DILLON CONSULTING

CITY OF KAWARTHA LAKES

Future Waste Disposal Options Study

November 2021 – 20-3756

November 9, 2021

City of Kawartha Lakes
Department of Engineering & Corporate Assets
26 Francis Street, Lindsay ON
K9V 5R8

Attention: Tauhid Khan, CET Asset Management Coordinator

Final Report on Future Waste Disposal Options Study

Dear Tauhid:

Please find the Final Report of the Future Waste Disposal Options Study attached. The Final Report has incorporated feedback received by the City on the Preliminary Draft and Final Draft Reports and includes the preliminary preferred option and related implementation considerations along with the next steps.

Sincerely,

DILLON CONSULTING LIMITED

Betsy Varghese, P.Eng
Project Manager

Our file: 20-3756

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Appendices (provided in a supporting file)

Acronyms, Abbreviations, Definitions

A M R – Annual Monitoring Report

C & D – Construction and Demolition

C A Z – Contaminant Attenuation Zone

D & O – Design and Operations Report

Diversion Rate – Represents the percentage of waste diverted from disposal

E C A - Environmental Compliance Approval

H H W – Household Hazardous Waste

I C & I – Industrial, Commercial & Institutional

I P R – Individual Producer Responsibility

L Y W – Leaf and Yard Waste

M E C P – Ministry of the Environment, Conservation and Parks

M H S W – Municipal Hazardous or Special Waste

O & M – Operations and Maintenance

P P P – Paper Products and Packaging

R D F – Refuse-derived Fuel

R G – Rural General

R P R A – Resource Productivity and Recovery Authority

R R C E A – Resource Recovery and Circular Economy Act

R U P – Reasonable Use Policy

S S O – Source Separated Organics

W D T A – Waste Diversion Transition Act

W F O A – Waste-Free Ontario Act

W P C P – Water Pollution Control Plant

Executive Summary

The City of Kawartha Lakes (City) is facing limited disposal capacity within its five landfill sites which is similar to the Provincial disposal capacity that is also diminishing. The Future Waste Disposal Options Study (Study) was undertaken to review alternative options to manage residual waste once the City's capacity is exhausted. Currently, the City's five landfills have a range of three to 61 years of remaining capacity with the earliest forecasted closures in 2024 at the Laxton and Fenelon Landfill. The Lindsay Ops landfill, which receives almost 60% (2020) of the City's waste, is estimated to reach capacity by 2037 based on current disposal rates and approved capacity.

Dillon Consulting Limited (Dillon) was retained by the City in 2020 to conduct the Study, which included reviewing background and historical information about the City's landfill and waste management system, analyzing current and future residual waste quantities, assessing different alternative disposal technologies and landfill-related options and operational experiences, and evaluating disposal options and identifying implementation considerations for the preferred option.

It is estimated that the City will require an annual disposal capacity of between 44,000 and 67,000 tonnes, depending on the diversion rate achieved. The Council approved "Making Waste Matter: Integrated Waste Management Strategy" set a target of 70% diversion from disposal by 2048 and the City's current diversion rate is 43%. The current estimated waste disposal rate is 357 kg per household and it is recommended that the City start tracking this metric and set targets to reduce the quantity of waste disposed.

Several non-landfill related waste disposal technologies that handle residual waste and are employed in Ontario and worldwide were assessed as options for this Study. These alternative disposal technologies include: combustion, gasification, pyrolysis and mixed waste processing. Landfill-related options that were considered include: expansion, new greenfield site, landfill mining and/or reclamation, export and privatization of City facilities. These options were reviewed and analyzed in terms of process description, status (proven or unproven), target material and outputs, high level capital and operating costs, major advantages and disadvantages, operational experience, and applicability to the City. Interviews with neighboring municipalities, individuals and

companies were conducted to assess potential partnerships and similar interests in the identified options.

An evaluation assessment tool was developed to compare options. Each alternative technology and landfill-related option was evaluated by applying triple bottom line criteria considering the economic feasibility, social impacts and environmental impacts. Each criteria group included several indicators that were evaluated and scores were applied.

The results from the evaluation identified that the preferred option is expansion of a City-owned landfill site(s). This Study did not review site specific considerations as it relates to expansion potential and therefore, a preferred City landfill site is not identified. Reconfirming the waste projection forecasts with potential diversion goals (e.g., with the impact of an organics collection program should it be implemented) and the remaining site life of the landfills is recommended noting the City is currently reviewing the impacts of two City landfill sites reaching capacity within the next few years on the remaining three landfill sites. The City should complete a conceptual study of the City's landfill sites to estimate the potential capacity available, building on investigative work currently being completed by the City. These items will also contribute to the initial stages of an Individual Environmental Assessment (EA), which will be required for a landfill expansion. The EA will begin with the development of the Terms of Reference which provides a roadmap for how the EA will be conducted. It is recommended that the City initiate the EA process soon given how long the process can take.

The next steps are to inform City Council and engage and consult with key stakeholders and the general public on the Study findings.

1.0 Introduction

In September 2020, Dillon Consulting Limited (Dillon) was retained by the City of Kawartha Lakes (City) to review options for future waste disposal capacity once the City's landfills reach the approved capacity. The City is facing limited disposal capacity within its five disposal sites with the major site (Lindsay Ops) estimated to reach capacity by 2037. Given how long approvals and permitting for waste management facilities can take and the limited disposal capacity within Ontario, it is the appropriate time for the City to start reviewing and evaluating options to secure economically feasible future disposal capacity.

As part of the Future Waste Disposal Options Study, Dillon undertook the following nine tasks to provide the City with guidance on potential future waste options:

Task 1: Project Initiation and Virtual Site Visit of all Landfills

Task 2: Review of Background and Historical Information

Task 3: Confirm Future Residual Waste Management Quantities

Task 4: Review of Alternative Technologies and Operational Experiences

Task 5: Review of Landfill Related Options and Operational Experiences

Task 6: Confirmation of Potential Options and Evaluation Criteria

Task 7: Evaluation of Potential Disposal Options

Task 8: Identification of Preferred Option(s) and Implementation Considerations

Task 9: Reporting

The purpose of this report is to document the findings from Tasks 1 through 8.

1.1 Study Area

The Corporation of the City of Kawartha Lakes (City) is located in western portion of eastern Ontario and is bordered by Counties of Haliburton, Peterborough and Simcoe, District of Muskoka and Region of Durham. The City is a single-tier municipality and is responsible for municipal services which includes solid waste management. There is no

lower-tier government, such as a township, village or town, operating within the City. The City was established in 2001 when the former Victoria County merged with 16 lower-tier municipalities. The City's area covers 3,000 square kilometres and is a unique mix of urban and rural populations. **Figure 1** provides a map of the City and surrounding municipalities along with the locations, 2020 quantities of waste landfilled and remaining capacity (expressed in both cubic metres and years) of the City's five active landfill sites. The remaining capacity is based on current rates of waste landfilled.

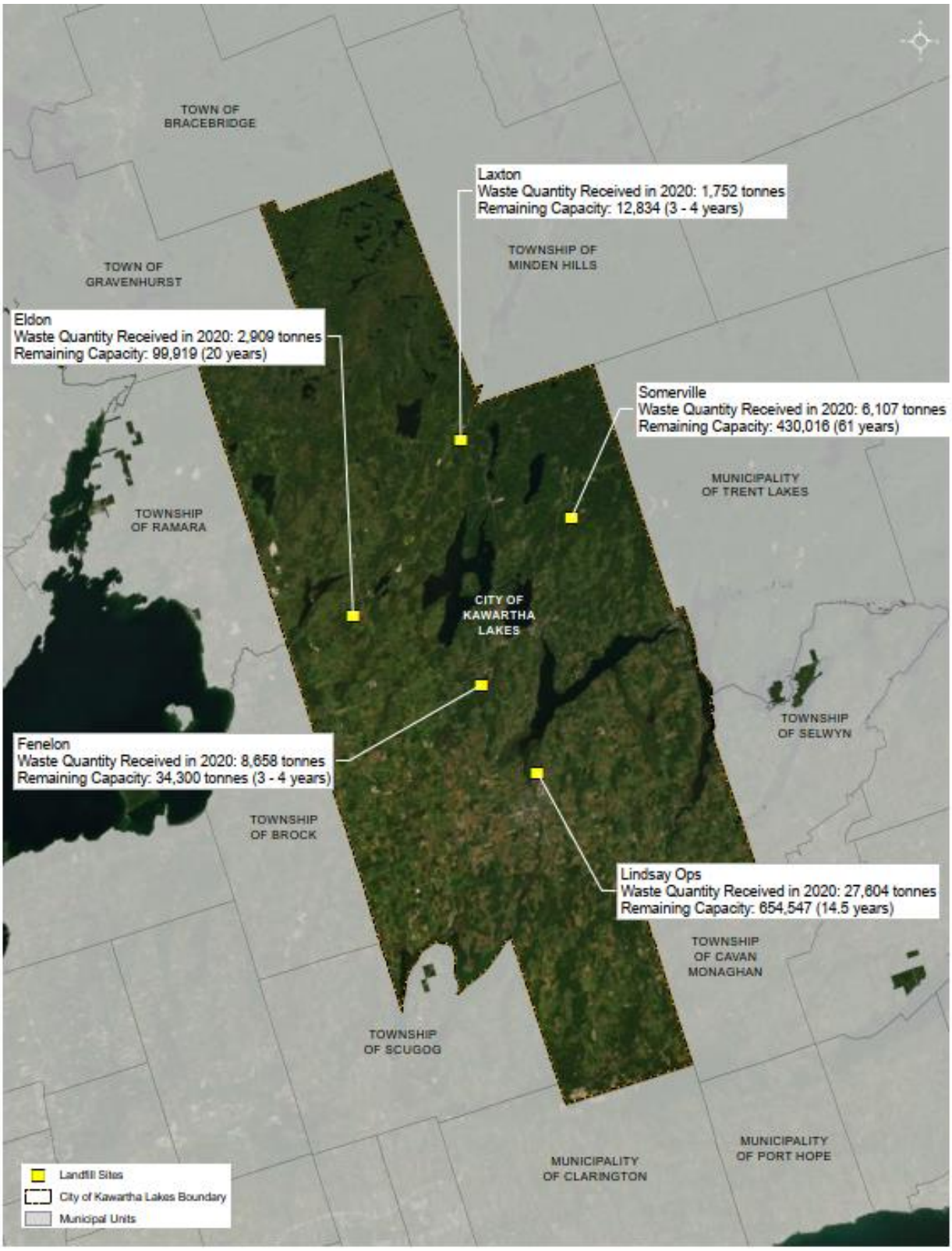


Figure 1: City Site Map

1.2 Population

From 2011 to 2016 the City's population grew by 2.9%, which is slightly lower than average population growth in Ontario and Canada (4.4% and 5.9%, respectively). The City is mostly rural, however, there is a large seasonal population during the summer months. During cottage season the City receives over 31,000 seasonal residents and in 2016, Statistics Canada reported that over 1.6 million tourists visited the City during summer months.

The City currently provides waste management diversion and disposal services to approximately 75,000 residents, and several businesses and institutional facilities. Based on the City's Growth Management Strategy, an approximate 1.2% annual population growth rate is expected.

1.3 Waste Disposal

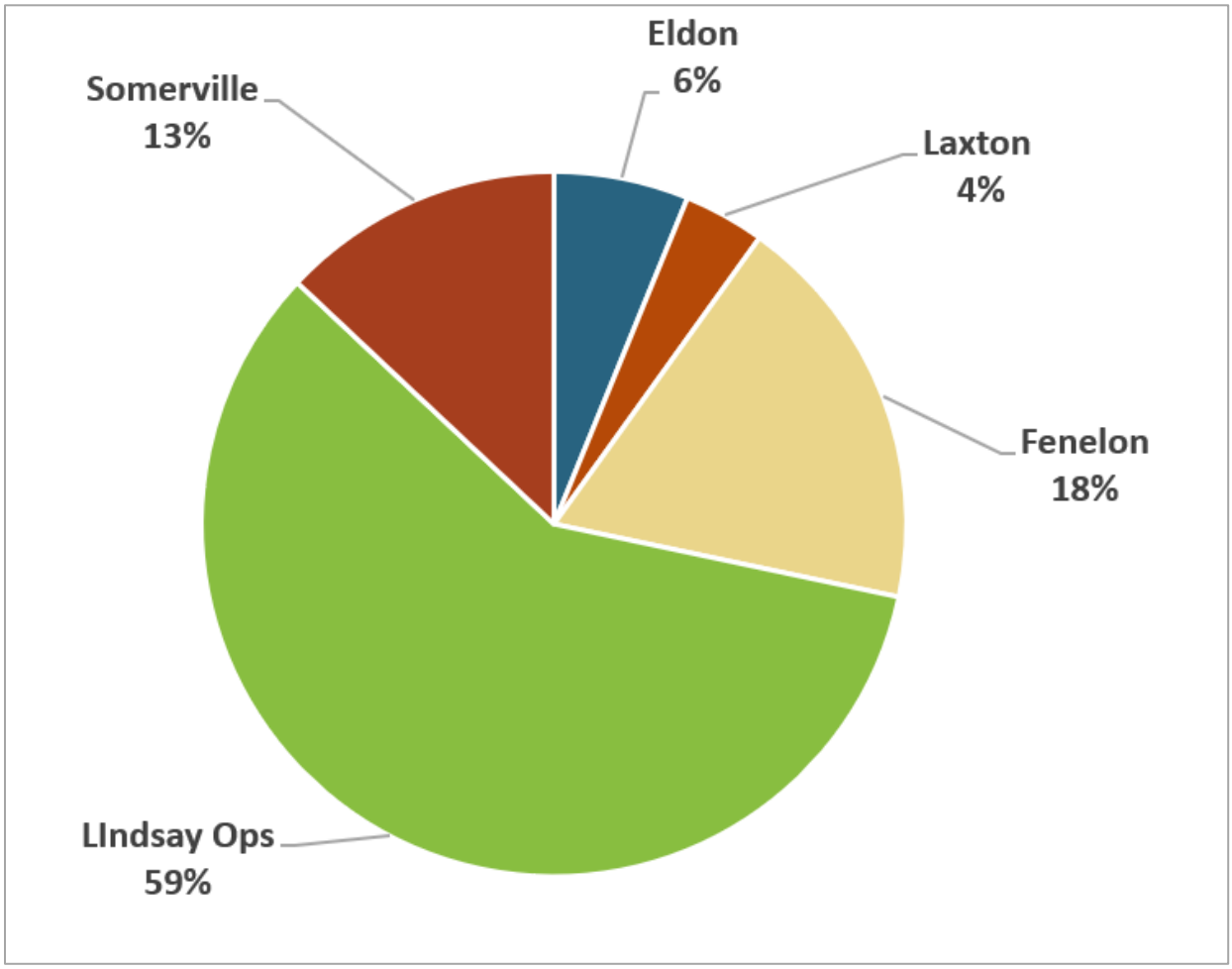
Five active landfill sites receive the waste that is generated within the City and each landfill site operates under Environmental Compliance Approvals (E C As) by the Ministry of the Environment, Conservation and Parks (M E C P). The five landfills are listed below, with the associated anticipated closure date.

- Lindsay Ops Landfill (forecasted closure date 2037);
- Somerville Landfill (forecasted closure date 2084);
- Eldon Landfill (forecasted closure date 2046);
- Fenelon Landfill (forecasted closure date 2024); and
- Laxton Landfill (forecasted closure date 2024).

In 2020, the City's landfill sites disposed of 47,030 tonnes. The Lindsay Ops landfill receives the majority of waste with nearly 60% of the City's waste being disposed of at that landfill, which equates to approximately 28,000 tonnes of waste annually, based on 2020 data. The City anticipates that the Lindsay Ops landfill will reach capacity in 2037 based on current disposal rates. However, the City expects the annual tonnes received at Lindsay Ops to increase once the Fenelon and Laxton landfill sites are closed which is anticipated in 2024. The City is currently reviewing potential increases to the capacity at both Fenelon and Laxton through additional height lifts. However for purposes of this report any additional capacity increases to these sites were not considered as they have yet to be approved. Based on current approvals and waste distribution projections the

additional waste will likely result in Lindsay Ops landfill site reaching capacity sooner than 2037. The City currently does not have an approved viable alternative for disposal of waste generated within the City once the Lindsay Ops landfill reaches capacity. **Figure 2** provides a breakdown of the waste delivered to each site based on 2020 data.

Figure 2: Waste Breakdown per Landfill (2020)



It is noted that the City is currently completing a separate study to assess the impact of tonnages and traffic when the two landfills close and waste is directed to the other City landfills. This assessment is expected to be completed later in 2021.

2.0 Background Review

As part of the Task 2 of the Study, Dillon completed background and historical reviews of the documentation and reports provided by the City. These documents are as follows:

- Applicable Provincial regulations and policies;
- Operations and Maintenance (O & M) Manual for Lindsay Ops;
- Design and Operations Report (D & O) for Fenelon;
- D & O Report for Laxton;
- D & O Report for Eldon;
- D & O Report for Somerville;
- 2019 Annual Monitoring Report (A M R) for Lindsay Ops;
- 2019 A M R for Fenelon;
- 2019 A M R for Laxton;
- 2019 A M R for Eldon;
- 2019 A M R for Somerville;
- 2015 Integrated Waste Management Strategy;
- 2015 Integrated Waste Management Strategy Supplementary Data;
- 2019 Integrated Waste Management Strategy Update;
- 2016-144 Consolidated By-law Regarding the Collection and Management of Waste and Recyclables;
- Original Hydrogeological Investigation and Design Lindsay Ops 1978;
- Application and Environmental Assessment 2000 Lindsay Ops Northern Expansion;
- Response to Ministry of the Environment (MOE) Comments Northern Expansion 2001;
- Landfill Waste Quantities 2012-2020;
- City of Kawartha Lakes Growth Management Strategy 2011;
- City of Kawartha Lakes Healthy Environment Plan;
- Kawartha Lakes Strategic Plan 2020 – 2023;
- Construction and Demolition Diversion Feasibility Study 2017;
- City of Kawartha Lake Curbside Collection Study Report 2017; and,
- Source Separated Organics Study 2011.

Upon the initial background review, Dillon provided a technical memorandum to the City, which provided a summary of the data gaps that were identified and necessary to

complete the overall assessment. However, no major gaps that would require further investigative assessments (i.e., laboratory testing, geotechnical investigations) were identified. The City provided clarification on the data gaps, which were used as reference during the completion of this task.

The details of the background review are below and have been divided based on the City's previous waste management initiatives and site specific information for each of the landfill sites.

2.1 Provincial Policies

There is a lot of change happening in Ontario when it comes to the management of municipal solid waste including diverting more food and organic waste from disposal and fully transitioning responsibility of the Blue Box program to producers. It is also noted that the federal government is intending to ban certain single-use items (e.g., straws, plastic shopping bags) and if implemented, this could see a further reduction of materials being sent for disposal.

The following section details some of the relevant Provincial government policies and legislation that can impact how solid waste is managed within the City. **Figure 3** provides an overview of the changes made and coming.

