



## REPORT FOR ACTION

### Mixed Waste Processing Study Update

**Date:** February 13, 2020

**To:** Infrastructure and Environment Committee

**From:** General Manager, Solid Waste Management Services

**Wards:** All

#### SUMMARY

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Toronto's Long Term Waste Management Strategy (the Strategy) was adopted by City Council in July of 2016. The Strategy recommendations incorporate strategic system planning to minimize the need for new capital investment. Amongst several other actions to recover resources from the waste stream, the Strategy recommends studying and pilot testing mixed waste processing with organics recovery with a focus on the multi-residential garbage stream (due to lower waste diversion rates from this sector). The purpose of the study and pilot testing as originally outlined in the Strategy was to help inform the development of a business case on whether or not to pursue capital investments in mixed waste processing with organics recovery.

This report provides an update on the mixed waste processing with organics recovery study (the Study) work completed to date, preliminary findings and outlines policy and market conditions that have changed since the approval of the Strategy. This report also recommends not advancing a standalone mixed waste processing with organics recovery facility but to broaden the Study approach to include the consideration of thermal processing for materials that cannot be diverted for recycling or organics processing and its impact on long term residual disposal planning.

#### RECOMMENDATIONS

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The General Manager of Solid Waste Management Services recommends that:

1. City Council direct the General Manager, Solid Waste Management Services to consider future work on the development of a mixed waste processing facility, only in conjunction with a thermal treatment process, where the overarching goals are maximizing resource recovery through reduce, reuse, recycle, energy recovery then residual disposal, minimizing the dependence on long term landfill use all while ensuring the financial sustainability of the Solid Waste Management Services program.
2. City Council direct the General Manager, Solid Waste Management Services to report back to the Infrastructure and Environment Committee no later than the end of

2023 with a business case, including a triple bottom line analysis (environment, social and financial) and a utility rate impact assessment on the thermal processing of waste with and without mixed waste processing compared to traditional landfilling.

3. City Council directs the General Manager, Solid Waste Management Services to pursue potentially applicable federal government, provincial government, and non-profit organization funding opportunities to assist in implementing Recommendations 1 and 2 and to negotiate and enter into all necessary agreements to receive any available funding in a form satisfactory to the City Solicitor.

## **FINANCIAL IMPACT**

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Funding is available within the 2020 Solid Waste Management Services budget to advance Recommendations 1 and 2. There is currently \$8.085 million in funding identified in the Solid Waste Management Services 10 Year Capital Plan and committed as part of the Long Term Waste Management Strategy project (CSW013-02) for detailed studies and initiatives associated with mixed waste processing; and, a total planned project cost of \$20 million for the Landfill Capacity Development project (CSW960) including thermal processing studies and initiatives. The capital budget required to build a mixed waste processing facility or thermal processing facility, or to expand a current or develop a new landfill site, is not within the 10 year capital plan and is a currently unfunded estimate of \$310 million.

The Chief Financial Officer and Treasurer has reviewed this report and agrees with the financial impact information.

## **DECISION HISTORY**

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At its meeting of September 19, 2017, the Public Works and Infrastructure Committee (the Committee) adopted item PW23.6, entitled "Municipal Principles to Guide Transition of the Blue Bin Program". Staff provided an update to Committee regarding the transition of the Blue Box Program Plan under the *Waste Diversion Transition Act, 2016* and as a future full Extended Producer Responsibility program under the *Resource Recovery and Circular Economy Act, 2016*; and, City staff engagement with implementation of the *Waste Free Ontario Act, 2016* to advance transition of existing diversion programs to full Extended Producer Responsibility.

The Public Works and Infrastructure Committee Decision document can be viewed at: <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2017.PW23.6>

At its meeting of July 12, 13, 14, and 15, 2016, City Council adopted Item PW14.2 entitled "Final Long Term Waste Management Strategy" and adopted the recommended options and implementation plan, as presented in Attachment 1 to the report from the General Manager, Solid Waste Management Services. The implementation plan included the study of mixed waste processing as an option to increase the diversion of waste from landfill.

