**RECOMMENDATION**

That the Integration Study of an Energy From Waste with the Operation of the Glanbrook Landfill, December 18, 2009, by Stantec Consulting Limited, be received and referred to the Solid Waste Management Master Plan (SWMMP) review process for information.

**EXECUTIVE SUMMARY**

Following the termination of the Niagara Hamilton WastePlan Environmental Assessment Study in October of 2008, Council approved the participation with Hamilton Utilities Corporation (HUC) in a study of Integration of Energy from Waste (EFW) with the operation of the Glanbrook Landfill.

The Integration Study is now complete and it provides a great deal of valuable information about the comparative financial, environmental and social impacts between a landfill only system and a system that includes and EFW facility and landfill.

**Alternatives for Consideration - See Page 6**

This report contains the comparison of the alternatives that were explored in the Study including Scenario 1, Base Case Landfill with Scenarios 2a to 4a and 2b to 4b, which
are variations on incorporating the EFW component into the City’s waste disposal system.

The financial benefit of a system including EFW would be minimal unless the City was to market the extra capacity that resulted at the landfill. However, this is not in keeping with the current Solid Waste Management Master Plan.

In general, a system including EFW has lower environmental impacts than a landfill only system.

A system involving EFW has social benefits that a landfill only system does not offer. The benefits of a waste disposal system with an EFW component include construction and permanent employment opportunities; added value to the City’s building permit fees; avoidance of siting a new landfill and the community resistance that can result from the siting process; and not removing agricultural land from production for location of a landfill site.

The City’s disposition of the Integration Study could include pursuing an agreement with HUC to contract capacity at an EFW, venturing into an EFW facility on its own, referring the study as information to the SWMMP review process which is about to commence or receiving the Study with no further action.

In 2001 when the SWMMP was complete, it was estimated that the Glanbrook Landfill had a capacity of 25 years. In 2007, it was estimated that there was approximately 27 years of capacity remaining, indicating a need to continue to pursue options for reducing the amount of waste being landfilled. While some of the additional capacity was achieved through waste diversion, landfill design efficiencies also contribute.

The Integration Study projects longer landfill capacity of 33 years from 2014 for a landfill only based system, excluding EFW. This indicates, while it will be important to address long term disposal capacity, there is not an immediate need. A review of the SWMMP is being initiated and RFP C11-70-10 is currently out for proposals for the review and the future role of EFW can be addressed as part of this process.

Since the Study contains a great deal of valuable information, it is recommended that Council receive the Study and refer it to the SWMMP review process for information.

FINANCIAL / STAFFING / LEGAL IMPLICATIONS

Financial: The approval of the recommendation has no financial impact on the Operations and Waste Management budget. The review of the SWMMP is funded through the approved capital budget.

Staffing: There are no staffing implications from the approval of the recommendation. Operations and Waste Management staff have been assigned to the SWMMP review.

Legal: There are no legal implications from the approval of the recommendation.
HISTORICAL BACKGROUND

The information contained in this report has City wide implications, although it potentially relates more particularly to Ward 11 where the Glanbrook Landfill is located, should the life of the landfill change.

The Solid Waste Management Master Plan (SWMMP), approved in 2001 includes the following recommendation:

Recommendation #5 - “A new state-of-the-art Energy From Waste (EFW) facility may form part of the City of Hamilton’s waste management system so the need for the EFW facility must be revisited in 2006 to determine if such a facility is needed to optimize the disposal capacity at the Glanbrook landfill site. Our diversion rates will be continuously monitored in order to determine the likelihood of success of achieving our 2006 diversion target.”

With the early closure of SWARU in 2002, Council approved the following recommendation:

“That in view of the early closure of SWARU, the General Manager of Transportation, Operations and Environment begin exploring the need for a new state-of-the-art Energy From Waste (EFW) facility to form part of the City of Hamilton’s waste management system to optimize the disposal capacity at the Glanbrook landfill immediately instead of 2006 as set out in Recommendation #5 of the SWMMP.”

Subsequently, in 2003, Niagara Region and the City of Hamilton initiated a project, known as WastePlan, related to the mutual need to pursue alternative waste disposal alternatives. An Environmental Assessment process, pursuant to the Environmental Assessment Act, commenced early in 2004 and continued to 2008 when it was concluded that Niagara had secured landfill capacity that would enable it focus on diversion programs for the next few years.

In October 2008, Report PW08113 was presented to the Public Works Committee recommending termination of the agreement with Niagara Region and direction to participate with Hamilton Utilities Corporation in an Energy From Waste Integration Study with the Glanbrook Landfill operations and the management of biosolids. Item 8 from the October 6, 2008 Public Works Committee, as approved by Council on October 15, 2008 is attached as Appendix “A” to Report PW08113a.

The biosolids component of Report PW08113 was undertaken separately and will be reported on as part of the work being done under the Biosolids Management Plan.

In 2001 when the Solid Waste Management Master Plan was approved it was estimated that there was about 25 years of capacity at the Glanbrook Landfill. The 2002 closure of SWARU reduced the capacity by about 3 years. In the update on the report on the Status of Solid Waste Management Master Plan, Options for Increasing Diversion and Landfill Capacity (PW07151) was presented to Public Works Committee on November 19, 2007, it was estimated that there was approximately 27 years of capacity
remaining, indicating a need to continue to pursue options for reducing waste being landfilled.

The Integration Study is now complete and the purpose of this report is to provide Council with an overview of the study, next steps available and to recommend a disposition on the conclusions of the study.

**POLICY IMPLICATIONS**

Three (3) policy documents affect the proposal including the Corporate Strategic Plan, the Public Works Business Plan and the Solid Waste Management Master Plan (SWMMP).

**Corporate Strategic Plan**

In Focus Area 5, Environmental Stewardship, reducing the impact of City activities on the environment includes a desired end result of 65% diversion of waste from landfill by 2011. Although most diversion will be achieved through recycling and composting, consideration of an alternative disposal technology would extend the life of the Glanbrook landfill significantly.

**Public Works Business Plan**

Consideration of an alternative disposal technology would contribute to greening and stewardship of the City and sound financial management.

**Solid Waste Management Master Plan**

This report relates to three (3) recommendations of the SWMMP:

Recommendation #2 recognizes that the Glanbrook landfill is a valuable resource and that the City must optimize its disposal capacity.

Recommendation #5 acknowledges that Energy From Waste (EFW) may form part of the waste management system that contributes to the extended capacity at the Glanbrook landfill. Although consideration of EFW was originally intended to start with the closure of SWARU in 2006, the early closure in 2002 accelerated the exploration of this option to start immediately.

Recommendation #9 suggests that the City should implement the components of the new waste management system as soon as possible. Most of the key components for diversion are in place, Recommendation #5 is one that is outstanding.

**RELEVANT CONSULTATION**

The findings of the Integration Study will be presented to the Solid Waste Management Master Plan Steering Committee on April 14, 2010 and the results of the discussion will be provided to the Public Works Committee verbally.