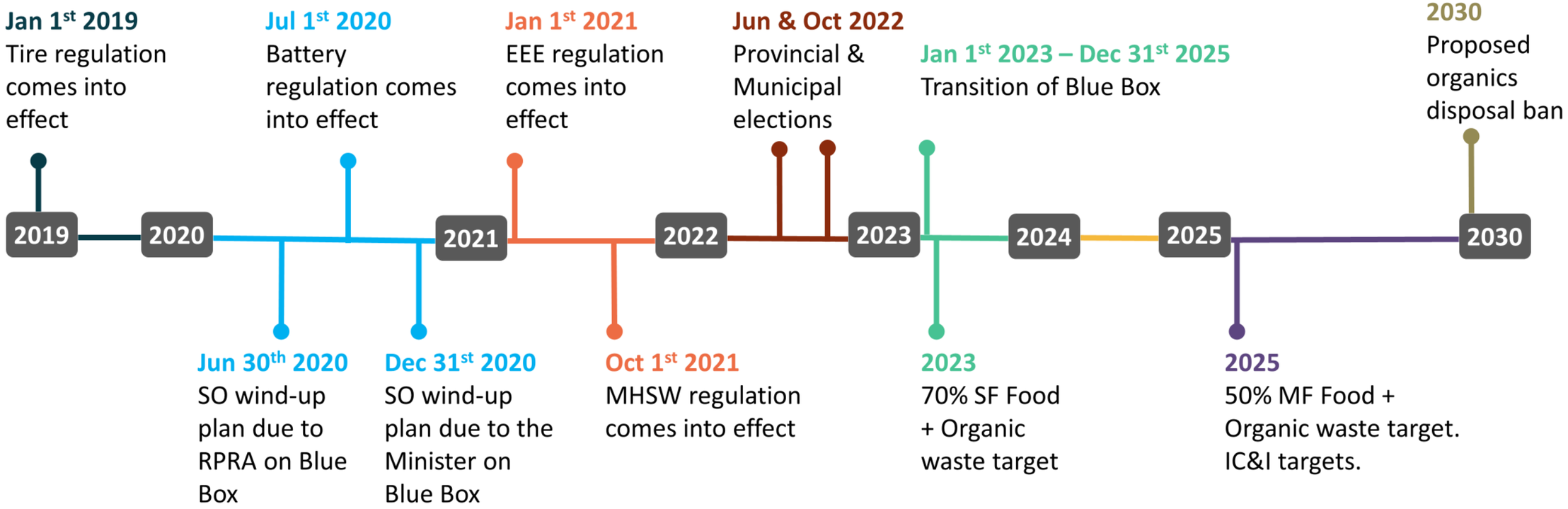


Figure 3: Timeline of Provincial Regulation Changes

2.1.1 Food and Organic Waste Policy Statement

Ontario's Food and Organic Waste Policy Statement, approved by the Ontario Cabinet in 2018, sets a policy direction for the Province for food and organic waste. It is a legal document providing direction to public and private parties on "waste reduction and resource recovery through preventing and reducing food waste, effectively and efficiently collecting and processing food and organic waste, and reintegrating recovered resources back into the economy." It states that certain sectors must ensure that they act in a manner that is consistent with the policy statement when engaging in actions related to resource recovery and waste reduction. The Policy must be cross-referenced and considered alongside other existing policies, e.g., Environmental Protection Act, Planning Act; Environmental Assessment Act, Water Resources Act, etc.

The Statement references the Ontario Food Recovery Hierarchy, which provides the following priorities in order of importance:

- Reduce: prevent or reduce food and organic waste at the source.
- Feed People: safely rescue and redirect surplus food before it becomes waste.
- Recover Resources: recover food and organic waste to develop end products for beneficial reuse.

Resource recovery means the extraction of useful materials or other resources from things that might otherwise be waste, including reuse, recycling, reintegration, regeneration or other activities. This includes the collection, handling, and processing of food and organic waste for beneficial uses. Beneficial use means the use of recovered food and organic waste to recover nutrients, organic matter, or moisture to improve soil fertility, soil structure, or to help build soils where they do not exist.

Section 4 of the Policy Statement has policy directions and targets for single-family and multi-residential sectors based on the local municipality population and population density and for industrial, commercial and institutional sectors based on food and organic waste generation quantities. Section 4.2ii states that municipalities in southern Ontario that currently do not provide a curbside organics collection program will be required to provide one to single-family dwellings within urban settlement areas if the local municipality has a population greater than 50,000 and a population density less than 300 persons per square kilometre. The City does not currently have a curbside organics collection program and given its population (approximately 71,000) and

population density (approximately 25 people per square kilometre), the City will be required to collect from single-family dwellings in urban settlements. The Policy Statement includes targets (Section 2.1) and the City will be required to achieve 50% waste reduction and resource recovery of food and organic waste by 2025.

The City is undertaking a separate study on the implementation of a curbside organics collection program which is anticipated to be completed in late 2021.

2.1.2 Waste-Free Ontario Act (W F O A)

On June 1, 2016, the Ontario Legislature passed Bill 151, the W F O A, 2016. W F O A comprises the Resource Recovery and Circular Economy Act (R R C E A) and the Waste Diversion Transition Act (W D T A). The W D T A prescribed how the existing waste diversion programs would continue to operate until their wind-up, and laid out the framework for wind-up. After wind-up, the diversion systems continue to operate under the R R C E A. Under the R R C E A, outcome based regulations hold individual producers fully responsible for collection and management of the products and packaging they put onto the **Ontario** market. The R R C E A aims at further promoting resource recovery and reduction of waste to landfill. While application of the R R C E A is not limited to materials that were covered by the existing waste diversion programs, these are the first material categories to have regulations developed under this act.

On October 19, 2020 the M E C P announced its proposed producer responsibility regulation for the new Blue Box system in Ontario. The proposed regulation makes producers responsible for providing collection services to local communities, managing a standard list of blue box materials, meeting diversion targets, tackle plastic waste and protecting the environment. The Ministry finalized the regulation in June 2021 and as per the Transition Schedule, the City of Kawartha Lakes will transition by April 1, 2024. The composition of waste the City manages, including what remains in the residual waste stream, could change as a result of the transition of the Blue Box program from municipalities to producers.

2.2 Integrated Waste Management Strategy

In 2015 Council approved the waste management strategy update titled “Making Waste Matter: Integrated Waste Management Strategy”, which is a guide to delivery of recycling and waste management services to the City for the next 30 years. The

overarching target of the Strategy is a waste diversion rate of 70% by 2048 through several initiatives/programs to reduce the amount of waste generated and divert as much waste as possible. The Strategy highlighted where waste management within the City was at that time and provided short and long term initiatives for waste management into the future up until 2048. The Strategy also noted that it was important to review, update and expand the document on a regular basis due to the frequent changes in waste management practices, legislations and quantities. The following summarizes initiatives based on short term and long term (launch beyond 2019).

2.2.1 Summary of 2015 Waste Management Strategy Initiatives

2.2.1.1 Reduce

Short Term

- Clear bag waste collection (launch 2016);
- Alternative daily cover for Fenelon and Somerville Landfill Sites (launch 2016 to 2017);
- Tipping fee increase (launch 2017);
- Backyard digester/ composter program (launch 2017);
- Lowering of the curbside waste bag limit (launch 2018/2019); and
- Bi-weekly curbside waste collection (launch 2018/2019).

Long Term

- Centralized landfill facilities; and
- Alternative daily cover at landfills (Eldon).

2.2.1.2 Reuse

Short Term

- Local business partnership (launch 2016).

Long Term

- Searchable online waste material database; and
- Landfill construction reuse program.

2.2.1.3 Recycle

Short Term

- Construction waste recycle program (launch 2018).

Long Term

- Weekly blue/green box collection;
- Mattress recycling program; and,
- Increased commercial curbside recycling cap.

2.2.1.4 Innovative

Short Term

- Alternative fuel collection vehicles (launch 2018 to 2019).

Long Term

- Packaging redesign committees.

2.2.2 Summary of 2019 Update Initiatives

The City recently updated their Integrated Waste Management Strategy for 2020 to 2024 to continue to find ways to meet the waste diversion target of 70%, noting the current diversion rate was approximately 43%. The update to the Strategy reviewed and discussed the strategies that were previously identified and proposed new opportunities to continue to improve the City's waste management structure. The following provides a summary of the waste management related opportunities that were included in the Strategy Update for implementation between 2020 and 2024.

2.2.2.1 Updated Initiatives

Reduce

- Increased focus of public education (launch 2020).
- Improved backyard composting program (launch 2021):
  - In 2021, the City initiated a backyard composter free giveaway to provide incentive for residents to backyard compost;
  - From June to August 2021, 400 composters were given to residents; and
  - Increased promotion and education on benefits of backyard composting to reduce food waste.

- Decreased the amount of recycling allowed in waste (launch 2020 to 2021):
    - In 2017, the City initiated the clear bag program, which permitted residents to up to 20% of recyclable material within each clear bag of waste. In order to increase diversion further and promote recycling, the permissible limit of recycling in each bag will be reduced to 10% in 2020 to 2021. The City also moved to a 2 bag weekly program to reduce the amount of waste being sent for landfill disposal.
    - The City saw a 20% reduction in the amount of garbage collected curbside.
- Review source separated organics (S S O) program options (launch 2021):
    - The desire for a S S O program was a common theme in the Strategy Update public consultation process;
    - The City is currently completing a study on S S O options which will go to Council in November 2021. Options considered are curbside, depot, and/or backyard composting collection options as well as various processing options; and,
    - The City is also reviewing efficiencies to implement S S O at the same time as the blue box transition.
- Continually improve curbside collection (launch 2024); and,
- Corporate waste reduction initiatives (launch 2021 to 2023).

Reuse

- Textile diversion program (launch 2021).

Recycle

- Expand mattress recycling program (launch 2020);
- Successfully diverted more than 10,000 mattresses in 3 years; and,
- Mattress ban at all landfills (launch 2022).
- Improve public space recycling (launch 2020);
- Bulky plastics recycling (launch 2022); and,
- Virtual tag service for mattresses and other bulky waste (launch 2021).

Innovative

- Explore options for the Fenelon and Laxton Landfills after the end of site life (launch 2020). Options include feasibility of transfer stations and potential capacity increases.

2.3 Waste Management System Overview

The following sections provides an overview of the City's waste management system in terms of collection, drop-off facilities, disposal facilities and promotion and education initiatives.

Collection

The City provides the following collection programs:

- 2-Bag Weekly Waste Limit Clear Bags;
- Unlimited Residential Weekly Recycling;
- Public Space Recycling;
- Large Item, Mattress & Freon;
- Curbside Batteries; and
- Event Days.

The City collects approximately 5% of I C & I waste generated within the City. For the I C & I sources collected they are typically commercial customers in Business Improvement Areas (BIAs) as well as group homes, some retirement homes, and other local businesses. It is noted that the City does not collect from institutions and places of worship.

Depot and Drop-off

The City has 5 depot / drop-off facilities which accept the following materials:

- Electronics;
- Scrap Metal;
- Mattresses;
- Boat Wrap;
- Household Hazardous Waste (only accepted at two facilities);
- Leaf & Yard; and
- Blue & Green Box Recycling.

Accepted at particular sites:

- Reuse Centre (Fenelon);
- Habitat for Humanity Reuse Bin (Lindsay Ops); and
- Paint Reuse (Fenelon and Lindsay Ops).

Disposal

The City operates five open landfills and has 11 closed landfill sites. For more information, see Section 2.5 for a full review of landfill sites.

Promotion and Education

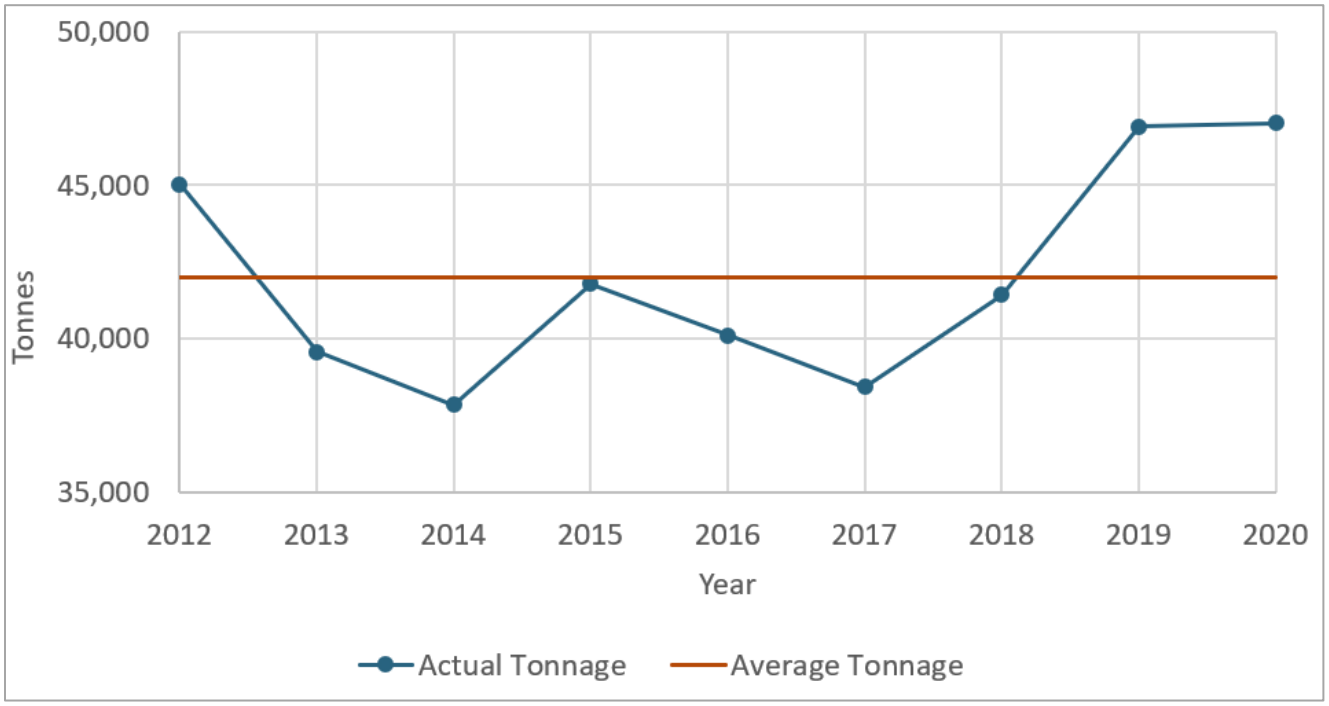
The City uses the following approaches to promote and educate its customers about waste management:

- Social Media (Facebook, Twitter)
- Recycle Coach App
- City website
- Earth and Waste Reduction Week activities
- Roadside Signage
- Waste Management Calendar

2.4 Waste Quantities and Characterization

The City landfills 42,000 tonnes of residual waste annually, with a year over year average increase of 3%. **Figure 4** provides quantities of the waste landfilled from 2012 to 2020.

Figure 4: Quantities of Waste Landfilled between 2012 and 2020



It is noted that annual tonnages landfilled have fluctuated since 2012, however, in 2019, there was an increase in waste that was disposed which was maintained for 2020 as well. Seasonality trends were also identified based on a review of 2017 to 2020 data for all the landfills. **Figure 5** provides monthly quantities of waste landfilled from 2017 to 2020. The data shows seasonal trends of lower quantities of waste landfilled in winter months and higher amounts from May through October. This is likely due to the increase in population from people visiting their cottages during the summer months.

Figure 5: Tonnage Seasonality Trends (2017 to 2020)