## COMMENTS

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### **Background: Mixed Waste Processing as presented in the Strategy**

The Strategy prioritizes waste reduction, reuse, recycling, recovery and residual disposal (the 5Rs waste management hierarchy) in that order, to develop policies and programs that are cost-effective, socially acceptable and environmentally sustainable for the long term. It also identifies waste management planning as an ongoing process that requires flexibility and includes reviews at five year intervals. Many factors were identified in the Strategy as a basis to consider revising any original options including:

- Changes in the City's waste composition,
- Changes in Provincial and Federal legislation as it relates to program and/or service delivery by the City, and
- Decreased material markets, customers and/or commodity prices.

The Strategy reviewed numerous policies, programs and facilities/technologies to identify options to achieve its aspirational zero waste and circular economy goals. Mixed waste processing was estimated to have the potential to recover up to 75,000 tonnes of Blue Bin Recycling and Green Bin Organics from the 150,000 tonnes of multi-residential garbage collected by the City on an annual basis. The recovery of this material would result in an approximately seven per cent increase to the City's diversion rate of 53 per cent (using 2014 as the baseline year).

The Strategy implementation plan sought to study, research and test mixed waste processing options in the first five years of implementation to inform the City's future business case review and long term decision-making, capital infrastructure investments and utility rate impacts.

### **Mixed Waste Processing Study Update and Findings**

Professional services were sought through a competitive Request for Proposal process in 2018 and the Study commenced November 2018. The scope of the Study includes the following four tasks:

- Task 1: Waste characterization and waste forecasting exercises to develop an understanding of the quantity and composition of materials that a mixed waste processing facility designed for Toronto would have to process.
- Task 2: Jurisdictional scan and vendor/market engagement to develop an understanding of the existing/emerging technologies and end market demands for material processed through mixed waste processing of the City's waste stream.

- Task 3: Pilot testing of potential technologies using the City's waste stream.
- Task 4: Development of a final report summarizing results, recommendations and business case of implementing mixed waste processing in the City of Toronto.

To date, the waste forecasting, characterization and jurisdictional scan exercises have been completed. The waste forecasting and characterization findings are outlined in the Executive Summary of Technical Memorandum #1, which is included in Attachment 1.

## **Preliminary Study Findings**

The Study has determined that achieving the City's diversion target as estimated in the Strategy requires a facility that processes nearly twice the annual tonnage of waste (from 150,000 to 270,000 tonnes) than what was originally anticipated. To achieve this, both single family and multi-residential garbage would need to be processed. The Study has also determined that both garbage streams have similar compositions and do not contain a large volume of revenue generating and marketable recyclables to recover under current market and regulatory conditions. However, it also identified a substantial volume of recoverable organic material in both streams. The following section summarizes the methods and results of the work completed to date.

### *Task 1: Waste Characterization and Forecasting*

The Strategy originally recommended focusing on the multi-residential garbage stream; however, the scope of the Study was expanded to include waste streams that have historically had high contamination rates. The scope was expanded to determine whether these streams were of sufficient quality to continue to be processed through the City's existing waste diversion infrastructure, or if the City could benefit by managing these materials through mixed waste processing.

To develop the waste characterization, the Study team customized and implemented an extensive audit plan and in November and December of 2018, approximately 6,300 kg of material was audited from the following waste streams:

- Multi-residential garbage
- Single family garbage
- Multi-residential Blue Bin Recycling
- Multi-residential Green Bin Organics
- Street litter bins

The waste characterization provided a better understanding of the City's waste profile and the material available for recycling and organics processing in each waste stream.

A waste forecast based on socio-economic indicators was developed to project the tonnage that the City could expect to manage annually over the next 25 years. Findings from the waste characterization were then applied to the forecasted tonnages to project the composition of the single family and multi-residential garbage streams that could be directed to a mixed waste processing facility.