The findings of the study will also be presented to the Waste Reduction Task Force at an upcoming meeting.
ANALYSIS / RATIONALE FOR RECOMMENDATION

In the Analysis of Alternatives section of this report, a summary of the Study alternatives was provided and the four options for addressing the disposition of the Study outlined as follows:

1) Option 1 - Proceed with a long term agreement with HUC to process the City’s residual waste for a period of 30 years from 2014 to 2044
2) Option 2 - Investigate the feasibility of the City building its own EFW
3) Option 3 - Include the findings of the Study in the upcoming SWMMP review, or
4) Option 4 - Take no further action

The HUC Integration Study contains a great deal of valuable information that will be helpful to the City in making decisions about the future waste disposal system and the future of the Glanbrook landfill.

The Study proposes that the inclusion of an EFW facility, regardless of ownership, could facilitate the commercialization of capacity at Glanbrook that would generate significant revenue. However this commercialization is not in keeping with the current Solid Waste Management Master Plan.

Option 1 would provide the City with an opportunity to optimize the capacity at Glanbrook without the capital cost of constructing an EFW. The City would serve as a supplier of fuel, i.e. waste and the responsibility of facility operations and sale of energy would be the responsibility of HUC. This option could significantly extend the life of landfill and would fulfil the requirements of Recommendation 5 of the SWMMP. The direct financial benefit to the City would be limited unless the City marketed some of the extra capacity at Glanbrook commercially. This aspect would however not be in keeping with the SWMMP. An Environmental Assessment Study would be required to be undertaken by HUC.

Option 2 is similar to Option 1, the differences being that the City would incur the capital cost of construction the EFW facility. The City would directly assume the risk and benefit financially from the sale of energy and the marketing of any capacity at either the EFW or landfill that wasn’t required for the City’s use. This option would also require that a full Environmental Assessment Study be undertaken by the City.

Option 3 would see the information from the Study used to review the SWMMP, not only relative to the future of EFW as a component of the City’s waste management system, but also the review of the options around the use of the landfill for other than the City’s purpose. Consideration would be given to advantages and disadvantages of EFW and marketing capacity at the City’s landfill, which could generate significant revenues while providing landfill capacity for the long term. The Request for Proposals C11-17-10 for the SWMMP review has been issued and will close in April 2010 so the information collection stage of the review will commence in the near future and can accommodate the inclusion of the Integration Study.
Option 4 would result in the Study being received with no resolution and no further direction around Recommendation 5 of the SWMMP, and a study with limited value. Although the Study is now public information and could be referenced by anyone in future waste management decision making processes.

Staff is of the opinion the information in the Study has value and should not simply be received. However, it is apparent that the benefits of Options 1 and 2 are limited without the marketing of the extra capacity at Glanbrook. Since this commercialization is not in keeping with the SWMMP, staff would recommend that the most appropriate approach is to refer the study to the SWMMP review process to become part of the public consultation process around the recommendations related to EFW and principles of the existing Master Plan.

### ALTERNATIVES FOR CONSIDERATION

The intent of the EFW component of the Integration Study (Study) was primarily to evaluate the financial implications of integrating an Energy From Waste facility into the City’s waste disposal system. To ensure capacity at the Glanbrook landfill well into the future it is important that the City continues to pursue waste diversion and alternatives to landfill. An alternative disposal technology, such as an Energy From Waste Facility, would extend the life of the landfill and generate energy to benefit the community.

As the intent of this report is to consider the disposition of the Study, it is important to understand the nature of the Study and its conclusions. The Introduction and Background section of the Study act as an executive summary and is attached as Appendix "B" to Report PW08113a.

In this section of the report an overview of the Integration Study will be presented and the options for next steps outlined.

#### a) Overview of the Integration Study

The Study was essentially intended to provide a cost comparison of the current landfill system with a combined system of EFW and landfill. Consideration was also given to environmental, community, economic and social impacts related to the options.

The following summary includes discussions on key assumptions, landfill airspace, financial analysis, environmental and social impacts and conclusions.

1. **Key Assumptions**

A number of key assumptions were developed to guide the Study process.

The study period is 30 years from 2014 to 2044, (2014 being the earliest that an EFW facility could be operational).

The Study compared a Base Case Landfill Scenario with a Base Case EFW Scenario, but also included variables on the EFW component included capacities of 100,000 tonnes per year (tpy) and 200,000 tpy, and alternative uses for ash, as indicated on the following table.
TABLE 1:  SCENARIOS EVALUATED

<table>
<thead>
<tr>
<th>Scenario 1 – Base Case landfill Only (Status Quo)</th>
<th>Scenario 2(a) – Base Case EFW, 100,000 tpy, bottom ash landfilled</th>
<th>Scenario 2(b) – Base Case EFW, 200,000 tpy, bottom ash landfilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 3(a) – EFW, 100,000 tpy, bottom ash used as landfill cover</td>
<td>Scenario 3(b) – EFW, 200,000 tpy, bottom ash used as landfill cover</td>
<td></td>
</tr>
<tr>
<td>Scenario 4(a) – EFW, 100,000 tpy, bottom ash used as aggregate</td>
<td>Scenario 4(b) – EFW, 200,000 tpy, bottom ash used as aggregate</td>
<td></td>
</tr>
</tbody>
</table>

The increase in capacity from 100,000 to 200,000 tpy would require consideration of economies of scale and marketability and was assumed to be operational in 2024.

The EFW would be owned by HUC and the City would pay a tipping fee.

The City would want to ensure that capacity for the 30 years beyond the planning period to 2074 would be available. Any excess capacity would be marketed to sources with similar waste composition to that of the City.

The City would manage an average of 106,000 tonnes of residual waste per year of which approximately 94,000 tonnes would be processed through the EFW.

The EFW would be a mass burn facility with the waste by-product being ash.

The bottom ash from an EFW would have a density of 2000 kg/m³, compared with a density of approximately 750 kg/m³ for municipal residual waste.

Information from the 2007-08 Pre-feasibility Study carried out by HUC was used in the Integration Study including capital and operating costs, air emissions, ash, energy generation and revenues associated with the EFW technology.

Operating costs of the Glanbrook landfill are based on the current contract and long term cost estimates of capital and operating budgets and reserves, excluding post closure costs.

2. Landfill Airspace Projections

Although waste quantities are typically measured by weight in tonnes, landfill capacity and consumption are more appropriately measured by volume in cubic metres (cm). Landfill airspace varies with the type, composition and density of the material received.

It is estimated that the airspace available at the Glanbrook Landfill is 5.5 million cm³, based on achieving a diversion target of 65% by 2011.

Based on diversion and residual tonnage projections, the Base Case Landfill scenario would see three (3) years of landfill capacity remaining at the end of the planning period in 2044, to 2047. This would fall short of the desired capacity to 2074.

Under the EFW scenarios, the landfill airspace is significantly increased from the Base Case Landfill Scenario, with 107 to 183 years remaining landfill capacity in 2044 depending on the disposition of the ash. That represents 77 to 153 years beyond the desired capacity to 2074.
The study assumes that, in the EFW scenarios, it would be in the interest of the City to market the air space that would remain beyond 2074 to offset costs.

