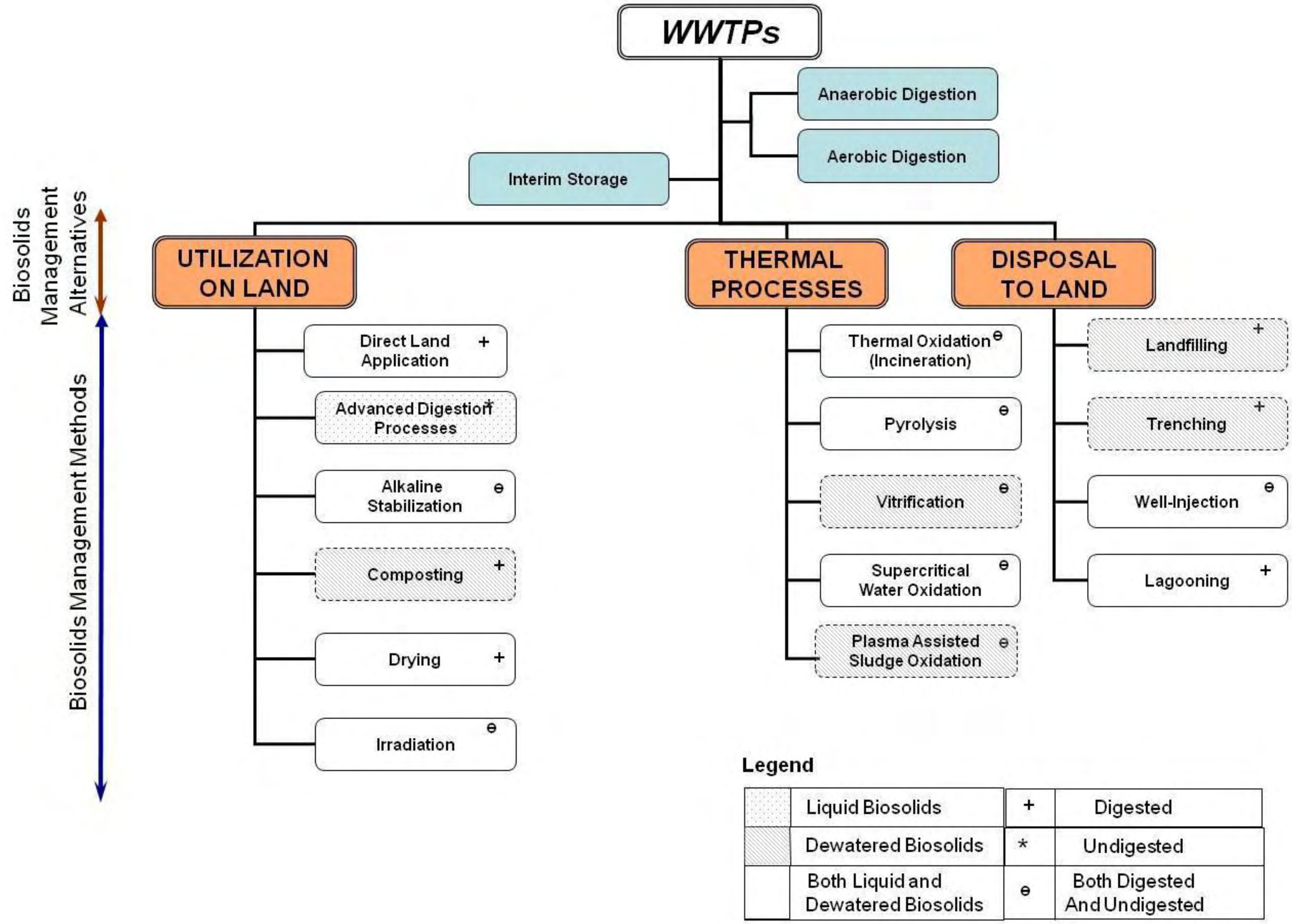
- It represent a beneficial source of nutrients for agriculture; and
- It represents economical management option.

Disadvantages of utilizing biosolids on land include:

- Biosolids must meet quality requirements before application and if they do not the biosolids must be disposed of by another means; and
- Land application is weather, crop and season dependent and storage of biosolids is required during periods when land application cannot be practised.

Biosolids Management Methods which can be used to allow utilization of biosolids on land as the management alternative can be categorized into six major categories as described below. Figure 5.2 summarizes the Biosolids Management Methods that could be used to support land application of biosolids.

Figure 5.1 Schematic of Biosolids Management Alternatives and Methods



5.2.1.1 Conventional and Advanced Digestion Processes

Conventional digestion processes that can be used to allow direct land application of stabilized biosolids include:

- Mesophilic Anaerobic Digestion; and
- Aerobic Digestion.

Advanced digestion processes can be used to produce a better quality biosolids product, termed Class A biosolids under the U.S. Environmental Protection Act (EPA) Part 503 Rule. Advanced digestion processes include:

- Thermophilic Anaerobic Digestion;
- Staged Anaerobic Digestion which includes Staged Mesophilic Digestion, Staged Thermophilic Digestion, and Temperature Phased Anaerobic Digestion (TPAD);
- Autothermal Thermophilic Aerobic Digestion (ATAD or ATTAD);
- Vertad™ (Vertical ATAD); and
- Dual Digestion (Aerobic/Anaerobic).

5.2.1.2 Alkaline Stabilization Processes

Alkaline stabilization processes utilize pH, sometimes in conjunction with elevated temperature, to stabilize biosolids. The source of the alkaline material may include hydrated lime [$Ca(OH)_2$, slaked lime, calcium hydroxide], quicklime (CaO), kiln dust (lime of cement), fly ash, carbide lime (CaC_2), and sodium or potassium hydroxide. The specific alkaline stabilization methods that could be considered include:

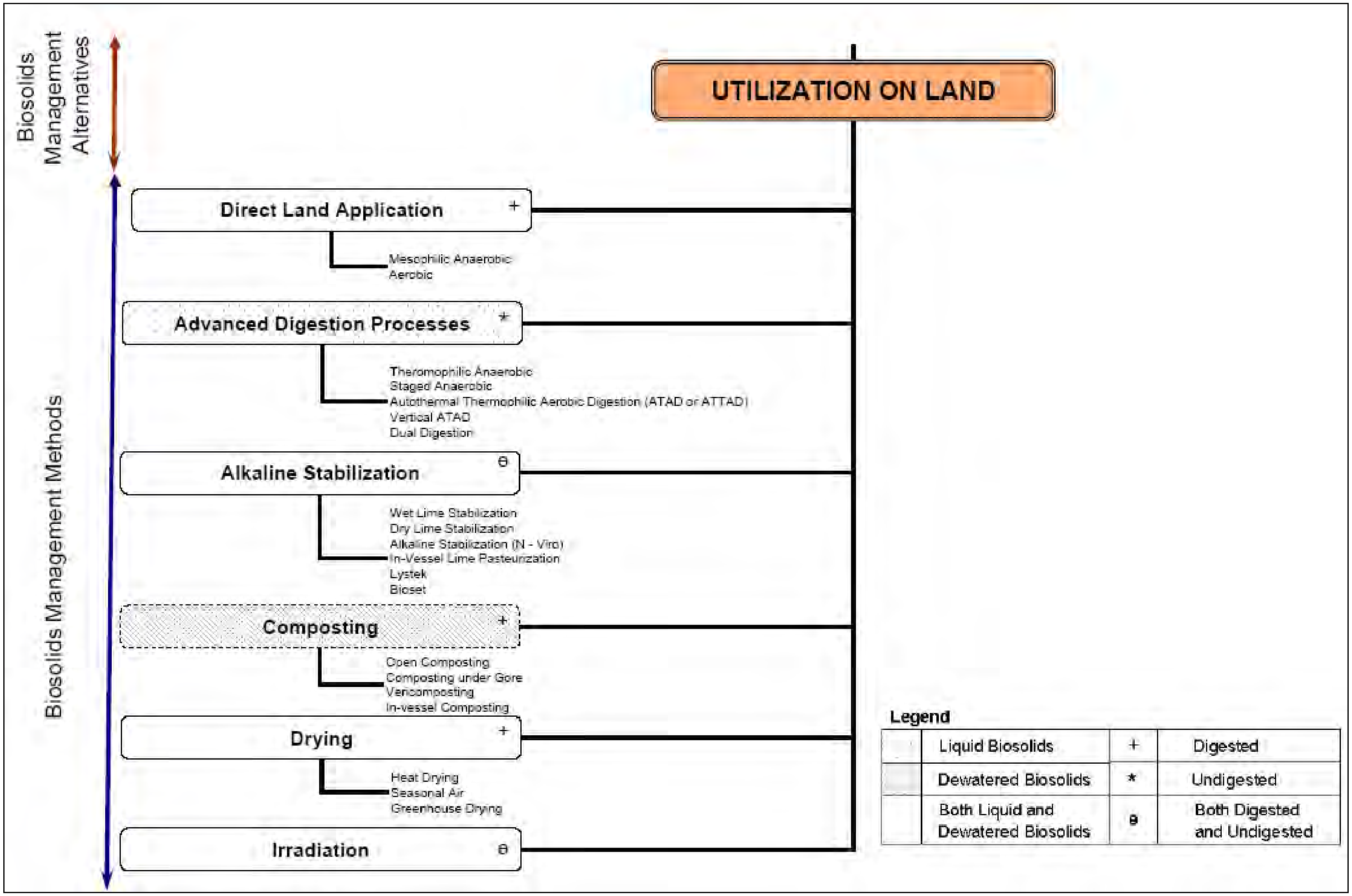
- Wet Lime Stabilization;
- Dry Lime Stabilization;
- Alkaline Stabilization (N-Viro Process);
- In-vessel Lime Stabilization;
- Lystek; and
- Bioset.

5.2.1.3 Composting Processes

Composting is a biological, self-heating stabilization process that results in a low odour, well-stabilized biosolids that can be stored indefinitely even if it is rewet (National Biosolids Partnership, 2005). There are several composting methods that can be used to stabilize biosolids, including:

- Open Composting;
- Composting Under Gore™;
- In-vessel Composting; and
- Vermicomposting.

Figure 5.2 Biosolids Management Methods Applicable to Utilization on Land Alternative



5.2.1.4 Drying Processes

The objective of the drying process is to remove through evaporation most of the water in dewatered biosolids. The dried product typically has a solids content of between 90 to 95 percent. There are a number of drying methods that could be applied to biosolids to allow land application, including:

- Heat Drying;
- Greenhouse Drying; and
- Seasonal Air Drying.

5.2.1.5 Irradiation

Irradiation utilizes radiation to destroy pathogens within biosolids. There are two varieties of irradiation possible: beta and gamma rays (EPA, 2006).

5.2.2 Thermal Processes

Thermal processing involves high temperature treatment of biosolids and results in a large reduction in the volume of end product which requires disposal and, in some cases, allows for energy recovery.

Some of the advantages of utilizing thermal processes include:

- They are not weather dependent; and
- They results in less by-products (ash) requiring disposal compared to the amount of by-product (biosolids) from conventional stabilization processes.

Disadvantages of thermal processes include:

- Typically high capital cost; and
- Complex operational and maintenance requirements.

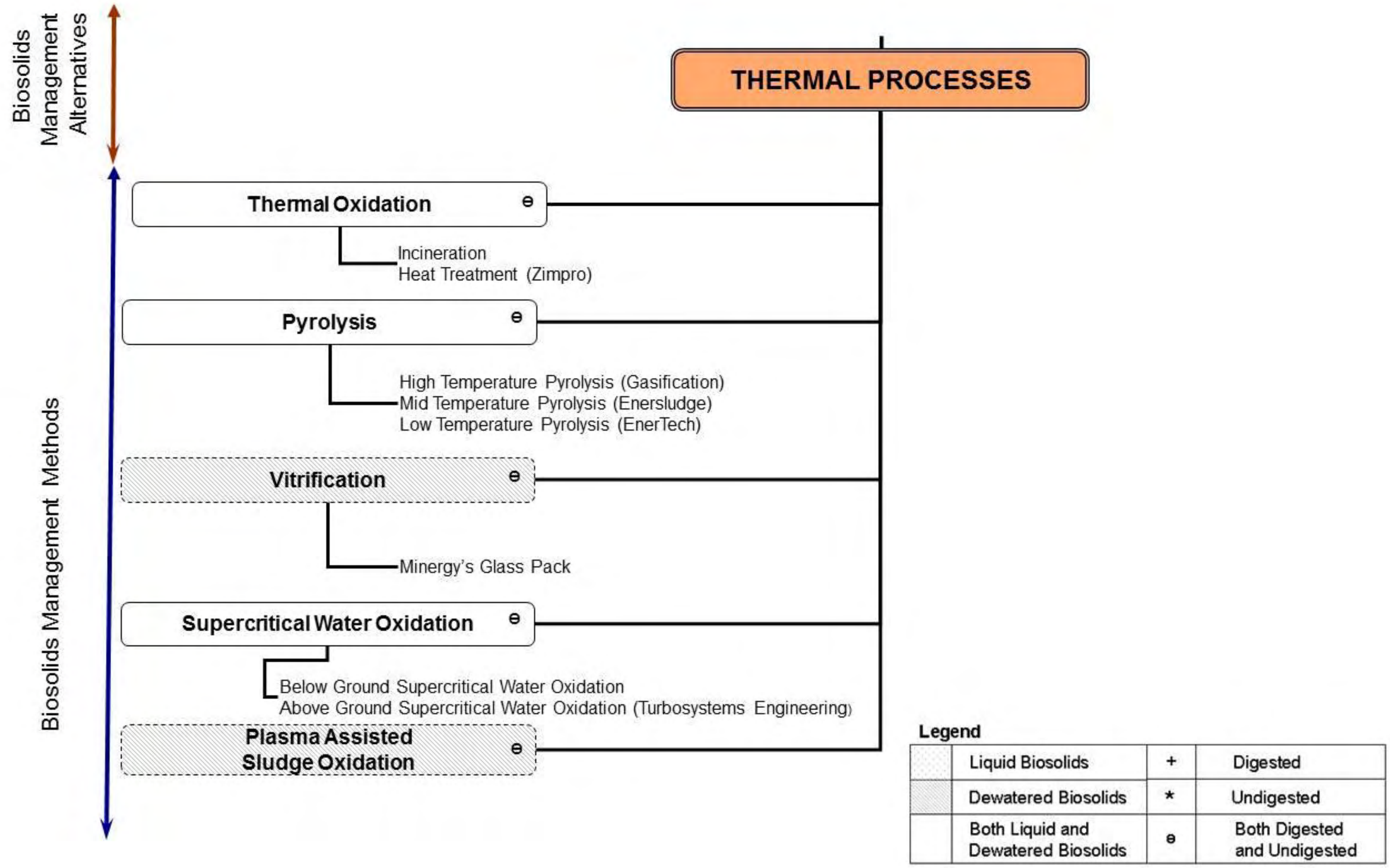
Figure 5.3 summarizes the biosolids management methods that are considered to be Thermal Processes.