Figure 1 and Figure 2 show the composition of the current multi-residential and single family garbage streams. For a recyclable material to be considered marketable, the material must have an established end market and meet current market quality parameters. The marketable recyclables are producer packaging and consist of revenue generating high value plastics such as Polyethylene Terephthalate (PET), High Density Polyethylene (HDPE) and metals (steel and aluminum).

Figure 1: Current Multi-Residential Garbage Composition

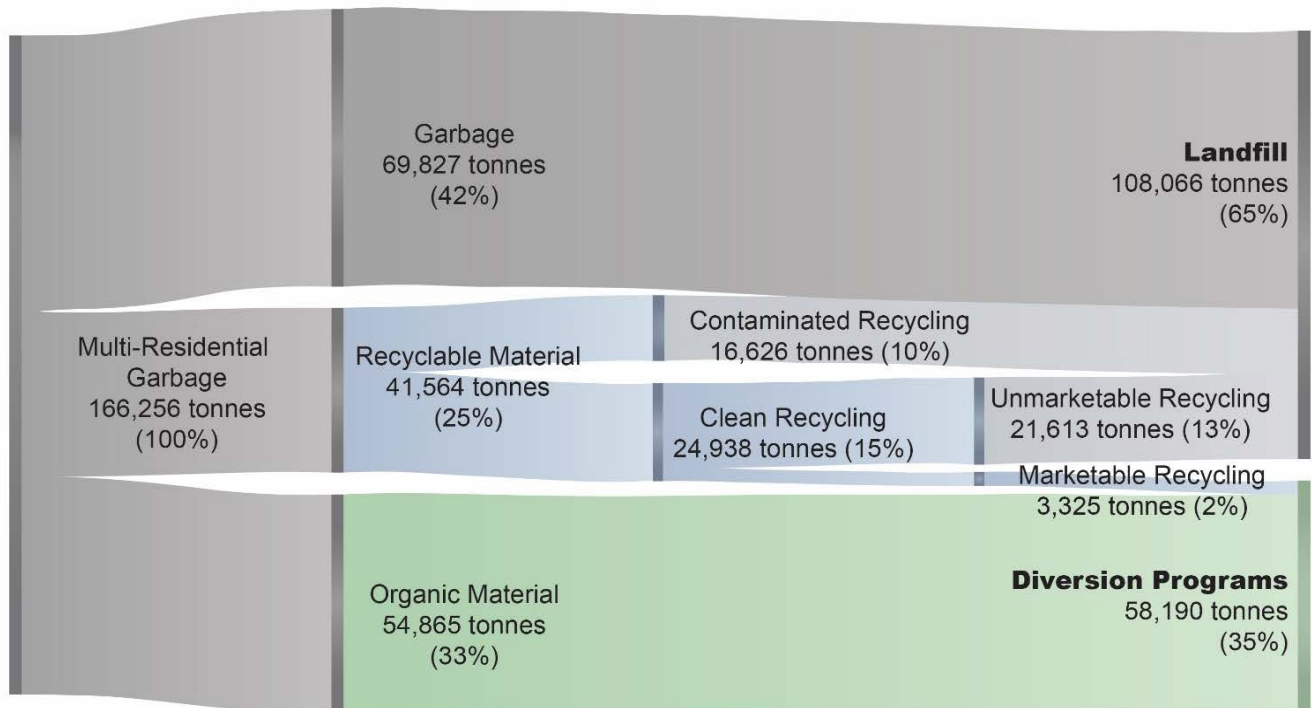
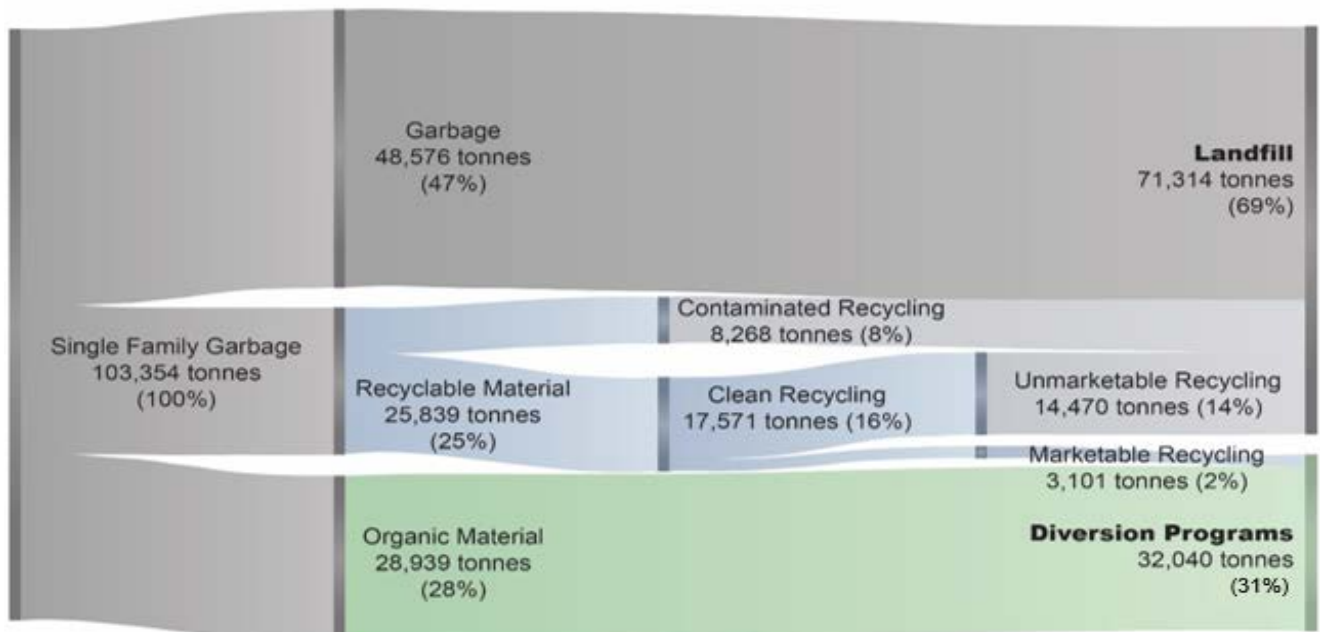