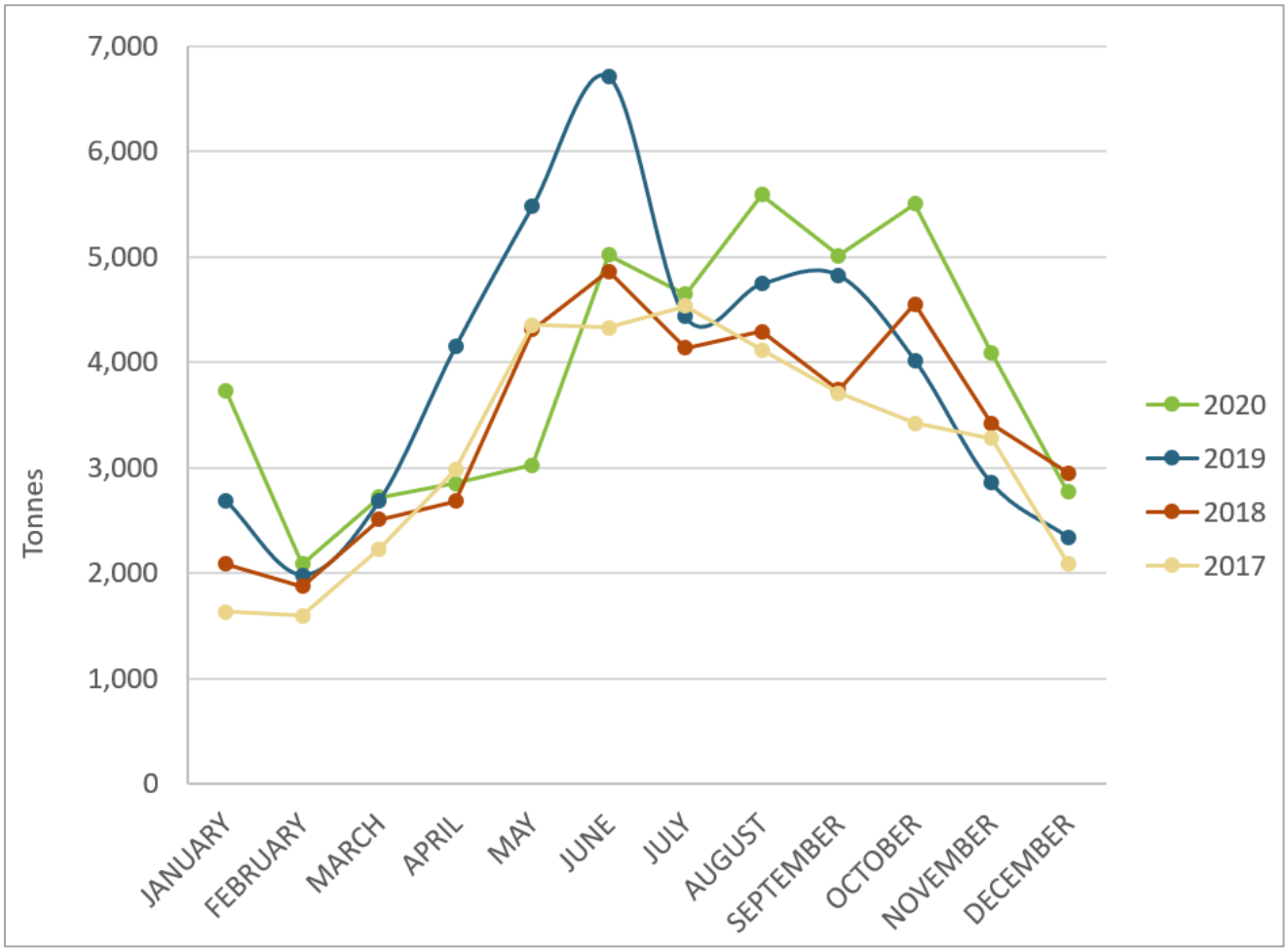
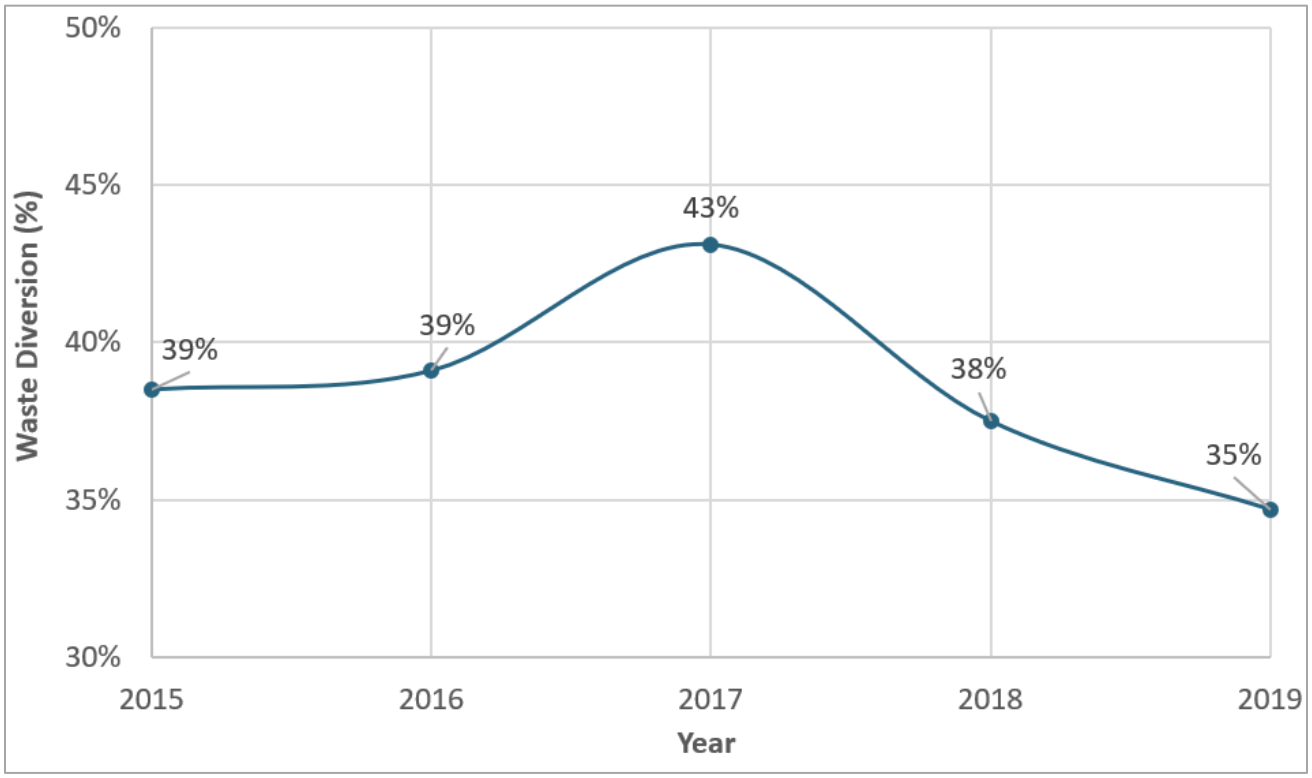


Figure 6 provides the City's annual waste diversion rate since 2015 and are based on the Resource Productivity & Resource Authority (R P R A) data call. The City has implemented several waste management programs in an effort to increase diversion of waste from disposal. The City's waste diversion rate has fluctuated since 2015 with the highest diversion rate being 43% in 2017.

Figure 6: Diversion Rates (2015 to 2019)



Diversion is a weight-based metric and measures the amount of waste diverted from disposal over the total quantity of waste managed by the City. The reported waste diversion rate does not account for any source reduction initiatives that are happening at the consumer/household level like waste avoidance, reduction and reuse. The weight of waste, particularly in the Blue Box, has been declining for several years (e.g., bottles switching from glass to plastic, packaging switching from containers to bags, reduced newspapers) and many other municipalities are reconsidering the metrics used to gauge performance in waste diversion programs. One such metric is measuring the amount of waste disposed by person (or capita) or by household as this would capture source reduction initiatives and be a constant data point that the City would have access to. The City currently collects residential waste from approximately 36,400 households that generate on average 13,000 tonnes of garbage that is landfilled each year. Therefore, the current estimated waste disposal rate is 357 kg per household.

2.5 Review of Landfill Sites

As noted, the City has five active sites to manage the waste generated within the City. The following sections provide a detailed review of each site, including site background, environmental information related to surface waste, groundwater and leachate and landfilling operations.

2.5.1 Lindsay Ops Landfill

2.5.1.1 Site Background

The Lindsay Ops Landfill is located on Part of Lots 25, 26, and 27, Concession 6 and began receiving waste in 1980. The site services the City and is licensed to accept solid non-hazardous municipal waste (as defined in O.Reg. 347/90) including the following wastes:

- Wastes generated by the residential sector;
- Industrial, commercial and institutional (I C & I) sectors;
- Contaminated fill; and,
- Biosolids (processed organic waste) restricted to treated and dewatered sewage sludge from the Lindsay Water Pollution Control Plant (W P C P).

The Lindsay Ops Landfill operates under Environmental Compliance Approval (E C A) No. A321504 originally issued on December 14, 2001. Following the issuance of the E C A, the M E C P has issued six amendment notices dated March 8, 2013, October 5, 2015, May 26, 2016, March 27, 2017, July 11, 2017 and April 19, 2018. On January 8, 2021, the M E C P issued an Amended E C A that consolidated previous notices into an updated E C A. The Landfill is operated by municipal staff.

The City applied for an expansion of the landfill located immediately north of the original southern disposal area and the M E C P granted approval on December 14, 2001. In 2002, construction began in the north expansion area and started receiving waste in Cell 1 in late 2002.

There are other waste management components at the Lindsay Ops Landfill, which include a leaf and yard compost pad, Household Hazardous Waste (H H W) depot and curbside recycling transfer facility.

The final contours in the Old Landfill area were reached in 2004. The City also added soil materials to this area from the excavation of Cell 2 of the expansion area in 2004 for pre-loading of the north slope of the Old Landfill. Following a two-year period after closure to allow for settlement, the City initiated placement of the final cover and the geosynthetic cap on the Old Landfill in 2006. Application of the liner and final capping was started on the east side of the Old Landfill in 2006 and was completed in October 2007. Seeding for vegetation of the entire Old Landfill was completed in 2008.

Disposal occurred in the northwest section in 2019, and in the northeast section in 2020 of Cells 4 and 5. Final cover, including topsoil and seed, was placed on the north and south sections of Cell 2 as well as the sections of Cells 3 and 6 in 2018. Material excavated as part of the construction of Cells 4 and 5 were used as final cover. Interim cover was placed in the southeast sections of Cells 3 and 6.

2.5.1.2 Surrounding Land Use

The Lindsay Ops Landfill is surrounded by various properties, all zoned and designated differently. The following provides a summary of the surrounding land uses at the site:

- The Lindsay W P C P is located west of the Landfill.
- The Sturgeon Lake Wetland and the Scugog River are located west of the Lindsay W P C P and Lindsay Ops Landfill.
- The City owns the land to the north of the Lindsay Ops Landfill.
- The adjacent land south of Lagoon Road is owned by the City and identified as a contaminant attenuation zone (C A Z).
- The City owns all of the properties to the east side of Wilson Road with the exception of one at the northeast corner of Wilson Road and Highway 36.

2.5.1.3 Waste Volumes and Site Capacity

The Lindsay Ops Landfill consists of two parts, known as the original southern disposal area that began operation in 1980 and the northerly expansion area that was approved in December 2001.

The total approved waste disposal capacity for the north expansion fill area including waste, daily cover and interim cover is 1,487,240 cubic meters. Based on the volume of waste (including daily cover) disposed in 2020 (i.e., ~27,604 cubic meters of airspace used in 2020), the remaining capacity is 654,547 m3 and site life is approximately 14.5

years as of December 31, 2020. Based on the estimated remaining capacity, approximately 44% of the total approved capacity of the north expansion area has been used to the end of 2020.

2.5.1.4 Environmental (Groundwater Quality)

For environmental monitoring, chloride, ammonia, phenols, phosphorus and toluene have been defined as the leachate indicator parameters for the Lindsay Ops Landfill as the historical leachate samples have demonstrated higher concentrations of these parameters. Alkalinity, calcium, dissolved organic carbon (DOC), iron, sulphate, total Kjeldahl nitrogen (TNK), barium, boron, electrical conductivity and total dissolved solids (TDS) were added to the indicator parameter list over time. The Lindsay Ops Landfill currently has a monitoring groundwater network of 53 wells.

The historical interpretation of the groundwater results based in the Reasonable Use Guidelines (RUG) are summarized at a high level below:

- The property boundary to the south of the Lindsay Ops Landfill is outside the potential pathway of leachate migration from the landfill and therefore is not expected to be impacted by the landfill. This is supported by the absence of any significant leachate impacts at the furthest south monitoring wells for both overburden and bedrock depths.
- The property boundary to the north of the landfill is also outside of the potential pathway of leachate migration from the landfill and therefore is not expected to be impacted by the landfill. However, the upper bedrock well 53-98 has indicated an overall increasing trend in chloride concentration since approximately 2003, reaching 480 mg/L in 2019. It is noted that the increasing trend in chloride concentration likely reflects impacts from salt application over the asphalt surface surrounding the landfill administration building.
- The property boundary to the east is at a distance of approximately 130 m from the edge of the landfill and is up gradient of the landfill relative to the direction of groundwater flow. This boundary is therefore not expected to be impacted by landfill leachate. Parameters that are naturally at concentrations above the Ontario Drinking Water Quality Standards (ODWQS) at the east boundary monitoring wells include iron, hardness and manganese.

- The RUG does not apply to the west property boundary as it is owned by the City up to the Scugog River, which is deemed the sensitive receptor. Therefore RUG, based on groundwater at the property boundary, do not apply. There is no drinking water usage of the groundwater along the groundwater flow path downgradient of this boundary.

2.5.1.5 Environmental (Surface Water Quality)

Surface water quality at the Lindsay Ops Landfill is monitored at various locations along the drainage ditch system bordering the site and at the compost facility located on-site. In addition, surface water quality is also monitored along the Scugog River, which is located downgradient of both the landfill and W P C P.

Stations along the Scugog River are monitored four times per year following rainfall events. Stations located along the drainage ditches (nine locations) are also sampled four times per year following rainfall events. Based on historical data, the parameter concentrations between the upstream and the downstream are generally similar. As such, the Lindsay Ops Landfill demonstrates no significant influence on the surface water system.

2.5.1.6 Environmental (Landfill Gas)

The E C A for the Lindsay Ops Landfill requires that landfill gas monitoring occur monthly during frozen ground conditions and quarterly thereafter at eight monitoring probes within the original southern disposal area and at ten shallow monitoring probes that were installed to the depth of the groundwater table in January 2002.

The following provides a high-level summary of the methane results in the past at particular wells:

- Methane is often detected in leachate monitoring wells 6-90-II, 7-90 and 7-90-II at concentrations greater than 100% Lower Explosive Limit (LEL). This is expected as these monitoring wells are screened in the waste.
- Methane is also measured at concentrations greater than 100% LEL in monitoring well 16-91-II.
- Monitoring well nest 16-91 is located immediately adjacent to the northwest corner of the old landfill area and concentrations greater than 100% LEL have been noted in previous years.

- GP 1 to GP 10 have historically indicated non-detectable methane concentrations.

2.5.2 Somerville Landfill

2.5.2.1 Site Background

The Somerville Landfill is located at 381 Ledge Hill Road within the City. In 1972, landfilling began at the 61.6 hectare site and continues, with a landfilling area of 13 hectares. The site also has a 50 m by 90 m composting area, and includes buffer lands and a contaminant attenuation zone.

The Site operates under E C A #A321604, which was most recently amended on August 1, 2019. It is noted that Condition 15 of the E C A specifies the service area for the Somerville Landfill as the City of Kawartha Lakes.

The Somerville Landfill includes the following waste management areas:

- Historical waste areas, referred to as "Area 1" and "Area 3." Area 1 reportedly received approximately 60,000 cubic metres of household waste prior to being closed and covered with a clay cap in the spring of 2002. Area 3 received approximately 13,000 cubic metres of construction and demolition waste.
- The compost area is currently located over a portion of Area 3, which is limited to leaf and yard waste, tree trunks, stumps, branches, and leaves and brush.
- The active landfill area is referred to as "Area 2." Area 2 has been receiving waste since 2002, with waste types including residential, commercial, and construction and demolition.
- The waste fill areas are located within a drumlin which trends south-west to north-east through the Site. The Somerville Landfill relies on natural attenuation to manage landfill leachate and gas produced by the waste.
- On October 13, 2015 the City approved its long-term Waste Management Strategy. Within this strategy document, the Somerville Landfill was identified as a facility with sufficient long term disposal capacity to eventually accept waste from other City landfill sites reaching the end of their service lives.

2.5.2.2 Surrounding Land Use

The adjacent land is zoned as Rural General (R G), and deemed agricultural under the Township of Somerville Zoning By-Law 78-45.

2.5.2.3 Waste Volumes and Site Capacity

The total approved disposal capacity of the site is 598,000 cubic metres including waste, and daily, intermediate, and final cover soils. The remaining capacity at the end of 2020 was 430,016 cubic metres, indicating a site life of 61 years remaining.

Landfilling in Area 1 was completed after 2000 when the City began landfilling in Area 2. Area 1 was closed with a clay cap and vegetated in 2002. Area 1 will be blended into Area 2 when landfilling occurs in that vicinity again. It is noted that the cover material may be removed from Area 1 in areas to be blended, however, the landfilled waste is not to be disturbed.

As of the 2016 topographic survey, and based on the final contours presented in the 2016 Design and Operations Report, there remains 393,300 cubic metres of capacity in Area 2 (428,100 cubic metres total volume less 34,800 cubic metres of final cover volume). Landfilling has taken place in Cells 2A and 2, with eight future cells planned (Cells 2C to 2J). Based on an annual filling rate of 7,000 cubic metres per year, the estimated remaining lifespan of Area 2 is more than 50 years.

A capacity calculation for Area 3 was not undertaken as part of the Design and Operations Report, as Area 3 is only permitted to receive construction and demolition (C & D) material. A portion of Area 3 has been converted into a compost pad for receiving leaf and yard waste. The City intends to continue with compost operations in the foreseeable future but should that change, the compost pad could be abandoned to fully develop Area 3 for landfilling of C & D wastes.

2.5.2.4 Environmental (Groundwater Quality)

Groundwater samples are collected semi-annually in the spring and fall from a network of 20 monitoring wells. The monitoring wells are completed within the waste, the shallow overburden, the deep overburden and the bedrock.

Exceedances with respect to the Reasonable Use Policy (R U P) B-7-1 have historically been recorded at the Site, with a number of elevated concentrations along the northeastern property boundary. However, results indicate that migration of leachate impacts within the bedrock to the northeast is limited to within the road alignment. Further, the shallow overburden aquifer has not been found to be present beyond the City road alignment. Given these conditions, it has been determined that the Site meets

R U P with respect to both overburden and bedrock quality at the northeastern property boundary.

It is noted that future filling at the Site will continue in the southern section of Area 2. It is anticipated that this will shift leachate conditions over the next few years, with potential decreases in leachate mounding, lowering the horizontal gradients in the area.

2.5.2.5 Environmental (Surface Water Quality)

Surface water samples are collected three times per year (spring/summer/fall) at three monitoring locations. These monitoring points are used to assess whether there are any impacts to the wetland area and associated pond immediately north of the landfill limit of waste.

Surface water quality results do not indicate any leachate influence, suggesting that the site is providing adequate attenuation of leachate within the property boundary.

2.5.2.6 Environmental (Landfill Gas)

Landfill gas monitoring results indicate that gas is present within/adjacent to the active and historic waste areas, although only trace detections (<0.3% volume) were observed in the distant locations, and these were not likely attributable to the landfill.

Previous monitoring studies have recommended that the gas monitoring program continue with the existing monitoring well network to refine the understanding of gas concentrations at the Somerville Landfill. However, since there are no surrounding developments within 750 metres of the site that would represent a sensitive receptor for landfill gas, no additional monitors have been recommended.

2.5.3 Eldon Landfill

2.5.3.1 Site Background

The Eldon Landfill is located at 311 Rockview Road within the City. The site was originally operated as a sand borrow pit and is approximately 142.5 hectares in area. The facility began operation around 1980 as a natural attenuation landfill, with no engineered liner beneath the waste and no leachate collection system (Phases I and II of the landfill).

In late 2019, Phases I and II had reached capacity and active landfilling shifted to a newly designed Phase III. Phase III incorporates a liner and leachate collection system to provide additional protection against groundwater and surface water impacts. It is noted that Phases I and II represent a total approved waste footprint of 3.7 hectares, while Phase III has an approved waste footprint of 5 hectares. It is noted that as part of the development of Phase III of the landfill, the City relocated the scale house, site attendant shelter and other facilities such as the compost pad and recycling bins to the northeast corner of the site off of Rockview Road.

All leachate collected from Phase III is pumped and hauled to the Lindsay W P C P.

The site operates under E C A No. A321004, issued on February 21, 1980 and last amended on June 13, 2016. Under the E C A, the site is approved to receive solid, non-hazardous municipal wastes as defined by O.Reg 347, which include domestic, commercial/institutional and C & D waste. The site is also approved for the composting of leaf, yard waste, tree trunks, stumps, branches, leaves and brush.

2.5.3.2 Surrounding Land Use

The current boundary of the Eldon Landfill (142.5 hectares) reflects the original 19.2 hectare site area as well as an additional 123.3 hectare C A Z encompassing lands to the west, south, and southwest. These lands have been acquired for compliance with the R U P as they represent the downgradient area for the landfill.

The Eldon Landfill is zoned M4 (Disposal Industrial and E P - Environmental Protection), with the land uses bordering the site being:

- Privately owned rural lands adjacent to the northern and southern boundaries
- Provincially significant Butternut Creek Wetland adjacent to the western boundary
- Rockview Road and privately owned rural lands adjacent to the eastern boundary

The nearest residences are located approximately 740, 760 and 790 metres to the north, south and east of the waste fill area, respectively.

The surrounding rural lands are generally passive green space and are observed to have dense vegetation. There are no cemeteries, airports or municipal supply wells that would be impacted by the continued operation of the site. The surrounding lands are zones Agricultural (A1) under the Township of Eldon Zoning By-Law 94-14.

