CITY WIDE IMPLICATIONS

CITY OF HAMILTON

PUBLIC WORKS DEPARTMENT
Water and Wastewater Division

Report to:	Chair and Members Committee of the Whole	**Submitted by:**	Gerry Davis, CMA Acting General Manager Public Works Department
Date:	July 13, 2007	**Prepared by:**	Jim Harnum Extension 4483 Dan Chauvin Extension 5988 Chris Shrive Extension 7209

SUBJECT: Biosolids Master Plan - (PW07047a) - (City Wide)

RECOMMENDATION:

(a) That Council endorse the Biosolids Master Plan (Phases 1 and 2 document of the Class Environmental Assessment) and its preferred strategy of Thermal Reduction (with digestion for energy recovery);

(b) That the General Manager, Public Works, be authorized and directed to proceed with filing the Biosolids Master Plan for a 30-day review with the Ministry of the Environment's Environmental Board of Review.

_____
Gerry Davis, CMA
Acting General Manager
Public Works

EXECUTIVE SUMMARY:

In order to meet existing commitments, accommodate future growth, and address regulatory requirements, a Biosolids Master Plan (BMP) for the City of Hamilton has been developed to identify a preferred biosolids management strategy for the next 30 years and beyond.

In general, wastewater treatment entails two discharge trains: liquid and solid. The liquid train is discharged from the treatment plant to a body of water as "treated effluent". The solids train is also treated then dewatered and produces an organic by-

product known as “biosolids”. As a result of its nutrient content, biosolids generated by the City of Hamilton is currently utilized as a soil amendment or beneficial soil additive for agricultural land application. The average annual dry solids production at the Woodward Avenue Wastewater Treatment Plant is approximately 12,629 tonnes per year or approximately 53,000 wet tonnes per year which represents 1,200 to 1,250 truck loads per annum.

Two recommended solutions were developed and endorsed by the BMP’s Stakeholder Advisory Committee (SAC) and put forth as either:

- land application of Class “A” (highly processed) biosolids,
- thermal reduction (incineration),
- or a combination of both alternatives.

These recommendations were presented to the public at Public Information Centres in September 2006 and to Council as an Information Update in March 2007. The options were well received and the constraining issues associated with continuation of the present land application program and any ‘Class A’ production program (decreasing available land base, odour, metal and pathogen concerns) were acknowledged by the public. Recent significant advances in the technology of thermal reduction (incineration) have also increased the public’s perception of its viability and application. Through further analysis of the recommended alternatives, the preferred long-term strategy for the management of the City’s biosolids is Thermal Reduction (with digestion for energy recovery).

BACKGROUND:

The Biosolids Master Plan (BMP), as framed by the MEA’s Municipal Class EA, entails a two-phase process with problem/opportunity identification undertaken in the first phase, and alternative solution/strategy identification, evaluation and the selection of a preferred solution/strategy undertaken in Phase 2. The latter stages of Phase 2 of the current Master Planning process culminated in the recommendation that the City undertake any one, or a combination of two approaches; these being the production of a ‘Class A’ stabilized product (a US Environmental Protection Agency reference for an enhanced level of odour and pathogen reduction in comparison to standard stabilization processes) for further land application, and/or thermal reduction of the biosolids. A full description of BMP assessment activities and findings, including current practices, problem identification, technical review and analysis, alternative assessment and consultation leading to the identification of recommended alternatives, is described in Information Report PW7047 given to Public Works Committee on March 30, 2007 and then received by Council on April 25, 2007.

Additional detailed triple bottom line assessments, including energy recovery potential of that report’s recommended BMP alternatives has since been undertaken, resulting in the identification of a preferred management strategy for the City’s biosolids over the next 30 years. Commencing with a brief review of current practice and the problem for the purposes of context, the relevant and key findings of this detailed assessment of the recommended alternatives and delineation of a preferred alternative are provided below.