Figure 2: Current Single Family Garbage Composition



Key findings from Task 1: Waste Characterization and Forecasting are as follows:

- Neither the single family garbage stream nor the multi-residential garbage stream contains a significant quantity of producer packaging in the form of revenue generating, high value and marketable Blue Bin Recycling.
- Multi-residential Blue Bin Recycling and Green Bin Organics streams are of sufficient quality to be processed through the City's existing owned and contracted infrastructure. It is not recommended to use multi-residential Green Bin Organics and Blue Bin Recycling streams as potential feedstock for a mixed waste processing facility.
- Due to its high content of liquid and pet waste, the street litter stream could further contaminate clean, potentially divertible materials from other waste streams if combined on the tip floor of a mixed waste processing facility. It is not recommended that street litter be considered as potential feedstock for mixed waste processing.
- The multi-residential and single family garbage streams have similar profiles with respect to the split between garbage, Blue Bin Recycling and Green Bin Organics. Both garbage streams contain a significant quantity of Green Bin Organics that could potentially be diverted from landfill.
- The City will not be able to achieve the projected seven per cent increase in diversion attributed to mixed waste processing in the Strategy by processing only the multi-residential garbage stream. Both the single family and multi-residential garbage streams would need to be processed through a mixed waste facility to access a sufficient quantity of divertible material to achieve this diversion target. Assuming it is possible to separate and process 100 per cent of all Green Bin Organics and marketable Blue Bin Recycling from both garbage streams, the City could leverage a mixed waste processing facility to divert over 70,000 tonnes of material from landfills on an annual basis. However, this would require a facility with the capacity to process 270,000 tonnes of total feedstock per year and require that the organics are processed to meet the Province of Ontario's Compost Quality Standard (the Standard). This would be almost twice the processing capacity originally contemplated in the Long Term Waste Management Strategy.
- The Study's waste forecasting and characterization exercises identified between 56,000 and 88,000 tonnes of material in the City's single family and multi-residential garbage streams that may be of a suitable composition to be used as a Refuse Derived Fuel (RDF) product. However, Ontario does not currently have any long term end markets for RDF and the Province of Ontario's regulations do not count the production of RDF as waste diversion.