3. Financial Analysis

The financial impact analysis involved the development of cash flow models for the scenarios, in 2008 dollars. The cash flow models relate to the waste disposal system from the point of receipt at the transfer stations. As such, costs associated with the collection of waste, recycling and composting programs are not included.

The value of the remaining airspace after the City secures 65 years of capacity is a key factor in the financial evaluation.

The overall net cost comparison of the scenarios is included in the following table.

**TABLE 2: NET COST COMPARISON OF SCENARIOS**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Net Cost/(Revenue) in millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 Base Case Landfill</td>
<td>$86.8</td>
</tr>
<tr>
<td>Scenario 2(a) – Base Case EFW, 100,000 tpy, ash landfilled</td>
<td>($77.7)</td>
</tr>
<tr>
<td>Scenario 3(a) – EFW, 100,000 tpy, ash used as landfill cover</td>
<td>($141.5)</td>
</tr>
<tr>
<td>Scenario 4(a) – EFW, 100,000 tpy, ash used as aggregate</td>
<td>($105.4)</td>
</tr>
<tr>
<td>Scenario 2(a) – Base Case EFW, 200,000 tpy, ash landfilled</td>
<td>($176.8)</td>
</tr>
<tr>
<td>Scenario 3(a) – EFW, 200,000 tpy, ash used as landfill cover</td>
<td>($79.7)</td>
</tr>
<tr>
<td>Scenario 4(a) – EFW, 200,000 tpy, ash used as aggregate</td>
<td>($142.0)</td>
</tr>
</tbody>
</table>

The net cost of the Base Case Landfill scenario carries a cost of $86.8 million over the planning period. All of the EFW scenarios generate revenues over the planning period, ranging from $77.7 million to $176 million.

The next financial consideration was to consider the Net Present Value (NPV) for the costs/revenues for the scenarios. NPV is considered to be an appropriate accounting method for comparing overall financial differences amongst the scenarios. It employs the time value of money to appraise long term projects. NPV takes into account the uneven magnitude and timing of future benefits over long periods of time. NPV is essentially the amount of money that would be needed in 2009 to pay for the net capital and operating costs over the planning period of thirty (30 years).

The NPV for the scenarios is included in Table 3.

**TABLE 2: NET PRESENT VALUE (NPV) COMPARISON OF SCENARIOS**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>NPV in millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 Base Case Landfill</td>
<td>$58</td>
</tr>
<tr>
<td>Scenario 2(a) – Base Case EFW, 100,000 tpy, ash landfilled</td>
<td>$27</td>
</tr>
<tr>
<td>Scenario 3(a) – EFW, 100,000 tpy, ash used as landfill cover</td>
<td>$32.7</td>
</tr>
<tr>
<td>Scenario 4(a) – EFW, 100,000 tpy, ash used as aggregate</td>
<td>$14.8</td>
</tr>
<tr>
<td>Scenario 2(a) – Base Case EFW, 200,000 tpy, ash landfilled</td>
<td>$14.8</td>
</tr>
<tr>
<td>Scenario 3(a) – EFW, 200,000 tpy, ash used as landfill cover</td>
<td>$16.5</td>
</tr>
</tbody>
</table>
Vision: To be the best place in Canada to raise a child, promote innovation, engage citizens and provide diverse economic opportunities.

Values: Honesty, Accountability, Innovation, Leadership, Respect, Excellence, Teamwork

The final step in the financial analysis was to conduct a sensitivity analysis on the NPV to consider variable factors such as escalated capital costs, not marketing excess capacity at the landfill and removing the value of the remaining landfill capacity. This analysis revealed that there would be limited financial benefit if the capital costs were 30% higher and there would be no benefit to assuming that the remaining landfill capacity had no value. A sensitivity analysis involving the value of energy was not undertaken.

4) Environmental and Social Impacts

Although the primary function of the Integration Study was to consider the financial impacts of introducing EFW to the City's waste disposal system, it is also important that environmental and social impacts be assessed. In this section consideration will be given to the Lifecycle Analysis (LCA) impacts related to greenhouse gases (GHG), air emissions, energy generation and emissions to water; traffic flow; nuisances such as odour, litter, dust and vectors; employment and the local economy, consumption of landfill airspace and impact on agricultural land.

The emissions to air and water, and energy generation were assessed using a Lifecycle Analysis (LCA) model.

For the LCA analysis, the comparison was drawn between Scenario 1 – Landfill Base Case and Scenario 2a – EFW Base Case with recovery of metals. The following table is a summary of the comparison of the estimated emissions from the two (2) scenarios.

**TABLE 3: LIFECYCLE ANALYSIS (LCA) COMPARISON**

<table>
<thead>
<tr>
<th>Emissions (Reductions) Per Year</th>
<th>Scenario 1 - Base Case Landfill</th>
<th>Scenario 2a – Base Case EFW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse Gases (CO₂ Equivalents)</td>
<td>21,595 tonnes</td>
<td>-13,386 tonnes</td>
</tr>
<tr>
<td>Energy/Consumption/Generation</td>
<td>-5,632 GJ</td>
<td>-657,542 GJ</td>
</tr>
<tr>
<td>Electricity in Megawatt Hours</td>
<td>1564</td>
<td>182,650</td>
</tr>
<tr>
<td>Net Emissions to Air (Smog Precursors)</td>
<td>4,400 kg</td>
<td>-6,096 kg</td>
</tr>
<tr>
<td>Net Emissions to Air (Acid Gases)</td>
<td>-12,400 kg</td>
<td>-101,589 kg</td>
</tr>
<tr>
<td>Other Emissions</td>
<td>trace</td>
<td>10 kg</td>
</tr>
</tbody>
</table>

The GHG associated with EFW would be significantly lower than landfill because of avoided landfill emissions (methane gas). Scenario 1 is estimated to produce approximately 35,000 more tonnes of GHG than Scenario 2a. Although a gas collection system has been installed at Glenbrook, not all gas is collected. Other GHG reductions would be achieved through offsets from energy generation and recycled metals (avoiding the production of new metals from virgin materials).

Significantly more energy is generated by EFW than landfill. A 100,000 tpy EFW facility would generate 8.1 net Megawatts per year, which would power approximately...
Six thousand homes. The energy generated by the Landfill Gas to Energy facility is offset by the energy consumed in the landfill operations.

Emissions to air include smog precursors (total particulate matter and nitrogen oxides), acid gases (sulphur oxides, hydrochloric acid and nitrogen oxides) and other emissions (lead, mercury, cadmium and dioxins/furans). The net emissions of smog precursors are lower for EFW as a result of low particulate matter significantly offsetting nitrogen oxides.

Similarly the emission of acid gases is significantly lower for EFW, largely due to much lower emission of sulphur oxides, while hydrochloric acid and nitrogen oxides are marginally higher for EFW.

Other emissions (lead, mercury, cadmium and dioxins/furans) produced by landfill occur in trace only as they are too low to measure. EFW produces approximately 10 kg/year of lead, mercury and cadmium and about 0.025 grams/year of dioxins/furans.