Current Practice

The City of Hamilton's Woodward Avenue Wastewater Treatment Plant (WWTP) services a population of approximately 480,000. Treatment process solids from the Waterdown WWTP and Dundas WWTP are blended with the solids produced at the Woodward WWTP and anaerobically digested (i.e. mixed without oxygen at 35^{o}C for 15 days to reduce pathogens) to form biosolids. Prior to 1996, biosolids generated in Hamilton were incinerated at the Woodward wastewater treatment facility. As a result of the significant capital cost required to upgrade the incinerator, a report was approved by Council recommending the City dispose of biosolids through transportation and land application as a soil amendment onto agriculture land. This disposal practice continued from 1996 until the present whereby the average production of biosolids at the Woodward Avenue WWTP is approximately 12,629 tonnes per year or approximately 53,000 wet tonnes per year, representing 106 truck loads per month or 1,200-1,250 truck loads per annum.

The Problem

The practice of managing biosolids disposal through land application is increasing in both risk and complexity. The following is a list of emerging issues which limit the sustainability of a biosolids land application program:

- Recently implemented Provincial legislation (i.e. the Nutrient Management Act) have reduced and limited the future land bank available to the City for the spreading of biosolids onto approved agriculture lands.
- Increased regulated requirements for biosolids storage (i.e. 240 days) for off-season and inclement weather.
- Continuing concerns with certain biosolids constituents levels (i.e. metals, pharmaceutical residuals).
- Increased risk of utilizing the contingency disposal option of land filling. This is a result of off-season or times of inclement weather when land application is not feasible, or when biosolids storage is precluded.
- Competition for land from other municipalities.
- Securing agriculture lands from farmers and the reliability of retaining approved lands is difficult considering the land is obtained through a volunteer basis.
- Biosolids odours are generally problematic at the WWTP and the sites of application.
- Limited land application contractors to service the City.
- Increasing transportation distances to available lands.
- Historical stringent Certificate of Approval (C of A) requirements for land approvals.
- Increased concerns from the community of negative impacts land applying biosolids can pose to the environment.
- Increased expectation from the community as a result of improved technology, to treat biosolids to a higher standard.

As such, the overall sustainability of land applying municipal biosolids especially over the medium- to long-term is tentative and uncertain. As a result of this increased management risk and complexity a Biosolids Master Planning process was initiated.

Master Planning Approach

The City retained the services of Hydromantis, Inc. and XCG Consultants Ltd. who, together with input from other specialists and a Stakeholder Advisory Committee, collectively formed the Project Team and evaluated feasible biosolids processing options and end uses in order to determine the most appropriate long-term management strategy for the City. The BMP Stakeholder Advisory Committee (SAC) was comprised of staff from relevant City departments (i.e. Health, Waste Management, etc.), local industry health and safety representatives, biosolids and consultant specialists, representatives from the agriculture community and interested members of the public. The Ministry of the Environment and City Council were also represented on the SAC as further outlined in the Relevant Consultation section of this report.

The Project Team's short list of alternatives, as endorsed by the SAC recommended that the City undertake any one, or a combination of two approaches; these being the production of a 'Class A' stabilized product (a US Environmental Protection Agency reference for an enhanced level of odour and pathogen reduction in comparison to standard stabilization processes) for further land application, and/or thermal reduction of the biosolids.

The Project Team's recommendations were well received at the second round of Public Information Centres, and the constraining issues associated with the continuation of the present land application program or any 'Class A' production program (decreasingly available land base, residual odour and pathogen concerns) were acknowledged by the public.

The above activities and process culminated in a presentation on March 30, 2007 to Public Works Committee of the recommended BMP alternatives, with a commitment made at that time to further undertake detailed assessment and identification of a final preferred BMP strategy. Information Report PW7047 provided the basis for this presentation.

For Council's benefit, the short-listed recommended alternatives are reviewed below, and the additional information resulting from further assessment and studies of their implementation is summarized in the Analysis/Rationale and Alternatives for Consideration sections of this report, with detail provided in the Biosolids Master Plan Report which will be filed to the Ministry's Environmental Board of Review (EBR) for public review.

Alternative 1 - Thermal Reduction (Incineration)

Thermal reduction is a process for sludge management that oxidizes the organic matter present in the sludge by first heating a fluidized bed to a temperature of 800 degrees and feeding biosolids at a regulated rate. Combustion releases the heating value of the organic matter in the sludge and reduces considerably the volume and weight of solid residuals in the form of ash, resulting in greatly reduced transport and disposal requirements. The fluidized bed thermal reduction process is generally auto-combustive, meaning that the process can sustain its operations utilizing biosolids as its sole fuel source, supplemental fuel (such as natural gas) is required only for heating to combustion temperatures and to maintain heat balance periodically during routine operation. Depending upon the process temperature, trace organic materials are also reduced or destroyed.