5.2.2.1 Thermal Oxidation (Incineration)

Thermal oxidation (incineration) utilizes high temperatures to combust organic material and re-uses a portion of the energy from the process for internal system operations or as an external marketable product (i.e. steam, hot water, or electricity).

In the context of this Biosolids Master Plan, Thermal Oxidation (Incineration) is considered to include the combustion of dewatered biosolids as well as the combustion of dried or otherwise processed biosolids to produce a biofuel suitable for combustion and energy recovery.

Figure 5.3 Biosolids Management Methods Considered Thermal Processes



5.2.2.2 Other Thermal Processes

Other thermal processes that could be used for biosolids management include:

- Heat Treatment (Zimpro Process);
- High Temperature Pyrolysis (Gasification);
- Mid-Temperature Pyrolysis (Enersludge);
- Low Temperature Pyrolysis (EnerTech);
- Vitrification (Minergy's GlassPack);
- Below Ground Supercritical Water Oxidation (SCWO);
- Above Ground Supercritical Water Oxidation (Turbosystems Engineering); and
- Plasma Assisted Sludge Oxidation (PASO).

5.2.3 Disposal to Land

There are Management Methods that provide permanent disposal of biosolids.

Advantages of utilizing disposal of biosolids to land include:

- The Methods are not weather dependent; and
- They can be economical if ample access to land is available.

Disadvantages of utilizing disposal of biosolids to land include:

- It requires large amounts of land and/or space within existing landfill; and
- It has the potential to impact ground water quality.

Figure 5.4 summarizes the Biosolids Management Methods that could be used for land disposal of biosolids.

5.2.3.1 Landfilling

Landfilling of biosolids involves the co-disposal of municipal biosolids to a municipal waste landfill site. The biosolids must be combined with either the solid wastes being applied to the land fill or with soil utilized in a soil layer that acts as a landfill cover prior to application to the landfill.

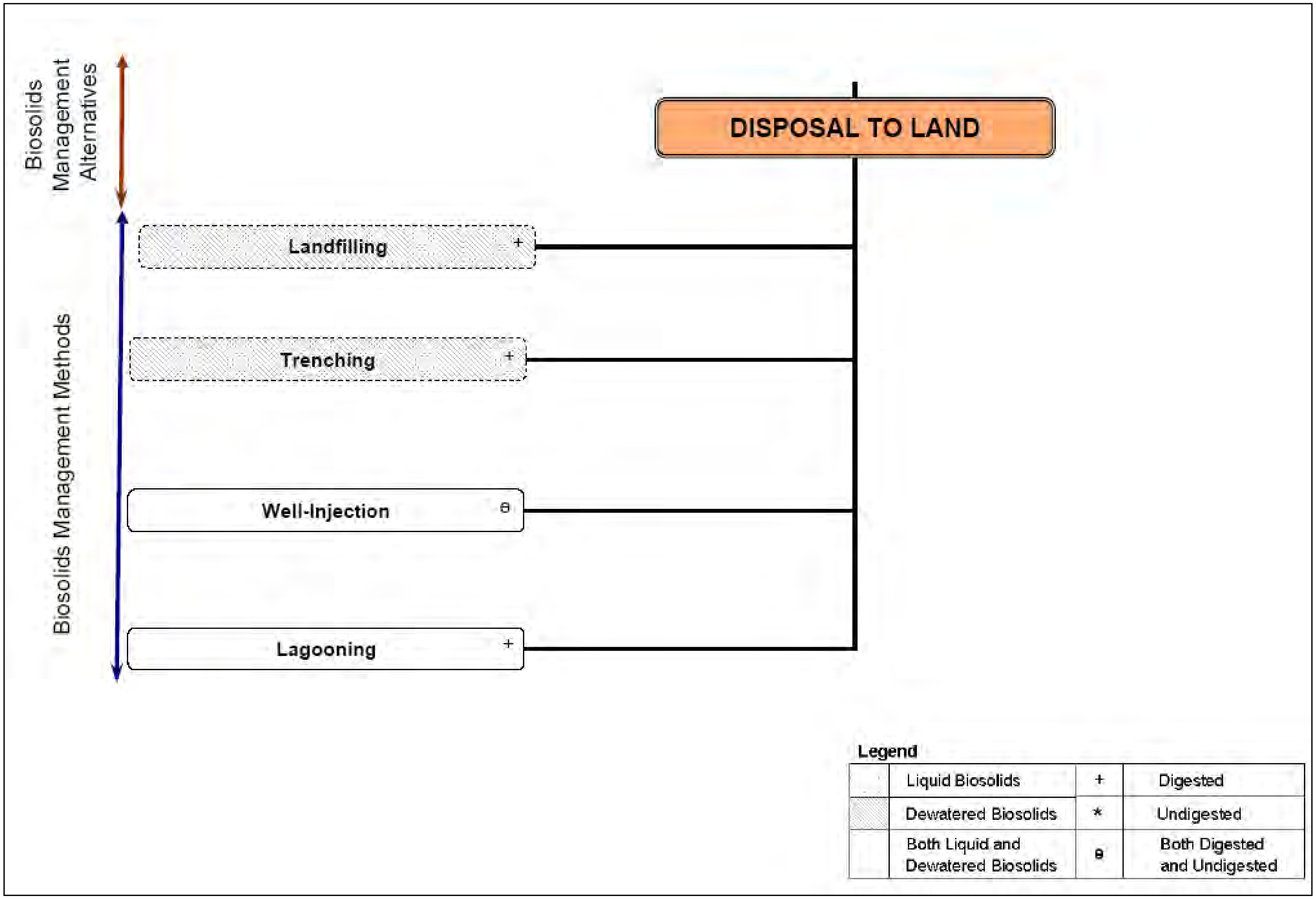
5.2.3.2 Trenching

Disposal of biosolids through trenching involves the excavation of land and dispersal of biosolids within the trenches and then covering the trenches with soil.

5.2.3.3 Well-Injection

The process of injecting biosolids involves the injection of biosolids deep underground (5,000 feet).

Figure 5.4 Biosolids Management Methods for Land Disposal of Biosolids



5.2.3.4 *Long-Term Lagooning*

Long-term lagooning involves placing biosolids in a below ground excavation with sloping sides.

5.3 *Summary of Biosolids Management Alternatives and Methods*

5.3.1 *Qualitative Costing*

An indication of the qualitative capital and operating costs associated with each of the Biosolids Management Methods discussed in TM2A is presented in Table 5.1. Within Table 5.1, the qualitative capital and operating cost of each Method has been given a ranking from least expensive to most expensive in comparison to the other Methods in the table.

5.3.2 *Advantages and Disadvantages of Biosolids Management Methods*

Table 5.2 summarizes some of the advantages and disadvantages of the individual Biosolids Management Methods.

Table 5.1 Qualitative Cost of Biosolids Management Methods

Method	Capital Cost	Operating Cost
Mesophilic Anaerobic Digestion	◔	◔
Aerobic Digestion	○	◑
Thermophilic Anaerobic Digestion	◔	◔
Staged Mesophilic Digestion	◔	◔
Staged Thermophilic Digestion	◔	◔
Temperature Phased Anaerobic Digestion (TPAD)	◔	◔
Autothermal Thermophilic Aerobic Digestion (ATAD or ATTAD)	◔	◑
Vertad (Vertical ATAD)	◑	◑
Dual Digestion (Aerobic / Anaerobic)	◑	◑
Wet/Dry Lime Stabilization	◔	◔
Alkaline Stabilization (N-Viro)	◑	◑
In-Vessel Lime Pasteurization	◑	◑
Lystek	◑	◑
Bioset	◑	◑
Open Composting	○	○
Composting under Gore™	◔	○
In-Vessel Composting	◔	◔
Vermicomposting	◔	○

Table 5.1 Qualitative Cost of Biosolids Management Methods (cont'd)

Method	Capital Cost	Operating Cost
Heat Drying	◕	◕
Greenhouse Drying	◔	○
Seasonal Air Drying	○	○
Irradiation	●	●
Wet/Dry Lime Alkaline Stabilization	◔	◔
Alkaline Stabilization (N-Viro)	◑	◑
In-vessel Lime Pasteurization	◑	◑
Lystek	◑	◑
Bioset	◑	◑
Thermal Oxidation (Incineration)	●	◕
Heat Treatment (Zimpro)	●	◕
High Temperature Pyrolysis (Gasification)	●	●
Mid Temperature Pyrolysis (Enersludge)	●	●
Low Temperature Pyrolysis (EnerTech)	●	◕
Vitrification (Minergy's GlassPack)	●	●
Below Ground Supercritical Water Oxidation	●	●
Above Ground SuperCritical Water Oxidation (Turbosystems Engineering)	●	●
Plasma Assisted Sludge Oxidation	●	●
Landfilling	◑	◔
Trenching	◑	◑
Well-Injection	◕	◑
Long-term Lagooning	○	○

Notes:

○ ◔ ◑ ◕ ●

Least expensive → Most expensive

Table 5.2 Summary of Biosolids Management Methods Advantages and Disadvantages

Methods	Advantages	Disadvantages
Mesophilic Anaerobic Digestion	• Well known process with large number of facilities currently in operation • Ability to recover gas produced • End-product is stabilized material that can be used as a soil conditioner • Moderate capital and operational cost	• Not considered Class A product • Poor settling characteristics possible resulting in a high solids concentration in the supernatant
Aerobic Digestion	• Lower capital cost than anaerobic digestion • Simpler operation • Safer operation as there is no potential for gas explosion • Supernatant contains lower BOD_5 concentrations	• High power cost resulting from aeration requirements (even for small plants) • Open tanks can result in odour production • Relatively large footprint required • Aerobic biosolids difficult to mechanically dewater • Reduced process efficiency in cold temperatures • Not able to produce biogas for energy production
Thermophilic Anaerobic Digestion	• Higher volatile solids reduction • Improved dewatering characteristics of digested solids • Greater reduction in pathogens over mesophilic digested solids	• Higher ammonia levels in supernatant • Higher energy requirements • Process sensitive to variations in temperature • Higher capital and operational cost
Staged Mesophilic Digestion	• Improved ability to dewater • High VSS destruction • Able to recover energy • Reduced pathogen content compared to conventional mesophilic anaerobic digestion	• High operating cost as both digesters are mixed and heated
Staged Thermophilic Digestion	• Increased gas production and recovery • Potential to produce a Class A product • Higher volatile solids reduction	• Increase energy input as both digesters are heated and mixed • Potential for higher ammonia levels in recycle stream which could impact liquid treatment • Moderately higher operating cost over mesophilic anaerobic digestion
Temperature Phased Anaerobic Digestion (TPAD)	• Improved solids destruction relative to mesophilic anaerobic digestion process • Higher gas production and recovery • Shortened HRT and reactor size for first reactor • Similar design concepts to conventional anaerobic digestion process	• Attention required to corrosion protection with high temperature operation • Requires pre-thickening to greater than 5 percent dry solids • Return flow could contain high ammonia levels

Table 5.2 Summary of Biosolids Management Methods Advantages and Disadvantages

Methods	Advantages	Disadvantages
Autothermal Thermophilic Aerobic Digestion (ATAD or ATTAD)	• Lower HRT to achieve similar VS reduction leading to smaller digester size • Able to recover and use heat produced • Mechanical process that is easy to operate • Pasteurization possible which can lead to pathogenic organisms reduction	• High energy costs • Foaming can be an issue • Pre-thickening required • Odour issues possible • Skilled operators required
Vertad (Vertical ATAD)	• Small land use footprint required • Produces sludge that can be classified as Class A biosolids	• High capital cost • Lack of full-scale experience
Dual Digestion (Aerobic / Anaerobic)	• Increased pathogen reduction • Higher methane production, energy recovery • Improved volatile solids reductions	• More complex operation than conventional mesophilic digestion
Wet Lime Alkaline Stabilization	• Simple process • Low capital cost • System can be quickly shut down in the event of process problems	• Odour generation • Loss of nitrogen reduces the recycling potential of nutrients • Safety issues regarding the use of alkaline materials which produce dust
Dry Lime Alkaline Stabilization	• Simple process • Low capital cost • No addition of water • Source of lime for farmers	• Odour generation • Loss of nitrogen reduces the recycling potential of nutrients • Safety issues regarding the use of alkaline materials which produce dust
Alkaline Stabilization (N-Viro)	• Essentially a pathogen free product • Developed market in Ontario • Stability of product in storage	• Energy requirement to reduce water content through evaporation • Process significantly increases volume of material to be managed • Gas stream generated requires particulate, contaminant and odour control
In-Vessel Lime Pasteurization	• Removal of pathogens • Short process time from feed to product • Reduced lime addition relative to conventional lime stabilization	• Additional operating cost due to heating requirements • Significantly increased product volume and mass due to lime addition • Safety issues with respect to lime handling
Lystek	• Small processing area • Essentially a pathogen free product • Product can be transferred in closed pipes (since pumpable) allowing transfer over longer distances (e.g. underground to storage areas)	• High viscosity of liquid product not typically seen by mechanical designers and therefore careful consideration is needed when selecting pumping equipment • High energy requirement for mixer • Product volume slightly greater than raw volume due to steam and chemical addition

Table 5.2 Summary of Biosolids Management Methods Advantages and Disadvantages

Methods	Advantages	Disadvantages
Bioset	• Produces an essentially pathogen free product • No supplemental heat is required • Enclosed reactor vessel minimizes odour and dust	• Increase in biosolids management volume due to the addition of lime • Cost of chemicals • Ammonia recycling that requires treatment
Open Composting	• High quality end product possible • Simple construction and operation • Revenue possible from sale of end product	• Process can be labour intensive • Regulatory restrictions • Odour issues • Large footprint required • Pathogen re-growth possible
Composting under Gore™	• Not as impacted by the weather • Typically less land required • More operational control • Quality of end-product is more consistent • Able to collect air to treat and reduce odour emissions	• Regulatory restrictions • Moisture and aeration required to prevent fires within piles • Slightly more complex process and more operational equipment required
In-Vessel Composting	• Potential beneficial end product. • Effects of weather are minimized • Less labour required to operate system and lower exposure of operators to composting biosolids • Lower space requirement than other forms of composting • Process air can be collected and treated to reduce odour emissions • More consistent quality of the final product.	• More costly than other types of composting in terms of capital expenditures • More complex operation and equipment which can increase maintenance requirements
Vermicomposting	• Simple operation • High quality biosolids produced	• Large footprint required • Sensitive to characteristics and composition of biosolids
Heat Drying	• Produces an essentially pathogen free product • Considerable reduction in volume of product to manage after heat drying • Can utilize digester gas that may otherwise be flared off	• Large surface area with high ceilings required to accommodate dryer and dust control systems • High energy requirement for dryer • Due to high carbon content and dryness of product, safety precautions are required to prevent auto-combustion
Greenhouse Drying	• Process can accept a wide range of solids concentrations • Significant reduction in product volume • No or minimal external fuel required	• Climate dependency • Difficult to produce an essentially pathogen free product consistently • Potential odour emissions must be controlled