To put the emissions into a broader context, the direct EFW emissions were compared with the total air emissions in the Province of Ontario. This was based on the updated Comparative Emissions Study that was carried out for the Niagara-Hamilton WastePlan Environmental Assessment Study in 2007, in which a 200,000 tpy EFW was compared with emissions from Ontario sources including energy facilities, transportation and domestic activities. The following table shows this comparison.

**TABLE 4:**
**COMPARISON OF A 200,000 tpy EFW AND ONTARIO AIR EMISSIONS**

<table>
<thead>
<tr>
<th>Air Emission</th>
<th>Amount / Year</th>
<th>% of Ontario Total</th>
<th>Equivalent / Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG (CO₂ Equivalent)</td>
<td>86,000 tonnes</td>
<td>.04</td>
<td>Heat 15,035 homes with natural gas</td>
</tr>
<tr>
<td>Acid Gases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Nitrogen oxides</td>
<td>185 tonnes</td>
<td>.1</td>
<td>203 diesel trucks each travelling 91,200 km¹</td>
</tr>
<tr>
<td>- Sulphur Dioxide</td>
<td>8.5 tonnes</td>
<td>.002</td>
<td>55 diesel trucks each travelling 91,200 km</td>
</tr>
<tr>
<td>Smog Precursors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Total Particulate Matter</td>
<td>4.9 tonnes</td>
<td>.008</td>
<td>39 diesel trucks each travelling 91,200 km</td>
</tr>
<tr>
<td>- Carbon Monoxide</td>
<td>10.2 tonnes</td>
<td>.007</td>
<td>44 automobiles each travelling 17,600 km</td>
</tr>
<tr>
<td>Trace Contaminants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cadmium</td>
<td>4.9 kg</td>
<td>.06</td>
<td>2,664 diesel trucks each travelling 91,200 km</td>
</tr>
<tr>
<td>- Mercury</td>
<td>7.9 kg</td>
<td>.5</td>
<td>4,331 diesel trucks each travelling 91,200 km</td>
</tr>
<tr>
<td>- Lead</td>
<td>50 kg</td>
<td>.02</td>
<td>9,071 diesel trucks each travelling 91,200 km</td>
</tr>
<tr>
<td>- Dioxins/Furans</td>
<td>.04 g</td>
<td>.2</td>
<td>192 tonnes of waste burned in open air</td>
</tr>
</tbody>
</table>

¹ 203 diesel trucks each travelling 91,200 km per year is about 22,300 trips between Windsor and Montreal along Hwy. 401.
With regard to GHG, emissions from sources like home furnaces and fossil fuel electricity generators represent 50% of the CO₂ equivalents generated in Ontario, transportation represents 31%, waste management activities represent less than 1% and GHG emissions from EFW represents .04%. The direct GHG emissions from EFW were estimated to be 86,600 tonnes per year (tpy) of CO₂ equivalent, which is equal to the CO₂ from natural gas furnaces in approximately 15,035 homes.

Emissions to water are most prevalent in the landfill component of any waste disposal system. Scenario 2a Base Case EFW Scenario would produce fewer emissions to water than Scenario 1 Base Case Landfill. Not only is the amount of untreated waste reduced, but the inert nature of the ash residues produces less leachate resulting in lower emissions to water.

Scenario 2b Base Case EFW could result in less truck traffic accessing the Glanbrook Landfill site, depending on the use of the site. Traffic has been a concern of the landfill neighbours since the facility opened.

In Scenario 1 Base Case Landfill it is estimated that 4,128 tractor trailer trucks would transport waste from Transfer Stations and residue from the Materials Recycling Facility to the landfill each year. In addition an unknown number of vehicles, typically dump trucks, transport street sweepings and Waste Water Treatment Plant (WWTP) grit and scum to the Landfill each year.

In Scenario 2b, approximately 77% of the tractor trailer truck traffic would be diverted to the EFW. In addition a factor for trucks transporting Industrial/Commercial/Institutional (ICI) waste (to maximize the EFW capacity at least in the early operating years) would result in an average annual estimate of 4,575 transfer vehicles arriving at the EFW.

Waste that would be sent to the Glanbrook Landfill would include street sweepings, WWTP grit and scum and rejected waste (predominantly bulky items) from the EFW.

The average annual number of trucks received at Glanbrook would be 945 plus trucks carrying street sweepings, grit and scum. However, if a decision was made to market the landfill airspace that the City would not require, the truck traffic could increase to about 4,354 trucks per year.

Nuisance effects include odour, litter, dust and vermin/vectors (bird and non-bird vectors and rodents). Nuisance effects associated with a disposal system with an EFW component are generally less than those associated with a landfill only disposal system. In a system involving EFW the majority of the waste received at the landfill is ash, whereas of traditional landfill receives residual solid waste.

(a) Landfill

Sources of odours at a landfill include waste materials, fugitive landfill gas emissions and leachate. Odours can be mitigated through the placement of waste at the toe of the working face, appropriate daily cover, odour suppressing agents, flaring or gas to energy systems to control gas and proper leachate management (collection systems).
Dust, mostly from moving vehicles, trucks on roads and the equipment on the working face has impacts on neighbours and equipment. It can be controlled through paved roads, dust suppressants, low silt gravel and speed reduction.

Vermin and vectors are attracted to organic material. This nuisance can be minimized by the use of birds of prey, proper compaction and cover and source separated organic programs.

Litter is a problem at the landfill caused by light-weight blowing materials. Control measures include fencing (particularly downwind of the tipping face), proper daily cover, minimizing working face area, tarping waste vehicle trailers and on and off site litter collection programs.

(b) EFW and Landfilling Ash

(i) EFW

Nuisance effects are significantly reduced in a waste disposal system that includes EFW. As such the cost of mitigating nuisances is also reduced. Waste handling is almost all carried out indoors and material landfilled is predominantly ash.

Odours at an EFW, generally associated with incoming waste can be controlled through closing doors, negative pressure, maximizing burn and air pollution control equipment including air scrubbers.

Dust at an EFW is produced from incoming waste, materials used in the process, residues from the ash, flue gases and vehicles. Impacts can be reduced through loading/unloading procedures, enclosing or covering equipment and storage areas, stabilizing ash and limiting the number of transfer points.

Although vermin and vectors may be attracted to incoming waste, gulls and other vermin can be controlled through design and operation of the facility.

Litter associated with incoming waste at an EFW is best managed through enclosed unloading areas.

(ii) Landfilling Ash

Most of the material landfilled in an EFW scenario consists of ash, rejected items, street sweepings and grit and scum from the Water Wastewater Treatment Plant (WWTP), so it is predominantly inert with minimal organic content, reducing nuisances associated with odours, vermin/vectors and litter. The waste would produce less landfill gas and inherent odours. If fewer trucks access the landfill site, dust would be reduced.

5. Social Impacts

The social impacts examined in the Study include employment, the local economy, consumption of landfill capacity (airspace) and consumption of agricultural land.

(i) Employment
The employment discussion relates only to a 100,000 tonne per year EFW. It is estimated that the capital cost of construction would be $95 million (2008 dollars) and that construction would take 30 months.

Employment related to the EFW facility includes construction employment, operating employment, indirect employment and induced employment, calculated using multipliers from a Statistics Canada model. It is estimated that an EFW facility would provide about 578 years of direct and indirect employment during construction, and 116 years of induced employment.