Air emissions criteria for a thermal reduction installation are a major consideration in the selection and cost of the system. The emissions resulting from system operation are monitored by regulatory agencies. Technologies to control emissions are now readily available, proven, and are further designed and implemented to meet or exceed regulatory requirements. Emissions criteria have been well addressed by other municipalities employing thermal reduction in southern Ontario and compliance with regulatory requirements has been maintained by their thermal facilities.

Alternative 2 - Class 'A' Alternative – Temperature-Phased Anaerobic Digestion (TPAD)

A second method of achieving production of the equivalent of a Class 'A' biosolids product is through the process of temperature-phased anaerobic digestion (TPAD). The Woodward WWTP currently operates a mesophilic (35^{o} to 40^{o} C) digestion process. The TPAD process consists of thermophilic (> 55^{o} C) digestion as a first phase, further stabilizing the biosolids by promoting a greater decomposition and conversion of acids to methane and carbon dioxide in the subsequent mesophilic phase. The TPAD process has demonstrated high rates of pathogen kill and the ability to produce Class 'A' biosolids.

In comparison to conventional mesophilic digestion, the TPAD process creates a higher ammonia recycle load resulting in the requirement for additional processing capacity being required in the liquid train of the Woodward WWTP. The TPAD process would also produce a higher methane gas production rate than that of a mesophilic process. The additional gas produced through the TPAD process could be included in the gas recovery and reuse design already in place at the Woodward WWTP and currently operated by HRPI. Increased gas production through TPAD increases fuel use and costs related to maintaining higher digester temperatures. The biosolids would then be dewatered as is currently practiced at the Woodward WWTP followed by land application for final disposal.

Alternative 3 - Class 'A' Alternative - Alkaline Stabilization

The high temperature and pH changes that occur with the addition of lime to biosolids result in a sterilized and low odour product. The alkaline stabilization process can be implemented in-house or through contract. The treatment may be applied to undigested (high solids content) or digested sludge (lower solids content) with a correspondent lime volume addition requirement and associated operational cost. There remains a need to further manage distribution/disposal of the end product, and a continuing requirement that the product meet the metal constituent levels as regulated for its end use as a fertilizer. This alternative assumes that a consistent and reliable source of lime be available through the planning period and transported to the biosolids facility as required. Perhaps less controllable is the requirement to have consistent access to lower pH (acidic) agricultural soils that will benefit from the neutralizing application of the alkaline stabilized biosolids.

Additional Analysis

Additional analysis in the final stages of this assessment was required in an effort to strengthen the assumptions made related to each of the respective alternatives. Based on the short-listing to a "Class A" stabilized product (alkaline stabilization or TPAD) and/or a thermal reduction process, a further triple bottom line evaluation was undertaken that assessed the following in more detail:

- Economic/Financial impacts, including related disposal options for the biosolids product generated from alkaline stabilization or TPAD, as well as capital and operating costs associated with each of the respective alternatives. In addition, opportunity exists for certain alternatives to produce energy which can assist in off-setting the overall cost should it be found that the energy recovery exceeds the required capital investment to recover such energy;
- Environmental impacts, including relative air emissions or environmental impacts associated with each alternative; and,
- Societal impacts, including those of health, noise, odour and transport accordant with each alternative's on-site and/or off-site operations.

The results of the final analysis were used to finalize the selection of the preferred strategy and the highlights of these particular investigations and findings are summarized in the Analysis/Rationale and Alternatives for Consideration sections of this report with supplemental information referenced in the Biosolids Master Plan Report which will be filed to the EBR for public review.

ANALYSIS/RATIONALE:

As a result of the final analysis as outlined above, the evaluation of short-listed alternatives was completed and is summarized in Table 1 of Appendix A. The preferred strategy being recommended is identified as Alternative 1 – Thermal Reduction (with sludge digestion for energy recovery).

As outlined in Table 1 of Appendix A, this alternative ranked the highest amongst the other alternatives when evaluated against the Triple Bottom Line of Social, Environmental and Economic indicators. In addition, this alternative demonstrated an additional environmental and economical benefit for its ability to recover waste (methane) and transfer it to energy. The following is a summary of the TBL for this preferred strategy.