Table 5.2 Summary of Biosolids Management Methods Advantages and Disadvantages

Methods	Advantages	Disadvantages
Seasonal Air Drying	• High quality biosolids possible • Minimal labour requirements • Low energy requirements • End-product can be sold	• Large footprint required • Process less effective during a portion of the year in Southern Ontario • Biosolids must be dewatered to at least 12 percent solids • Precipitation impacts process if no roof cover • Odour issues
Irradiation	• Destruction of pathogens in biosolids.	• No full scale experience • No reduction in solid concentration in biosolids • Requires supplementary treatment • Health and safety risk to operations staff possible
Thermal Oxidation (Incineration)	• Dramatic reduction of material to be managed • Does not compete with land utilization alternative • Reuse of energy from the process for internal system operations or external marketable product	• High capital cost • Large capacity required to make system viable • No recycling of nutrients
Heat Treatment (Zimpro)	• Can completely oxidize volatile solids producing a stabilized sludge with no pathogenic organisms • Can be self-sufficient with respect to energy requirements with the exception of system start-up	• Significant production of odorous gases • High capital cost with a strong preventative maintenance program • Generation of high strength liquid stream that must be processed
High Temperature Pyrolysis (Gasification)	• Complete pathogen destruction • Reduced exhaust gas volume relative to incineration • Energy releasing products can be created that can be stored and combusted at any desired time	• Relatively complex system • Potential generation of toxic compounds that can be present in the liquid, solids or gas streams (e.g. furans) • Safety issues relating to the generation of explosive gases
Mid Temperature Pyrolysis (Enersludge)	• Production of an storable energy source (i.e. oil) that can be utilized as required • Production of a saleable product (diesel oil) • Low pressure system reduces safety concerns	• Significant number of process components • Safety issues relating to the generation of explosive gases • Limited operational experience
Low Temperature Pyrolysis (EnerTech)	• Complete pathogen destruction • Lower operating temperature relative to gasification process • Energy releasing products can be created that can be stored and combusted at any desired time	• Potential generation of toxic compounds that can be present in the liquid, solids or gas streams (e.g. furans) • Safety issues relating to the generation of explosive gases • Relatively complex system if drying system included

Table 5.2 Summary of Biosolids Management Methods Advantages and Disadvantages

Methods	Advantages	Disadvantages
Vitrification (Minergy's GlassPack)	• Complete pathogen destruction • System uses energy in biosolids to off-set energy requirement • Dramatic reduction in volume of material to be managed	• Safety concerns regarding high temperature of system • High fuel usage • Relatively complex system
Plasma Assisted Sludge Oxidation	• End product can be used as an aggregate in cement or compost • Energy recovery possible • Process is not impacted by inclement weather	• No known full-scale experience • Complex system design and operation
Landfilling	• Process is not impacted by inclement weather • Depending on landfill can be cost effective	• Takes up space in the landfill which shortens the life expectancy • At the end of the landfill's life expectancy negotiation for landfill space and additional landfill may be required to continue landfilling biosolids.
Trenching	• Simple operation • Depending on location and land available can be low cost option.	• Requires large amounts of land • Depending on type of trenching may require higher solids content
Well-Injection	• Generation of beneficial biogas	• Little full scale experience
Long-Term Lagooning	• Simple operation • Low energy requirements • Not sensitive to sludge characteristics • Low cost	• Large footprint required • Odour issues

6. EVALUATION PROCESS AND CRITERIA

The evaluation of Biosolids Management Methods was a step-wise process. The process is illustrated in Figure 6.1. Key considerations in the development of the Biosolids Master Plan were Halton Region's current and future infrastructure requirements, the current biosolids management program, the commitment to organics recycling, and program diversification requirements to ensure flexibility and sustainability over the long-term. The selected Methods must be proven, cost effective, protective of human health, and respective of the environment.

The evaluation process comprised a three step process that included:

- Pre-Screening and Short Listing of Management Methods for Evaluation;
- Detailed Evaluation of Short Listed Management Methods; and
- Development of the Proposed Strategy.

A detailed discussion of the Evaluation Process and Criteria is contained in TM2B, which is provided in Appendix B of the report.

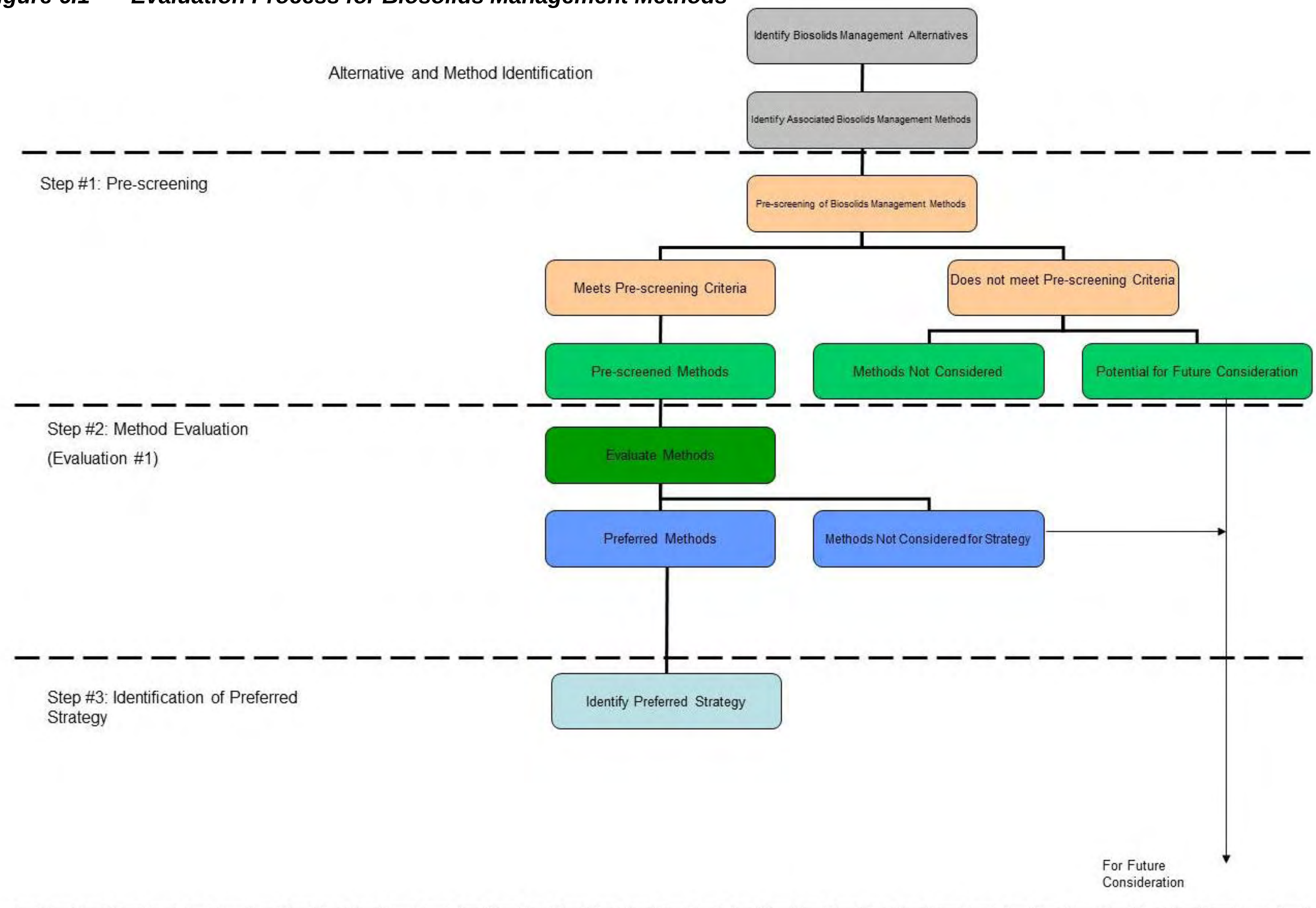
6.1 Pre-Screening of Biosolids Management Methods

Management methods were pre-screened to eliminate those that are not appropriate for application in Halton Region. The pre-screening process considered the following criteria:

- Ability to meet current and potential future regulatory requirements;
- At least three known systems in full-scale operation;
- System is operating at a similar scale as potentially required for Halton Region; and
- A minimum of three years of successful operating experience at full-scale.

Each Method had to meet all of the pre-screening criteria to proceed to the detailed evaluation stage. The pre-screening process resulted in a pass or fail rating for each Method. As this is a long-term strategy, some methods that do not qualify for detailed evaluation at this time may be of particular interest to Halton Region and may be identified for further consideration and review on a Research and Development basis.

Figure 6.1 Evaluation Process for Biosolids Management Methods



6.2 Detailed Evaluation of Biosolids Management Methods

Following the Biosolids Management Method pre-screening process, each short-listed Method selected for detailed evaluation was rated using pre-selected criteria. Evaluation criteria were grouped in the following categories:

1. Community Acceptance.
2. Environmental Considerations.
3. Financial Considerations.
4. Management.
5. Public Health and Safety.
6. Technical and Operating.

Table 6.1 identifies the evaluation criteria used in each criteria category. The definition of each evaluation criterion is provided in TM2B (Appendix B).

The weights for the criteria and the categories were developed in consultation with the Region and the BMPSAC. Table 6.2 presents the weightings for each category and each criterion that were developed in consultation with the BMPSAC.

All Biosolids Management Methods were assigned a numerical rating for each criterion from 1 to 5. The rating score represented the degree to which the Biosolids Management Method satisfied that criterion relative to all of the other Methods. The basis for the numerical ratings is shown in Table 6.3.

Table A.1 of TM2B (Appendix B) provides an example of the evaluation matrix and scoring methodology.

Table 6.1 Biosolids Management Method Evaluation Criteria

Criteria Category	Individual Evaluation Criteria
Community Acceptance	Off Site Odour
	Traffic
	Off Site Noise
	Aesthetics
	Social Perceptions
Environmental Considerations	Surface and Groundwater
	Soil Quality
	Air Pollutants
	Terrestrial Systems
	Environmental Benefits
	Natural Resources Preservation
Financial Considerations	Capital & Operational Costs
	Life-Cycle Costs
	Partnership Potential
Management	Flexibility
	Sustainability
	Availability of Market or Receiver
	Capacity of Market or Receiver
	Reliability of Market or Receiver
Public Health & Safety	Degree of Protection - Normal Operations
	Degree of Protection - Emergency Situations
Technical and Operating	Demonstrated/Proven Track Record
	Technical Reliability
	Technical Complexity
	Maintenance Requirements
	Ease of Expansion
	Impact on Current Operations and Infrastructure
	Disruptions Due to Uncontrollable Circumstances
	Operating/Process Flexibility
	Occupational Health & Safety

Table 6.2 Category and Criteria Weightings

Category	Category Weight (%)	Individual Evaluation Criteria	Criteria Weight Factor
Community Acceptance	15	Off Site Odour	4
		Traffic	2
		Off Site Noise	2
		Aesthetics	1
		Social Perceptions	4
Environmental Considerations	20	Surface and Groundwater	4
		Soil Quality	3
		Air Pollutants	4
		Terrestrial Systems	3
		Environmental Benefits	4
		Natural Resources Preservation	4
Financial Considerations	15	Capital Costs	3
		Net Operating Costs	3
		Life-Cycle Costs	3
		Partnership Potential	1
Management	15	Flexibility	3
		Sustainability	4
		Availability of Market or Receiver	3
		Capacity of Market or Receiver	3
		Reliability of Market or Receiver	3
Public Health & Safety	20	Risk to Public - Normal Operations	4
		Risk to Public - Emergency Situations	4
Technical and Operating	15	Demonstrated/Proven Track Record	4
		Technical Reliability	4
		Technical Complexity	2
		Maintenance Requirements	2
		Ease of Expansion	2
		Impact on Current Operations and Infrastructure	2
		Disruptions Due to Uncontrollable Circumstances	3
		Operating/Process Flexibility	3
		Occupational Health & Safety	3

Table 6.3 Criteria Ratings

Rating	Description
5	Method is superior relative to the other methods in meeting a criterion
4	Method is better than the other methods in meeting a criterion
3	Method is the same as the other methods in meeting a criterion
2	Method is not as good as the other methods in meeting a criterion
1	Method is poor relative to the other methods in meeting a criterion

7. EVALUATION OF BIOSOLIDS MANAGEMENT METHODS AND DEVELOPMENT OF PREFERRED BIOSOLIDS MANAGEMENT STRATEGY

Using the Biosolids Management Method evaluation process described in Section 6 and in TM2B (Appendix B), Biosolids Management Methods were pre-screened and the short-listed Methods subjected to a detailed evaluation. Based on the detailed evaluation, a Biosolids Management Strategy was developed that satisfies Halton Region’s goal of achieving biosolids program diversification and flexibility for the long-term. The details of the evaluation process are provided in TM3 “Evaluation of Biosolids Management Methods and Development of Preferred Biosolids Management Strategy”, that is provided in Appendix C.

7.1 Pre-Screening of Biosolids Management Methods

Table 7.1 presents the pre-screening results for each of the Biosolids Management Methods. Additional details regarding the rationale for pre-screening outcomes is provided in TM3 (Appendix C). Key considerations are provided in the paragraphs below.

Recently proposed changes to Ontario’s composting guidelines are expected to make composting of Halton Region’s biosolids a viable option for consideration as part of the Biosolids Management Strategy; however, it should be noted that without blending another organic material (i.e. leaf and yard waste, “green bin” waste, etc.) with biosolids to produce the final compost product, the compost would most likely be categorized as “Category B” which would have restrictions for use similar to Halton Region’s current land application program. Since this would result in limited advantages over Halton Region’s existing land application program, the ability to co-compost and/or blend biosolids with organic material in order to achieve a “Category A” product was a key consideration in evaluating composting Methods.

Many of the thermal processes are novel and many have not been either operated at full-scale or have not been constructed at a scale similar to Halton Region’s needs. Thermal oxidation (incineration) is the only thermal process Method that meets all of the pre-screening criteria. Thermal oxidation (incineration) is practised in Ontario and around the world.