The EFW itself would employ about 47 persons with annual labour costs of $4.8 million. Approximately 33 indirect jobs would be associated with the operation of the facility.

(ii) The Local Economy

The construction of an EFW would contribute to the City’s annual construction value which was $800 million in 2008. The construction cost of an EFW, estimated at $95 million, would be about 12% of the total construction value. With lower construction values expected for 2009, the percentage of the construction value associated with EFW would increase.

Based on the 2006 Census, Hamilton had a labour force of 263,595 persons and an unemployment rate of 6.5%. The unemployment rate in 2009 was 9.1%. Over 50 of the unemployed persons were identified as having appropriate skills for EFW construction (industrial engineer, pipe fitter, sheet metal worker). This suggests that the local labour force could adequately provide the construction resources to build an EFW.

(iii) Consumption of Landfill Airspace/Capacity

Consumption of landfill airspace impacts on the future need to site a new landfill and the potentially divisive impacts that siting a landfill would have on the community.

Under Scenario 1, the Base Case Landfill, landfill airspace capacity would be available for 2 or 3 years beyond the end of the planning period in 2044, depending on diversion.

Under EFW Scenarios 2a, 3a and 4a, for a 100,000 tonne facility, there would be airspace capacity for 107 to 183 years beyond the end of the planning period in 2044, depending on how the ash was managed. For a 200,000 tonne facility in Scenarios 2b, 3b and 4b, the airspace capacity was 61 to 120 years beyond the end of the planning period in 2044, assuming that all ash from the facility would be landfilled at Glanbrook.

All EFW scenarios would significantly increase the airspace capacity of Glanbrook, delaying the need to site a new landfill. This would allow time for new landfill or other disposal technologies to be developed and possibly incorporated into the City’s waste disposal system. It could also potentially generate revenues from the sale of a portion of the airspace.
(iv) Consumption of Agricultural Land

Landfills are typically located in rural areas while EFW facilities are typically located in urban settings. Should the City need to site a landfill in the future, the site size requirement including the landfill footprint and buffer areas would be in the order of 247 hectares, which could be prime agricultural land since landfills cannot be located in low, wet or sensitive areas.

The size requirement for and EFW site would be about 5 hectares.

6) Study Conclusions

The general conclusion of the Study is that development of an EFW could have financial, environmental and social benefits to the City.

More specifically the conclusions around financial matters are:

a) In the 30-year planning period to 2044, over 4 million cubic metres (m³) of landfill airspace could be saved in any of the EFW scenarios, allowing for 75,000 tonnes per year (tpy) to be marketed, while retaining enough airspace for the City’s needs for another 30 years, to 2074.

b) Net cost of Scenario 1 Best Case Landfill is estimated to be $118.6 million while the 100,000 tonne EFW scenarios are estimated to generate a net surplus (revenue) ranging from $77 to $105 million, as a result of marketing remaining landfill airspace and the value of the airspace to serve the City’s needs to 2074.

c) The Net Present Value (NPV) for Scenario 1 is estimated to be $58 million, while the NPV for the EFW scenarios ranges from $14.8 to $32.7 million.

d) The sensitivity analysis on the NPV concluded that:
   - If capital costs of an EFW were 30% higher the NPV benefit disappears,
   - the NPV advantage of the EFW would also be reduced should the City choose not to market the remaining landfill airspace, and
   - if the value of the landfill capacity at Glanbrook, at the end of the planning period was not accounted for, the NPV advantage of EFW would be minimal.

e) The potential tipping fee for the City at an EFW would be $72 per tonne, escalated by 2.5% per year. However, should a portion of the EFW capacity be marketed commercially at a higher rate, the tipping fee to the City could be reduced by a few dollars per tonne. The value of the remaining 4 million cubic metres of landfill airspace is not accounted for in the tipping fee.

f) The commercialization of the remaining landfill capacity could earn the City over $200 million over the 30 year planning period with a net surplus remaining after the EFW tipping fees are considered. The net financial effect on the City for Scenario 2(a) would be the combination of the net landfill costs to City and the annual tipping fee that the City would pay for EFW capacity. The NPV for the City’s costs would be $66 million under Scenario 1 Base Case Landfill and
$62 million under Scenario 2(a) Base Case EFW, not including the value of the remaining capacity at Glanbrook.

g) If the value of the remaining capacity at Glanbrook is accounted for in Scenario 2(a), the NPV to the City would be reduced to $22 million, resulting in an NPV of $44 million less than Scenario 1 Base Case Landfill, emphasizing the value of extending the landfill life beyond the Study period.

With regard to the environmental and social impacts the Study conclusions are:

a) Scenarios included and EFW have the potential to reduce:
   - Greenhouse Gases (GHG)
   - Smog precursors
   - Acid gases
   - Emissions to water
   - Truck Traffic
   - Nuisances

b) Scenario 1, Base Case Landfill, involving only landfill, has lower air emissions of heavy metals and dioxins.

c) While Scenario 1, Base Case Landfill would not generate any new employment, scenarios involving the construction of an EFW would generate about 695 direct, indirect and induced positions during the construction period and 47 full time positions to operate the facility.

d) Under Scenario 1, Base Case Landfill, there would be approximately 3 years of capacity remaining at Glanbrook however in any of the EFW scenarios there would be over 100 years of capacity remaining.

e) Siting of a new landfill would require about 247 hectares of rural (likely agricultural land) while and EFW could be sited on 5 hectares in an urban serviced area.

b) Staff Conclusion and Possible Next Steps

The completion of the HUC Integration Study provides valuable information for the City to consider in planning for its future waste disposal system. This study was an opportunity to focus on the potential capacity of the Glanbrook landfill and some options for optimizing its use. The option of commercializing a portion of the Glanbrook capacity presents a potential revenue source, but it does not fit with the principles of the current Solid Waste Management Master Plan.

The conclusions in the HUC Integration Study are related to Recommendation #5 of the SWMMP.

In conjunction with receiving the Study, the following options for next steps are for Council to direct staff to:

1) Proceed with a long term agreement with HUC to process the City’s residual waste for a period of 30 years from 2014 to 2044
2) Investigate the feasibility of the City building its own EFW
3) Include the findings of the Study in the upcoming SWMMP review, or
4) Take no further action

These options are discussed in the Analysis/Rationale section of this report.

**CORPORATE STRATEGIC PLAN**


**Skilled, Innovative & Respectful Organization**
- This project provided an opportunity for the City and HUC to collaborate on a mutually beneficial initiative.