2.5.3.3 Waste Volumes and Site Capacity

Phases I and II of the landfill reached capacity in October 2019. The remaining capacity is Stage 1 (Phase III) and is estimated at 99,919 cubic metres, indicating a site life of 20 years remaining.

2.5.3.4 Environmental (Groundwater Quality)

The Eldon Landfill has a monitoring groundwater network of 42 wells. Interpretation of monitoring data at the site has proved challenging, as several leachate indicator parameters are also associated with the naturally occurring reduced conditions in the downgradient wetland.

Exceedances have been recorded with respect to the R U P B-7-1, with a number of elevated concentrations to the north, south, and west; however, the majority of these were more related to the anoxic wetland conditions in which a number of the compliance monitoring wells are located. It is reported that the large C A Z located to the northwest, west and south is more than adequate to attenuate any elevated landfill related parameters.

As of 2020, there has been a location proposed by the City to place boundary wells on the most recently acquired C A Z lands southwest of the Site. The attenuation distance to the south and western groundwater flow path would limit the ability for non-compliance issues at the southern boundary of the C A Z. However, the City has not received confirmation from the M E C P as to whether the proposed location of the boundary wells are approved to be installed at the site.

2.5.3.5 Environmental (Surface Water Quality)

The environmental monitoring program incorporates five surface water stations monitored bi-annually in the spring and the fall. Monitoring is undertaken to assess potential leachate influence in the area downgradient to the west of the waste mound within the Butternut Creek Wetland Complex. Monitoring results have consistently indicated no leachate influence on downstream surface water quality, suggesting that the site is providing adequate attenuation of leachate within the property boundary.

2.5.3.6 Environmental (Landfill Gas)

On-site buildings/structures (i.e., scale house and equipment shelter) are within the potential zone of landfill gas migration and as such, they are constructed as ventilated above grade structures to minimize the accumulation of landfill gas. City staff measure landfill gas levels in the on-site buildings each day during their shift (as requested by the M E C P). To date, no detections in the buildings have occurred.

Historically, no landfill gas monitoring has been undertaken at the site, with the exception of a short term monitoring program requested by the M E C P which included landfill gas measurements within the monitoring well network in 2014, 2015 and 2016. The results indicated negligible values at all wells beyond the waste area and the requirement was subsequently omitted from the June 2016 amended E C A as a monitoring requirement.

2.5.4 Fenelon Landfill

2.5.4.1 Site Background

The Fenelon Landfill is located at 341 Mark Road in the City, approximately 9 km southwest of the Village of Fenelon Falls. In 1972, landfilling commenced at the site for disposal of domestic, commercial and industrial wastes from the Township of Fenelon and the Village of Fenelon Falls. The site was originally owned and operated by the Township of Fenelon. In 1992, the County of Victoria (now the City of Kawartha Lakes) assumed management of the site.

The site operates under E C A No. A321206 issued October 28, 2003 and last amended January, 2019. The E C A allows for the use and operation of a 21.3 hectare site which includes a waste disposal area, a H H W Depot, a collection and transfer facility, a Reuse Centre, and an outdoor leaf and yard waste composting facility.

The E C A also includes a 102.6 C A Z south and east of the landfill. The waste fill area is referred to as Phases 1 (6.1 hectares) and 2 (1.9 hectares) and is approved for the disposal of solid non-hazardous municipal waste (as defined in O.Reg. 347/90) generated within the boundaries of the City.

The site is approved and operates as a natural attenuation facility, with no engineered liner or leachate collection system. Natural attenuation occurs within the C A Z lands located south and east of the waste fill area.

2.5.4.2 Surrounding Land Use

A provincially significant wetland (Martin Creek Wetland) surrounds the site, except for the north-east boundary which is adjoined by privately owned agricultural land and a sand and gravel pit. It is noted that the nearest residences are located on Mark Road approximately 700 m south and 450 m north of the waste fill area. The surrounding areas are zoned Extractive Industrial (M3) under the Township of Fenelon Zoning By-Law 12-95.

2.5.4.3 Waste Volumes and Site Capacity

Condition 7(5) of the E C A states that the total remaining fill capacity of the Landfill (Phases 1 and 2 combined, exclusive of final cover) is 276,000 cubic meters, applicable from the former October 28, 2003 Certificate of Approval. Condition 7(4) of the E C A states that the final contour elevations inclusive of final cover shall not exceed 274.5 metres above sea level (masl). It is noted that the Phase 1 area of the landfill reached capacity in 2017.

The remaining capacity at the end of 2020 was 34,300 cubic metres, indicating a site life of 3 to 4 years remaining.

2.5.4.4 Environmental (Groundwater Quality)

The Fenelon Landfill has a groundwater monitoring network of 45 wells. Interpretation of monitoring data at the site has proved challenging, as several leachate indicator parameters are also associated with the naturally occurring conditions in the downgradient wetland and local aquifer.

Exceedances with respect to the R U P B-7-1 have been recorded, with a few elevated concentrations at the southeastern boundary; however, the majority of these were more related to the naturally mineralized bedrock water quality found on-site and natural variability. Downgradient monitoring results have remained very consistent, indicating the site is likely in a steady state condition and that attenuation processes are

active a short distance downgradient from the limit of waste, such that leachate influence is not observed east of Mark Road.

2.5.4.5 Environmental (Surface Water Quality)

Historically, downstream surface water quality at Martin Creek has not indicated any leachate influence. This suggests that the site is providing adequate attenuation of leachate within the property boundaries.

2.5.4.6 Environmental (Landfill Gas)

Passive landfill gas venting occurs through the landfill cover. The risk of lateral migration to off-site buildings is deemed to be low. Since 2016, monitoring for explosive methane gas levels is conducted on a routine basis in all on-site buildings. Landfill gas has not been detected in the buildings to date.

2.5.5 Laxton Landfill

2.5.5.1 Site Background

The Laxton Landfill is located at 3225 Monck Road (City Road 45) in the City, approximately 2 kilometres west of Highway 35 and operates as a natural attenuation landfill.

The site began operation in 1973 and operates under E C A A321304 issued by the Ministry on February 14, 1980 and last amended October 29, 2012. The E C A allows for the landfilling of non-hazardous domestic, municipal, commercial, institutional, and solid industrial wastes authorized within a 2.5 hectare area. The site is also approved to accept leaf and yard wastes, recycling, H H W, Electrical and Electronic Equipment (EEE), metals and scrap tires for diversion. Only waste generated within the City's geographic boundaries may be accepted at the site. In addition, leaf and yard waste is segregated and composed at the site, where it is ground and piled for later use onsite.

The boundary of the site is irregularly shaped and is bordered by a swath of mixed forest. A wetland and associated watercourse flowing east is located central to the site, north of the limit of waste. An Ontario Hydro easement crosses the site in a southwest to northeast orientation.

2.5.5.2 Surrounding Land Use

The landfill is currently zoned M3 - Industrial Disposal Zone. Surrounding lands are as follows:

- To the immediate north, M2-2 - Industrial Extractive;
- To the immediate west, M2 - Industrial Extractive and Environmental Protection with exceptions. A gravel pit is situated along the western limit of the site;
- To the immediate south, City Public Works Yard zoned M1 - General Industrial; and
- East, unopened road allowance. Further east of the road allowance and south across Highway 45, A1 - General Rural.

New development around the landfill is restricted by subsection 18.28 of the zoning by-law that states that no dwelling, building or structure shall be permitted within 470 m of a sanitary landfill.

2.5.5.3 Waste Volumes and Site Capacity

The site has an approved capacity of 125,000 cubic metres with a remaining capacity of 12,834 cubic metres, indicating an estimated site life of approximately 3 to 4 years remaining.

2.5.5.4 Environmental (Groundwater Quality)

The Laxton Landfill has a groundwater monitoring network of 17 wells. Monitoring results indicate that leachate impacts are quite limited. Some Reasonable Use Concept (RUC) exceedances are noted within many of the distant and boundary wells; however these are mainly limited to elevated concentrations of naturally occurring earth elements and natural organic sources attributable to the surrounding peat deposits and not the landfill.

To better evaluate potential off-site migration to the east and whether or not obtaining C A Z lands is needed, the City had proposed in an October 16, 2018 letter to the M E C P to install a new monitoring well nest along the road allowance that extends along the eastern property boundary, immediately east of the waste footprint. As of August 2021, the City is still waiting for confirmation from the M E C P on this item.

2.5.5.5 Environmental (Surface Water Quality)

The surface water quality program includes five surface water monitoring locations, monitored bi-annually (spring and fall). Although groundwater discharge is likely within the tributary north and east of the landfill, the impacts would appear to be quite limited with a number of the elevated leachate indicator parameters more likely related to the natural wetland water quality rather than leachate.

2.5.5.6 Environmental (Landfill Gas)

The landfill gas monitoring program, which includes two gas monitors, was undertaken on seven occasions in 2019 with no detection recorded.

Recommendations in the 2019 Annual Monitoring Report included discontinuation of the landfill gas monitoring program given the lack of detections and limited sensitive land uses that surround the site.

2.5.6 Summary of the Landfill Sites

- A high level summary and comparison of the five sites is provided in **Table 1**.

Table 1: Summary of City Landfill Sites

Site	Lindsay Ops Landfill	Somerville Landfill	Eldon Landfill	Fenelon Landfill	Laxton Landfill
Opening Year	1980	1972	1980	1972	1973
Forecasted Closure Date	2037	2084	2046	2024	2024
Expansion Possible	Yes	Not required at this time since there is sufficient capacity available	Not within currently owned lands	Only available for vertical expansion	Only available for vertical expansion
E C A Reference Number and Amendments	C of A No. A321504 originally issued on December 14, 2001 and amended January 8, 2021	E C A No. A321604 issued in January 1980 which was amended on August 1, 2019 to reflect the updated D & O	E C A No. A321004, issued on February 21, 1980 and last amended on June 13, 2016.	E C A No. A321206 issued October 28, 2003 and last amended January, 2019	Provisional E C A No. A321304 issued on February 14, 1980 and last amended October 29, 2012
Location	51 Wilson Road, approximately 500 m east of the Scugog River and 2.5 km north of Lindsay	381 Ledge Hill Road	311 Rockview Road	341 Mark Road, approximately 9 km southwest of the Village of Fenelon Falls	3225 Monck Road (City Road 45), approximately 2 km west of Highway 35
Total Site Area	53.9 hectares	61.6 hectares	19.2 hectares	123.9 hectares (total site area), 21.3 hectares (use and operation)	29 hectares
Contaminant Attenuation Zone Area	Area not specified	Area not available	123.3 hectares	102.6 hectares	None
Approved Landfill Area	21.2 hectares	13 hectares	Phase I/II: 3.7 hectares Phase III: 5 hectares	8 hectares	2.5 hectares
Areas Serviced	City of Kawartha Lakes	City of Kawartha Lakes	City of Kawartha Lakes	City of Kawartha Lakes	City of Kawartha Lakes
Estimated Remaining Capacity	The remaining capacity at the end of 2020 is 654,547 cubic metres in the north expansion fill area, providing approximately 14.5 years of site life remaining.	The remaining capacity at the end of 2020 was 430,016 cubic metres, indicating a site life of 61 years remaining.	Phases I and II of the landfill reached capacity in October 2020. The remaining capacity is Stage 1 (Phase III) is estimated at 99,919 cubic metres, indicating a site life of 20 years remaining.	The remaining capacity at the end of 2020 was 34,300 cubic metres, indicating a site life of 3 to 4 years remaining.	The remaining capacity at the end of 2020 was 12,834 cubic metres, indicating an estimated site life of approximately 3 to 4 remaining.
Annual Tonnes Waste Received (2020)	27,604 tonnes	6,107 tonnes	2,909 tonnes	8,658 tonnes	1,752 tonnes

Site	Lindsay Ops Landfill	Somerville Landfill	Eldon Landfill	Fenelon Landfill	Laxton Landfill
Other Waste Management Operations Onsite	Leaf and yard compost pad, H H W Depot, curbside recycling transfer facility	Waste transfer and disposal facility and composting area	Composting of leaf and yard waste. It is noted that the City plans to relocate the scale house, shelter and other facilities such as the compost pad and recycling bins to the northeast corner of the Site off of Rockview Road (as part of the Phase III development)	H H W Depot, collection and transfer facility, Reuse Centre, and an outdoor leaf and yard waste composting facility	Leaf and yard waste, recycling, H H W Depot, WEEE, metals, scrap tires
Landfill Engineering Details (i.e. liner, leachate collection treatment)	The old landfill area has no base liner system; but, has a synthetic membrane cap and perimeter leachate collection system. The north expansion area has a geomembrane/compacted clay composite base liner system and an overlying leachate collection system	Natural attenuation landfill	Natural attenuation landfill (Phases I and II)Phase III incorporates a liner and leachate collection system	Natural attenuation landfill	Natural attenuation landfill
Expanded Previously (Y/N)	Yes	Yes - minor expansion of Area 2 (additional 39,100m3)	Yes - expansion into the Phase III area (E C A amendment with June 2016 D & O report)	No	No
Groundwater Monitoring Network	53 monitoring wells	20 monitoring wells	42 monitoring wells	45 monitoring wells	17 monitoring wells
Surface water Monitoring Network	7 surface water monitoring locations	3 surface water monitoring locations	5 surface water monitoring locations	12 surface water monitoring locations	5 surface water monitoring locations
Landfill Gas Monitoring Network	8 gas monitors	Collected from available monitoring wells and on a daily basis inside the onsite buildings	Historically, no landfill gas monitoring has been undertaken at the site, with the exception of a short term monitoring program requested by the M E C P which included landfill gas measurements within the monitoring well network in 2014, 2015 and 2016. Landfill gas is measured from onsite buildings on a daily basis	None	2 gas monitors

3.0 Future Residual Waste Projections

Estimating the future population and quantities of waste to be landfilled over a planning period (i.e. 25 years) helps to support and rationalize the direction of future waste management programs and services. The steps involved understanding historical and current trends in waste generation, reviewing available waste composition data and population projection data and using this information to estimate the future total quantities of residual waste to be managed. Using the data from waste projections can confirm that the recommended actions being carried forward can manage the requirements of the predicted waste quality and quantity.

In the City's 2015 Integrated Waste Management Strategy, the waste generation rates and projections were completed to 2048 with approximately 56,000 tonnes of waste requiring disposal by 2048 for both the residential and I C & I waste stream. As part of the Future Disposal Options Study, Dillon prepared a model to estimate waste projections under a range of different waste diversion rate scenarios.

As part of the waste projection estimation, Dillon used the following sources for audit data:

- Single Family: Continuous Improvement Fund/Stewardship Ontario Terms of Reference Year 3 (2018/19) Residential Waste Composition Study – Results Summary Report - Rural Regional – Single Family Residential Curbside Results (4 seasons).
- I C & I: City's most recent I C & I audit data. The data was gathered by the City as part of its 2017 Curbside Composition Study, where both the recycling and garbage bins were audited by City Staff. It is noted that this is a "snapshot" of the waste composition generated at the City since it was a one-time waste audit study. Seasonal variations are likely to play a role in waste composition, which are not reflected in the waste audit data provided by the City.
- Rural: Continuous Improvement Fund/Stewardship Ontario Terms of Reference Year 3 (2018/19) Residential Waste Composition Study – Results Summary Report - Rural Depot North – Single Family Residential Depot Results (4 seasons).

With this information, Dillon's model incorporated projections for the residual waste stream defined in the waste audit data and characterized by defining a percentage breakdown by specific material types. The overall goal of this exercise is to estimate the

future quantities of residual waste that require management through the potential disposal options.

The model provides the total tonnage of residual waste materials managed by the City. These waste material breakdown are as follows:

- Recyclable Materials;
- Non-Divertible Paper Products and Packaging (P P P);
- M H S W;
- S S O;
- L Y W Materials;
- All Other Materials (e.g., garbage and any materials that do not fall into the other categories).

The approach for confirming the future residual waste management also involved the following factors:

- Projecting future population based on a population growth of 1.2% estimated by the City's Growth Management Strategy in 2011;
- Determining an annual waste generation rate based on the projected population;
- Estimating the per capita waste generated by material category; and
- Estimating the total quantity of waste to be managed over the planning period for the projected generator sectors of residential and I C & I.

It is important to note that the future projections were estimated based on the "as generated rates" (by weight) for both the residential and I C & I waste stream characterizations.

In addition to the waste audit data, tonnages from each of the five landfills (from 2019) were used to build a full waste characterization of the waste generated in the projection model developed. For planning purposes, it was assumed that the composition of waste would remain the same throughout the projected period. The projections were completed up to 2048 to align with the "City's 2015 Making Waste Matter" report. In addition, the estimated population growth of 1.2% was used to estimate the projected population up to 2048, using the Statistics Canada 2016 population of 75,423. The residential waste landfilled in 2019 of 13,606 tonnes was used in conjunction with the estimated population to determine the City's tonnes per capita generation (tonnes/capita/year).

The I C & I waste landfilled (21,113 tonnes) and estimated population in 2019 was used to determine the per capita waste generation for I C & I. An I C & I waste stream characterization was also developed using the City's 2017 waste audit data. It is noted that the waste landfilled from the materials received at the depot accounted for 12,198 tonnes. The composition and quantities received at public depots can vary year to year.

Overall, 46,917 tonnes of waste were landfilled from residential, I C & I and depot in 2019.

The waste characterization developed for the residential and I C & I sector and the resulting estimating quantities of waste to be generated over the planning period is provided in **Tables 2 and 3** respectively.

Table 2: Residential Waste Audits for 2020 to 2048

Material	Percent Composition (%)	2020 Per Capita Annual Waste Generation (kg/person)*	2020 Total Waste Generated (tonnes) Population 79,109	2030 Total Waste Generated (tonnes) Population 89,131	2040 Total Waste Generated (tonnes) Population 100,424	2048 Total Waste Generated (tonnes) Population 110,479
Recyclable Material	10	0.017	1,354	1,718	2,181	2,640
Non-Divertible P P P	7	0.013	1,000	1,269	1,611	1,950
M H S W	0	0.000	13	17	21	26
S S O	48	0.082	6,493	8,242	10,463	12,664
L Y W	1	0.002	171	218	276	334
All other waste	34	0.058	4,575	5,807	7,372	8,922
TOTAL	100%	0.172	13,606	17,272	21,925	26,536

Assumed a 1% annual waste generation growth rate

Table 3: ICI Waste Audits for 2020 to 2048

Material	Percent Composition (%)	2020 Per Capita Annual Waste Generation (kg/person)*	2020 Total Waste Generated (tonnes) Population 79,109	2030 Total Waste Generated (tonnes) Population 89,131	2040 Total Waste Generated (tonnes) Population 100,424	2048 Total Waste Generated (tonnes) Population 110,479
Recyclable Material	11	0.030	2,401	3,048	3,869	4,683
Non-Divertible P P P	11	0.029	2,269	2,880	3,656	4,424
M H S W	0	0.000	10	13	16	20
S S O	41	0.109	8,642	10,971	13,927	16,855
L Y W	13	0.036	2,811	3,568	4,530	5,482
All other waste	24	0.063	4,979	6,321	8,024	9,711
TOTAL	100%	0.267	21,113	26,801	34,022	41,177

Assumed a 1% annual waste generation growth rate

The assumed residual waste stream percentage breakdowns by material type based on the waste characterization is presented, for residential and I C & I residual waste in **Figure 7** and **Figure 8,** respectively.