Most of the Disposal to Land Methods are novel, have not been conducted at full-scale, or have not been constructed at a scale similar to Halton Region’s requirements. Trenching is not practised widely and requires a significant amount of dedicated and approved land, which is not currently available in Halton. Long-Term lagooning also requires a significant amount of land and could not be practised at most of the facilities in Halton Region, primarily due to potential odour issues. Well-injection is a novel process, but the process does not have full-scale facilities and operating experience required to be considered as a Management Method for Halton Region.

Table 7.1 Pre-Screening of Biosolids Management Methods

Process	Regulatory Requirements (1)	Existing Full Scale Systems (2)	Existing Similar Scale as Region (3)	Three Years at Full Scale (4)	Pre-Screening Pass/Fail
Utilization on Land					
Mesophilic Anaerobic Digestion	Y	Y	Y	Y	P
Thermophilic Digestion	Y	Y	Y	Y	P
Aerobic Digestion	Y	Y	N	Y	F
Staged Anaerobic Digestion	Y	Y	Y	Y	P
ATAD	Y	Y	N	Y	F
Vertad™ (Vertical ATAD)	Y	N	N	N	F
Dual Digestion (Aerobic/Anaerobic)	Y	Y	N	N	F
Wet Lime Stabilization	Y	Y	N	N	F
Dry Lime Stabilization	Y	Y	N	N	F
Alkaline Stabilization (N-Viro)	Y	Y	Y	Y	P
In-Vessel Lime Pasteurization	Y	Y	N	N	F
Lystek	Y	N	N	Y	F
Bioset	Y	Y	N	Y	F
Open Composting	Y	Y	Y	Y	P
Composting Under Gore™	Y	Y	Y	Y	P
In-Vessel Composting	Y	Y	Y	Y	P
Vermicomposting	N	Y	N	N	F
Heat Drying	Y	Y	Y	Y	P
Greenhouse Drying	Y	Y	N	Y	F
Seasonal Air Drying	N	Y	N	Y	F
Irradiation	Y	N	N	N	F

Table 7.1 Pre-Screening of Biosolids Management Methods (cont'd)

Process	Regulatory Requirements (1)	Existing Full Scale Systems (2)	Existing Similar Scale as Region (3)	Three Years at Full Scale (4)	Pre-Screening Pass/Fail
Thermal Processes					
Thermal Oxidation (Incineration)	Y	Y	Y	Y	P
Heat Treatment (Zimpro)	Y	Y	N	Y	F
Pyrolysis	Y	Y	N	N	F
Vitrification	Y	Y	N	N	F
Supercritical Water Oxidation	Y	N	N	N	F
Plasma Assisted Oxidation	Y	N	N	N	F
Disposal to Land					
Landfilling	Y	Y	Y	Y	P
Trenching	N	N	N	N	F
Well Injection	N	N	N	N	F
Long-term lagooning	Y	N	N	Y	F

Notes:

1. Ability to meet current and probable Future Regulatory Requirements
2. At least three known systems in full-scale operation
3. System is operating at a similar scale as potentially required for Region
4. A minimum of three years of successful operating experience at full scale.

Landfilling met all of the pre-screening criteria but was not carried forward for detailed evaluation. Landfilling of biosolids will only be considered a contingency measure in case of emergency for the following reasons:

- Landfilling biosolids would not support the principles of Halton Region's 2006 – 2010 Solid Waste Management Strategy regarding organics diversion from landfill.
- Landfilling biosolids would not support the Provincial Government's 60 percent landfill diversion directive.
- Landfilling of a significant portion of Halton Region's biosolids is not considered to be sustainable with Halton Region and would necessitate reliance on external landfills such as those in the U.S. Accessibility to U.S. landfills would be vulnerable to foreign government influence and policy such as Michigan's recent efforts to ban the importation of solid municipal wastes from Ontario.

7.2 Short Listed Biosolids Management Methods

Table 7.2 presents the short-list of Alternatives and Methods that met the pre-screening requirements.

Table 7.2 Short-Listed Biosolids Management Methods

Alternative	Method
Utilization on Land	Mesophilic Anaerobic Digestion
	Thermophilic Digestion
	Staged Anaerobic Digestion
	Alkaline Stabilization (N-Viro)
	Open Composting
	Composting Under Gore™
	In-Vessel Composting
	Heat Drying
Thermal Processes	Thermal Oxidation (Incineration)

The list of methods presented in Table 7.2 was expanded and/or refined to include additional options available to Halton for implementation of a particular Method. This refined list of Methods for evaluation is presented in Table 7.3. The considerations used to generate the refined list include the following.

- Some of the short-listed Methods could be accommodated through a shared facility outside of Halton Region, under a partnership arrangement with a private or public organization. Where such opportunities could be available, the Method was evaluated both as a shared facility (partnership) and as a dedicated Halton Region facility (owned by Halton Region).
- For the purposes of this evaluation, the term "conventional digestion" represents mesophilic anaerobic digestion as currently practised at Halton Region's WWTPs.
- Thermophilic and staged anaerobic digestion are similar processes and for the purposes of the evaluation were grouped and referred to as "advanced digestion". The type of advanced digestion process (i.e. thermophilic or staged) that would be implemented would be site-specific to individual WWTPs.
- Two Methods of land application were considered for further evaluation: Land Application of Cake Only and Land Application of Liquid and Cake. Liquid only land application was eliminated from consideration as this Method has limited end use flexibility in the event of poor weather and field conditions as large storage capacity is needed to support a liquid only land application program and a liquid product cannot be directed to any other end-use such as landfilling in the event of a short-fall in land application capacity.

Table 7.3 Refined Short-Listed Biosolids Management Methods

Alternative	Method
Utilization on Land	Land Application of Liquid and Cake (Conventional Digestion)
	Land Application of Cake Only (Conventional Digestion)
	Land Application of Liquid and Cake (Advanced Digestion)
	Land Application of Cake Only (Advanced Digestion)
	Alkaline Stabilization (Regional Facility)
	Alkaline Stabilization (Shared Facility)
	Open Composting
	Composting Under Gore™
	In-Vessel Composting
	Heat Drying (Regional Facility)
	Heat Drying (Shared Facility)
Thermal Processes	Thermal Oxidation (Incineration, Regional Facility)
	Thermal Oxidation (Incineration, Shared Facility)

7.3 Detailed Evaluation and Ranking of Biosolids Management Methods

The refined short list of Biosolids Management Alternatives and Methods was evaluated based on the evaluation criteria and weightings presented in Section 6 and in TM2B (Appendix B).

The following guiding principles were applied in the development of scoring during the detailed evaluation of the Management Methods.

- It is assumed that the portion of Halton Region's biosolids allocated to a Method under evaluation is greater than 50 percent of Halton Region's total biosolids production (majority), but not all of Halton Region's production would be allocated to any Method to meet the objective of program diversity.
- The evaluation considered existing biosolids and wastewater treatment infrastructure currently in place in Halton Region.
- Thermal Oxidation (Incineration), Heat Drying, and Alkaline Stabilization Methods were evaluated both as Halton Region exclusive facilities built and located within Halton Region, and as a partnership between Halton Region and a Private or Public organization at a shared facility outside the Region.
- Landfilling of biosolids will only be considered a possible contingency measure in case of emergency for the reasons outlined in Section 7.2 above.
- Evaluation of biosolids composting assumed that the biosolids would be co-composted or blended with other organic material to meet "Category A" requirements as defined in the Draft Guideline for Composting Facilities and

Compost Use in Ontario. A “Category A” designation will be considered the minimum product category level for the Method to be of benefit to Halton Region should Composting be adopted as a component of the Biosolids Management Strategy. For the purposes of the evaluation, it was assumed that this Method would be a Halton Region operated facility within Halton Region, although other options are available (shared facility inside or outside of Halton Region).

- The scoring is based on knowledge of the current biosolids industry practices and experience in Ontario.

The results of the detailed evaluation of the Biosolids Management Methods including total scoring and ranking of the Methods are shown in Table 7.4. These results are also presented graphically in Figure 7.1. Table 7.5 summarizes some of the key points that were considered in assigning the scores to each Method.

Table 7.4 Summary of Scores and Ranking for Method Evaluation

Method	Total Score	Rank
Land Application Liquid & Cake (Conventional Digestion)	8.97	6
Land Application Cake Only (Conventional Digestion)	8.89	8
Land Application Liquid and Cake (Advanced Digestion)	8.73	11
Land Application Cake Only (Advanced Digestion)	8.88	9
Alkaline Stabilization (Regional Facility)	8.78	10
Alkaline Stabilization (Shared Facility)	8.90	7
Open Composting	9.69	4
In-Vessel Composting	9.96	2
Composting Under Gore	9.89	3
Heat Drying (Regional Facility)	6.54	13
Heat Drying (Shared Facility)	6.99	12
Thermal Oxidation [Incineration (Regional Facility)]	9.06	5
Thermal Oxidation [Incineration (Shared Facility)]	10.00	1

Figure 7.1 Results of Detailed Evaluation of Biosolids Management Methods

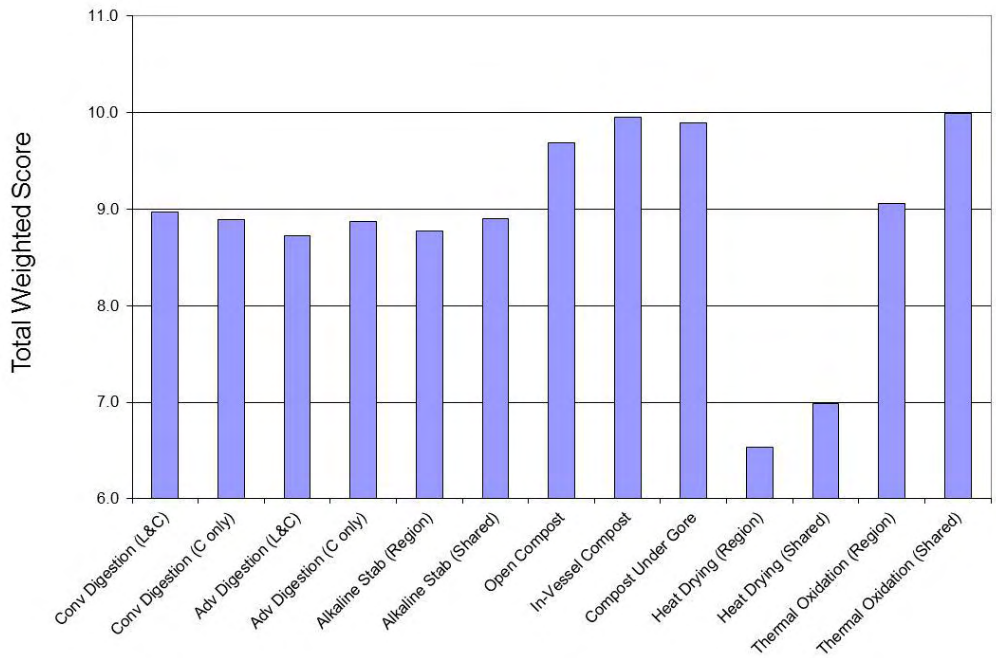


Table 7.5 Evaluation Considerations

Rank	Method	Category					
		Community Acceptance	Environmental	Financial	Management	Public Health and Safety	Technical and Operating
1	Thermal Oxidation [Incineration (Shared Facility)]	No impacts within Halton Region due to odour or aesthetics. Existing truck traffic routes may change to take biosolids to facility. One way haulage (to facility only). Higher acceptance using existing facility outside Halton Region.	Nutrients not recycled to land. No potential bacterial contamination as none present in product. Emission control devices used to reduce impact to air quality. Reduced truck emissions. Potential for energy recovery.	Initial capital outlay minimized by partnering with existing facility. Known partnerships opportunities available.	Not dependent on capacity of market. Once initiated, options are limited if policy change significantly alters availability of method Long-term commitment likely required. Not reliant on a market Partnership contract commits Halton Region for period of agreement.	If Halton Region contracts out process to partner, responsibility is borne by owner and not Halton Region. During normal operation public exposure to process feed is limited. Product is pathogen free so public health effects due to product pathogens are considered minimal. Under process upset conditions, process can be stopped quickly to minimize exposure to public.	Proven track record if an existing site is used. Many existing sites throughout North America. Technical, operating and health and safety issues are already addressed if partnering at an existing facility. Ability to accommodate volume generated by Halton Region can be determined in advance (if existing facility). Can accommodate variations in feed. Maintenance not responsibility of Halton Region included in cost.
2	Composting	Composting is generally considered favourably by the public. No change in off-site odour expected due to additional compost material. Open composting harder to control odours.	Recycling of nutrients. Leachate collection during process will control impact to surface and groundwater. Process considered a low energy input system.	Could be integrated into current yard waste composting process at minimal cost.	Increased market potential since application may not be restricted to just agricultural land. If policies were altered, procedures can be quickly changed for digested biosolids land application since processes already in place for land application.	During normal operation, public exposure to process feed is limited. Depending on process selected, aerosols may be generated during process; emission equipment should control these emissions. During upset conditions, process can be interrupted to minimize public exposure.	Many existing sites throughout North America with proven track records. Systems vary in complexity but are not considered technically complex. Can accommodate varying feed stocks.
3	Thermal Oxidation [Incineration (Regional Facility)]	Truck traffic can be controlled by having cake taken to facility. One way haulage (to facility only). Lowest community acceptance based on history in Halton Region.	Nutrients not recycled to land. No potential bacterial contamination as none present in product. Emission control devices used to reduce impact to air quality. Reduced truck emissions. Potential for energy recovery.	Large capital investment required.	Not dependent on a capacity of market. Once initiated, options are limited if policy change significantly alters availability of method. Long-term commitment needed to justify capital expenditure. Not reliant on a market.	During normal operation, public exposure to process feed is limited. Product is pathogen free so public health effects due to product pathogens are considered minimal. Under process upset conditions, process can be stopped quickly to minimize exposure to public.	Many existing sites throughout North America. Technically complex systems with specialized training required for operators. Can accommodate variations in feed.
4	Land Application of Liquid & Cake (Conventional Digestion)	Liquid application has increased truck traffic.	Nutrients recycled to land. Potential impact to surface and groundwater if improperly applied to land.	Same as current costs.	Continual effort to secure available land for product application. Other options can be quickly utilized for cake product (e.g. landfill) but more difficult for liquid if not enough dewatering facilities are available.	Potential risk to pathogen exposure of public for land applied material. During normal operation, public exposure to process feed is limited. During uncontrolled operation, process can be stopped quickly with greatest public risk associated with potential air emissions.	Existing system in Halton Region. Dominant biosolids treatment process in Ontario with proven track record. Land application of product technically well understood.