Social

For each alternative, social impacts were evaluated against noise, odour. and public health. As indicated, there are both positive and negative societal effects for each alternative, but the location of those effects may be of greatest significance in terms of both impact and in the opportunities for applying mitigation to achieve a lowest net impact. It was found that managing biosolids at a point source, as is the case with the preferred strategy, has far more potential to control any negative social elements than the alternatives which depend on transporting the biosolids product over significant distances and applying onto agriculture lands in many local communities (being non-point source).

As a result, the preferred strategy is effective at mitigating noise and odour by drastically reducing the number of trucks traveling to and from the Woodward WWTP for which it was estimated that by the year 2035 (the period for which the master plan studied) 2,200 truck trips per annum would be required. The greatest impact of each haulage route at its outset would be in the area immediately surrounding the WWTP. Subsequently, for most activities associated with biosolids haulage and land application, impacts are then dispersed over a wider area with an increased difficulty to consistently mitigate risk. These impacts include noise, odour, dust, and other emissions from

transport and land application, as well as increasing exposure with distance traveled to the risks associated with road transport of biosolids, such as spills, accidents, and contamination.

The City receives a significant number of odour complaints related to the biosolids land application program, most of which are concentrated in the area of the Woodward WWTP and associated with the daily challenge of containing odour when the trucks are being loaded and leaving the facility. The preferred strategy allows for all biosolids to remain enclosed within the WWTP facility throughout the dewatering and conveyance process through to the incinerator, thereby drastically reducing fugitive odour emissions. In addition odourous plant air can be used as combustion air in the incinerator in an effort to further reduce plant odours.

Noise abatement measures will need to be employed at the incinerator site to mitigate the impacts of noise to plant workers and neighbours in the vicinity of the WWTP. Noise and odour mitigation initiatives are part of an ongoing practice at the WWTP and the siting of an incinerator at the WWTP location would concentrate noise and odour disturbance to better manage and mitigation effects. In addition to reducing truck traffic to and from the Woodward WWTP, an incinerator constructed within a building manages the overall process air and noise emissions under conditions tightly controlled by the Ministry of the Environment. As an additional due diligence reference, the biosolids incinerator facility in the Region of Peel was visited by staff and found to have noise levels which were relatively undetectable at the perimeter of the facility.

Public health issues stemming from the siting of an incinerator at the WWTP are a primary social element which must be addressed. The main concerns include emissions and flue gas control. It must be noted that constructing an incinerator requires approval from the Ministry of the Environment and its operation is stringently regulated and closely monitored by the Province. In addition, considering biosolids incinerators as a point source emission, emission control can be continually improved as technology improves throughout the planning period. Further detail associated with emissions from a biosolids incinerator is outlined in the Environmental section of this TBL review.

Environment

The preferred strategy provides the benefit of diverting residuals from land, but requires a high level of emissions control. In order to adequately assess these environmental impacts, residual thermal reduction emissions were assessed and placed in context with modelled emissions from biosolids trucking over the planning period as well as with City emissions as a whole. The details of these analyses are provided in Technical Memorandum 17 from the BMP document and summarized below.

Emissions of the greenhouse gas (GHG), CO_2 and of Criteria Air Contaminants oxides of nitrogen (NO_x) and sulphur (SO_x) and of Total Particulate Matter (TPM) were assessed. Current haulage distances from Woodward WWTP to land application sites range from as low as 30 km, with the bulk of sites located more than 60 km and as far as 85 km or more. Based on planning year 2035 sludge quantities, GHG emissions from biosolids haulage would range from 192,630 Tonnes CO_2 per year for a 35 km haulage radius to 373,030 Tonnes CO_2 per year for a 65 km radius. Comparative GHG emissions from an thermal reduction flue/ash trucking operation based upon 2035 sludge quantities range from 36,000 (digested) to 56,000 (undigested) Tonnes CO_2 per

year, and represent an order of magnitude difference and only 15 percent of year 2035 65 km haulage emissions. Ash generated from the incineration process would also require trucking and its CO_2 emissions are a significant fraction of the incinerator operation CO_2 emissions, despite the relatively small quantity of ash trucking fuel used to transport the ash.

In the case of specific Criteria Air Contaminants, however, biosolids trucking to land application sites produces comparatively lower emissions than thermal processing. This results mainly from the relatively small quantities of sulphur and nitrogen components in refined engine fuels. For example, year 2035 NO_x emissions at 2.26 Tonnes per year for 65 km haulage are significantly less than the estimated incinerator emissions of 6.0 to 9.0 Tonnes per year for digested and undigested sludge respectively.