**Financial Sustainability**
- The collaborative approach to this study resulted in shared costs.

**Intergovernmental Relationships**
- Maintain effective relationships with other public agencies.

**Environmental Stewardship**
- Aspiring to the highest environmental standards.

**APPENDICES / SCHEDULES**

Appendix “A”: Minutes of the Public Works Committee, October 6, 2008, as approved by Council on October 15, 2008

Appendix “B”: Introduction and Background (Integration Study of an EFW with the Operation of the Glanbrook Landfill Final Report)
8. **Long Range Waste Disposal Options for the City of Hamilton (PW08113) (City Wide) (Item 8.3)**

(a) That the recommendations of the July 11, 2008 Niagara-Hamilton WastePlan Joint Working Group meeting, as follows, be approved;

(i) That the Niagara-Hamilton WastePlan staff report be received;

(ii) That the Niagara Region and City of Hamilton, represented by current members of the WastePlan Joint Working Group or other members of the Niagara Region Waste Management Planning Steering Committee and the Hamilton Solid Waste Management Master Plan Steering Committee members, continue to meet not less than annually or at the call of the co-chairs to consider opportunities of mutual interest including but not limited to waste management;

(iii) That the Councils of the Niagara Region and City of Hamilton be requested to enter into an agreement to terminate the Agreement for Joint Study of Waste Disposal dated January 1, 2004; and that the Chair of the Niagara Region, the Mayor of the City of Hamilton and the respective Clerks be authorized to execute the agreement within three (3) months of the approval by both Councils;

(iv) That the WastePlan website at [www.wasteplan.ca](http://www.wasteplan.ca) be posted with a notice that the site will be discontinued on a specified date to be three (3) months after, and subject to, the approval by both councils to terminate the agreement and end the Environmental Assessment (EA) Study;

(v) That subject to the approval by both Councils to terminate the agreement and end the EA Study, the Ministry of the Environment be so advised.

(b) That the City of Hamilton enter into a Termination Agreement to discontinue the waste disposal initiative and the WastePlan Environmental Assessment Study with Niagara Region, be approved;

(c) That the Mayor and Clerk be authorized to execute the Termination Agreement referred to in recommendation (b) above, in a form satisfactory to the City Solicitor;

(d) That Councillor Powers continue to fulfill the role of co-chair of the Working Group through the balance of the current term of Council;

(e) That private sector vendors of residual waste treatment technologies continue to be advised that the City will not be entertaining proposals unless or until the City is involved in an Environmental Screening process for an alternative disposal technology;

(f) That the Water and Wastewater and Waste Management Divisions of the Public Works Department participate in the Energy From Waste (EFW) Integration Study process with Hamilton Utilities Corporation (HUC);
Introduction and Background

The purpose of this Study was to assess and quantify, where possible, the impacts (financial, environmental, and social) associated with integrating an Energy-from-Waste (EFW) facility into the City’s waste management system over the long term (30 years beginning in 2014).

During the course of this Study the consultant team of Stantec Consulting Ltd. and Watson & Associates, with the guidance provided by the broader Study team made up of representatives from the City of Hamilton, the Hamilton Utilities Corporation (HUC) and North American Carbon (NAC), completed:

 ✓ A comprehensive review of all relevant background information related to the City’s waste management system and the EFW pre-feasibility study undertaken by HUC in 2008;
 ✓ Analysis of the potential flow of waste and tonnage projections associated with the City’s waste transfer and disposal system under the current status quo (Base Case Landfill Scenario 1) and with the integration of an EFW (Scenarios 2 through 4);
 ✓ Analysis of the financial implications of integrating a 100,000 tpy or 200,000 tpy EFW Facility within the City’s waste transfer and disposal system, and,
 ✓ Analysis of the environmental and social implications, considering a number of parameters commonly considered in Environmental Assessments, of integrating a 100,000 tpy or 200,000 tpy EFW Facility within the City’s waste transfer and disposal system.

The following scenarios were examined in this Study.

Scenario 1 – Base Case Landfill Only System
(the do-nothing scenario)

Scenario 2(a) – Base Case EFW System, 100,000 tpy
Capacity, bottom ash landfill disposed

Scenario 3(a) – EFW System, 100,000 tpy Capacity,
bottom ash used as landfill cover

Scenario 4(a) – EFW System, 100,000 tpy Capacity,
majority of bottom ash used as aggregate

Scenario 2(b) – Base Case EFW System, 200,000 tpy
Capacity (expansion in 2024), bottom ash landfill
disposed

Scenario 3(b) – EFW System, 200,000 tpy Capacity
(expansion in 2024), bottom ash used as landfill cover

Scenario 4(b) – EFW System, 200,000 tpy Capacity
(expansion in 2024), majority of bottom ash used as aggregate
Background Data Collection and Analysis

Before completing any assessments or analysis regarding the environmental, social and financial effects associated with the integration of an EFW facility into the City’s waste management system, a review of relevant background information and confirmation of various assumptions was necessary.

Study Assumptions

The following key assumptions were confirmed:

- The study period would be 30 years (2014 to 2044). For Study and analysis purposes, it was assumed that if an EFW is pursued the facility would become operational in 2014. This would represent the likely earliest date that an EFW could become operational, given the time required to complete required approvals processes and to construct and commission a new facility.

- The EFW facility would be initially sized to handle 100,000 tpy (approximately the amount of residential post-diversion solid waste that the City will manage in the long-term) but would provide the opportunity for additional expansion.

- If expansion did occur, it would occur around 2024 with an increase in the Facility’s size to 200,000 tpy. The viability of this expansion would depend on economies of scale and would need to be determined at a later date. It was assumed that additional EFW capacity could be marketed to the private sector or other municipalities.

- The EFW facility could be owned and financed by HUC and HUC and the City could enter into an agreement that would set a ‘tip fee’ for the City’s use of the EFW capacity.

- EFW bottom ash was assumed to be landfilled as a regular waste, in the EFW Base Case (Scenario 2(a)). Alternative EFW Scenarios considered the use of the ash as landfill cover or as aggregate material (Scenarios 3 and 4).
Study Assumptions (continued)

- The Glenbrook Landfill would continue to fulfill the City’s disposal needs for a minimum of 30 years, beyond the study period (to 2074). Any additional landfill capacity that would not be needed during this 65 year period (2009 to 2074) would be marketed to the private sector or another municipal jurisdiction to offset the City’s costs.

- It was assumed that the City would only accept materials that would be similar in nature to the City’s materials for disposal at Glenbrook Landfill during the study period. These materials would be inert and would contain minimal to no recyclable or organic material.

- The density of bottom ash assumed throughout the Study and used in landfill airspace projections was 2000 kg/m³. Ash is much denser than Municipal Solid Waste (MSW) which was assumed to have in-place density of 730 to 750 kg/m³ and contributes to the savings in landfill airspace for the EFW scenarios.

- Over the course of the 30-year study period, it was estimated that approximately 106,000 tonnes per year of residual waste managed by the City would require disposal, and of this, approximately 94,000 tonnes per year (89%) would be suitable for use as fuel for an EFW facility. The remaining 12,000 tpy per year are largely inert materials that would continue to be sent to landfill.