Table 7.5 Evaluation Considerations (cont'd)

Rank	Method	Category					
		Community Acceptance	Environmental	Financial	Management	Public Health and Safety	Technical and Operating
5	Alkaline Stabilization (Shared Facility)	No increase in truck traffic from Halton Region facilities.	Natural resources (i.e. admixture) are used to create product. Can minimize impact if waste products utilized (i.e. cement kiln dust). Increased air pollutants due to increased truck traffic. Some removal of nutrients (e.g. nitrogen) in biosolids during process.	Initial capital cost minimized if existing infrastructure is used. Known partnerships opportunities available.	Other options (e.g. landfill) can be quickly utilized should policy changes stop alkaline process. Agreement with established partner will ensure that a market for the product is already developed. Partnership contract commits Halton Region for period of agreement. Product viewed as more sustainable as it is approved and sold to a wider market.	If Regional contracts out process to partner, responsibility is borne by owner and not Halton Region. During normal operation, public exposure to process feed is limited. Product is pathogen free so public health effects due to product pathogens are considered minimal.	Proven track record if existing site used. Technical, health and safety issues are addressed by partner if existing facility used. System modestly flexible to varying feed stock characteristics. Maintenance not responsibility of Halton Region included in cost.
6	Land Application of Cake Only (Conventional Digestion)	Reduced truck traffic with cake relative to liquid and cake.	Nutrients recycled to land. Potential impact to surface and groundwater if improperly applied to land.	Additional dewatering capacity required over combined liquid and cake program.	Continual effort to secure available land for product application. Other options (e.g. landfill) can be quickly utilized for product if land application becomes unavailable.	Potential risk of pathogen exposure for land applied material. During normal operation, public exposure to process feed is limited. During uncontrolled operation, process can be stopped quickly with greatest public risk associated with potential air emissions.	Existing system in Halton Region. Cake application to land not as common as liquid application. Land application of product technically well understood.
7	Land Application of Liquid & Cake and Cake Only (Advanced Digestion)	High degree of treatment with product considered near pathogen free.	Nutrients recycled to land. Minimal potential bacterial contamination to ground and surface water since minimal present in product.	Conventional digesters may be modified to advanced digestion systems; no regulatory approval needed.	Continual effort to secure available land for product application. Other options can be quickly utilized for cake product (e.g. landfill) but more difficult for liquid if not enough dewatering facilities are available.	Since product is near pathogen free, public exposure to land applied product is minimal.	Less common than convention anaerobic digestion although there are full-scale facilities to provide proven track record. Technically more complex than conventional anaerobic digestion. Land application of liquid and cake similar to existing practices used by Halton Region.
8	Alkaline Stabilization (Regional Facility)	Additional truck traffic due to haulage of admixture and increased product leaving facility Advanced treatment will produce product near pathogen free	Natural resources (i.e. admixture) as used to create product. Can minimize impact if waste products utilized (i.e. cement kiln dust) Increased air pollutants due to increased truck traffic Some removal of nutrients (e.g. nitrogen) in biosolids during process	High capital cost to construct facility.	Other options (e.g. landfill) can be quickly utilized for feed to system (i.e. dewatered cake) should policy changes stop alkaline process. Market for product must be developed by Halton Region. Product viewed as more sustainable as it is approved and sold to a wider market.	Since product is near pathogen free, public exposure to land applied product is minimal.	Proven track record of technology. Technical, health and safety issues must be considered due to complexity of operation in addition to handling corrosive materials. System modestly flexible to varying feed stocks.

Table 7.5 Evaluation Considerations (cont'd)

Rank	Method	Category					
		Community Acceptance	**Environmental**	**Financial**	**Management**	**Public Health and Safety**	**Technical and Operating**
9	Heat Dry (Shared Facility)	Facility may be located outside Halton Region with facility not affecting Halton residents. Advanced treatment will produce product that is near pathogen free. Reduced traffic leaving site due to reduction in product volume.	Much of nutrients are recycled. No potential bacterial contamination since none present in product. Emission control devices used to reduce impact to air quality. Additional energy required for processing.	Initial capital outlay minimized if sharing existing infrastructure.	Other options (e.g. landfill) can be quickly utilized for feed to system (i.e. dewatered cake) should policy changes stop heat dry process. Agreement with established partner will ensure that a market for the product is already developed. If agreement is with un-established partner then market will need to be developed. Partnership contact locks Halton Region into system for period of agreement. Product viewed as more sustainable as it is approved and sold to a wider market.	Product is pathogen free so public health effects due to product pathogens are considered minimal	Proven track record of facilities in North America. If partnering with existing facility, historical performance of facility can be evaluated. Technical, health and safety issues are addressed by partner if existing facility used. Maintenance not responsibility of Halton Region included in cost.
10	Heat Dry (Regional Facility)	Advanced treatment will produce product that is near pathogen free; increases community acceptance. Reduced traffic leaving site due to reduction in product volume.	Much of nutrients are recycled. No potential bacterial contamination since none present in product. Emission control devices used to reduce impact to air quality. Additional energy required for processing.	Large capital investment required.	Other options (e.g. landfill) can be quickly utilized for feed to system (i.e. dewatered cake) should policy changes stop heat dry process. Market for product needs to be developed by Halton Region. Product viewed as more sustainable as it is approved and sold to a wider market.	Product is pathogen free so public health effects due to product pathogens are considered minimal	Proven track record if existing site used, although success in Ontario has varied. Technical, health and safety issues need to be considered.

7.4 Identification of the Preferred Methods for Strategy Development

Based on the detailed evaluation of the Methods, Thermal Oxidation (Incineration) as a partnership in a shared facility outside of Halton Region scored higher than the other Methods and is therefore ranked first.

The In-Vessel Composting, Composting Under Gore™ and Open Composting Methods ranked 2, 3, and 4, respectively. As a group, these Methods ranked second and will be collectively referred to as Composting.

The next highest ranked Method was Thermal Oxidation (Incineration) as a Regional facility. However, since Thermal Oxidation (Incineration) as a partnership at a shared facility outside the Region scored higher than Thermal Oxidation (Incineration) at a Regional facility, Thermal Oxidation (Incineration) in a Regional facility will not be considered further for the strategy as there is no benefit to Halton Region to include both Methods within the Biosolids Management Strategy. Therefore, Land Application of Liquid and Cake (Conventional Digestion) was considered to be ranked third.

In summary, Thermal Oxidation (Incineration) as a partnership in a shared facility outside Halton Region, Composting and Land Application of Liquid and Cake (Conventional Digestion) are considered to be the preferred Methods.

7.5 Development of the Preferred Biosolids Management Strategy

Thermal Oxidation (Incineration) in a shared facility outside of Halton Region, Composting and Land Application of Liquid and Cake (Conventional Digestion) were determined to be the preferred Methods based on the evaluation methodology applied. Halton Region's Biosolids Management Strategy will incorporate these Methods.

7.5.1 Strategy Considerations

At the on-set of the Biosolids Master Plan Study, a list of key considerations for developing the Long-term Strategy was identified to help guide the process. The key considerations were generally as follows:

- Consideration should be given to the Region's long standing relationship with the agricultural community (over 25 years) in providing biosolids to area farmers for crop production.
- The changing biosolids environment has emphasized the need to develop a Strategy with diversification and flexibility. The Strategy will consider the need to include one or more complimentary Management Methods to ensure that Halton Region's program is reliable and sustainable over the long-term.
- To be considered in the Strategy, the Method must be proven sustainable, economically viable, protective of human health, and respective of the environment.

7.5.2 Strategy Outline

The Preferred Biosolids Management Strategy for the Halton Biosolids Master Plan is as follows:

1. Continue Halton's **Land Application** program to the extent that costs are controlled and reasonable, and vulnerabilities are minimized.
2. Investigate **Composting** opportunities to enhance Halton's land application program.
3. Investigate **Thermal Oxidation (Incineration)** partnership opportunities at a facility outside of the Region to diversify the Strategy.

Inclusion of Land Application of Liquid and Cake (Conventional Digestion) as a preferred Method and an element of Halton Region's Biosolids Management Strategy continues a long and successful program in Halton Region that has resulted in a long standing relationship with the agricultural community. However, recent changes in regulations along with the development of agricultural land in Halton Region has shown that this Method as the only element of a Strategy is not sustainable in the long-term as land availability will decline and costs will increase as biosolids must be land applied at greater distances from the source. In addition, a significant increase in biosolids storage would be needed to accommodate a Land Application only strategy.

Composting was the second ranked Method and its use in Halton Region as part of the Strategy would augment and diversify the existing land application program by diversifying the market and providing a higher quality product to other potential users outside of the agricultural community. Inclusion of composting in the Halton Region's Biosolids Management Strategy satisfies two of the key strategy considerations by continuing the Region's relationship with the agricultural community while diversifying with an enhanced product that may attract new agricultural users and new end users such as landscapers. However, the new Composting Guidelines are still in draft form and the market in Ontario for a biosolids compost product is uncertain at this time; therefore, considerable additional effort will be needed to determine the optimum biosolids composting process, the preferred product, and the marketability of a compost product containing biosolids.

Thermal Oxidation (Incineration) as a partnership in a shared facility outside Halton Region was the first ranked Method based on the evaluation process. Thermal Oxidation (Incineration) effectively diversifies Halton Region's Biosolids Management Strategy as it is the only Method that does not depend on land application in some form as the final end use. Further, Thermal Oxidation (Incineration) reduces the risk associated with the other two elements of the Strategy as it is not sensitive to weather conditions, product acceptability, or market issues that challenge the other two elements of the strategy. Current Thermal Oxidation (Incineration) technologies using fluidized bed reactors comply with all recent stringent emission regulations and can produce recoverable energy.

Each of the three Methods (Land Application of Liquid and Cake; Composting; and Thermal Oxidation) could be an integral part of the Region's Biosolids Management Strategy depending on the outcome of further investigations. Further investigations will be needed to define the specific details of each Method of the Strategy [e.g. composting technology, allocation of biosolids to each Method, partnership options for Thermal Oxidation (Incineration), etc.].

7.5.3 Strategy Cost Sensitivity

The allocation of biosolids among the three elements of Halton Region's Strategy is uncertain at this time and will depend on a number of factors that will need further investigation. However, to assess the impact of the proposed Strategy on the costs of biosolids management in the Region, a cost sensitivity analysis was undertaken to assess total life cycle costs for a broad range of distribution of biosolid among the Methods. It is important to note that the ranges considered in this cost sensitivity analysis are used strictly for the purposes of developing possible life cycle costs and are not intended to indicate how Halton Region's biosolids might be allocated in the future nor is it intended to suggest a preference for one Method over another Method.

The following assumptions were made in completing the cost sensitivity analysis.

- No individual Method was allocated 100 percent of the Halton Region's biosolids as this would not be consistent with the principle of diversification.
- A range of 0 to 75 percent of the Region's biosolids was allocated to each Method in 25 percent increments. In some cases, one Method could be allocated 0 percent of Halton Region's biosolids, in which case the other two Methods would together receive 100 percent of Halton Region's biosolids.

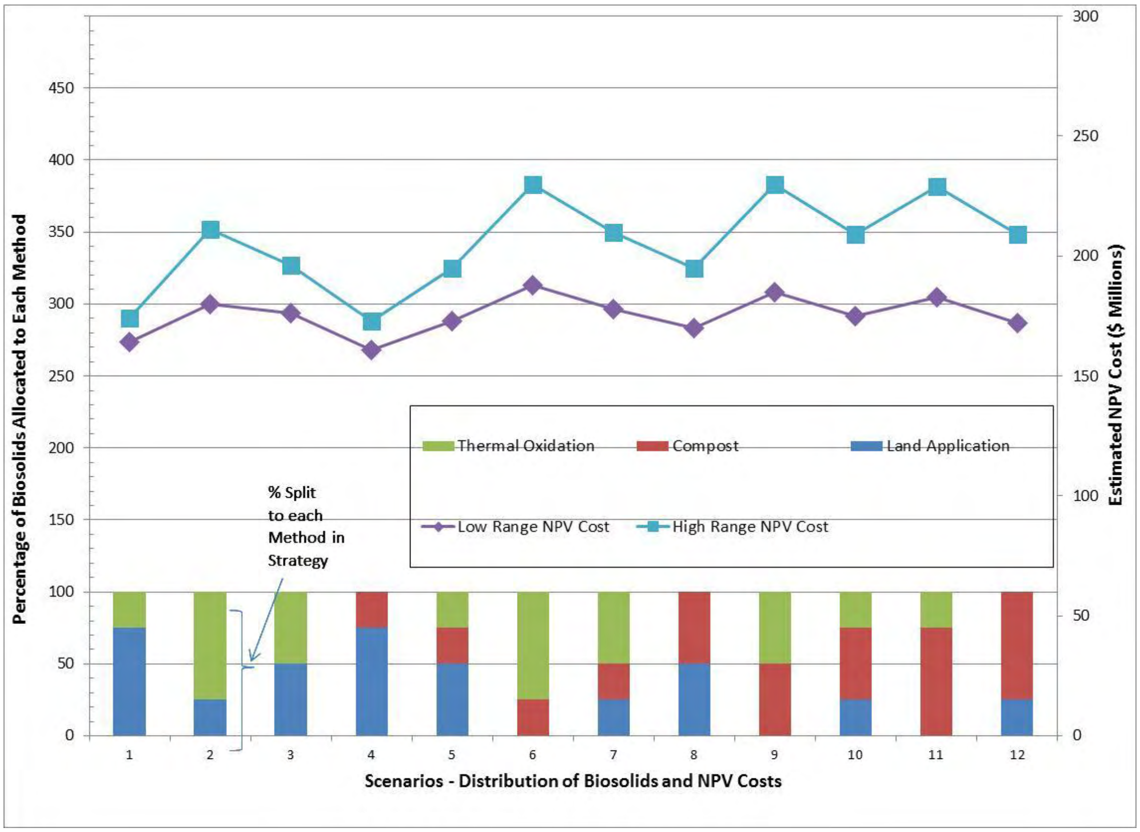
More detail regarding the cost sensitivity analysis is provided in TM3 (Appendix C) that summarizes all of the assumptions made.

The results of the cost sensitivity analysis are shown graphically in Figure 7.2 for a broad range of biosolids allocations to each Method included in the Strategy. A low range of cost estimates and a high range of cost estimates are presented. For Composting, the low range costs assume that an Open Composting process could be used while the high range costs assume that an In-Vessel technology would be used. For Thermal Oxidation (Incineration), the low and high range costs are based on processing costs provided to Halton Region staff by external parties who have expressed an interest in providing this service to the Region.