It is important to note, however, that haulage and incinerator CAC emissions are found to be comparatively insignificant when placed in context with data from Clean Air Hamilton (2006) of current overall City of Hamilton emission levels. Under a worst case scenario, year 2035 incinerator NO_x emissions would represent less than 0.04 percent of current City-wide NO_x emissions. Similar comparatively small incinerator contributions for SO_x (0.025%) and TPM (0.012%) are anticipated from thermal reduction in relation to current overall City-wide releases of these Criteria Air Contaminants. In this context and in reference to the comparative emissions of GHG CO_2, the thermal reduction alternative is preferred over Class 'A' production and haulage.

As indicated, ash is a product from the incineration process requiring disposal. It is estimated that 10,370 tonnes of ash would be produced annually requiring landfill as its final disposal.

Financial/Economic

An economic analysis of the short-listed alternatives was undertaken based on a net present value (NPV) over the 30-year planning period for both Capital and Operation and Maintenance (O&M) costs. The potential for continued co-generation of electricity from digester gas and the potential for energy from waste (EFW) from the incinerator emission were also analyzed. Considering that the NPV of an individual alternative can be influenced by how the biosolids are processed prior to treatment, a number of sub-alternatives were evaluated for each to ensure all possible cost savings were considered.

The supporting analysis and assumptions for all alternatives and sub-alternatives was complex considering the impacts of capital investment, O&M, storage requirements, and level of pre-processing of biosolids. Table 2 in Appendix A summarized the financial analysis. Prior to any energy from waste consideration, the Thermal Reduction alternative represents a NPV of $134.6 M, the lowest of each of the other alternatives. With the overall benefit of retaining the North digester complex for energy recovery of methane gas to maximize the co-generation facility, the net NPV remains the lowest of all other alternatives.

In summary, the thermal reduction alternative negates the risks associated with a continued reliance on land application, and is further characterized by environmental and societal impact potentials that are manageable and more readily subject to mitigating measures. Emission levels of CACs from thermal reduction, at times a prime

societal concern, are demonstrated to be an infinitesimal constituent of overall City-wide emissions, and incinerator GHG emissions are estimated as being an order of magnitude and 85 percent less than those associated with Class 'A' haulage and land application. As a highly managed and regulated point source process within the WWTP site, a biosolids thermal reduction process together with the benefits derived from digestive gas power cogeneration, is better subject to the success of applied mitigatory measures on the impacts of noise, odour, and emissions.

ALTERNATIVES FOR CONSIDERATION:

There are two alternatives to the recommendations of this report for consideration with respect to the Biosolids Master Plan:

Alternative 1 – *Class 'A' Alternative - Alkaline Stabilization*

Should this item be considered, the following is a summary of risks and issues that would need to be addressed:

- **Community/Social:** Proceeding with treating and marketing a Class 'A' alkaline product, either in-house or contract based, is not recommended as disposal would be limited to only those agriculture lands requiring alkaline materials for pH adjustment, the planning period availability of which have been shown previously to be uncertain and subject to considerable risk and dependant on volunteer farm base in need of such materials. The uncertainty and risk associated with the availability of land for biosolids disposal could position the City and its community with the burden of increased stockpiling and eventual last resort contingency disposal in landfill.

  The greatest impacts of each haulage route at its outset would be in the area immediately surrounding the Woodward Wastewater Treatment Plant. Subsequently, for most activities associated with biosolids haulage and land application, impacts are then dispersed over a wider area with an increased difficulty to consistently mitigate. These impacts include noise, odour, dust, and other emissions from transport and land application, as well as increasing exposure with distance traveled to the risks associated with road transport of biosolids, such as spills, accidents, and contamination.

- **Environmental:** In addition to demonstrated risks associated with land availability speculation and associated increased trucking distances then, there are environmental impacts of haulage and disposal emissions. In particular, the greenhouse gas emissions associated with these activities have been demonstrated to be significant. The reduction of the City's reliance on energy consumptive transport was a key recommendation of the Council-endorsed Peak Oil report (CM06012) of 2006.