Typically, waste audits are conducted over four seasons to reflect the seasonal variability of waste generation. Since Task 1 only captured winter 2018 data, additional waste audits that replicate the methodology could generate a stronger waste characterization and more detailed understanding of the composition of waste streams that could be directed to a mixed waste processing facility.

## *Task 2: Jurisdictional Scan*

The Study team conducted a jurisdictional scan of operational facilities whose focus is the mechanical processing of waste streams for resource separation and processing. The scan sought facilities that are operating in conditions similar to the City of Toronto, such as comparable waste tonnages managed, waste legislation and seasonal climate. Facilities were not considered if they implemented a thermal process, such as incineration, as the primary strategy to reduce the amount of material sent to landfill.

In North America, 21 facilities were identified, and an additional 29 facilities were identified in Europe, that met the City's jurisdictional scan criteria.

Of the 50 facilities identified, 37 facilities (74 per cent) incorporated a thermal process as part of their operation to manage materials that are not marketable due to contamination and/or a lack of available end markets. These materials include contaminated paper and low value/non-recyclable plastics. Thermal processes range from the production of a fuel product, to processing a portion of the material through a gasification facility or an energy-from-waste facility.

### **Impacts of Study Findings**

The lower than anticipated volume of recoverable material available in the multi-residential garbage stream results in an increased facility throughput to achieve the Strategy's goals for diversion from landfill attributed to mixed waste processing. The results of Task 2 suggest that many mixed waste processing facilities include a thermal process to further derive resource value from the waste that remains after mechanical sorting. The Study has identified a considerable volume of material in the waste stream that could be suitable as an RDF product, although these tonnages would not contribute toward the municipal diversion rate, based on current Provincial definitions of diversion.

Inclusion of a thermal process as part of mixed waste processing may deliver a significant impact in reducing the amount of waste being landfilled and reduce the City's reliance on future long term landfill capacity.

### *Impact to Green Lane Landfill*

The City of Toronto currently sends approximately 500,000 tonnes of garbage to Green Lane Landfill annually, of which 270,000 tonnes are garbage collected from single family and multi-residential homes. As per Green Lane Landfill's Environmental Compliance Approval, the site is approved to fill a total air space of 18,832,625 cubic meters, of which an estimated 8,301,643 cubic metres remains as of December 2019, exclusive of future settlement at the site. Based on current waste generation trends, and assuming the City sends all its garbage to Green Lane Landfill, the Green Lane Landfill is expected to reach capacity by approximately 2036.

Solid Waste Management Services has determined that the earliest date that a mixed waste processing facility could realistically be operational is 2034, assuming a standard permitting and implementation timeline. The table below identifies two scenarios and the

associated garbage tonnages that could be diverted from Green Lane Landfill, assuming a 2034 facility completion date.

Table 1: Impact to Green Lane Landfill based on mixed waste facility operational in 2034

Scenarios	Annual tonnes diverted	Increase in life of Green Lane Landfill if mixed waste facility is operational in 2034
1. Recovery of marketable recyclables* + digestate	53,000	Less than 1 year
2. Recovery of marketable recyclables* + digestate + finished compost**	~70,000	Less than 1 year

\*marketable recyclables account for approximately 5,000 tonnes of recovered material

\*\*assuming the organic fraction produces a product that meets Ontario Compost Standards

Implementation of a mixed waste processing facility that focuses on the production of digestate and diversion of marketable recyclables would extend the life of Green Lane Landfill by less than one year. However, depending on which streams are recovered, and if thermal processing is considered, the implementation of mixed waste processing could reduce the City's ongoing need for new landfill capacity. These scenarios are assessed within the sections that follow.