Figure 7: Residential Residual Waste Composition

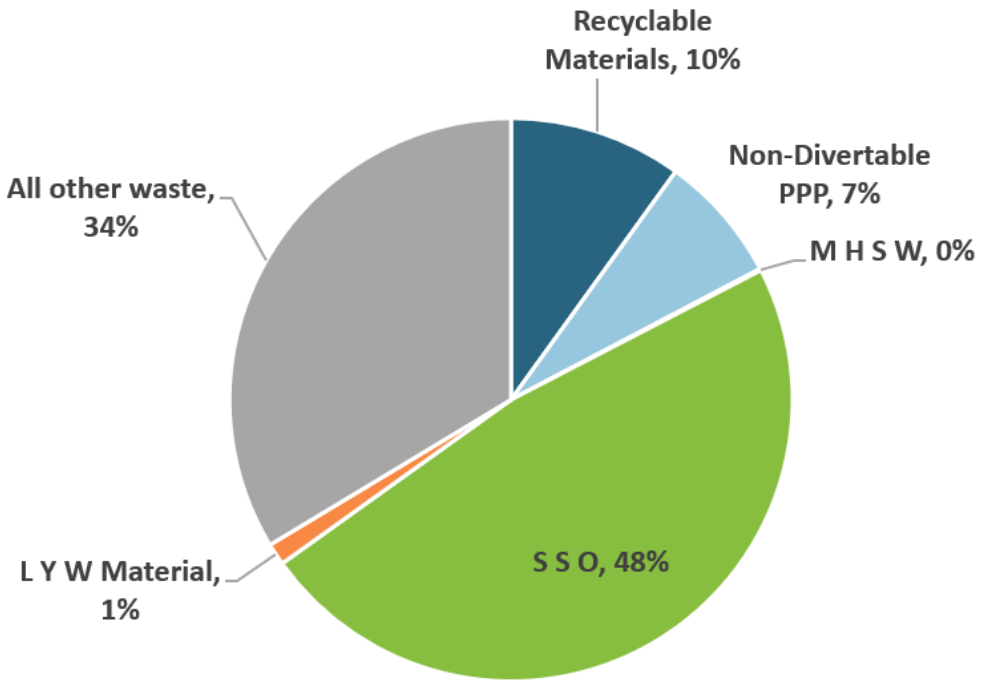
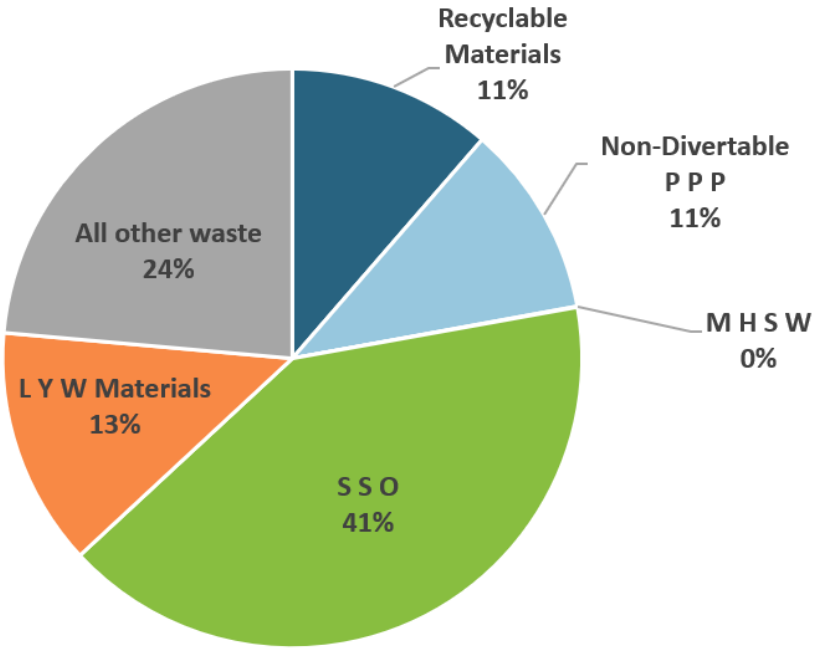
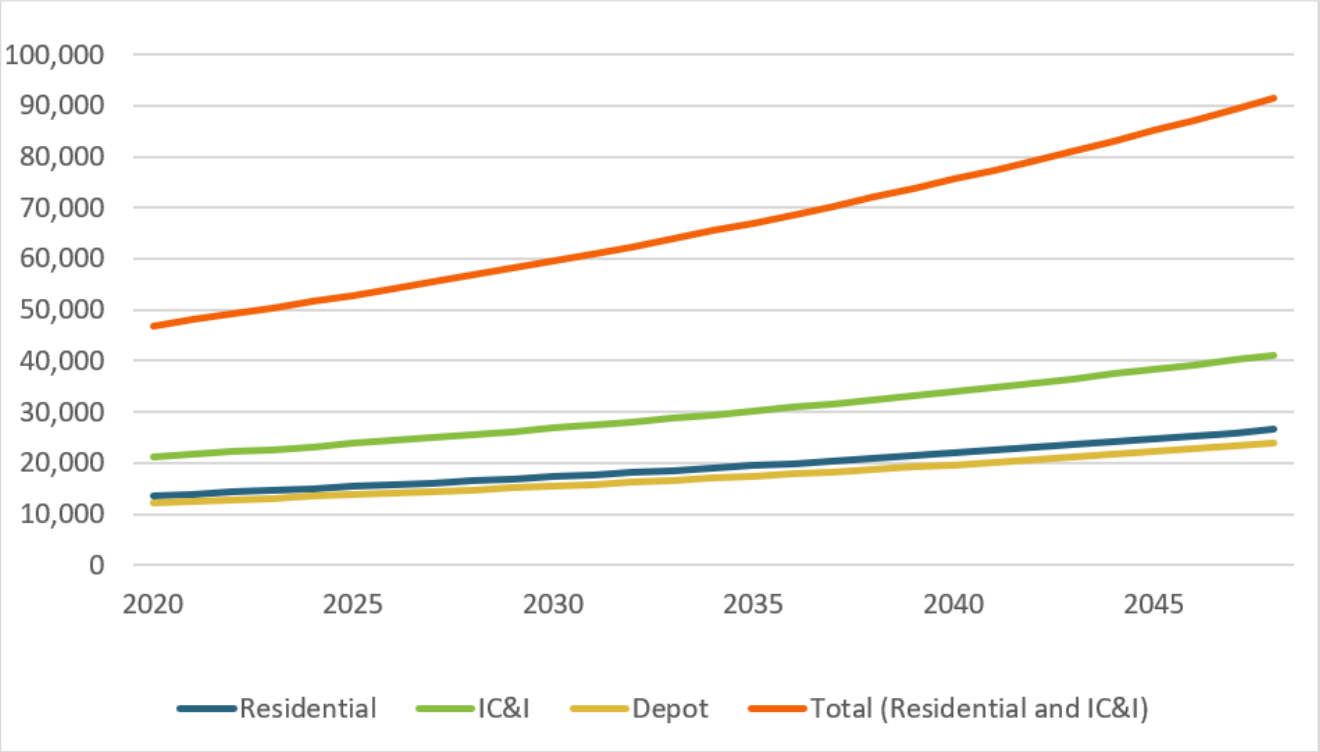


Figure 8: ICI Residual Waste Composition



Based on the model and as shown in **Figure 9**, it is projected that the City will be generating approximately 26,500 tonnes of residential, 41,200 tonnes of I C & I and 23,800 tonnes of depot residual waste by 2048, respectively (a total of 65,800 tonnes by 2048) assuming no change in the current overall diversion rate.

Figure 9: Residential and I C & I Residual Waste Projections (tonnes) (2020 to 2048)

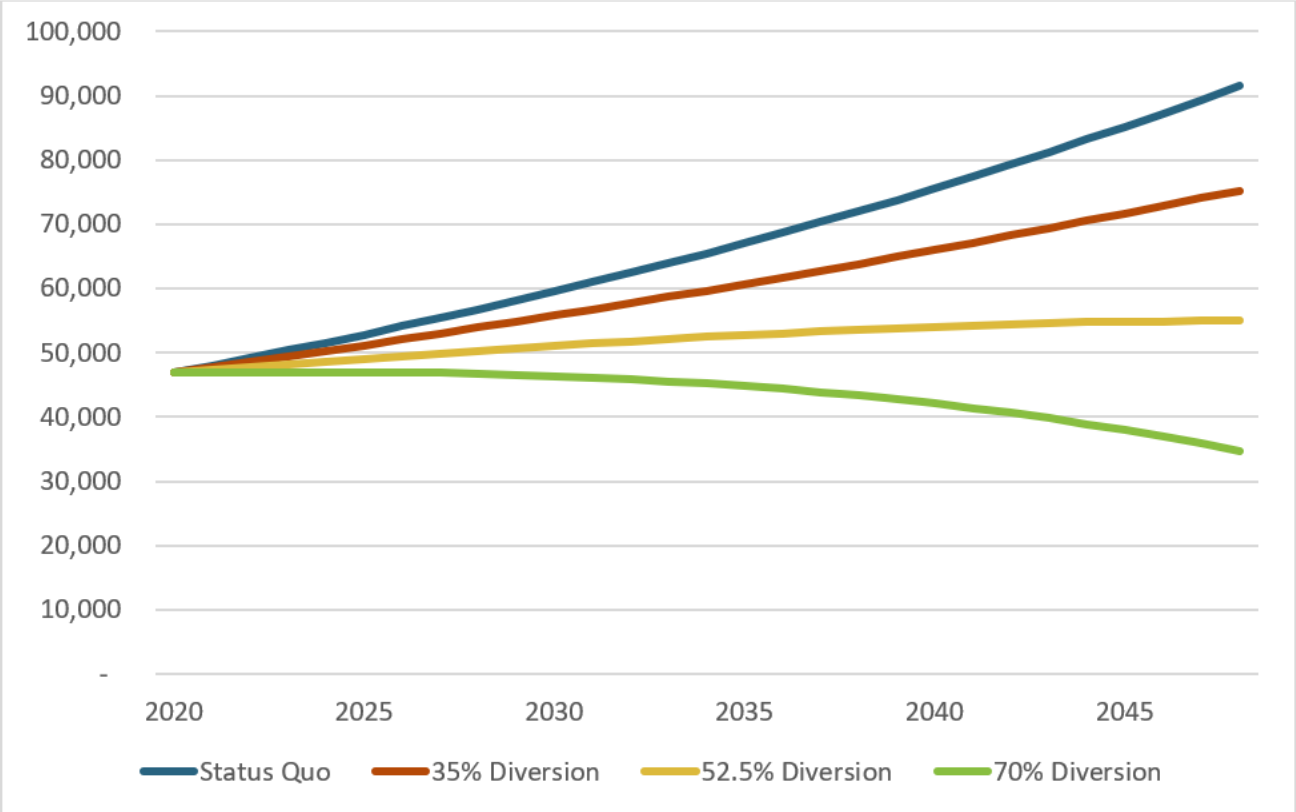


3.1 Future Needs

As previously mentioned, the City is striving to achieve a 70% diversion target by 2048. For the purposes of estimating future residual waste quantities to be managed, sensitivity analyses were completed that reflect different diversion targets that could be achieved. A status quo scenario was modelled which refers to the overall diversion rate for residential, I C & I and depot waste (current diversion rate of 21% when modelling the total waste from all three sources versus a 43% diversion rate for residential waste). The status quo scenario would continue with the City's current waste diversion rate over the planning period and achieving 70% by 2048 was also modelled. The sensitivity analyses involved the City achieving 50% of the diversion target (i.e., 35%) and 75% of the diversion target (i.e., 52.5% diversion by 2048).

Figure 10 provides the forecasted quantities of residual waste requiring disposal with various diversion targets from 2021 to 2048. The status quo diversion target would result in approximately 91,500 tonnes of residual waste to be managed, whereas the highest diversion target of 70% would result in approximately 35,000 tonnes to manage by 2048. The purpose of this graph is to showcase the importance of diversion programs and the impact it can have on reducing the amount of waste disposed. **Table 4** illustrates the impact of the four diversion rate scenarios, including status quo. The analysis assumed that both single family, I C & I and depot waste quantities would increase the same increments per year, noting that this may be impacted based on what programs/policies/initiatives Kawartha Lakes, economic factors, the provincial and federal governments initiates over the planning period.

Figure 10: Diversion Scenarios for Residual Waste to be Managed (2021 to 2048)



The City currently has approximately 1.2 million cubic metres of landfill airspace remaining among their five landfill sites. The cumulative quantities of residual waste requiring management for each scenario was estimated and then converted to air space assuming the landfills can achieve a waste density of 700 kg/m^3. The additional air space

required to accommodate the estimated future residual waste quantities ranges from 608,000 cubic metres (for the 70% diversion scenario) to 1.6 million cubic metres (for the status quo scenario).

Table 4: Projected Residual Waste Quantities for each Diversion Scenario

Scenario	2021 (tonnes)	2035 (tonnes)	2048 (tonnes)	Additional Air Space Required (m^3)
Status Quo	47,000	60,000	91,500	-1,570,000
35% Diversion	47,000	55,800	75,300	-1,294,000
53% Diversion	47,000	51,100	55,000	-951,000
70% Diversion	47,000	46,400	34,700	-608,000

In the Environmental Assessment Act (O.Reg. 101/07), an Environmental Screening Process is required for landfill sites that handle between 40,000 m^3 and less than 100,000 m^3 and an EA is required for sites larger than 100,000 m^3. In recent conversations with the M E C P, it is understood that the Ministry is reviewing the thresholds for approvals through their modernization program.

The detailed projections are presented in **Appendix A**.

4.0 Alternative Technologies

This section reviews and analyzes various alternative technologies that are emerging in Canada as opposed to the traditional methods of waste disposal (i.e. landfilling). Alternative technologies have been reviewed at a high level to provide the City with further information on considerations behind these options.

The alternative technologies discussed in this section include:

- Mixed waste processing;
- Mass burn incineration;
- Gasification; and
- Pyrolysis.

Information and considerations for each technology are discussed in the following sections in a table format and includes: Description of the option; Operational Experiences; Target Material / Feedstock and Outputs; Capital and Operating Cost Range; Advantages and Disadvantages; and Applicability to the City for the specific technology.

The information presented below was gathered from the Dillon teams' experience and various publicly accessible sources including municipal websites, discussions with third parties and reports completed for long term waste planning projects including the City of Ottawa's Solid Waste Master Plan which was completed by HDR Corporation and Dillon Consulting Limited.

4.1 Mixed Waste Processing

Mixed waste processing is a process to recover materials such as recyclables, organics or reusable materials, which leave the residual waste for landfilling or another waste processing application. Mixed waste processing facilities are also known as "dirty" material recovery facilities (MRFs) depending on the streams processed.

Mixed waste processing begins with unsorted and unseparated solid waste from residential and/or commercial collection vehicles being off-loaded onto a designated tipping floor. After off-loading into the tipping floor, the following processes are completed:

- Materials are first sorted on the floor using manual labour (if appropriate) and mobile equipment to remove larger or bulky items (e.g. wood, metal, large pieces of plastics), which might interrupt processing operations.
- Materials are then processed through multi-stage screens to separate fibre, plastic, metal and glass containers, and small contaminants. This process is often done through the use of mechanical, optical or pneumatic screening equipment to separate materials into size classifications and/or light versus heavier materials.
- The remaining material (residual) is transported to a local landfill or another appropriate waste processing/conversion facility.

The garbage stream is typically the feedstock for mixed waste processing and the recoverable materials (quality and quantity) depends on whether diversion programs are present (which reduces the amount of recyclable/recoverable material) or whether there are no diversion programs (which increases the amount of recyclable material).

Those programs that have curbside diversion programs for recyclables and organics have less recoverable material in the garbage, and any materials recovered are typically somewhat better quality than those recovered from a system where there are no diversion programs (particularly organics).

For communities with no source separation, mixed waste processing is used to divert some higher value commodities from disposal. It is noted that for communities with well-established source separation programs, there is less benefit if there is available landfill capacity. Communities without landfill capacity are considering mixed waste processing to divert additional material from landfill.

Mixed waste processing will divert some materials from disposal but compared to a traditional waste management program with source separation, there are fewer environmental benefits due to greater contamination of materials that are not marketable and will require disposal. Mixed waste processing performs better when the material source is consistent in nature or has had organic materials removed prior to being received at the facility.

4.1.1 Operational Experiences

Mixed waste processing has been deemed a proven technology, and it is common throughout Europe, with some increasing use in the United States.

Examples of mixed waste processing are described below, it should be noted that there is limited use on an operational or commercial scale in Canada and because of this, examples have also been pulled from the United States.

- The Otter Lake Waste Processing and Disposal Facility was built in 1998 and handles municipal solid waste from Halifax Regional Municipality (HRM). The facility has a unique system which sorts materials through a Front-End Processor (FEP), stabilizes organic material at the Waste Stabilization Facility (WSF) and then disposes any residual material. HRM chose to use a WSF to treat organic materials before disposal due to the increasing amount of blowing litter, leachate, and pests. Since implementation, the City has undergone a change in government which resulted in amending waste management bylaws to have all commercial waste go to a different facility. The high operational costs of this unique system and the significant decrease in received waste no longer justifies its existence and there will likely be a change in waste management. In the future they will likely be looking at enhancing their organics capabilities through anaerobic digestion.
- The City of London, Toronto and Region of Peel had sent some of their waste to Dongara Waste Processing Facility in Etobicoke, Ontario to learn more about mixed waste processing technology. The facility has since closed.
- The City of London conducted a mixed waste processing pilot project as a part of their Multi-residential Organics Program. The study determined that a mixed waste processing facility could capture up to 80% more organic material while still reducing greenhouse gas emissions and offering a more convenient system for residents. They noted that capital costs for a 100,000 tonne per year capacity facility would be approximately $50-100 (CAD) million and net operating costs at approximately $100-150 (CAD) per tonne.
- In 2017, Peel Region conducted a feasibility study to assess if mixed waste processing would support their current source separation programs diversion targets. Options considered in this study were to secure a regionally-owned facility, partial ownership with other municipalities or private companies, and procuring capacity at a private facility. The capital cost of processing 250,000 tonnes per year is approximately $250 million, excluding land. In 2020, Peel Region issued a REOI to develop a mixed waste processing pilot; decisions will be finalized likely by fall of 2021.
- Durham Region is in the process of developing a mixed waste pre-sort facility to recover materials from garbage. The first step will remove bulky items, hazardous

waste, and cardboard, followed by a pre-sorting process to recover dry recyclables and separate organics for further processing. Durham Region intends to develop an Anaerobic Digestion facility to process organics recovered from this process, along with source separated organics. As of late 2020, the Region has completed a siting process for the mixed waste processing pre-sorting and anaerobic digestion facility and have issued a Request for Pre-Qualification.