- **Financial:** The alkaline stabilization alterative is the most costly option for Hamilton, with or without digestion/co-generation. An in-house alternative was originally assessed, and as part of the latter detailed analyses, details for contract operation were solicited from representatives of the industry. The costings for in-house and contract alkaline stabilization operations were found to be comparable, remaining the most costly of all alternatives.

  Regulatory: With increasingly restrictive regulations, the ability to consistently generate a biosolids or fertilizer that is acceptable for land application through the

planning period will become challenging. The City would need to ensure that its sludge constituent metal concentrations (and other potential emerging contaminants) are maintained at or below those of present and future applicable regulatory and Fertilizer Act requirements. Failure to meet these requirements would result in a need for contingency plans and a corresponding increase in disposal cost.

For these reasons this alternative is not recommended.

Alternative 2 - *Class 'A' Alternative – Temperature-phased Anaerobic Digestion (TPAD)*

Should this item be considered, the following is a summary of risks and issues that would need to be addressed:

- **Community/Social** The Class 'A' alternatives assume that land for biosolids disposal is readily available through the planning period. As emphasized previously, analyses from the BMP Technical Memoranda indicate that with regulation stringencies, biosolids characteristics, and developing land use patterns, any lands available for biosolids disposal will be increasingly distant from the Woodward production source, resulting in significantly increasing haulage requirements over the planning period to 2035. The uncertainty and risk associated with the availability of land for biosolids disposal could position the City and its community with the burden of increased stockpiling and eventual last resort contingency disposal in landfill.

  The greatest impact of each haulage route at its outset would be in the area immediately surrounding the WWTP. Subsequently, for most activities associated with biosolids haulage and land application, impacts are then dispersed over a wider area with an increased difficulty to consistently mitigate. These impacts include noise, odour, dust, and other emissions from transport and land application, as well as increasing exposure with distance traveled, to the risks associated with road transport of biosolids, such as spills, accidents, and contamination.

- **Environmental** In addition to demonstrated risks associated with land availability speculation then, there are environmental impacts of haulage and disposal emissions. In particular, the GHG emissions associated with these activities have been demonstrated to be significant. The reduction of the City's reliance on energy consumptive transport was a key recommendation of the Council-endorsed Peak Oil report (CM06012) of 2006.

- **Financial** The Class "A" TPAD costs, while 20 to 30 percent less than Class 'A' Alkaline Stabilization costs and similar to Thermal reduction with energy from waste (EFW) costs, are also 20 to 30 percent greater than thermal reduction alternatives without EFW.

  Regulatory With increasingly restrictive regulations, the ability to consistently generate through the planning period a biosolids or fertilizer that is acceptable for land application will become challenging. The City would need to ensure that its sludge constituent metal concentrations (and other potential emerging contaminants) are maintained at or below those of present and future applicable regulatory and Fertilizer Act requirements. Failure to meet these requirements would result in a need for contingency plans and a corresponding increase in disposal cost.

  For these reasons this alternative is not recommended.

FINANCIAL/STAFFING/LEGAL IMPLICATIONS:

Financial Implications:

A breakdown of the estimated net present value (NPV) costs for the preferred alternative of thermal reduction with digestion and energy recovery is provided in Table 2 of Appendix A.

The preferred alternative has a NPV of $134.6 M over the 30-year planning period. The new process capital portion for construction is estimated at $60 M, with the remaining NPV of $74 M being operation and maintenance costs over the 30-year planning period.

Staffing Implications:

The addition of a new process and operations at the wastewater facility will not have significant implications on staffing levels. It would require the addition of some operational support in about five years' time once the facility is constructed.

Legal Implications:

Each of the recommended alternatives has specific regulatory/legal implications that stem from the overall responsibility the City carries with respect to the production and the regulated management of its biosolids. Many of these regulatory/legal responsibilities exist with the current biosolids operations.

As with any WWTP upgrade, regulatory compliance is required. Regulations associated with emissions will require compliance and a new Certificate of Approval will be required; however, proper design, sampling and monitoring can ensure that compliance will be met. Emissions criteria have been well addressed by other municipalities in southern Ontario with the satisfactory compliance of regulatory requirements by their thermal facilities.