### *Organics Recovery*

On April 30, 2018 the Ministry of Environment and Climate Change (now Ministry of Environment, Conservation and Parks) issued the *Food and Organics Waste Policy Statement, pursuant to Section 11 of the Resource Recovery and Circular Economy Act*, which provides direction on the recovery of food and organic waste using technologies including mixed waste processing. The Policy Statement provides direction to the Province, municipalities, and industrial commercial and institutional sector, to increase waste reduction and recover food and organic waste. The Policy Statement furthers the provincial interest by establishing sector-specific targets, including 70 per cent reduction and recovery of food and organic waste generated by single-family homes by 2023 for existing municipal curbside collection systems, and 50 per cent for multi-residential buildings by 2025.

Source separation of waste by residents is the most effective way to avoid contamination in each stream. It is likely that the organic fraction recovered from a mixed waste processing facility would have a higher contamination rate than organics collected in the Green Bin Organics program because the organic fraction would have to be mechanically separated from the garbage stream. In order to minimize contamination in the separated organics stream, a mixed waste processing facility would require a robust design to separate and clean organic material, and to process it



to create a final product of quality that meets the Standard. Processing of the organic fraction through anaerobic digestion may allow the City to generate Renewable Natural Gas (RNG) and digestate, a product that can be processed into compost. Finished compost that does not meet the Standard would not contribute to increasing the City's diversion from landfill rate and would either need to be landfilled or used as landfill cover, however the reduction in organic material due to anaerobic digestion may be considered an acceptable form of diversion from landfill. As part of the consultation process for the Organics Framework the City will seek clarity from the Province on anaerobic digestion and its impact to the City's diversion from landfill rate.

Globally, legislation varies on the ability to use a final compost product derived from a mixed waste process for beneficial land application. For example, the United Kingdom, Denmark, Belgium and the Netherlands have banned the land application of facility sorted organics while Spain, Italy, Australia, Portugal and the state of California allow restricted use.

The City's current and planned future Green Bin Organics processing infrastructure (including the future third anaerobic digester) does not have the capacity to process the additional material that could be separated from the garbage stream through a mixed waste processing facility. Similarly, the City's existing infrastructure has been designed for source separated material and may not be able to manage the level of contamination expected from an organic fraction recovered through mixed waste processing.

Investment in additional organics processing capacity would be required should the City proceed with organics recovery through mixed waste processing. As such, an additional organics processing facility has been factored into a high-level capital estimate of a potential future mixed waste processing facility. Further analysis of separation technologies will be required to determine whether a quality organic fraction can be recovered.

#### *Capital Cost of a Mixed Waste Processing Facility*

A rough order-of-magnitude costing exercise was conducted to better determine the preliminary budget impacts in the Strategy against the Study findings to date. The exercise was technology agnostic and was based on industry-standard costs for mechanical waste sorting and wet anaerobic digestion. The exercise focused primarily on the estimated throughput tonnage and the targeted materials identified in the Study. An allowance for land purchase or remediation of an existing site was included in the estimate.

Based on the rough order-of-magnitude costing exercise, the Strategy budget of \$310 million can be considered sufficient for a facility as contemplated by the Study. Such a facility would include a front-end sorting component for separation and capture of recycling and organic fractions, followed by organics contaminant removal and an anaerobic digester to process the organic fraction. However, further analysis will be necessary to determine specific technology costs and to refine the estimate for effective planning.