- In 2018, the City of Edmonton chose not to reopen their mixed waste processing facility in favour of progressing a source separation system. They noted that capital costs for a 100,000 tonne per year capacity facility would be approximately $50-100 (CAD) million and net operating costs at approximately $100-150 (CAD) per tonne.
- A recommendation from the City of Toronto's Long Term Waste Strategy was to further explore mixed waste processing with organics recovery that would process the City's multi-residential garbage stream. The City underwent a study to determine if a business case should be developed however, the study revealed that the facility would have minimal impact on extending the life of the Green Lane Landfill (less than one year) and that the high operating and capital costs are prohibitive when considering the overall future landfill space savings[1].
- A review of mixed waste processing facilities in California were conducted by staff from Metro Vancouver and the City of Vancouver in 2013 to examine governance, operation and performance. Assessments showed high costs and limited success in recovering recyclables; final decisions were made against developing a private facility as it was inconsistent with their ISWRMP and would disadvantage local recyclers who depended on the current source separation programs.

Examples from the United States are as follows:

- The Montgomery/RePower South (formerly Infinitus facility) facility in Montgomery, Alabama originally opened in 2014 and was expected to divert 75 to 85 percent of waste with revenue derived from the recycled commodities. After one year, the facility closed, for financial reasons. In 2018, the City of Montgomery acquired the $37M ($48M CAD) facility and negotiated a public private partnership with RePower South to operate the facility. More than $12M ($15M CAD) was invested in the plant

[1] Accessed May 2020: https://www.toronto.ca/legdocs/mmis/2020/ie/bgrd/backgroundfile-146477.pdf.

prior to opening again in early 2019. The facility is designed to separate cardboard, paper, polyethylene terephthalate (PET), some high-density polyethylene (HDPE), polypropylene (PP), steel and aluminum. Organic material, glass and other contaminants are sent for disposal. The remaining materials are converted to a Refuse Derived Fuel (R D F) product. It is noted that the City of Montgomery does not provide any curbside diversion programs (recycling or S S O). It is unknown at this time how the facility is operating and what recovery rates are being achieved.

- Western Placer Waste Management Authority materials recovery facility was constructed in the mid-1990s. The facility serves the cities of Roseville, Lincoln, and Auburn in addition to several towns and the unincorporated area of Western Placer County, California. The facility is permitted to process up to 1,100 tonnes per day and currently operates at approximately 725 to 825 tonnes per day. Waste Management Authority communities do not have separate curbside recycling programs and all materials are collected together under a 'One Big Bin program and delivered to the facility for processing. The initial cost of the facility was approximately $20M ($26M CAD). A renovation in 2004 expanded the facility and increased its ability to process additional volume with increased recovery. The renovation cost was approximately $19M ($25M CAD). The facility employs approximately 40 staff and recovers approximately 35 percent to 37 percent by weight of the arriving materials.

4.1.2 Target Material / Feedstock

The target material is typically the garbage stream. Some jurisdictions do not provide any source separation programs and all waste is processed through the mixed processing facility. Other jurisdictions manage a more contaminated stream (e.g. recyclables from multi-residential) from particular sectors.

4.1.3 Outputs

The outputs from this type of facility include a variety of recyclable streams, organic waste and R D F. There is revenue potential from the sale of the R D F and recyclables, although the outputs are typically less valuable compared to source separated recycling.

4.1.4 Capital and Operating Cost Range

Capital and operating costs will depend on the size and capacity of the mixed processing facility and materials handled. In some of the mixed processing facilities in the United States, the capital costs were in the order of $32M to $49M USD ($42 to $64M CAD).

Operating costs would depend on the size and throughput of the mixed waste processing facility.

4.1.5 Advantages

- Organic diversion from landfill disposal.
- Benefits relate to extended landfill life and delayed need to locate new disposal capacity.
- Potential to produce a fuel and recover recyclable material from mixed waste.
- Potential revenue stream from R D F.

4.1.6 Disadvantages / Risks

- Lower quality of recovered material compared to source separated recycling recovery.
- R D F does not currently count towards waste diversion in Ontario and there are minimal long term end markets for R D F.
- Greater contamination of materials can mean less marketable products, and result in material being disposed of instead of recycled.
- High capital costs and costs for siting a new facility.
- Regulatory requirements (e.g. E C A).

4.1.7 Applicability to the City

The City will need to investigate the size of the facility required for the residual waste generated (i.e., between 44,000 and 67,000 tonnes per year) as well as if it economically feasible for the City to build a facility.

The City could explore whether or not other municipalities would be interested in developing a joint facility to achieve economies of scale given the cost of the technology and/or send waste to another facility.

If Durham Region or Peel Region successfully opens a mixed waste processing facility, the City could explore the potential to enter into a contract with either Region to process some of the City's waste at the facility. It is noted that Durham Region is currently looking to build for Durham's waste only whereas Peel Region is discussing partnerships with other interested municipalities.

4.2 Mass Burn Incineration

Mass burn incineration involves the use of traditional combustion, or mass burn incineration, to manage waste and generation of heat that can be converted into electricity. The complete oxidation of a fuel at high temperatures is referred to as direct combustion. The mass incineration occurs under controlled conditions and yields a significant net energy production. The process is also referred to as waste-to-energy (WTE), energy from waste (EFW), or advanced thermal recycling (ATR).

Temperatures in the combustion zone of the units are generally in the range of 800° to 1650°C. Actual temperatures depend upon the type of fuel used, stoichiometric conditions (i.e., ratio of air to fuel), heat losses, and design of the combustion unit.

Heat is recovered from the hot gases produced and converted to electricity, steam, or both from the direct combustion process.

The end result of the combustion process also produces fly ash and bottom ash. Both types of ash are then disposed of at a landfill, with fly ash typically being hazardous due to concentrations of heavy metals and other pollutants, and disposed of at a hazardous waste landfill.

4.2.1 Operational Experiences

Mass burn incineration has been a proven technology and currently used worldwide. There are over 500 operating facilities in Europe and over 85 operating facilities in North America, with seven sites in Canada, which are as follows:

- Durham-York Energy Center – Durham Region, Ontario;
- Emerald Energy from Waste Facility – Brampton, Ontario;
- Metro Vancouver Waste to Energy Facility – Burnaby, B.C;
- Wainwright Energy from Waste Facility- Wainwright, Alberta;
- L'incinérateur de la Ville de Québec – Quebec City, Quebec;

- L'incinérateur de Lévis – Lévis, Quebec; and,
- PEI Energy Systems – Charlottetown, Prince Edward Island.

Case studies relating to the two of the examples above are described below:

- Emerald Energy from Waste Inc. (previously known as Algonquin Power Energy From Waste Inc., (EEFW)) owns and/ operates a mass burn combustion facility in Brampton, Ontario. The initial design was developed in 1984 with the Environmental Assessment process initiated in 1988 and the facility was commissioned in 1992. The incinerator has a processing capacity of 500 tonnes per day and accepts municipal, institutional, commercial and industrial wastes and is operated by more than 40 employees. Heat from the combustion process produces steam, which is directed to a turbine to produce electricity or to a neighbouring paper mill. Fly ash is collected and sent to a hazardous landfill and bottom ash is disposed of in a landfill.
- In 1999, Durham Region released its 20-year waste reduction and disposal strategy which identified a number of objectives for waste disposal, including searching for waste disposal capacity in advance of the closure of a landfill site they had been utilizing, supporting the development of WTE type of facilities, and not supporting the development of a landfill in Durham Region.
- In 2003, the Durham Region was shipping waste to Michigan and in 2004, the Durham Region commenced the Durham Residual Waste Disposal Study EA. In 2005, Durham Region partnered with York Region to develop the facility. In 2006, consultants were retained to identify the most feasible technologies to manage post-diversion residual waste. WTE was identified as the preferred technology. A three-year siting process was undertaken to identify the preferred location. In 2008, a RFP was issued for the design, construction, operation and maintenance of the WTE facility and in 2009, the contract was awarded to Covanta. The EA was submitted to the Province in 2009 and approved just over a year later. Construction commenced in 2011 and the facility began commissioning in 2015. The facility processes 140,000 of residential waste per year.

4.2.2 Target Material / Feedstock

The target material for mass burn incineration includes municipal solid waste (residual waste), including hazardous wastes (in some facilities). It is noted that minimal preprocessing is required.

4.2.3 Outputs

This type of facility generates electricity and/or steam, and metals. The outputs include bottom ash, fly ash, and carbon dioxide. There are revenue opportunities from process through the recovered energy.

4.2.4 Capital and Operating Cost Range

The capital and operating costs of a mass burn incineration facility will depend on the negotiated rate of energy sales, capacity and throughput capacity. For example, the Durham-York Energy Center cost $255 million (2016) to construct the facility and $29 million for the EA, permitting and approvals, site servicing, consulting fees and economic development activities in the host community of Clarington. It is noted that the gross annual operating costs are approximately $14.7 million (2010 dollars).

4.2.5 Advantages

- Recovery of energy and materials.
- Significant decrease in waste volume (e.g. fly ash, bottom ash).
- The reduction of landfill airspace used for disposal.
- Renewable energy source which would increase energy reliability and security.
- Reduction of single use plastics and plastic waste entering landfills.
- Reduces landfill airspace consumption rate and extends the life of landfills.
- Reduced land requirements compared to landfill.
- Potential for net GHG emissions reductions due to avoided GHG emissions associated with the generation of renewable electricity and steam which offsets (avoids) emissions from electricity generation sources (depends on electricity mix).

4.2.6 Disadvantages

- Complex approval process, requiring a full Environmental Assessment.
- Must comply with stringent environmental monitoring and mitigation plans, regulations, standards and guidelines.
- Public opposition of incineration facilities is common.
- Hazardous waste and fly ash results in disposal costs.
- Complex air pollution control systems must be used to make sure mass burn systems comply with emission and environmental requirements.

4.2.7 Applicability to the City

The City will need to investigate the size of the facility required for the waste generated and confirm if enough waste is generated within the City for this facility to be feasible. Capital and operational costs of the facility will need to be investigated to determine if it is feasible within future funding and budgets. The City could explore the availability of capacity at existing facilities and whether there is interest from neighbouring municipalities for a joint facility to achieve economies of scale given the cost of the technology.

4.3 Gasification

Gasification involves converting solid or liquid carbon-based wastes into gas form at high temperature without combustion. Gasification is a process that converts solid organic material under controlled conditions of partial oxidation into fuel gases and other by-products.

The process can be used during the production of chemicals such as methanol and liquid fuels, in addition to producing fuel gases for direct conversion into energy.

Partial oxidation is achieved by utilizing less oxygen than required for complete combustion of the material. Heating temperatures range from 750° to 1,650°C. The fuel gas that is produced is known as syngas. Syngas primarily consists of carbon monoxide, hydrogen, methane, and other hydrocarbons. In some gasification processes, carbon dioxide and nitrogen gas can also be produced. Concentrations of the gases depend heavily on the composition of the organic material used for processing and the operating conditions of the process.

4.3.1 Operational Experiences

Gasification is currently an emerging technology for municipal solid waste, however, it is proven for biomass (e.g., organic agricultural and industrial wastes, sewage sludge, vegetation waste, wood).

Pilot projects and test facilities for municipal solid waste have not been successful for differing reasons, including not being able to achieve energy efficiency and become economically viable, unable to maintain continuous uptime, and issues related to environmental emissions or spills.

There are currently several operating facilities in Japan and some select pilot facilities in North America designed to use municipal solid waste feedstock.

Examples of the gasification technology are as follows:

- In Edmonton, Alberta, the Alberta Biofuels Facility is currently using a gasification/pyrolysis technology to convert non-recyclable and non-compostable municipal solid waste feedstock into methanol and ethanol via Fischer-Tropsch reactions (a chemical process to convert carbon monoxide into liquid hydrocarbons). The technology provider, Enerkem, claims the plant has achieved commercial operation, but has not produced any detailed operating or performance data to date.
- It is noted that other gasification technologies have developed pilot and demonstration facilities that may be using some fraction of municipal solid waste as a feedstock, but no data has been made available.
- Gasification technologies are used in Japan and on a smaller scale in Europe using some fraction of municipal solid waste as a feedstock.

4.3.2 Target Material / Feedstock

Pre-processing is required to prepare a uniform feedstock source (e.g., R D F) from municipal solid waste. Feedstock consists of wastes containing high carbon content, such as plastics, agricultural residues, wood wastes, sewage sludge, and mixed waste of these materials.

4.3.3 Outputs

This type of facility has the potential to generate electricity and/or heat, metals (ferrous, aluminum), depending on the process ethanol or biofuels. The outputs include carbon dioxide and ash residuals. There are revenue opportunity for the recovered fuel gas from the process.

4.3.4 Capital and Operating Cost Range

Capital costs depend on the size of the facility, however construction costs can be within the $100 million range.

Operating costs for such facilities are not publicly available.

4.3.5 Advantages

- Benefits relate to higher waste capacity of the landfill and delayed need to locate new landfill capacity.
- Reduced land requirements compared to landfill.
- The process generates biofuels, displacing some need for fossil fuels.
- Recovery of energy and materials (e.g., ferrous and aluminum material);
- Reduction of landfill airspace used for disposal;
- Renewed resource could displace fossil fuels currently being used in market; and,
- Reduction of single use plastics and plastic waste entering landfills.

4.3.6 Disadvantages

- Must comply with stringent environmental monitoring and mitigation plans, regulations, standards and guidelines.
- Reliability of technology (there has been mixed success and failure using municipal solid waste).
- Lengthy and uncertain approvals process.
- Stringent feedstock requirements including moisture content and homogeneous nature of waste can be difficult to provide and maintain.
- Process generates wastewater from the syngas clean-up which need to be managed;
- Stringent air pollution control systems must be used to make sure the gasification system complies with emission and environmental requirements.

4.3.7 Applicability to the City

With respect to municipal solid waste, this technology is too early on its development stage to determine if it is feasible for the City to implement in the future or partner with local municipalities.

The City could explore whether or not neighbouring municipalities would be interested in developing a joint facility to achieve economies of scale given the cost of the technology

4.4 Pyrolysis

Pyrolysis involves heating municipal solid waste in an oxygen-free environment to produce a combustible gaseous or liquid product and a carbon char residue. Pyrolysis is

a chemical process in which organic materials are decomposed by high temperatures in the absence of oxygen. The decomposed materials are converted to gas, liquid, and solid fuels.

Pyrolysis is similar to the process of gasification, but the process generally takes place at slightly lower temperatures. Syngas can be used as fuel for boilers, internal combustion units, or turbines, provided that the produced gas is clean enough and of sufficient quality. The feedstock for pyrolysis largely dictates whether the process will produce a good enough product to make the operation viable, the higher the content of organic materials the better.

4.4.1 Operational Experiences

Pyrolysis for municipal solid waste is in the pilot project state (research).

Some facilities in North America have processed municipal solid waste at a pilot-scale level, however, no facilities are currently operating on a commercial scale. Reportedly, there are some commercial-scale facilities in operation in Europe and Japan, however, the feedstock for these facilities is unclear and there is no further information publicly available.

4.4.2 Target Material/Feedstock

Pre-processing of municipal solid waste to segregate organics is required to prepare a uniform feedstock source (e.g., R D F).

4.4.3 Outputs

This type of facility has the potential to generate electricity and/or heat, metals, pyrolytic oil, ethanol, and other biofuels. Waste outputs include carbon char residue and carbon dioxide. There is also potential for revenue from the recovered fuel gas.

4.4.4 Capital and Operating Cost Range

Capital and operating costs are dependent on the facility size and negotiated rate for energy sales.

4.4.5 Advantages

- Benefits relate to higher waste capacity of the landfill and delayed need to locate new landfill capacity.
- Reduced land requirements compared to landfill.
- The process generates renewable fuels, displacing some need for fossil fuel.
- Recovery of energy and metals.
- Reduction of landfill airspace used for disposal and extended landfill life.
- Reduction of single use plastics and plastic waste entering landfills.

4.4.6 Disadvantages

- Must comply with stringent environmental monitoring and mitigation plans, regulations, standards and guidelines.
- Reliability of technology is still being tested, and is not yet commercially available.
- Lengthy and uncertain approvals process.
- Stringent air pollution control systems must be used to make sure the gasification system complies with emission and environmental requirements.
- Process generates wastewater from the syngas clean-up which need to be managed.

4.4.7 Applicability to the City

With respect to municipal solid waste, this technology is too early on its development stage to determine if it is feasible for the City to implement in the future or partner with local municipalities.

The City could explore whether or not neighbouring municipalities would be interested in developing a joint facility to achieve economies of scale given the cost of the technology.

5.0 Landfill-Related Options

This section reviews and analyzes various landfill-related options in Canada. Options have been reviewed at a high level to provide the City with further information on considerations behind these options.

The landfill-related options discussed in this section include:

- Expansion;
- New Greenfield Site;
- Landfill mining/reclamation;
- Export waste out of the City; and,
- Privatization of City Facilities.

Information and further considerations for each option are discussed in the following sections in a table format and includes: Description of the option; Operational; Capital and Operating Cost Range; Advantages and Disadvantages; and Applicability to the City. Other factors such as availability, status, approval requirements, potential environmental impacts, benefits and potential known health impacts are also discussed. It is noted that the target materials for landfills are residual waste.

The information presented below was gathered from the Dillon teams' experience and various publicly accessible sources including municipal websites, discussions with third parties and reports completed for long term waste planning projects including the City of Ottawa's Solid Waste Master Plan which was completed by HDR Corporation and Dillon Consulting Limited.

5.1 Expansion of City Landfill Sites

Municipalities throughout Ontario have increased disposal capacity by extending the fill area at existing landfill sites. The expansion can be vertically and/or horizontally depending on factors such as site environmental and geotechnical conditions, adjacent land uses and availability of land.

Expanding a landfill generally involves regulatory approvals such as an Environmental Assessment (EA), multimedia E C A amendment (air/noise, sewage works and waste

disposal), engineering and design of new cells (including landfill gas and leachate collection systems) and construction.

5.1.1 Operational Experiences

Landfill expansion has been proven in various municipalities throughout Ontario. The City's Lindsay Ops landfill was previously expanded and went through the EA process in the 1980s.