POLICIES AFFECTING PROPOSAL:

A number of policies, regulations and statutes pertain to this document, namely:

- Nutrient Management Act
- Regulation 347
- Water and Wastewater Master Plan Policy Paper endorsed by Council on May 11, 2005 (refer to PW05050).
- Places to Grow Legislation.
- Greenbelt Protection Act.
- Safe Drinking Water Act.
- Environmental Assessment Act.
- Source Water Protection Act.

RELEVANT CONSULTATION:

An extensive public consultation program was undertaken for the Biosolids Master Plan. A Stakeholder Advisory Committee (SAC) was convened and consulted throughout the process. As part of the advertisement for the Notice of Commencement, an invitation was extended to any parties interested in being a part of a stakeholder group. No responses were received. City staff, in turn, issued Letters of Invitation to groups/

committees and parties that were felt would have in interest in being on the SAC. The composition of the SAC was as follows:

- City of Hamilton:
  - Public Works, Waste Management Division
  - Public Works, Water and Wastewater Division, Compliance and Regulation Section
  - Public Health Services
  - Agricultural and Rural Affairs Committee representative
- County of Haldimand
- Ministry of the Environment
- Environment Hamilton
- Hamilton Industrial Environmental Association
- Dr. George Sorger, Microbiology Professor Emeritus, McMaster University
- Councillor David Mitchell, Ward 11, City of Hamilton

Consultative communications to explore potential strategic cooperative opportunities and initiatives were undertaken throughout the BMP process with the following entities:

- The Regional Municipality of Peel
- The Regional Municipality of Halton
- The Regional Municipality of Niagara
- Hamilton/Niagara Wasteplan
- Terratec
- N-Viro

Regulatory agencies were notified and consulted throughout the BMP process. Feedback has been supportive of the Master Plan. Consultation will continue through Phases 3 and 4 of the Schedule C Class EA. A Community Liaison Committee has been formed to provide input into Phases 3 and 4 of the Class Environmental Assessment for the CSO Control Program and Woodward Avenue WWTP Expansion. A Technical Advisory Committee has been struck with representation from pertinent regulators and industry experts. A Public Works Sub-committee has also been developed to assist with this project.

The following summarizes the public consultation process which took place during the development of Phases 1 and 2 of the Biosolids Master Plan:

- Notice of Commencement and Advertising for Members of the Stakeholder Advisory Committee, September 2004
- Stakeholder Advisory Committee Meeting #1, February 25, 2005
- Public Information Centres #1, March 7, 2005 (Glanbrook Municipal Service Centre (MSC)), March 8, 2005 (Dundas MSC), and March 10, 2005 (Stoney Creek MSC)
- Stakeholder Advisory Committee Meeting #2, June 28, 2005
- Stakeholder Advisory Committee Meeting #3, June 7, 2006
- Public Information Centres #2, September 19, 2006 (Stoney Creek MSC), and September 21, 2006 (Woodward Public School)

CITY STRATEGIC COMMITMENT:

By evaluating the **"Triple Bottom Line"**, (community, environment, economic implications) we can make choices that create value across all three bottom lines, moving us closer to our vision for a sustainable community, and Provincial interests.

Community Well-Being is enhanced. ☑ **Yes** ☐ **No**
Reduced trucking from the Woodward Wastewater Treatment Plant to biosolids storage or to land application, biosolids management program is totally in control of the City of Hamilton and does not depend upon willing "hosts" or supportive weather conditions for land application or for contractors to haul biosolids away.

Environmental Well-Being is enhanced. ☑ **Yes** ☐ **No**
Provides a long-term solution which is not susceptible to regulatory changes such as emerging source water protection planning. Does not require trucking of biosolids to rural locations outside the city, thereby reducing fossil fuel emissions and roadway congestion.

Economic Well-Being is enhanced. ☑ **Yes** ☐ **No**
By moving away from reliance on third-party service providers, the City maintains control over management of its biosolids and over the cost of disposal. The option is not as susceptible to price escalation as it is not as dependant on the intensive use of fossil fuels nor the influence of third-party negotiations for access to resources.