The characterization of the City’s future residual waste stream was anticipated to be as follows:

![Waste Characterization Chart]

- Organics: 37%
- Paper Fibre: 9%
- Other Materials: 18%
- Glass: 4%
- Metals: 2%
- Plastic: 10%
- Bulky Waste: 12%
- Construction Materials: 8%
- Other: 38%
Review of EFW Facility Assumptions

In March 2008, a Prefeasibility Study for an Energy From Waste (EFW) Facility on behalf of HUC was completed. The Prefeasibility Study provided the following information:

- Capital cost estimates including all costs for approvals design, engineering, procurement, construction and commissioning of the facility;
- Operating cost estimates including all pre-processing, processing, odour control, materials, staffing, ash management, wastewater management and site management costs (e.g., truck cleaning, litter control) for the facility;
- Identification of the preferred EFW technology;
- Estimates of air emissions performance;
- Estimates of residual wastes (ash) that would require disposal/management;
- Estimates of potential energy generation; and,
- Revenue estimates from the sale of electricity and/or heat, and from recovered materials.

Review of Glanbrook Landfill and Other Waste Management Facility Assumptions

- The operation of the Glanbrook Landfill has been contracted out for some time, and recently the City awarded a new operating contract (Contract C11-40-08) that will begin on January 1, 2010 to Waste Management of Canada Corporation (WMCC).
- Operating contract costs from 2010 to 2019 for the Glanbrook Landfill are based on the new Contract C11-40-08 with WMCC.
- Review and analysis of the City’s own internal cost estimates resulted in developing a long term capital and operating budget for the Glanbrook Landfill for both the Base Case Landfill Only (Scenario 1) and the EFW Scenarios.
- For 2020 onwards, annual fixed and variable operating costs were determined based on the City’s internal estimates for the landfill operations, adjusted as necessary to reflect any changes in landfill operations in the EFW scenarios.

Capital Projections

Capital budget projections for the City’s disposal and transfer system were obtained from various sources as well as from discussion with City Staff.
Landfill Airspace Projections

A key aspect of this Study was the determination of the effect of an EFW on the use of the Glenbrook Landfill. Tonnage projections were developed for the City’s residual waste stream over the study period. Landfill airspace consumption projections were based on the tonnes and density of materials that would be landfill under every scenario.

As is indicated in the table below, considerable landfill space is saved through all of the EFW scenarios. In the Base Case EFW Scenario (Scenario 2(a)), 65% of the remaining approved airspace at the Glenbrook Landfill would still be available at the end of the 30 year planning period. The other EFW scenarios result in even more remaining landfill airspace over the planning period.

<table>
<thead>
<tr>
<th>Landfill Projections (100,000 tpy EFW)</th>
<th>Scenario 1 (Base Case Landfill Only)</th>
<th>Scenario 2(a) (Base Case EFW, bottom ash disposed)</th>
<th>Scenario 3(a) (EFW, bottom ash as cover)</th>
<th>Scenario 4(a) (EFW, bottom ash marketed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Airspace Consumed (2014 to 2044)</td>
<td>4,556,006 m³</td>
<td>1,147,619 m³</td>
<td>580,871 m³</td>
<td>727,628 m³</td>
</tr>
<tr>
<td>Approved Airspace Remaining at end of planning period (m³)</td>
<td>535,657 m³</td>
<td>4,344,043 m³</td>
<td>4,510,791 m³</td>
<td>4,764,034 m³</td>
</tr>
<tr>
<td>Approved Airspace Remaining at end of planning period (%)</td>
<td>8%</td>
<td>65%</td>
<td>67%</td>
<td>71%</td>
</tr>
<tr>
<td>Estimated Remaining Operating Years</td>
<td>3 Years</td>
<td>107 Years</td>
<td>130 Years</td>
<td>183 Years</td>
</tr>
<tr>
<td>Stage 1 &amp; 2 Capacity Fully Utilized</td>
<td>2018</td>
<td>2032</td>
<td>2035</td>
<td>2041</td>
</tr>
</tbody>
</table>

Under all EFW Scenarios there would be well over 100 years of remaining life available at the Glenbrook Landfill. The availability of capacity over this long term timeframe supports the concept of marketing a portion of the landfill capacity that would remain under any of the EFW scenarios. The prediction of the quantity of landfill capacity that could be marketed was based on setting a ‘reasonable’ lifespan for the Glenbrook Landfill of 65 years (representing the 5 years between now and the start of the study period, the 30 year study period, and an additional 30 years of landfill operation beyond that) and that the ‘surplus’ capacity that is not required for disposal of City materials would be marketed at a reasonably steady rate over the 30 year planning period. As can be extrapolated from the table above, progressively more airspace could be marketed from Scenario 2 through Scenario 4 as less airspace would be consumed by City materials under these Scenarios.
Financial Impact Assessment

Cash flow models were developed to compare the front end financing and annual cash requirements of each scenario.

For the Base Case Landfill, Scenario 1, the overall net cost of the system over the 30-year planning period is $86.8 million. For the 100,000 tpy EFW Scenarios 2 to 4, the overall net cost of the system over the 30-year planning period ranges from a net surplus (expenditures less revenues) of $77.7 to $105.4 million. When comparing the Base Case Landfill and EFW scenarios, the significant difference is related to:

- The revenue from marketing the excess landfill airspace that would not be required by the City ranges between $206 and $258 million in revenues over the 30-year planning period, and,
- The value of the landfill airspace that would remain in 2044 which ranges from $88 to $142 million.

Essentially, from a cash flow perspective, the additional cost of including an EFW facility within the City’s waste transfer and disposal system is more than offset by the combination of the revenues earned by marketing some of the excess airspace at Glenbrook and by the value of the landfill capacity that would remain at the landfill as of 2044.

Overall, from a cash flow perspective, the 200,000 tpy EFW Scenarios indicate greater financial benefits over the Base Case Landfill scenario, with a net surplus over the planning period that ranges from $141 to $177 million.
Comparison of Net Present Values (NPV)

The net present value for all scenarios was determined based on assumptions of how costs would inflate over the Study period and then discounting them to determine the costs in 2008$. The NPV calculation was the primary means used to determine the overall financial differences amongst the different scenarios.

The NPV is essentially the amount of money the City would need in 2008$ to pay for the net capital and operating costs (after revenue) for the Scenarios. NPV analysis is the recognized method to take into account the uneven magnitude and timing of future benefits over long periods of time (e.g. 30 years).

Figure 4 indicates that with the EFW Scenario 2(a), over time the NPV for the EFW declines, after the initial capital investment, while the NPV for the net revenues from the landfill peaks in 2044 due to the value of the remaining airspace. Integrating an EFW into the current disposal system for the City would represent a tradeoff between the initial capital investment in the EFW facility and the value of the landfill capacity that could be marketed and that will remain in 2044.

![Figure 4: Comparison of the NPV of Operating EFW with the Revenue from the Remaining Landfill Airspace](image-url)
Comparison of Net Present Values (continued)

Similar to the results of the cash flow analysis discussed earlier, the EFW Scenarios offer greater benefit when comparing NPV, to the Base Case Landfill Scenario 1 under both the 100,000 tpy and 200,000 tpy EFW capacity assumptions. The NPV for the Base Case Landfill Scenario 1 was estimated as $58 million, in comparison to the NPV for EFW Scenarios 2 to 4 which ranged from $14.8 to $27 million under the 100,000 tpy capacity assumption and $14.8 to $32.7 million at 200,000 tpy. Essentially the NPV for all of the EFW scenarios was less than half that which could be incurred if the City was to continue to use the Glanbrook Landfill under the status quo. Much of this difference is based on the value of the revenue derived from the commercialization of the landfill space and the value of the remaining capacity at Glanbrook as of 2044.