In Figure 7.2, the bar chart at the bottom of the figure represents 12 different hypothetical allocations of biosolids among the three Methods comprising the Strategy that were considered in the cost sensitivity analysis.

The low range NPV costs ranged from about \$160M to \$190M or less than +/- 10 percent from the average. Similarly, the high range NPV ranged from about \$173M to \$230M or about +/- 15 percent from the average. The sensitivity analysis suggests that there is little difference in the life cycle costs resulting from the allocation of biosolids among the Methods included in the Strategy, although the higher estimated NPVs are associated with higher proportions of biosolids allocated to Thermal Oxidation (Incineration) and the lower estimated NPVs are associated with higher proportions of biosolids allocated to Land Application.

Figure 7.2 Cost Sensitivity of Preferred Biosolids Management Strategy



8. PROPOSED IMPLEMENTATION PLAN

Key decisions that will need to be made by Halton Region regarding the recommended Biosolids Management Strategy include:

- The quantities and sources of liquid and dewatered biosolids that can be accommodated in a sustainable land application program (including storage requirements);
- The feasibility of composting biosolids;
- The details of a partnership agreement for Thermal Oxidation (Incineration) of biosolids;
- The approximate quantity of biosolids that should be allocated to each Method of the Strategy to minimize risk and optimize the cost of the program; and
- The need for and location of additional dewatering.

These decisions will allow the final costs and details of the Biosolids Management Strategy to be defined. Additional detail regarding the investigations that will need to be done after completion of the Biosolids Master Plan are provided in TM4 "Proposed Implementation Plan" that is provided in Appendix D of the report.

8.1 Sustainability of Land Application Program

A major driver for the development of Halton Region's Biosolids Master Plan was concern regarding the long-term sustainability of the current program that is based entirely on land application. More and more of Halton Region's biosolids are being land applied outside of the Region at significantly higher cost as the land available to receive biosolids within Halton Region declines. Lack of available land makes a land application program a significant risk. Despite these concerns, land application of liquid and dewatered biosolids allows beneficial reuse of the nutrients contained in this material, has a long history of success in Halton, is cost effective, and is generally supported by the agricultural community.

As part of the Implementation Plan, Halton Region should undertake an assessment of the amount of land available for land application, the location of the available land, and the constraints on use of this land for land application of biosolids, if any. This analysis will assist Halton Region to better define the quantity of biosolids that can be land applied in the future, the relative market for liquid and dewatered biosolids, the WWTPs that are best suited to be included in a land application program, and the need to provide additional liquid or dewatered cake storage and dewatering capacity to support this element of the Biosolids Management Strategy.

Particular attention should be paid to assessing the need for dewatered cake storage in the future as currently all cake storage is provided at facilities leased by the Halton Region's land application contractor. This adds additional risk to Halton Region in the event that this storage facility is not available at some time in the future. This arrangement also limits Halton Region's flexibility in selection of a land application contractor.

8.2 Biosolids Composting Feasibility Investigation

As noted previously, the composting guidelines in Ontario are currently being revised. With these revisions, composting of biosolids for an end-use other than application on agricultural land with the same restrictions as other non-agricultural source material (NASM) may be possible if a Category A product is produced. While these changes would be positive in terms of the implications for future management of biosolids, there is still some uncertainty about how the new guidelines will be applied and implemented for biosolids.

A feasibility study should be undertaken by Halton Region with the following objectives:

- To determine, through consultation with the MOE, the specific approvals required and the conditions under which composting of biosolids would be approved;
- To conduct a more detailed assessment of the technical and economic feasibility of alternate biosolids composting and co-composting technologies, including open composting, in-vessel composting and composting under Gore™;
- To undertake a comprehensive review, including site visits, to assess the experience of jurisdictions outside of Ontario who have operated a biosolids composting program for a number of years;
- To evaluate various feedstock materials (i.e. yard waste, kitchen organics) that could be used as part of the compost mix and the quantities that would be available;
- To estimate the amount of biosolids that could be co-composted or blended with other materials to produce a Category A product;
- To determine which of Halton Region's WWTPs should supply biosolids for composting to ensure that the quality requirements are met and costs are optimized;
- To evaluate the potential market for a Category A compost product that contains biosolids;
- To assess the possible impacts of co-composting biosolids on Halton Region's overall composting program; and
- To explore partnership opportunities for a biosolids composting operation that could be beneficial to Halton Region.

Subsequent to the feasibility study, a demonstration should be undertaken by Halton Region to assess composting technologies and methodologies, evaluate compost quality, and provide a preliminary indication of the marketability of the compost product.

8.3 Investigations Related to Thermal Oxidation (Incineration)

There are both public and private sector partners in the immediate vicinity of Halton Region who could participate with the Region in a Thermal Oxidation (Incineration) partnership. Key considerations in the selection of a Thermal Oxidation (Incineration) partner should include:

- Flexibility in the amount of biosolids that can be processed to ensure that during periods when the quantity of biosolids that can be managed by the other methods changes due to weather conditions, demand, etc., there is an ability to increase or decrease the amount of biosolids processed by Thermal Oxidation (Incineration) without penalty;
- The technology available from possible partners and the location so that possible health effects from emissions and biosolids transport can be considered;
- Minimization of risk to Halton Region in the event that the Thermal Oxidation (Incineration) facility is off-line for maintenance or other reasons;
- Duration of the agreement; and
- Processing costs.

The possibility of multiple Thermal Oxidation (Incineration) partnerships to reduce risk and increase flexibility should be considered.

8.4 Allocation of Biosolids to Strategy Elements

To further refine the allocation of biosolids to each element of the Strategy, a costing model should be developed by Halton Region that will optimize the overall costs of the Biosolids Management Strategy based on the allocation of biosolids quantities and more precise capital and operating costs for each element of the Strategy. This model should also be used to assess which WWTPs should provide biosolids to which element of the Strategy based on minimizing transportation costs and, at the same time, reducing carbon emissions associated with the haulage of biosolids.

It should be noted that cost is only one factor that Halton Region should consider to determine the allocation of biosolids to each element of the Strategy. Other factors include contractual agreements, quality factors, weather conditions, availability of land, reliability, ease of operation, and market availability. At all times, there needs to be flexibility within the Strategy to divert biosolids from one element of the Strategy to another or to change the allocations based on changing conditions.

8.5 Biosolids Management Strategy Update

It should be expected that changes in the regulatory environment, improvements in technology, and changes in public perceptions regarding biosolids will occur in the next five to ten years that may impact Halton Region’s Biosolids Management Strategy. Changes that should be anticipated include:

- Full implementation of the new Ontario composting guidelines;
- Increased urbanization of the Greater Toronto Area and in particular, Halton Region;

- More stringent regulations regarding the quality of biosolids that can be applied to agricultural land, including possible limits on Emerging Contaminants of Concern (ECOCs), such as pharmaceuticals and personal care products (PPCPs);
- More widespread experience with technologies such as Lystek, Plasma Assisted Oxidation or Supercritical Oxidation, that were not considered for inclusion in the Strategy due to the lack of widespread use and long-term operating experience; and
- An increased public awareness of environmental issues, particularly as they pertain to sustainability and climate change.

In anticipation of these and other changes, it is recommended that Halton Region review and update its Biosolids Master Plan and the Strategy on a regular basis every five years. It is important however that Halton Region has the flexibility within the Plan to allow pilot testing or other evaluation of innovative, emerging technologies as they are developed without waiting for the next scheduled update of the Biosolids Master Plan.

8.6 Implementation Schedule

The time required for implementation of the Methods included in Halton Region's Biosolids Management Strategy, specifically composting and Thermal Oxidation (Incineration), will be dependent on the outcome of further investigations.

8.7 Additional Approvals Required

Under the MCEA process, Schedule A, A+, and B projects identified in the Biosolids Master Plan can proceed to implementation without further Class EA requirements, subject to addressing any public or review agency comments or concerns. Schedule C projects require that Phases 3 and 4 of the Class EA process be completed before the Region can proceed to implementation.

The Class EA Schedule that would apply to the three elements of the Biosolids Management Master Plan is not defined at this time; however, it is anticipated that the following approvals will apply.

- For continued land application of biosolids, no additional approvals are needed under the MCEA; however, the construction of additional storage may require further Class EA approval depending on the site selected for a storage facility.
- Establishing a biosolids composting operation will require Environmental Protection Act approval by MOE and may require further Environmental Assessment Act approval depending on the ownership of the facility and the project proponent. Specific approvals needed will be determined as part of the Implementation Plan after the draft Composting Guidelines are finalized.

- Thermal Oxidation (Incineration) as a partnership at an existing facility outside Halton Region will require Environmental Protection Act approval by MOE. Thermal Oxidation (Incineration) at a new facility built in partnership outside of Halton Region may require Environmental Assessment Act approval depending on the ownership of the facility and the project proponent.

Construction of a composting facility or storage facility and any agreement with partners for Thermal Oxidation (Incineration) or Composting will be subject to approval by Regional Council.

9. PUBLIC, AGENCY, STAKEHOLDER, AND ABORIGINAL CONSULTATION

Public and agency consultation is an important element of the Class EA process. A vital component of the Master Plan process involved consultation with interested stakeholders, including regulatory and review agencies, the public and Aboriginals. As such, a Consultation and Engagement Strategy was developed, outlining key opportunities for participation in the Biosolids Master Plan Class EA Study. This Consultation and Engagement Strategy was implemented through the Master Plan process and is included in Appendix E.

9.1 Notifications

Members of the public and those on the project mailing list were provided with project notifications at key points in the Master Plan process. These notifications were published in local newspapers. In addition, direct mail outs of project notifications were sent to those on the project mailing list (see Section 9.5).

The following provides details on: the Notice of Commencement; the Notice of Public Information Centres (PICs); and the Notice of Completion.

9.1.1 Notice of Commencement

The Notice of Commencement for the Master Plan was placed in the following publications in Halton Region:

Publication	Dates Notice of Commencement Published
Acton Tanner	May 21 and 28, 2009
Georgetown Free Press	May 22 and 29, 2009
Burlington Post	May 22 and 29, 2009
Milton Canadian Champion	May 22 and 29, 2009
North Halton Compass	May 21 and 28, 2009
Oakville Today	May 21 and 28, 2009
Oakville Beaver	May 22 and 29, 2009

The Notice of Commencement newspaper advertisement is provided in Appendix E.

Notice of Commencement letters were hand delivered to neighbours of the Biosolids Management Centre on June 4, 2009. In addition, a letter and attached Notice of Commencement were mailed to those on the project mailing list on May 21, 2009. An example of this letter is provided in Appendix E.

9.1.2 Notice of Public Information Centres

PICs were held to provide opportunities for members of the public to obtain information on the Master Plan process, obtain responses to questions, and provide comment and input to the project (see Section 9.4).

The first PIC was held in three locations on: Tuesday, December 1, 2009; Thursday, December 3, 2009; and Wednesday, December 9, 2009. The second PIC was held in two locations on: Tuesday, March 27, 2012; and Thursday, March 29, 2012. The notices for these PICs are included in Appendix E.

The Notice of PIC #1 was placed in the following publications in Halton Region:

Publication	Dates PIC Notice Published
Tanner	November 19 and 26, 2009
Georgetown Free Press	November 20 and 27, 2009
Burlington Post	November 20 and 27, 2009
Milton Canadian Champion	November 20 and 27, 2009
North Halton Compass	November 19 and 26, 2009
Oakville Today	November 19 and 26, 2009
Oakville Beaver	November 20 and 27, 2009

In addition, a letter of notification of PIC #1 was mailed to those on the project mailing list on November 13, 2009. An example of this letter is provided in Appendix E.

The Notice of PIC # 2 was placed in the following publications in Halton Region:

Publication	Dates PIC Notice Published
Oakville Beaver	March 9, 16 and 23
Burlington Post	March 9, 16 and 23
Georgetown Independent	March 8, 15 and 22
Milton Champion	March 8, 15 and 22
Oakville Today	March 8
Acton Tanner	March 8, 15 and 22

In addition, a letter of notification of PIC # 2 was mailed to those on the project mailing list on March 7, 2012. An example of this letter is provided in Appendix E.

9.1.3 Notice of Completion

The Notice of Completion will be placed in the following publications in Halton Region: Oakville Beaver; Burlington Post; Georgetown Independent; Milton Champion; and Acton Tanner. The Notice of Completion will be published in two separate issues of each of these publications.

The following are the publication dates for the Notice of Completion:

Publication	Dates Notice of Completion Published
Acton Tanner	July 26 and August 2, 2012
Georgetown Independent	July 26 and August 2, 2012
Milton Canadian Champion	July 26 and August 2, 2012
Burlington Post	July 27 and August 3, 2012
Oakville Beaver	July 27 and August 3, 2012

The Notice of Completion will advise members of the public of the opportunity to review and provide comments on the Master Plan. A period of 30 calendar days will be provided for the public review of the Master Plan. Contact information for Halton Region and the consulting team project manager will be provided. The Notice of Completion newspaper advertisement is provided in Appendix E.

Copies of the Master Plan will be available for public review and comment at the following locations:

- Town of Oakville, 1225 Trafalgar Road, Clerks Department
  Monday - Friday: 8:30 a.m. - 4:30 p.m.
- City of Burlington, 426 Brant Street, Clerks Department
  Monday - Friday: 8:30 a.m. - 4:30 p.m.
- Town of Milton, 150 Mary Street, Communication Centre
  Monday - Friday: 8:30 a.m. - 4:30 p.m.
- Town of Halton Hills, 1 Halton Hills Drive,
  Clerk's Department
  Monday - Friday: 8:30 a.m. - 4:30 p.m.
- Halton Hills Public Library, Georgetown Branch, 224 Maple Avenue
  Tuesday - Thursday: 9:30 a.m. - 8:30 p.m.
  Friday - Saturday: 9:30 a.m. - 5:00 p.m.
- Oakville Central Library, 120 Navy Street
  Monday - Thursday: 9:30 a.m. - 9:00 p.m.
  Friday - Saturday: 9:30 a.m. - 5:00 p.m.
  Sunday - 1:00 p.m. - 5:00 p.m.
- Burlington Tansley Woods Library, 1996 Itabashi Way
  Monday - Thursday: 9:00 a.m. - 9:00 p.m.
  Friday: 9:00 a.m. - 6:00 p.m.
  Saturday - 9:00 a.m. - 5:00 p.m.
- Milton Public Library, 1010 Main Street
  Tuesday - Thursday: 10:00 a.m. - 9:00 p.m.
  Friday - Saturday: 10:00 a.m. - 5:00 p.m.
- Region of Halton, 1151 Bronte Road, Citizen's Reference Library
  Monday - Friday: 8:30 a.m. - 4:30 p.m.