Does the option you are recommending create value across all three bottom lines?
☑ **Yes** ☐ **No**
The Master Planning and Class EA process by its very nature considers natural, social and economic impact

Do the options you are recommending make Hamilton a City of choice for high performance public servants? ☐ **Yes** ☑ **No**
Not Applicable

Table 1 – Summary Analysis for Short-Listed Alternatives

Triple Bottom Line Factor	SHORT-LISTED ALTERNATIVE					
	Alternative 1 - Thermal Reduction of Biosolids		Class 'A' Biosolids Production			
			Alternative 2 - TPAD / Thermophilic Digestion		Alternative 3 - Alkaline Stabilization With Digestion	
	Pros	Cons	Pros	Cons	Pros	Cons
Social	○ Diverts from agricultural land – no requirement or reliance on availability of land over the planning period ○ Noise, odour and emission impacts are localized and on-site where subject to better and effective current and future mitigative measures ○ No off-site storage required	○ Recycling of biosolids nutrients to agricultural lands is terminated	○ Recycle of nutrients to multiple land uses	○ Land unavailability foreseen, with accordant risk of increasing haulage distances over the planning period, or of limiting to other less responsible disposal options (i.e. landfill) ○ Off-site storage required ○ High degree of off-site transport and land application required, leading to increasing levels of both local and distanced off-site disturbances including noise, odour, and truck traffic risks.	○ Recycle of nutrients to multiple land uses	○ Land unavailability foreseen, with accordant risk of increasing haulage distances over the planning period, or of limiting to other less responsible disposal options (i.e. landfill) ○ Off-site storage required ○ High degree of off-site transport and land application required, leading to increasing levels of both local and distanced off-site disturbances including noise, odour, and truck traffic risks
Environment	○ Order of magnitude reduction in GHG emissions from all operations when compared to Class 'A' alternative haulage and application requirements ○ Minimal off-site transport required, traffic reduced and sludge spills risks eliminated ○ Biosolids-sourced metals accumulations (and other emerging contaminants) in agricultural soils is terminated ○ Ash reuse potential (road base, cement, landfill daily cover)	○ Flue gas emissions of NO_x, SO_x &TPM comparatively higher, but similar in context to those of Class 'A' haulage alternatives when compared to overall City wide emissions – and subject to regulation and further mitigative measures over the planning period	○ Process offers some greater acceptance for land application ○ Comparatively lower haulage NO_x, SO_x &TPM emissions, but similar in context to those of incineration when compared to overall City wide emissions	○ High degree of off-site transport and land application required, leading to an order of magnitude increase in GHG emissions ○ Biosolid-sourced metal accumulations (and other emerging contaminants) in agricultural soils remain a concern	○ Process offers some greater acceptance for land application ○ Comparatively lower haulage NO_x, SO_x &TPM emissions, but similar in context to those of incineration flue gasses when compared to overall City wide emissions	○ High degree of off-site transport and land application required, leading to an order of magnitude increase in GHG emissions ○ Biosolid-sourced metal accumulations (and other emerging contaminants) in agricultural soils remain a concern
Economy (NPV)	*$134,600,000*		*$164,750,000*		*$264,950,000*	

Table 2 – Summary Net Present Value Analysis for Selected Short-Listed Alternatives

NPV Factor	Thermal Reduction	TPAD/ Temperature Phased Anaerobic Digestion	Alkaline Stabilization
	1ad	2a	3a
Applicable Digesters	NDC	NDC & SDC	NDC & SDC
Sludge Disposal Cost	n/a	$82,000,000	$82,000,000
Existing Digester Improvements Capital Cost	$6,550,000	$20,000,000	$20,000,000
New Process Capital Cost	$59,800,000	$10,400,000	$15,800,000
Process O&M Cost	$72,700,000	$18,800,000	$113,600,000
Digester O&M Cost (20 Yr Basis) [2]	$18,000,000	$24,000,000	$24,000,000
Seasonal Storage	n/a	$32,000,000	$32,000,000
Sub-Total NPV	*$157,050,000*	*$187,200,000*	*$287,400,000*
COGEN			
New Process Capital Cost	excl	excl	excl
Cogen O&M [4, 5]	$10,320,000	$10,320,000	$10,320,000
Cogen Revenue [5]	-$25,170,000	-$25,170,000	-$25,170,000
Cogen Heat Recovery Fuel Benefit [5]	-$7,600,000	-$7,600,000	-$7,600,000
Cogen Sub-Total NPV	*-$22,450,000*	*-$22,450,000*	*-$22,450,000*
	1ad	2a	3a
Sub-Total NPV	*$134,600,000*	*$164,750,000*	*$264,950,000*
Total NPV	*$134,600,000*	*$164,750,000*	*$264,950,000*