Although the \$310 million mixed waste processing facility was recommended in the Strategy, the funding is not yet included in the Solid Waste Management Services rate structure. As a result, the processing facility is currently unfunded and not within the 2020 to 2029 capital plan. The capital budget, plan and utility rates will be revised as required following Council's consideration of this item as part of future budget processes.

### *Operating Cost of a Mixed Waste Processing Facility*

A preliminary operating cost estimate was developed based on the Study findings to date and existing Solid Waste Management Services operating contracts. The operating cost estimate includes the additional processing costs of digestate from anaerobic digestion and was not technology specific.

Assuming a City-owned facility operated by a third party, the anticipated operating cost is approximately \$16.9 million per year, or \$63 per tonne of waste processed. The estimate does not include revenue or savings from the sale of recyclables which are estimated at \$2.7 million. The potential revenue from the generation of RNG and cost recovery of recyclables captured under current or future Extended Producer Responsibility legislation have not been considered.

### Scenario Analysis

The Study has determined that implementing a mixed waste processing facility will not have a significant impact of the lifespan of Green Lane Landfill. As such, staff have assessed two scenarios for their impact on volume of material sent to landfill based on the 40 year lifespan of a mixed waste processing facility and have developed high-level estimates for the associated cost impact of the two scenarios identified in Table 1. In Scenario 1, a mixed waste processing facility is used to capture marketable recyclables and the digestate is of sufficient quality to be processed into a compost product. In Scenario 2 a mixed waste processing facility is used to capture marketable recyclables but the digestate is too contaminated to generate compost and would need to be landfilled.

Table 2: Impact to Landfill Life Based on Recovery Scenarios

<b>Scenario</b>	<b>1. Capture of marketable recyclables and digestate processed to compost</b>	<b>2. Capture of marketable recyclables and digestate sent to landfill</b>
Total material avoided from landfill (tonnes)	70,000	53,000
Total material avoided from landfill over 40 year life of facility (tonnes)	2,800,000	2,120,000

<b>Scenario</b>	<b>1. Capture of marketable recyclables and digestate processed to compost</b>	<b>2. Capture of marketable recyclables and digestate sent to landfill</b>
Extension of landfill life attributed to mixed waste processing over 40 years*	5-6 years	4 years

\*based on annual landfilling of 500,000 tonnes of garbage

In the best case scenario, based on current market conditions, a standalone mixed waste processing system will have minimal impact on the amount of material sent to landfill and on the useful life of a landfill. The following table presents high-level estimates for the associated cost impact of the two scenarios.

Table 3: Estimated Lifetime Impact of a Mixed Waste Facility on Landfill Capacity

<b>Scenario</b>	<b>1. Capture of marketable recyclables and digestate processed to compost</b>	<b>2. Capture of marketable recyclables and digestate sent to landfill</b>
Estimated capital cost of mixed waste processing facility	\$310 million	\$310 million
Total annual operating cost	\$16.9 million	\$15.4 million
Potential revenue from sale of recyclables	\$2.7 million	\$2.7 million
Facility lifetime operating cost (not adjusted for inflation)	\$568 million	\$508 million
Total lifetime cost of mixed waste facility	\$878 million	\$818 million
Cost per tonne of saved landfill capacity	\$314/tonne	\$386/tonne

\*assuming 40 year life for mixed waste processing facility

Based on current waste generation trends, it is anticipated that over the 40 year life of the facility, mixed waste processing would extend the life of a landfill by four to six years at a lifetime cost of between \$818 million and \$878 million.

### *Diversion from Landfill as a Metric*

The Province of Ontario does not count material managed through a thermal process towards the diversion from landfill metric. The Province of Ontario also does not count any organic material products that do not meet the Standard. As such, if the City developed a mixed waste processing facility that managed garbage through thermal treatment or produced a contaminated organic fraction, these tonnes would not count towards the City's annual waste diversion rate, based on the Province's definition. If the final compost product does not meet the Standard, it is not yet known whether the City would still be able to attribute the reduction in tonnes of organic material achieved through anaerobic digestion towards the diversion from landfill metric.