The Master Plan will also be available electronically at: http://www.halton.ca.

In addition, a letter and attached Notice of Completion will be mailed to those on the project contact list. An example of this letter is provided in Appendix E.

9.2 Regional Project Committee

A RPC, consisting of Halton Region staff from various departments, was formed to participate and provide input to the Master Plan process.

Table 9.1 presents the dates for each of the three RPC meetings, along with the items discussed.

Table 9.1 Summary of RPC Meetings

BMPSAC Meeting	Items Discussed
Meeting # 1 – May 28, 2009	• Introductions • Project Organization and Role of RPC • Overview of Work Plan • Background to the Study • Biosolids Master Plan Stakeholder Advisory Committee • Other Business • Next Meeting
Meeting # 2 – October 20, 2009	• Welcome and Introductions • Review of Meeting Notes from RPC Meeting # 1 • Summary of Biosolids Master Plan Stakeholders Advisory Committee Chartering Workshop Outcomes • Review of Technical Memorandum 2A: Biosolids Management Alternatives • Review of Technical Memorandum 2B: Evaluation Process • Agenda and Format for Biosolids Master Plan Stakeholders Advisory Committee Meeting # 2 • Other Business • Next Meeting • Closure
Meeting # 3 – May 11, 2010	• Review of Meeting Notes from RPC Meeting # 2 • Update on Project Status • Review and Discussion of Technical Memorandum No. 3 • Next Steps and Schedule • Other Business • Next Meeting

Agendas and relevant information were provided to RPC members in advance of the meetings. Appendix E contains detailed information on the three RPC meetings, including agendas, presentation materials and meeting notes.

9.3 Biosolids Master Plan Stakeholders Advisory Committee

A BMPSAC was formed to participate in the Master Plan process. Membership was by invitation, with the BMPSAC consisting of representatives with technical experience in the biosolids industry from the following groups:

- Region of Halton;
- Regional Councillors;
- Former members of the Biosolids Management Advisory Committee;
- Adjacent municipalities (Peel, Waterloo);
- Provincial ministries (Ministry of the Environment, Ontario Ministry of Agriculture and Rural Affairs);

- Conservation authorities (Halton, Credit Valley);
- Agricultural organizations (Ontario Soil and Crop Improvement Association, Halton Federation of Agriculture, Halton Agricultural Advisory Committee); and
- Academia.

A list of BMPSAC members is provided in Appendix E.

The BMPSAC was an advisory body with no voting undertaken at the meetings. The BMPSAC provided an opportunity for focused agency and stakeholder input to the development of the Master Plan and was a forum for the discussion of issues, concerns, and potential solutions.

Table 9.2 presents the dates for each of the four BMPSAC meetings, along with the items discussed.

Table 9.2 Summary of BMPSAC Meetings

BMPSAC Meeting	Items Discussed
Meeting # 1 – Chartering Workshop – September 9, 2009	• Welcome and Introductions • BMPSAC – Role and Terms of Reference • Purpose of Chartering Workshop • Purpose and Background to the Study • Overview of Work Plan • Consultation Strategy • Overview of Work Completed to Date • Next Steps and Timing • Next Meeting • Closure
Meeting # 2 – November 4, 2009	• Welcome and Introductions • Review and Finalization of Meeting Notes from Chartering Workshop • Purpose of Meeting, Role of Advisory Committee in Evaluation Process and Meeting Format • Technical Memoranda 1A to 1D • Technical Memorandum 2A • Technical Memorandum 2B • Presentation of Small Group Discussion Findings • Next Steps and Timing • Next Meeting • Closure
Meeting # 3 – November 30, 2010	• Welcome and Introductions • Purpose of Meeting and Meeting Format • Review of Meeting Notes from BMPSAC Meeting # 2 • Review and Discussion of Technical Memorandum No. 3 • Review and Discussion of Technical Memorandum No. 4 • Next Steps and Schedule • Closure

Table 9.2 Summary of BMPSAC Meetings (cont'd)

BMPSAC Meeting	Items Discussed
Meeting # 4 – February 29, 2012	• Welcome and Opening Remarks • Meeting Format and Meeting Objective • Review of Purpose and Objectives of Biosolids Master Plan • Issues Raised at November 30, 2010 BMPSAC Meeting • Responses to Stakeholder Comments • Summary of Proposed Strategy • Next Steps • Schedule • Closure

Agendas and relevant information were provided to BMPSAC members in advance of the meetings. Appendix E contains detailed information on the four BMPSAC meetings, including agendas, presentation materials, and meeting notes.

As a result of issues raised at BMPSAC Meeting #3, additional work was undertaken to address the potential for bioaugmentation (Effective Microorganisms, EM) for use in wastewater processes. A separate report was prepared to address this issue and is included in Appendix E. A summary of the key findings of this report was presented at BMPSAC Meeting #4.

9.4 Public Information Centres

As noted in Section 9.1.2, two PICs were held at multiple locations to provide an opportunity for members of the public to obtain information on the Master Plan process, obtain responses to questions, and provide comment and input to the project.

9.4.1 Public Information Centre # 1

PIC # 1 was held from 5:30 pm to 8:30 pm at the following locations:

Date	Location
December 1, 2009	Halton Region Museum, Kelso Conservation Area, Hearth Room, Milton, Ontario
December 3, 2009	St. Volodymyr Cultural Centre, Arbour Room, Oakville, Ontario
December 9, 2009	Burlington Art Centre, Rotary Room, Burlington, Ontario

The purpose of the PIC was to:

- Present an overview of the project;
- Present the Biosolids Management Methods to be evaluated; and

- Describe the evaluation process to be used to develop the biosolids management strategy.

The PIC was a drop-in format with display boards available for viewing and an opportunity for one-on-one discussions with project team members. Members of the project team, including Halton Region and consultant representatives, were available to provide and discuss information on the Master Plan, and to receive public comments and input.

A Comment Sheet and Handout were available to attendees. The display boards provided information on:

- Purpose of the Study.
- What are Biosolids?
- Where are Halton's Biosolids Produced?
- Biosolids Disposition in Ontario.
- Halton Biosolids Disposition in 2008.
- Projected Biosolids Production.
- Biosolids Master Plan Study Goals.
- Class EA Master Plan Process.
- Class EA Study Overview.
- Management Alternatives and Methods.
- Utilization on Land.
- Thermal Processes.
- Disposal to Land.
- Evaluation Process.
- Evaluation Categories and Criteria.
- What Will Happen Next?

The PIC materials were also posted on the Halton Region web site. In addition, reminders about the upcoming PICs were provided to members of the RPC and BMPSAC.

Table 9.3 summarizes the comments received. A total of 29 people provided their name and contact information on the Attendance Sheets for the PICs. A total of nine Comment Sheets were submitted. In addition to the Comment Sheets, one comment was submitted to Halton Region by e-mail, subsequent to PIC # 1.

Table 9.3 Summary of Comments Received – PIC # 1

Comment Sheet Item	Comments Received
Please provide your comments on the proposed biosolids management alternatives and methods that have been identified to date. Please note any other methods that you would like to bring to the attention of the project team.	• Would think materials could be routed to the existing Halton landfill site that currently has a methane fuelled co-generation facility and the site is approved for an incineration/energy from waste operation. • Concerns regarding pathogens and heavy metals; feel more comfortable from discussions but concern (possibly unfounded) still lingers somewhat; it would be helpful to address the major concerns including odours, etc. in a more direct way to the general public who probably don't attend these useful events. • Do not do land application; do not compost, trench, or well injection; interested in pyrolysis and other thermal approaches with distributed heat and energy production; interested in membrane technology, no digestion. • All product should be analyzed to show the public the heavy metals, pathogens, and carcinogens that make people sick; Halton Region has aligned themselves with a company that has proved time and again to be incompetent, not meeting guidelines and regulations with no consequences; the Region's alliance does not act in the public's best interest. • Need to do some more reading and am not aware of all the terms and processes (i.e. pyrolysis…). • Very informative regarding the displays; suggest some charts could be replicated (with a brief description) via the media.
Do you have any comments on the proposed evaluation process for evaluating biosolids management methods? This proposed process includes a pre-screening of methods to identify those that may not be suitable for inclusion in a biosolids management strategy, followed by a detailed evaluation of those methods that remain after the pre-screening.	• Sensible process. • All test results should be easily accessible to the public; farmers need to be aware of the toxins, pathogens and carcinogens, not just the nitrogen. • Interesting to see the evaluation criteria and weighting of them (categories); you should keep the process open to the public, showing all methods and explaining why some are ruled out.

Table 9.3 Summary of Comments Received – PIC # 1 (cont'd)

Comment Sheet Item	Comments Received
Please provide any comments on the individual criteria and weightings that are being proposed for the detailed evaluation of the biosolids management methods? Please note any other criteria that you would like to bring to the attention of the project team.	• A general look showed logical weightings. • Unmet guidelines and mismanagement show complacency on the Region's responsibility to its residents. • Looks very detailed and thoughtful; agree with most criteria weights; only concern is that Uncontrollable Circumstances should be a 2 because they are uncontrollable, while Occupational Health and Safety is controllable and should only be a 4. • Seems fair; environment at top is expected.
Please provide any comments on the evaluation categories weightings that are being proposed for the detailed evaluation of the biosolids management methods?	• Health of area residents should be the Region's number one concern. • Well done. • O.k. value to public. • Halton used to promise to spread only in Halton – now they spread in other communities; used to spread at agronomic rate – not anymore; food safety issues, pathogens; property values need to be represented; devaluation of real estate is a big issue.
Please provide any additional comments.	• Again, a bigger message to the public is needed; maybe the newspaper should do an in-depth article. • Please provide report on where all the Power Grow sludge went; how much was land applied, landfilled - from all sources; data for 2006, 2007, 2008 [response provided by Halton Region – see Appendix A]. • Explain how Source Water Protection Committees review sludge threat to water wells. • More on public health, food safety needed → pathogens → energy use. • Off-site odour; hopefully your reporting procedures have improved; do normal operations include when guideline/regulation not met as Halton deems acceptable. • Very well presented and interesting. • Notes to add; 20 loads a day out of Halton systems stored in winter at tank farms and not on fields; any payment to farmers and if so by whom and why farming crop gains (e.g. value of fertilizer at $ 200.00 a hectare). • Next PIC should be in area (Halton Hills) where most biosolids applied. • Thanks for your time and explanation. • Should talk to Micromedia and Fab Groups (funded through Hydro Quebec); they have very modern technologies that are of interest over the next 20 years.

Table 9.3 Summary of Comments Received – PIC # 1 (cont'd)

Comment Sheet Item	Comments Received
E-mail Comment Received Subsequent to PIC# 1	
• When attending one of the PICs, the individual had neglected to question what happens to pharmaceuticals and the metabolites humans create (and that make their way into the sewage); the commenter requested examples of how these components are dealt with in other jurisdictions [response provided by Halton Region – see Appendix E].	

Copies of the Comment Sheet, display boards, and handout are provided in Appendix E. Appendix E also contains the PIC attendance record and submitted Comment Sheets.

9.4.2 Public Information Centre # 2

PIC # 2 was held from 5:30 pm to 8:00 pm at the following locations:

Date	Location
March 27, 2012	Halton Regional Centre, Glenorchy/Dakota Room, Oakville, Ontario
March 29, 2012	Mold-Masters SportsPlex, Gordon Alcott Heritage Hall, Georgetown, Ontario

The purpose of the PIC was to:

- Present an overview of the project;
- Describe the evaluation process used to develop the biosolids management strategy;
- Present the short-listed Biosolids Management Methods that were evaluated;
- Present the results of the evaluation process; and
- Present the Preferred Biosolids Management Strategy.

The PIC was a drop-in format with display boards available for viewing and an opportunity for one-on-one discussions with project team members. Members of the project team, including Halton Region and consultant representatives, were available to provide and discuss information on the Master Plan, and to receive public comments and input.

A Comment Sheet and Handout were available to attendees. The display boards provided information on:

- Objectives of the PIC.
- What are Biosolids?
- Where are Halton's Biosolids Produced?
- Biosolids Disposition in Ontario.

- Halton Biosolids Disposition in 2011.
- Biosolids Master Plan Study Purpose.
- Biosolids Master Plan Study Objectives.
- Class EA Study Overview.
- Terminology Change [the term “energy from waste” used throughout the earlier stages of the Class EA study was changed to “thermal oxidation (incineration)].
- Management Alternatives and Methods.
- Evaluation Process.
- Pre-Screening Criteria.
- Short List and Refinement of Alternatives and Methods.
- Detailed Evaluation Categories and Criteria.
- Method Evaluation Results.
- Outcome of Method Evaluation.
- Recommended Biosolids Management Strategy.
- Key Considerations for Implementation of Methods.
- Potential Approvals Required Prior to Implementation of Strategy.
- Strategy Updates.
- What Happens Next?

The PIC materials were also posted on the Halton Region web site. In addition, reminders about the upcoming PICs were provided to members of the RPC and BMPSAC.

Table 9.4 summarizes the comments received. A total of 22 people provided their name and contact information on the Attendance Sheets for the PICs. A total of eight Comment Sheets were submitted.

Table 9.4 Summary of Comments Received – PIC # 2

Comment Sheet Item	Comments Received
Please provide any comments on the recommended Biosolids Management Strategy.	• Continue with putting on fields; later agree with the other two ideas. • The composting option for biosolids is realistic only if Ontario regulations are changed to allow unrestricted land application of the compost product. • Please, please do everything you can to not use incineration; but also concerned about hazardous materials in landfill; am happy you are looking closely at composting – very encouraging; thanks for the PIC. • Beneficial reuse/land application appears to be the most cost effective, environmentally sound and agriculturally appropriate means of biosolids management; as a citizen of Halton, would want to see a proper cost/benefit analysis; there are various reliable methods of building and financing storage facilities including involvement of the private sector through DBOFM mechanisms. • I enjoyed the presentation and would like to see incineration implemented in Halton Region Plan.
Please provide any comments on the process that was used to develop the recommended Biosolids Management Strategy.	• The consultants are professional and credible; staff are knowledgeable and dedicated; not sure how different options were looked at from a suppliers viewpoint in that there was little opportunity for industry stakeholders to provide input; the committee was not necessarily made up of objective experts who may have had certain biases against, for example, land application or incineration.
Additional comments that you would like to provide to the Region	• Good PIC; the informal format encourages dialogue and makes people feel more comfortable to ask questions. • If it ain’t broke, don’t fix it; but do plan for the future in a cost effective and environmentally sound way; also note new regulations on emissions from incinerators in the U.S. which make it tougher; new Nutrient Management Regulations from OMAFRA and MOE have created a good and solid framework for sustainable biosolids land application.