Recent landfill expansion projects in Ontario are as follows:

- In 2020, Waste Connections of Canada completed an EA for the proposed expansion of the Ridge Landfill located in Blenheim, Ontario. The permitting process took over six years for approvals. The EA provided 20 years of additional capacity at 1.3 million tonnes per year.
- The County of Brant completed the environmental assessment (EA) for the Biggars Lane Landfill Expansion in February 2021. As required under section 6.2(1) of the Ontario Environmental Assessment Act (EAA) and according to the Terms of Reference (T o R) approved by the Minister of the Environment, Conservation and Parks on May 15, 2015, the County of Brant has submitted its environmental assessment to the M E C P for review and approval. The County is currently seeking Environmental Assessment Act (EAA) approval to increase the Biggars Lane Landfill disposal capacity to meet the County's disposal requirements for the estimated 30-year planning period following the closure of the existing approved landfilling area.
- On April 10, 2002, Ottawa Council approved a report entitled Trail Waste Facility Landfill Optimization/Expansion - Environmental Assessment (EA) and Environmental Protection Act, (EPA) which sought Council approval to submit the Final EA/EPA Report to the Ministry of the Environment for approval of the expansion of the Trail Landfill. The EA/EPA Report was submitted to the Ministry on May 31, 2002, which was followed by an extensive review process. The Minister approved the EA to expand the Trail Waste Facility in June of 2005. The expansion was anticipated to provide an additional 10 to 40 years of landfill capacity (past 2008).

5.1.2 Outputs

This type of option creates increased in landfill disposal capacity, keeps waste management local, maintains a steady revenue stream from tipping fees and minimizes the need to site a new landfill or direct waste to a different landfill.

5.1.3 Capital and Operating Cost Range

Capital costs will depend on several factors such as the site, site constraints, expansion capacity, complexity of the expansion, potential affects and mitigation measures. Typically, for the expansion of a landfill, an individual EA could take several years and cost between $3 and $6 million. The additional approvals, permits, initial design and construction costs could range between $10 and $50 million again for the varying factors as mentioned above. Landfill expansion will require studies such as feasibility, environmental and geotechnical, which are typically completed by consultants.

Changes to operating costs will be minimal as operations will continue in a similar manner to current.

5.1.4 Advantages

- Site is already being used as a landfill and approval process to amend operations is less complex than siting a new facility.
- Additional landfill capacity.
- Secure landfill disposal for a certain amount of time.
- Existing site infrastructure can be used, reducing capital costs.
- Curbside collection vehicles can continue to deliver waste directly to landfill without affecting collection costs or requiring a transfer station.

5.1.5 Disadvantages

- Any expansion of the landfill (either vertically or horizontally) may introduce concerns from the public regarding continued use of the site. Public concerns could be addressed through appropriate public consultation defining mitigation measures and social benefits.
- High capital costs associated with obtaining the necessary permits and approvals (i.e., individual EA), design and construction (which depends on several factors as previously mentioned).

- Strict and lengthy environmental approval process.

5.1.6 Applicability to the City

Based on the background review of the City's landfill, it is noted that three of the five sites, (Fenelon, Eldon, Laxton) may not have expansion potential for the level needed to secure overall meaningful capacity for the City. Some expansion such as additional lifts, may be possible at these sites though any expansion is dependent on the outcome of approvals. In addition, neighbouring lands would have be purchased to provide additional capacity. Somerville site has sufficient capacity (projected to close in the 2080s) with potential expansion capabilities to the south and the Lindsay Ops site could be expanded through regulatory approvals and studies.

5.2 Development of a New City Owned Landfill

Development of a new landfill site would require availability of suitable land and environmental approvals. Disposal capacity in Ontario is quickly diminishing and the process involved in securing additional disposal capacity (e.g., new landfills or energy from waste facilities) is lengthy and very expensive.

The development of a new landfill would require considerations such as:

- The completion of a siting study and/or business case of siting and developing a new landfill within the City.
- The engineering design of a new landfill facility, including landfill gas collection and leachate management systems.
- Regulatory approvals such as an EA and relevant E C A approvals.
- Extensive planning, public consultation and siting of a new facility.
- Additional waste management infrastructure such as a transfer station, if the location of the landfill is not in a close proximity to the main City population.

5.2.1 Operational Experiences

Although landfilling of waste is a proven disposal method in the private and municipal sector, approval of new sites has become increasingly difficult due to lack of suitable land and public opposition.

The following are examples for the development of new landfills in Ontario:

- Halton Region was incorporated in 1974 and at that time assumed responsibility for the disposal of waste. This included four active landfills that were closed when they reached capacity from 1974 to 1988. An 18 year long process to search for additional disposal capacity began and led to the opening of the Halton Waste Management Site in 1992. From 1988 to 1992, waste was exported outside of the Halton Region for disposal. In 1992, the landfill started receiving residential waste and has a site capacity life past 2020.
- An example of a private company trying to develop a new landfill in Ontario is the Walker Southwest Landfill proposal. Walker Environmental Group started the process for developing a Greenfield (new) landfill in 2012. Their proposal is to develop a landfill located in Oxford County to manage 17.4 million tonnes (~850,000 tonnes annually) of solid non-hazardous waste generated in Ontario from municipalities, residences and industrial, commercial and institutional operations. Walker released its draft EA in March 2020. There is some opposition from local municipalities and recent legislation (as part of Bill 197, which was enacted in July 2020) gives these local municipalities more say in the approvals process.
- The Essex-Windsor Regional Landfill received EA approval in August 1995 and was opened in July 1997. The landfill is operated by the Essex-Windsor Solid Waste Authority. The site is 123 hectares in size and has a waste footprint of 58 hectares with five landfill cells.

5.2.2 Target Material / Feedstock

- Municipal solid waste.

5.2.3 Outputs

This option provides additional disposal capacity, keeps waste management local, and maintains a steady revenue stream from tipping fees.

5.2.4 Capital and Operating Cost Range

The capital costs will depend on the capacity of the proposed landfill, however the costs tend to be higher than expansion of existing sites as the development of a new landfill includes a number of factors (i.e., siting studies, land acquisition, regulatory approvals, planning, design, construction, commissioning, new equipment, etc.).

Operating costs are expected to increase as additional staff are likely to be required for a new landfill.

Staffing needs to operate a new landfill would include managers, lead hands, operators, compliance staff, supervisors, etc. Should the City decide to operate the new site, it is likely that additional staff will be required, especially if the existing landfills remain still active and staff cannot relocate.

5.2.5 Advantages

- Secure disposal capacity.
- Generate jobs.
- Potential to partner with nearby municipalities to offset costs of developing and operating a new site.

5.2.6 Disadvantages

- Potential to introduce groundwater and surface water impacts at a new location.
- Developing a new landfill is dependent on availability of suitable land within the municipality.
- Developing a new landfill would pose significant environmental risks that need to be managed and addressed throughout the siting and design process.
- After closure of the landfill, the City would be responsible for on-going environmental monitoring of the site and responding to any issues that are identified.
- Siting a new landfill could see significant public resistance.
- A new landfill could produce odour, noise, increased traffic, litter, dust and a visual impact to the community where it is located.
- The process to secure additional disposal capacity through a new landfill site in Ontario is an expensive and lengthy process. Historically, there has been significant effort and time spent on finding sites for a new landfill(s) in the Greater Toronto Area.

5.2.7 Applicability to the City

The City currently has five operating landfills, which serve different areas throughout the municipality. Some of these landfills are expected to reach capacity within the next 10 years, and some of the landfills are located in areas that would not be easily

accessible to serve the main population within the City. Developing a new landfill within the City would be a lengthy and uncertain process to find suitable land for an engineering landfill site and get approvals.

5.3 Landfill Mining

Landfill mining refers to the process of excavating previously landfilled waste to recover valuable recyclable materials and/or space. This is a complicated process involving the excavation, screening and sorting of waste. The economic feasibility is based on a number of factors including the expected content of the landfill, reducing long-term liabilities for the site and value of the recovered airspace. Reducing long-term liabilities can be related to re-disposal of previously improperly landfilled waste or re-engineering of the landfill base with a more robust base liner system.

Landfill mining is only considered or completed when its benefits outweigh the associated high costs, and concerns related to odours and health and safety. The process typically is completed according to the following sequence:

- Planning and approvals: Prepare health and safety plan, air quality plan, odour mitigation plan, dust and erosion and sediment control plan, leachate control plan.
- Site preparation: Strip and stockpile existing soil cover.
- Waste excavation and pre-separation: separate out large materials that may damage screening equipment and large recyclable materials.
- Waste screening: Screening process used to separate fines (soil) from residual materials. Recovered residual materials can then be recycled or reused as appropriate. Separated soil material could be reused as daily cover material for the landfill.
- Fines: Haul fines to active face for use as daily/intermediate cover or stockpile.
- Compaction and cover: Haul residual materials to active face to be re-landfilled.

5.3.1 Operational Experiences

Landfill mining has been proven in Canada and the suitability of landfill mining is site-specific.

Ontario examples are as follows:

- In 2018, Durham Region began a landfill mining pilot project at the former Blackstock landfill site in order to reduce GHG emissions from methane, leachate impacts on groundwater quality, divert material not previously separated for recycling, recover energy from reclaimed waste, and eliminate the need for long-term groundwater monitoring. Landfilled scrap metal and concrete were sorted and set aside for recycling. Approximately 98 tonnes of scrap metal, and 500 tires were recovered from the 4,796 tonnes of waste excavated from the site. Recovered combustible waste was processed at the Durham York Energy Centre and the remainder sent to a landfill for disposal. Durham anticipates the final grading to bring the old landfill site back to original condition will be complete in 2020.
- The City of Barrie excavated the City's landfill, beginning in 2008. This project encompassed excavating old garbage (approximately 1,600,000 cubic metres) and screening it to separate sand from the garbage. This sand was then re-used for current daily cover, some other materials such as concrete and metal were removed and recycled. After excavation, the City lined the landfill with HDPE and geosynthetic clay liners, and installed a landfill gas collection system. After the new liner and systems were installed, the excavated garbage was recompacted into the cells. This project has extended the life of the landfill by an additional 18 years. The gain is largely due to re-use of fines as daily cover, greater density of compaction and reductions in waste disposal rates since the project began.

5.3.2 Target Material/Feedstock

- Landfilled waste.

5.3.3 Outputs

This options provides soil for daily or intermediate cover or valuable recyclable material, landfill airspace. By mining, you are also increasing landfill airspace and extending landfill life. Some projects in Ontario had airspace recovery rates ranging from 20 percent to 60 percent. There is potential to reduce costs related to importing soil for daily/intermediate cover as well as generate revenue from recovered valuable recyclable materials; however, contamination of materials is likely.

5.3.4 Capital and Operating Cost Range

Landfill mining costs have been estimated to be approximately $50/m3 for 2020.

Operating costs include: construction from waste excavation and pre-separation, waste screening, and re-landfilling; managing nuisances such as litter, odour and dust at the mining site; managing surface water, landfill gas and leachate at the mining area; hauling of waste off-site (if required); and, potential Municipal Hazardous waste disposal expenses.

5.3.5 Advantages

- Reduction of potential environmental liabilities as a risk management strategy, for example, improperly disposed of wastes or an unlined portion of a landfill.
- Gain landfill capacity.
- Opportunity to address soil shortages for future landfill operations.
- Reclamation of other materials, such as tires for internal road construction.

5.3.6 Disadvantages

- Health and safety concerns from worker exposure to landfill gas, unknown waste materials and/or leachate.
- Potential for increased nuisances (odour, litter, dust) for site neighbours during the mining process.
- Unknown waste conditions may result in a low rate of material recovery (i.e., mining cost exceeds value of recovered airspace or material). Recovery rates are dependent on a number of parameters (e.g., age of waste, waste density, soil type, filling practices).
- Presence of certain materials (e.g., wires and industrial fabrics) may slow down the reclamation process.
- Given the requirement to expose and handle previously buried waste, a short-term increase in release of GHG at the landfill mining area is likely.
- Creates a risk of contaminants (e.g., fly plastics, leachate spill) escaping to the environment.

5.3.7 Applicability to the City

Additional studies would be required to determine the feasibility of landfill mining at City's landfill sites. It is important to note that the location of specific waste streams (e.g. C & D, asbestos containing material) should be identified in all of the landfills before landfill mining is considered.

5.4 Export Waste

Exporting of waste consists of shipping waste to a disposal facility (e.g., landfill or energy from waste facility) outside the jurisdiction's boundary. Exporting waste is typically done when there is limited or no disposal capacity within a jurisdiction's boundary. It may be a short term disposal option until new disposal facilities are developed or a long term approach if there is a lack of available land to site a new landfill or disposal facility.

Waste from curbside collection trucks is consolidated at a transfer station into transport trailers to minimize the amount of trucks required to travel long distances and reduce transportation costs. Municipalities enter into contract(s) with disposal facility operators, typically determined through a procurement process.

Contracts may also include haulage of waste from the municipality to the disposal facility (ies). Negotiated agreements may be required if there are limited disposal options.

5.4.1 Operational Experiences

Exporting waste to other facilities has been proven in Ontario, with municipalities exporting waste out of their boundaries for final disposal.

Some examples in Ontario are as follows:

- The Municipality of Chatham-Kent uses a private landfill (Ridge Landfill) to dispose of its residential waste. The Ridge Landfill located in Blenheim Ontario in the Municipality of Chatham-Kent is owned and operated by Waste Connections. The Ridge Landfill is approved to receive waste from the I C & I sector in southern and northern Ontario and residential waste from the Municipality of Chatham-Kent.
- Municipalities such as the Region of Peel and City of Guelph send their waste to the privately owned Twin Creeks Landfill in Watford, Ontario. The landfill is owned and operated by Waste Management and is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous waste, including non-hazardous contaminated soil. The landfill is located within Lambton County and the municipality also has a long-term contract with Waste Management for access to landfill disposal capacity.

- York Region uses a combination of private landfill sites, Durham York Energy Centre and private energy from waste facilities to meet its disposal requirements.

5.4.2 Target Material / Feedstock

- Municipal solid waste.

5.4.3 Outputs

This option provides secure waste disposal and minimizes the need to site a new disposal facility or increase the capacity of existing landfills.

5.4.4 Capital and Operating Cost Range

Capital costs will be required for a transfer station. There may be capital costs associated with the purchase of transfer trailers for hauling materials to the disposal facility depending on the contractual arrangements the City makes for hauling waste.

Operating costs will increase with added transportation costs and tipping fees at the disposal facility. The operating costs will depend on the distance to the disposal facility and agreed upon tipping fees.

5.4.5 Advantages

- Environmental and material liabilities and responsibilities remain with the disposal facility owner.
- Secure waste disposal.
- Using an existing landfill or disposal facility would minimize the potential environmental impacts associated with siting a new disposal facility, landfill or expanding an existing landfill.
- Minimize the need to site a new landfill.

5.4.6 Disadvantages

- Lack of available disposal capacity in Ontario.
- Disposal capacity is limited to the term of the contract.
- Increased transportation costs and GHG emissions.
- New transfer station(s) may increase traffic, odour, and noise issues in nearby areas depending on the location.

5.4.7 Applicability to the City

The City could explore potential private sector disposal alternatives through a request for expression of interest, to determine if there are options available.

5.5 Privatization of City Facilities

Local governments face increasing regulatory costs in owning and operating landfills, as well as finding politically acceptable locations for new facilities to replace sites that have reached capacity or accommodate new landfill growth. Many governments have responded to these regulatory and siting challenges by privatizing their landfills.

Privatization of landfills is becoming a growing trend. The many reasons for this privatization trend include managing liabilities, improving efficiency, cutting costs or debt, improving access to capital, and improving accountability. Each reason, or combination of reasons, lends itself to a different option for managing landfills. Privatization options range from cooperative agreements with private firms for support services to management contracts, asset sales, and even complete reliance on the landfill market for services.

It is noted that some municipalities choose to retain the ownership of landfills, however, contract third party companies to manage and operate the landfill. This is considered a government ownership and private operation of facilities structure. This structure can maintain all assets and complete oversight of the system, however it can still be tied into some liabilities. This structure is not considered fully privatized as the government still maintains ownership of the asset.

5.5.1 Operational Experiences

Privatization of landfills has been proven in Nova Scotia at the Cumberland Central Landfill. It is also proven in the United States.

It is noted that some municipalities in Ontario are managed or operated by private firms. Municipalities such as the City of Hamilton outsource the operation of its active landfill to a private operator, but retain ownership of the asset and compliance costs. However, this is not considered fully privatized as the municipalities have ownership of the landfill.

In the United States, the San Diego County completed a sale of all solid-waste assets to a private company in 1997. The sale included four landfills, the recycling facility, and 10 rural bin stations. The county netted $184 million from the sale, after paying off $100 million in debt from the construction of the recycling facility. The county used these funds to create an environmental trust fund to finance the long-term maintenance of closed county-owned landfills, to fill up a number of county reserve funds, and to enhance other county services. Along with the facilities, the private company received all future liability, and all current liabilities were transferred through a contractual arrangement and figured into the price.

5.5.2 Target Material / Feedstock

- Municipal solid waste.

5.5.3 Outputs

This options provides secure waste disposal and minimize material and environmental liabilities on the City.

5.5.4 Capital Operating Cost Range

The private company that purchases the landfill will be responsible for the capital and operating costs associated with the Site.

Tipping fees would be a direct cost to the City to dispose of their waste at the landfill. The tipping fees will vary depending on the contractual agreement.

5.5.5 Advantages

- Greater efficiency and productivity.
- Receive an immediate cash flow from asset sales, which can be used to eliminate debt.
- May reduce annual operating costs due to lower fees from private operations and lower staffing requirements (since in-house staff are only needed for planning and monitoring).
- Receive property, income, and sales tax revenues.
- May experience reduced risks and liabilities.

5.5.6 Disadvantages

- Less control of landfill disposal.
- Increase in disposal costs is anticipated (i.e. tipping fees).
- Reduced service quality.
- Potential increase in service interruptions.
- Loss of flexibility and capital assets.
- Must rely on others to fulfill municipal solid waste needs.
- May retain some long-term liabilities.
- May experience legal costs associated with contract negotiations and asset sales.

5.5.7 Applicability to the City

The City will need to investigate which landfill could be privatized and identify interests from private companies. Further feasibility studies would be required to determine if it is in the City's best interest to privatize one of their sites.

6.0 Partnership Options

Interviews were held with several municipalities, private companies and individuals to assess interest in collaborating in any of the recommended options. Partnership options are stated in the following sections.

6.1 Mixed Waste Processing

Peel Region issued a REOI for a mixed waste processing pilot project, similar to the City of London, and will have a better understanding of their direction in mid-to-late fall 2021 after meeting with their waste management committee. It is probable that they will move forward with more than one pilot project, to initially process the Region's waste, at a scale where they can investigate and prove the technology and/or approach while still managing the cost and risks. They are particularly interested in long contracts between 15-20 years, guarantees in waste processing capabilities and large facilities with processing capacity of 100,000 tonnes per year.

6.2 Mass Burn Incineration

A group of three individuals presented a pilot project to develop an EFW facility which would be owned and operated by the five counties of Hastings, Kawartha Lakes, Northumberland, Peterborough County and Prince Edward and Cities of Bellville, Peterborough and Quinte West. The population for the selected regions is approximately 500,000 and total waste generated would be about 160,000 tonnes of residual waste per year. They are an unregistered group so are not eligible for FCM funding, however they are open to municipality representation or private ownership. This potential opportunity is in the early stages where the group is looking to confirm participation from the municipalities to pursue further.