On November 29, 2019 the Ministry of Environment, Conservation and Parks released "*Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan*" (the Environment Plan). In order to reduce waste and recover resources from waste, the Environment Plan identifies among its actions:

- Investigating options such as chemical recycling or thermal treatment to recover resources from waste and reduce the amount of waste going to the landfill.
- Encouraging increased recycling and new projects or technologies that recover the value of waste (such as hard to recycle materials).

The Province recognizes that recovery precedes residual disposal in the 5R's waste management hierarchy and are currently seeking feedback on thermal processing as part of the consultation on the Blue Bin transition to Extended Producer Responsibility (EPR).

### *Impacts of Policy and Market Changes on the Approach to Mixed Waste Processing*

The policy and market context for waste management in Ontario has changed substantially since the Strategy was adopted in 2016, which factors into the assessment on when and how to proceed with studying mixed waste processing.

The composition of the Blue Bin Recycling stream continues to evolve in response to consumer demand and purchasing decisions, as well as changes to producer packaging design choices. Quantities of compostable, non-recyclable or difficult to market recyclables are increasing and/or substituting traditionally high-value recyclables in the waste stream. Furthermore, recycling processing operations globally have been substantially impacted by the implementation of China's National Sword campaign for quality control of recyclables entering China. More stringent market quality specifications have impacted both access to recycling markets and the market value of recyclables. These trends are evident in the Study findings, as only a small quantity of marketable recyclables were identified in the garbage streams. These influences are important considerations for mixed waste processing, emphasizing the need for adaptability and resilience in design, and increasing the importance of organics recovery in the business case for the facility.

The Province of Ontario is currently moving forward with next steps in transitioning the Blue Box program to EPR, which could further influence the composition of the City of Toronto's waste streams. The technology selection process for mixed waste processing relies heavily on the composition of the feedstock, and as such significant changes to the waste streams could impact the processing efficacy of a facility.

Furthermore, the City's role in the marketing of eligible and obligated recyclables will change under EPR, which in turn may affect the revenue potential of the recycling stream recovered through mixed waste processing. Solid Waste Management Services will not be able to make a robust assessment of EPR's impact on the integrated waste management system until the Province releases draft regulations, which are currently anticipated to be released before the end of 2020. It is unknown if future regulations would allow for cost recovery for the capture of producer materials through mixed waste processing.

Ongoing monitoring of the City's waste profile through audits will allow Solid Waste Management Services to develop an understanding of the proposed feedstock for a mixed waste processing facility and adjust the design of the facility accordingly. To that end, staff will replicate the Study audits in 2020 to capture additional seasonal data on the City's garbage streams.

## **Next Steps**

Study results to date have demonstrated that the business case to proceed with a standalone mixed waste processing facility is not favorable. The facility would have minimal impact on extending the life of Green Lane landfill (less than one year). The capital and operating costs associated with the project are prohibitive considering the impact to overall future landfill space savings. Additionally there are regulatory and market risks with changes to product packaging as well as allowable uses of the separated organic fraction.

As outlined in the 2020 budget, Solid Waste Management Services will be advancing research on long term landfill capacity development including the use of thermal processing. In order to provide a comprehensive analysis of future landfill space needs, mixed waste processing should be reviewed in conjunction with a thermal treatment options study.

To generate additional data and account for seasonality, additional waste characterization audits will be undertaken that replicate the methodology of the Study. Additional audits will provide more understanding of waste stream compositions and further inform the development of a business case for a thermal treatment facility with or without mixed waste processing.

Solid Waste Management Services will also continue to monitor developments in relevant Federal and Provincial policy as they relate to mixed waste processing. Any updates or additional findings from these efforts will be taken into account within the thermal treatment options study.

## **CONTACT**

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## **SIGNATURE**

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## **ATTACHMENTS**

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Attachment 1: Technical Memorandum #1: Executive Summary: Waste Forecasting and Characterization