Copies of the Comment Sheet, display boards, and handout are provided in Appendix E. Appendix E also contains the PIC attendance record and submitted Comment Sheets.

9.5 Project Mailing List and Web-site Postings

A project mailing list was maintained throughout the Master Plan process. The mailing list was developed at the Notice of Commencement stage and names were added to the project mailing list in response to requests. A copy of the project mailing list is provided in Appendix E.

In addition, key project information such as notifications, PIC materials (i.e. display boards, comment sheet, handout) and the Master Plan Report were posted on Halton Region’s web site at http://www.halton.ca/biosolids.

9.6 Agency and Stakeholder Consultation

In addition to the agencies represented on the BMPSAC, other federal, provincial, and municipal agencies were consulted during the course of the Master Plan process. The following are examples of agencies included in the agency consultation for the project:

- Federal –Indian and Northern Affairs Canada, Environment Canada and Fisheries and Oceans Canada;
- Provincial – Niagara Escarpment Commission, Ministry of Aboriginal Affairs, Ministry of the Environment, Ministry of Culture, Ministry of Municipal Affairs and Housing and Ontario Realty Corporation; and
- Municipal – Milton Chamber of Commerce, Oakville Chamber of Commerce, Burlington Chamber of Commerce and Halton Hills Chamber of Commerce.

Utilities such as Hydro One, Milton Hydro Distribution Inc., and GO Transit were also included on the project mailing list and received project notifications.

Neighbours to the Biosolids Management Centre were also included on the project mailing list and received project notifications.

The project mailing list contains a complete listing of agencies and stakeholders contacted during the Master Plan process and is provided in Appendix E. Table 9.5 provides a summary of comments received from agencies, along with the response to these comments. Appendix E contains copies of replies received from agencies.

Table 9.5 Summary of Agency and Stakeholder Comments

Date	Contact	Comment	Action Taken
Federal			
March 15, 2012	Don Boswell Senior Claims Analyst Ontario Research Team Specific Claims Branch Indian and Northern Affairs Canada	• Response to notification of PIC # 2. • Noted that Halton Region may want to contact the First Nations in the vicinity of the area of interest. • Provided information sources.	• No response required.
June 12, 2009	Marc-André Millaire Litigation Team Leader Eastern Litigation Directorate Litigation Management and Resolution Branch Indian and Northern Affairs Canada	• Advise that their inventory does not include active litigation in the vicinity of this property. • We are unable to make any representations regarding potential or future claims. • Cannot make any comments regarding claims filed under other departmental policies. • Suggest contacting the Specific Claims Branch and Treaty and Aboriginal Government Central Operations.	• Comment noted. • No response required. • The Specific Claims Branch and Treaty and Aboriginal Government Central Operations have been contacted by Halton Region.
June 9, 2009	Joëlle Montminy Director General Negotiations – Central Assessment and Historical Research Indian and Northern Affairs Canada	• Our Directorate can confirm that there are no comprehensive or special claims to the Halton Region. • Cannot make any comments regarding potential or future claims, including claims under Canada's Specific Claims Policy or legal action by a First Nation against the Crown. • Suggest contacting the Specific Claims Branch and the Litigation Management and Resolution Branch.	• Comments noted. • No response required. • Halton Region contacted the Specific Claims Branch and the Litigation Management and Resolution Branch (May 2009).

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
June 2, 2009	Leah Lloyd Claims Analyst Ontario Research Team Specific Claims Branch Indian and Northern Affairs Canada	• Responding to May 21, 2009 letter addressed to Don Boswell. • The Mississaugas of the New Credit First Nation have submitted a specific claim. • May also wish to contact the Six Nations of the Grand River to advise them of your intentions. • Cannot make any comments regarding potential or future claims or claims filed under other departmental policies. • May want to contact the Assessment and Historical Research Directorate, the Consultation and Accommodation Unit and the Litigation Management and Resolution Branch.	• Mississaugas of the New Credit First Nation and the Six Nations of the Grand River were both contacted re. the Notice of Commencement. • The Assessment and Historical Research Directorate have provided a response (June 9, 2009) indicating that "there are no comprehensive or special claims to the Halton Region." • The Litigation Management and Resolution Branch (Mr. Dale Pegg) have been contacted by Halton Region.
Provincial			
May 29, 2012	Wendy Cornet Manager, Consultation Unit Aboriginal Relations and Ministry Partnerships Division Ministry of Aboriginal Affairs	• MAA is not the approval or regulatory authority for your project and receives very limited information about projects in the early stages of their development. • In circumstances where a Crown-approved project may negatively impact a claimed Aboriginal or treaty right, the Crown may have a duty to consult the Aboriginal community advancing the claim. • You should be aware that many First Nations and/or Métis communities either have or assert rights to hunt and fish in their traditional territories; for First Nations, these territories typically include lands and waters outside of their reserves.	• Comments noted. • No response required.
March 27, 2012	Lisa Grbinicek Senior Strategic Advisor Niagara Escarpment Commission (NEC)	• Requested the information that is to be presented at PIC # 2.	• PIC # 2 information sent to Lisa on March 28, 2012.

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
August 26, 2009	Alejandro Cifuentes Heritage Planner Ministry of Culture Programs and Services Branch – Cultural Services Unit	• The Ministry of Culture has an interest in the conservation of cultural heritage resources, including: archaeological resources; built cultural resources; and cultural heritage landscapes. • An archaeological assessment may be required for this project prior to any ground disturbance and/or site alterations. • Provided the Ministry's standard checklist for determining whether a heritage impact assessment is required. • Note that a heritage impact assessment (if required) should be forwarded to local municipality and local heritage organizations for their review and comment.	• Response from Halton Region indicated that this study is a master plan being conducted in accordance with Phases 1 and 2 of the Municipal Class EA, and that no sites for facilities have been selected yet. • Any projects resulting from the Class EA master plan process would subsequently be subject to the appropriate level of assessment, including a cultural heritage assessment, if relevant.
June 8, 2009	Shannon McNeill Environmental Resource Planner and EA Coordinator Ministry of the Environment Central Region, Technical Support Section	**Ecosystem Protection and Restoration** • Any impacts to ecosystem form and function must be avoided, where possible. • The EA Document should describe any proposed mitigation measures and how project planning will protect and enhance the local ecosystem. • Recommend consulting with MNR and DFO and local conservation authority. **Surface Water** • EA document must include a sufficient level of information to demonstrate that there will be no negative impacts on the natural features or ecological functions of any watercourse within the study area. • Recommend that a storm water management be prepared as part of the Class EA process.	• Comments noted. • No response required.

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
June 8, 2009 (cont'd)	Shannon McNeill Environmental Resource Planner and EA Coordinator Ministry of the Environment Central Region, Technical Support Section (cont'd)	**Groundwater** • The status of, and potential impacts to, any well water supplies should be addressed. • Potential impacts to groundwater-dependent natural features should be addressed. • Any potential approval requirement for groundwater taking or discharge should be identified in the EA Document. **Dust, Noise, and Odour** • The EA Document should consider the potential impacts of increased dust, noise, and odour levels on residential or other sensitive land uses resulting from this project during construction and operation. **Servicing and Facilities** • Contact the Environmental Assessment and Approvals Branch to determine whether a new or amended Certificate of Approval will be required for any proposed infrastructure. **Contaminated Sites** • If the removal or movement of soils may be required, appropriate tests to determine contaminant levels from previous land uses or dumping should be undertaken.	

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
June 8, 2009 (cont'd)	Shannon McNeill Environmental Resource Planner and EA Coordinator Ministry of the Environment Central Region, Technical Support Section (cont'd)	**Class EA Process** • The EA Document should clearly indicate the selected approach for conducting the Master Plan. • The EA Document must demonstrate how the consultation provisions of the Class EA have been fulfilled, including documentation of all public consultation efforts undertaken during the planning process; should include copies of any comments submitted on the project by interested stakeholders, and your responses to these comments. • Include in the EA Document a list of all subsequent permits or other approvals that may be required for the implementation of the preferred alternative. **First Nations Consultation** • You are advised to contact the Ministry of Aboriginal Affairs and INAC to determine potentially affected Aboriginal communities in the project area. • Once identified, you are advised to provide notification directly to Aboriginal communities who may be affected by the project and provide them with an opportunity to participate in any planned public consultation sessions and comment on the project.	

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
June 3, 2009	Lisa Grbinicek Senior Strategic Advisor Niagara Escarpment Commission (NEC)	• The Region of Halton should be aware that new biosolids facilities are prohibited within the Niagara Escarpment Plan Area (NEPA), as are expansions of existing facilities. • The use and application of biosolids on lands within the NEPA are subject to review by the NEC, respecting those areas where such may not be acceptable. • The Region and the NEC have participated in a number of discussions on this matter over the years. • NEC requests to remain on the mailing list for all matters related to this study.	• Halton Region provided a response to NEC (September 4, 2009). • Response noted that at an April 2003 Niagara Escarpment Committee meeting, the Commission interpreted the Development Permit Regulations such that the application of biosolids was development that was "customarily and normally related to agriculture", and as such, met the definition for "general agricultural development", and was therefore exempt from requiring a Development Permit from the NEC. • Halton Region noted that they would appreciate NEC's review of this matter for clarification. • Response noted that Halton's Biosolids Recycling Program meets all regulatory requirements and is respectful of environmental sensitivities on NECA lands.

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
September 14, 2009	Lisa Grbinicek Senior Strategic Advisor Niagara Escarpment Commission (NEC)	• Letter is to provide clarification on the matter of biosolids application and Biosolids Master Plans within the NEPA. • It is correct that in April 2003, the Commission determined that the application of sewage sludge and other non-agricultural wastes to cultivated rural lands met the definition for "general agricultural development" and as such would be considered a "permitted use" and would be exempt from requiring a Development Permit under Ontario Regulation 828/90. • However, the NEC still has an interest in being circulated the Biosolids Master Plan Class EA for review and comment, respecting compliance with the policies of the NEP.	• No response required.
July 2, 2009	Lisa Myslicki Environmental Coordinator Ontario Realty Corporation – Professional Services	• ORC managed property could be directly in the study area. • As a result, your proposal may have the potential to impact a property and/or the activities of tenants present on ORC managed lands. • Negative environmental impacts associated with project design and construction should be avoided and/or appropriately mitigated in accordance with applicable regulations, best practices and MNR and MOE standards. • Negative impacts to land holdings, such as the taking of developable parcels of ORC managed land or fragmentation of utility or transportation corridors, should be avoided. • If takings are suggested as part of any alternative, these should be appropriately mapped and quantified within EA report documentation – ORC requests circulation of the draft EA report prior to finalization if potential impacts to ORC managed lands are present as part of this study.	• Comments noted. • No response required. • Appropriate action will be taken to address OEC comments, if and when required, depending on results of the master plan process.

Table 9.5 Summary of Agency and Stakeholder Comments (cont'd)

Date	Contact	Comment	Action Taken
July 2, 2009 (cont'd)	Lisa Myslicki Environmental Coordinator Ontario Realty Corporation – Professional Services (cont'd)	• Should the proposed activities impact cultural heritage features on ORC managed lands, a request to examine cultural heritage issues, which can include the cultural landscape, archaeology and places of sacred or secular value could be required. • The ORC is required to follow the MEI Class EA Process for Realty Activities Not Related to Electricity Projects – the purchase of MEI owned/ORC managed lands or disposal of rights and responsibilities (e.g., easement) for ORC managed lands triggers the application of the MEI Class EA. • If any of these noted realty activities affecting ORC managed lands are being proposed as part of any alternative, contact ORC to discuss further.	
Stakeholders			
November 24, 2009	Kathryn Muir Administrative Assistant Pollution Probe	• Advised that Bob Oliver received PIC invitation but was unable to attend.	• No response required.

9.7 Aboriginal Consultation

9.7.1 Agency Contacts

All project notices were sent to the following agencies:

- Indian and Northern Affairs Canada (INAC) – Lands and Trusts Services;
- INAC – Specific Claims Branch;
- INAC – Comprehensive Claims Branch;
- INAC – Litigation Management and Resolution Branch;
- INAC – Consultation and Accommodation Unit;
- INAC – Office of the Federal Interlocutor for Métis and Non-status Indians; and
- Ontario Ministry of Aboriginal Affairs.

The contact information for these agencies is provided on the project mailing list included in Appendix E. In addition, all correspondence from these agencies is documented in Table 9.5 and included in Appendix E.

9.7.2 Aboriginal Contacts

All project notices, including the Notice of Commencement, Notice of PICs, and Notice of Completion, were sent to the following First Nations, as well as the Métis Nation of Ontario:

- Huron-Wendat Nation;
- Mississaugas of the New Credit First Nation;
- Six Nations of the Grand River; and
- Iroquois Confederacy.

The contact information for these First Nations and the Métis Nation of Ontario is provided on the project mailing list included in Appendix E. In addition, all correspondence to these First Nations and the Métis Nation of Ontario is included in Appendix E.

No responses were received from these First Nations or the Métis Nation of Ontario.

10. REFERENCES

Canadian Council of Ministers of the Environment (CCME). (2005). Guidelines for Compost Quality: PN 1340.

National Biosolids Partnership. (2005). Manual of Good Practice for Biosolids - January 2005. Accessed June 19, 2009 from http://www.biosolids.org/ems_main.asp?sectionid=48&pageid=189&pagename=Manual%20of%20Good%20Practice.

11. LIST OF ACRONYMS

ATAD - Autothermal Thermophilic Aerobic Digestion

ATTAD - Autothermal Thermophilic Aerobic Digestion

BFP - Belt Filter Press

BMC - Biosolids Management Centre

BMP - Biosolids Master Plan

BMPSAC - Biosolids Management Plan Stakeholder Advisory Committee

CAS - Conventional Activated Sludge

Class EA - Class Environmental Assessment

DAF - Dissolved air floatation

EAA - Environmental Assessment Act

ECOCs - Emerging Contaminants of Concern

EM - Effective Microorganisms

EPA - Environmental Protection Act

Halton Region - Regional Municipality of Halton

INAC - Indian and Northern Affairs Canada

MOE - Ministry of the Environment

NASM - Non-Agricultural Source Materials

NMA - Nutrient Management Act

NPV - Net Present Value

OMAFRA - Ontario Ministry of Agriculture, Food and Rural Affairs

PASO - Plasma Assisted Sludge Oxidation

PIC - Public Information Centres

PPCPs - pharmaceuticals and personal care products

RPC - Regional Project Committee

SCWO - Supercritical Water Oxidation

TM - technical memorandum

TPAD - Temperature Phased Anaerobic Digestion

WAS - waste activated sludge

W.T. - wet tonnes

WWTP - Wastewater Treatment Plant

XCG - XCG Consultants Ltd.