Figure 5
Comparison of Net Present Value By Expenditure (Revenue) Component 2008$

The NPV for the EFW Scenarios is sensitive to the following:
- Projected capital costs; if they should increase, it could result in lower or no real financial benefit for the EFW scenarios;
- Marketing of landfill capacity, which generates revenue to offset system cost; and,
- The value of the remaining capacity at Glanbrook.
**EFW Tipping Fee Calculation**

While NPV represents a reasonable and recognized method of comparing the scenarios, it does not represent the actual basis of payment by the City for the use of the EFW capacity.

A tipping fee for the EFW facility was determined which would cover net operating and capital costs of the EFW, representing a break-even or minimum tipping fee.

<table>
<thead>
<tr>
<th>Results of Tipping Fee Calculation</th>
<th>Scenario 2(a) (100,000 tpy)</th>
<th>Scenario 2 (200,000 tpy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow Tipping Fee (Net costs and Fee inflated by 2.5% per annum)</td>
<td>$72.37 (2008$)</td>
<td>$73.08 (2008$)</td>
</tr>
</tbody>
</table>

**Potential Financial Effect to the City**

The net financial effect to the City if an EFW were integrated into the City’s waste disposal system, would be the combination of net landfill costs directly borne by the City and the annual tipping fee charges it would pay to use an EFW.

Figure 6 indicates that over time the net annual cost to the City for Scenario 2(a) would be less than that related to the status quo until approximately 2032. Based on the projected minimum tipping fee, the net cost to the City for the disposal system in Scenario 2(a) would be $61.84 million (NPV). The net cost to the City for continue operation of the Glenbrook Landfill would be $66 million (NPV). Including the value of the remaining capacity at Glenbrook of $39.8 million increases the potential value to the City for integration of an EFW, resulting in an overall $44 million difference between the two scenarios.
Financial Assessment Summary

The potential financial advantages of integrating an EFW Facility within the City’s waste transfer and disposal system are summarized as follows:

- Over 4 million cubic metres of landfill airspace at Glenbrook could be saved under all the EFW Scenarios over the 30-year planning period, enabling at least 75,000 tonnes per year of surplus capacity at the landfill to be marketed while also providing the City with sufficient landfill space for another 30 years of disposal of City materials beyond 2044.

- In the cash flow analysis of the Scenarios, for the Base Case Landfill, Scenario 1, the overall net cost of the system over the 30-year planning period is $86.8 million compared to a net surplus of $77.7 to $105.4 million for the 100,000 tpy EFW Scenarios and higher net surpluses for the 200,000 tpy EFW Scenarios. When comparing the Base Case Landfill and EFW scenarios, the significant difference is related to:
  - The value of commercializing the excess landfill airspace over the 30-year planning period; and,
  - The value of the airspace that would remain as of 2044.

- The NPV for all of the EFW scenarios was less than half that which could be incurred if the City were to continue to use the Glenbrook Landfill under the status quo.

- The potential tipping fee that could be charged per tonne to all users including the City for use of the capacity at an EFW, would be in the order of $72 per tonne (2008$) escalated by 2.5% per annum. Should a differential tipping fee be set with the commercial sector being charged rates similar to those used in the cash flow analysis, the tipping fee charged to the City could be reduced. The tipping fee estimate does not account for the net savings in landfill costs because of commercialization revenues (and remaining value) of freed-up air space.

- The overall results of the financial analysis are sensitive to the revenues derived from the marketing of surplus landfill airspace at Glenbrook, the value of the remaining landfill capacity as of 2044 and the capital cost assumptions for the EFW facility.

The net cost to the City, if an EFW were integrated into the disposal system, could be lower than under the status quo, much lower if the additional long-term capacity at Glenbrook Landfill is considered.
Environmental and Social Impact Analysis

The information used in the environmental and social impact analysis was obtained from a variety of sources including data gathered during the background data collection and confirmation of assumptions stage (Stage 1) of the Study as well as information obtained from other similar studies such as those completed during the Durham/York Residual Waste Environmental Assessment Study and the Niagara-Hamilton WastePlan.

Scenarios 1 and 2(a) were compared using a Life Cycle Analysis (LCA) to assess GHG emissions, generation of renewable energy, and emissions to air and water. Life Cycle Analysis accounts for the direct effects of a waste management system (facilities and transportation) itself plus the indirect effects and offsets resulting from the recovery of energy and recyclable materials.

- The EFW Scenarios would result in lower net emissions of GHG from an LCA perspective in comparison with a landfill-only system, as the Base Case Landfill Scenario 1 would result in emissions of CO2 equivalents over 21,000 tonnes while the EFW Scenarios would result in a net decrease in emissions of over 13,000 tonnes.

- For net energy generation, the EFW Scenarios generate significantly more energy, in the order of 650,000 GJ compared to approximately 5,600 GJ for a landfill-only system.

- The EFW Scenarios generally result in reduced air emissions of smog precursors and acid gases compared to Scenario 1.

- The landfill-only option results in less emissions of heavy metals and dioxins (approximately 10 kg per annum less).

- The EFW Scenarios would result in far lower emissions to water, emitting approximately 151 kg of Biological Oxygen Demand (BOD) while the landfill-only Scenario 1 would emit over 34,000 kg of emissions to water annually.
Environmental and Social Assessment

The assessment of potential environmental and social effects of developing an EFW as part of the City’s waste transfer and disposal system resulted in the following conclusions:

**EFW compared to Status Quo**

- The EFW Scenarios would generally result in less truck traffic accessing the Glanbrook Landfill.

- Generally speaking, the nuisance effects associated with the operation of the Glanbrook Landfill in Scenario 1 would be greater than the nuisance effects associated with the EFW Facility and the Glanbrook Landfill in Scenario 2(a). This holds true even if airspace is marketed in Scenario 2(a).

- Related to employment, while the continuation of the status quo under Scenario 1 would not offer any change in employment within the City, the capital investment in the proposed EFW would be approximately 12% of the total annual construction activity within the City for each of the past two years. In total the construction of the EFW could generate or sustain an estimated total of 695 direct, indirect and induced positions, most within highly skilled trades that are available within Hamilton. During operations, an estimated 47 full time positions would be created to staff the facility.

- The effects of the EFW scenarios on the available landfill capacity at the Glanbrook Landfill indicate that an estimate of over 100 years of additional operating life could result from the reduced consumption of landfill capacity, some of which could be marketed. At minimum another 30 years of landfill capacity would be available at Glanbrook as of 2044, allowing the landfill to operate until 2074.

- As of 2044, it is estimated that there would be only approximately 3 years of remaining life at the Glanbrook Landfill under the landfill-only Scenario 1. As a result, the City would have to site/find additional landfill capacity. Approximately 53 hectares of agricultural land would be required for the footprint and buffer of a landfill to provide the City with 30 years of disposal space beyond 2044.

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**In summary:**

*Generally, it can be concluded that there could be both financial and environmental/social advantages associated with developing an EFW Facility in the City of Hamilton.*