Discussions were also had with Eco Waste Solutions (EWS). EWS designs and develops EFW systems able to process MSW, liquids and/or pharmaceutical waste for small and medium sized applications. The smallest system they have produced to date processes less than 1 tonne per day and the largest system accommodates 50 to 500 tonnes per day.

6.3 Exporting Waste

Emerald Power, formerly Algonquin Power, owned by U-Pak Disposal is expanding its EFW facility to have the annual processing capacity of 180,000 tonnes and are installing a new line which can process 30,000 tonne per year. They are willing to accept waste from Kawartha Lakes at any time and would be able to minimize transportation costs through contract negotiation.

7.0 Evaluation of Options

The evaluation process involved a detailed analysis of the following landfill and non-landfill related waste disposal facility options:

Alternative Technologies:

- Mixed waste processing;
- Mass burn incineration;
- Gasification; and,
- Pyrolysis.

Landfilling Alternatives:

- Expansion;
- New Greenfield Site;
- Landfill mining/reclamation;
- Export waste out of the City; and,
- Privatization of City Facilities.

As part of the evaluation process, an evaluation matrix table was developed which enabled comparison between options in a quantitative and qualitative way. The evaluation matrix was approved by the City during Project Update Meeting #2 and after populating it, it was presented to the City in Project Update Meeting #3.

7.1 Assumptions

The following subsections detail the assumptions utilized in preparing the options evaluation scoring criteria.

7.1.1 Baseline Assumptions

7.1.1.1 Landfill-Related Options

This study used information gathered by the City to calculate waste quantity projections until 2048. The City provided data showed in 2020 approximately 47,000 tonnes of residual waste generated in Kawartha Lakes was sent to City landfills. Based on waste projections, it is estimated that the City will need a facility large enough to process between an average of 44,000 and 67,000 tonnes on an annual basis noting the range is

based on the diversion rate achieved. It is assumed that the preferred site will only be processing and managing residual waste generated by single family households and the I C & I sector in the City of Kawartha Lakes.

As previously mentioned in **Section 3.1**, the additional landfill air space required is ranging from 350,000 to 1.2 million cubic meters. An EA will be triggered for sites with capacity greater than 100,000 cubic meters or mining activities at sites larger than 100,000 cubic meters. EA Screening will be required for landfill capacity and mining activities with capacities greater from 40,000 but less than 100,000 cubic meters. Screening will also be required when requesting increased rates of fill.

Based on information provided by the City, the annual landfill operational costs were estimated at approximately $2.7 million (CAD) dollars.

7.1.1.2 Alternative Technology Options

As stated above, it is estimated that the City will need a facility large enough to process between 44,000 and 67,000 tonnes on an annual basis based on the achieved diversion rate. It is assumed that the preferred site will only be processing and managing residual waste generated by single family households and the I C & I sector in the City of Kawartha Lakes.

The preferred site will be located within the City of Kawartha Lakes boundaries however, the exact location is not known and specific siting impacts are not considered. Impacts associated with collection and hauling of waste to a new facility have not been considered unless otherwise stated. If the City chooses an ownership model for a new facility, it assumes that the City will have full ownership and operational power. It is assumed that alternative technologies require less land than landfill-related options.

The preferred facility will require an E C A, at minimum, and potentially EA screening as it will be considered a new waste site and/or system and will be subject to conditions of approval. Due to the complexity of the selected alternative technology options, it is assumed that there will be multiple parties involved in processing, collection, hauling, etc. and will require equipment, vendors and suppliers.

7.1.2 Option Specific Assumptions

7.1.2.1 Mixed Waste Processing

The City will construct a mixed waste processing facility which will remove high value recyclables and organic materials from the residual waste stream. The remaining residual waste will be landfilled and/or through another disposal method. The Blue Box curbside collection system and source separation program will continue as usual. To meet diversion targets, the City will need to create a Green Bin source separation program for organic materials in the future.

7.1.2.2 Mass Burn Incineration

The mass burn incineration facility will process residual waste and recover some metals and energy where possible. Bottom ash generated will be beneficially and productively reused, and fly ash generated will require disposal at a hazardous landfill.

7.1.2.3 Gasification

It is assumed that the facility in which gasification takes place would process residual waste and recover material and/or energy.

7.1.2.4 Pyrolysis

It is assumed that the facility in which pyrolysis takes place would process residual waste and recover material and/or energy.

7.1.2.5 Landfill Expansion

A vertical expansion could occur at a City landfill site, however it will likely not meet the City's space and volume requirements according to calculated future waste projections. Therefore, horizontal expansion will likely be required to support the City's future volume needs.

An Environmental Assessment (EA) will likely be required for both horizontal and vertical landfill expansions given the future volume requirements. This process can take up to 10 years given the necessary environmental studies, stakeholder and public

consultation. Once the EA has been approved, the current site E C A along with other approvals will require amending and staff time and oversight.

7.1.2.6 Development of a New Landfill

The City will undergo a siting study to develop a new Greenfield landfill within Kawartha Lakes to manage residual waste generated by single family households and the I C & I sector. An EA will be required as well as subsequent approvals and permits such as EPA, Planning Act, and the Conservation Authority. This process can take up to 10 years given the necessary environmental studies, stakeholder and public consultation.

7.1.2.7 Landfill Mining/Reclamation

Landfill mining will occur at an active City landfill, not yet selected, in order to add air space for landfilling residual waste. It is expected that equipment required for mining activities will be available on the landfill operation site; additional equipment will be rented rather than purchased due to the short term nature of the project (one to two years). Exact quantities and proportions are unknown, however it is estimated that there will be less than 100,000 cubic meters of excavated materials and therefore an EA will not be required but an EA Screening may be required should more than 40,000 m3 and less than 100,000 m3 be required for mining. Recycled material and soil excavated will be screened and sent to a City-owned facilities for recycling and reuse, respectively.

It should be noted the City has explored mining at a closed site previously but concluded there was not a strong business case at that time.

7.1.2.8 Exporting Waste out of the City

Exporting waste will only occur once the City's major landfill has exhausted its capacity, however could also be used as a means to delay closure. This option relies on the assumption that there will be landfill capacity or a waste-to-energy facility located outside of the City's boundaries while still within Ontario. The City will need to upgrade and/or expand its existing transfer stations to receive and transfer residual waste to its exporting location. Tipping fees at the City's landfills are anticipated to increase given the additional transportation costs; the City will save in costs due to no longer needing to manage its landfills.

7.1.2.9 Privatization of City Facilities

The City will sell its landfill site to a private owner and operator where the buyer will be responsible for all capital and development expenses. It is assumed that the City will continue to send its residual waste to this facility and that the agreement will require extensive external legal counsel.

7.2 Evaluation Criteria

In order to asses each waste disposal option, Dillon reviewed background strategic documents provided by the City to understand goals and objectives set by the City. These documents included the Making Waste Matter: Integrated Waste Management Strategy (2015), the update to the Strategy in 2019, the Kawartha Lakes Strategic Plan 2020 – 2023, and the City of Kawartha Lakes' Healthy Environmental Plan (2019). Evaluation criteria and indicators were developed based on their alignment to the principles, goals and strategies within these documents.

An evaluation assessment tool was set up to evaluate each alternative technology and landfill-related option by applying the three criteria categories economic feasibility, social impacts and environmental impacts. These criteria each have three evaluation components: rank, relative weightings and key performance indicators (KPIs) which are described below.

- **Rank:** Each criteria indicator has either three choices for ranking the option. A ranking of 1 is most favourable and a ranking of 3 is least favourable.
- **Relative Weightings**: Based on background information, the proposed weightings per criteria were developed.
- **Key Performance Indicators (KPIs):** The KPIs establish how the indicators are evaluated. KPIs are provided for each criterion. KPIs are either quantitative or qualitative. For example, "Capital Cost" criterion is quantitative since it is measured as a cost, whereas rationale for "Public Acceptance" requires a qualitative response.

An evaluation assessment tool (**Appendix B**) was set up to evaluate each alternative technology and landfill-related option by applying the criteria. **Table 5**, below, shows the assessment criteria and indicators that were used to evaluate each option. As part of the assessment, the criteria was evaluated based on a ranking system for each individual option.

Table 5: Assessment Criteria and Indicators

Criteria	Criteria Indicator
Economic Feasibility	Annual operating costs
Economic Feasibility	Capital costs
Economic Feasibility	Level of risk - liability or environmental (e.g., low risk, expected results, may vary, City has little control)
Social Impacts	Public acceptance
Social Impacts	Collaboration with others (i.e. partner with other municipalities)
Social Impacts	Proven or unproven (e.g., unproven, proven at smaller scale, proven at larger scale)
Social Impacts	Level of effort to develop, implement, operate and maintain the option (e.g., low to high level of effort)
Environmental Impacts	Climate change impacts (e.g., estimated GHG reductions)
Environmental Impacts	Energy (e.g., produced, consumed)
Environmental Impacts	Air quality impact
Environmental Impacts	Land requirements
Environmental Impacts	Impact to groundwater and surface water
Environmental Impacts	Nuisance impacts (odour, noise, traffic, litter)
Environmental Impacts	Potential for diversion from landfill disposal

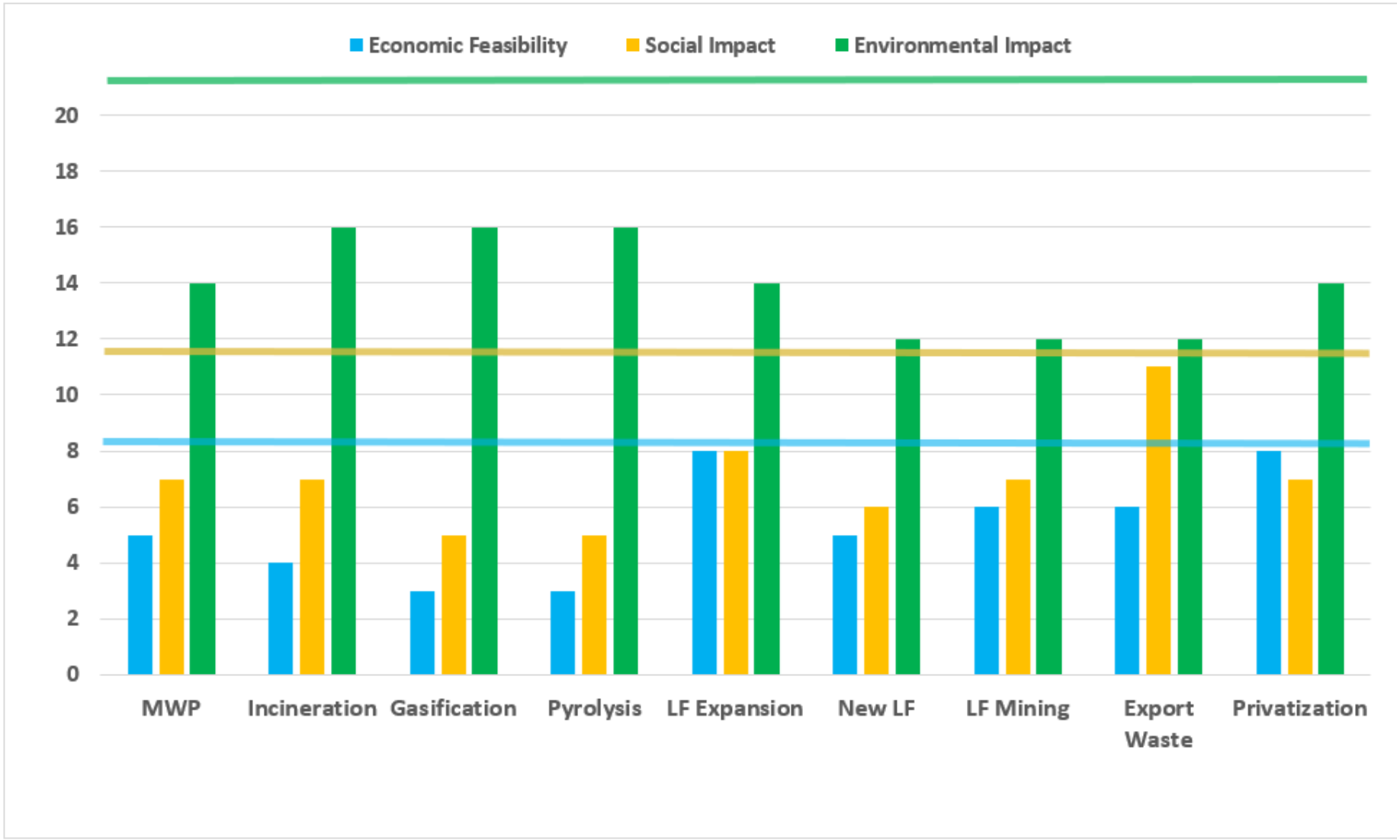
7.3 Evaluation Results

As noted previously, the scores are based on assumptions, information provided by the City, key performance indicators, as well as additional research and knowledge.

Figure 11 shows each option and their evaluated scores. The evaluation criteria of economic feasibility (blue), social impact (yellow), and environmental impact (green) each have different indicators. Each indicator has been scored out of three, with one as

the least favourable and three as the most favourable. The best possible score for each criteria is shown as a horizontal line; the highest score for economic feasibility is a nine, the highest score for social impact is a 12, and the highest score for environmental impact is a 21.

Figure 11: Options Total Scores by Evaluation Criteria



The weighted averages for each option are shown in **Table 6**, below, and are displayed in conditional formatting. The best possible scores for each of the evaluation criteria is three and the best possible overall score is nine. The conditional formatting shows the highest scores (i.e., most favourable) as bright green and lowest scores as bright red (least favourable).

The results show that the most favourable and highest scored option is Landfill Expansion which scored a 6.75 and the second best options are Exporting Waste and Privatizing City Facilities which both scored 6.35. The two least favourable and lowest scored options are Gasification and Pyrolysis—both scored at 4.65. The full evaluation results, along with rationale for each applied score, is provided in **Appendix C.**

Table 6: Summarized Weighted Averages of Options

Evaluation Criteria	Best Possible Score	Mixed Waste Processing	Mass Burn Incineration	Gasification	Pyrolysis	Landfill Expansion	New landfill	Landfill mining	Export waste	Privatization
Economic	3	1.70	1.40	1.00	1.00	2.70	1.60	2.00	2.00	2.60
Social	3	1.75	1.75	1.35	1.35	2.05	1.55	1.85	2.85	1.80
Environmental	3	1.90	2.30	2.30	2.30	2.00	1.70	1.75	1.60	1.95
Overall Total Score - out of 9		**5.35 (ranked 5th)**	**5.45 (ranked 4th)**	**4.65 (tie ranked 7th)**	**4.65 (tie ranked 7th)**	**6.75 (ranked 1st)**	**4.85 (ranked 6th)**	**5.60 (ranked 3rd)**	**6.35 (tie ranked 2nd)**	**6.35 (tie ranked 2nd)**

8.0 Preferred Option and Implementation Considerations

Based on the evaluation results, the preferred option to secure future disposal capacity for the City of Kawartha Lakes is to expand a City landfill site(s). This option would involve either vertically and/or horizontally expansion of one or more of the City's five landfill sites. Expansion will depend on factors such as site environmental and geotechnical conditions, adjacent land uses and availability of land. Expanding multiple sites to achieve the overall anticipated capacity over the planning period could be considered; however, this would involve looking at alternative methods for expanding each site, estimating the available capacity and the potential impacts of each site in addition to the other factors mentioned above.

Based on current information including previous work completed by the City, the Lindsay Ops Landfill, which is forecasted to close in 2037, appears to have the greatest potential for expansion within the current property boundaries. A vertical expansion would be above the existing landfill mound and within property boundaries, and there is possibility of a horizontal expansion if the landfill was extended over the existing composting area at the north end of the site.

It is expected that although a vertical expansion of existing landfills could provide some of the additional volume required, it is assumed that it would not meet the entire additional volume needed and some amount of horizontal expansion would be required. As previously mentioned, the City is currently reviewing the potential to gain additional capacity at the Laxton and Fenelon landfill sites through additional height lifts. Should these prove to be not feasible, these two landfill sites are forecasted to close in 2024. Somerville is deemed to have sufficient capacity with over 60 years of site life remaining based on current fill rates and Eldon would require the City to purchase additional lands to expand that site. It is noted that should Laxton and Fenelon close, waste will be redirected to the other three landfills which is likely to reduce their lifespans.

In terms of next steps, it is recommended that the City present the findings of the Study and the preferred alternative to City Council and go out for public and stakeholder

consultation. Completing a high level estimate of the potential additional air space through vertical and/or horizontal expansion of the Lindsay Ops, Laxton, and Fenelon landfill sites would also be a valuable exercise.

Following input, it is anticipated that an Individual Environmental Assessment (EA) will be initiated through the preparation of the Terms of Reference. The Terms of Reference will outline the steps to be taken to complete the EA and is anticipated to build on the work completed in this Study through demonstrating the need for expansion (e.g., reconfirming residual waste quantities and air space requirements), assessment the environment and potential effects and identifying site-specific landfill site development alternative methods. The Alternative Methods component would examine how the City could achieve its long term disposal requirements by expanding one or more of the City's landfill sites. The work undertaken in this Study has examined the Alternatives To the Undertaking (i.e., different ways to manage residual waste) which could support a more focused EA process. The Terms of Reference will outline the necessary technical studies that will be undertaken in the EA that will confirm the existing environmental conditions, provide data towards alternative methods to site development and identify and mitigate potential effects. Technical studies that are anticipated to be required are for agriculture, air quality, archaeology, biology, cultural heritage, design and operations, hydrogeology, noise, socio-economic, surface water and transportation. Consultation is an integral component to the EA process from the initiation of the Terms of Reference through to the notice of completion of the EA. Following EA approval, additional permits and approvals would be sought and then the engineering, design and construction of the new landfill cells, including landfill gas and leachate collection system would be completed.

In summary, the implementation steps include:

- Development of an EA Terms of Reference;
- EA planning process to assess site conditions, preliminary design and potential capacity and filing and develop a recommended approach for M E C P approval;
- Design and regulatory approvals of the approved option from the EA (e.g. multimedia E C A amendment (air/noise, sewage works and waste disposal site), Planning Act);

- Engineering and design of new cells (including landfill gas and leachate collection systems); and,
- Construction.

The following outlines implementation considerations for the preferred option of expanding the City's landfill site(s) in terms of financial, environmental, social, technical and operational, and regulatory considerations. These will be further defined in an EA.

8.1 Financial Considerations:

- The estimated cost for the Environmental Assessment (EA) process for a landfill expansion will vary depending on the site(s) considered, site constraints, complexity of expansion, etc. The technical studies will be defined and an extensive consultation plan will be developed during the Terms of Reference.
- A high level estimate, based on Dillon's experience with EAs for other landfill expansions in Ontario, for the anticipated size required to meet future capacity needs is between $2 and $5 million to expand one site through the following breakdown:
    - EA Terms of Reference is approximately 10% of the total cost, and ranges between $200,000 and $500,000.
    - The remainder of the total cost would be for the EA and consist of:
    - Technical studies (approximately 65%),
    - Public and stakeholder consultations (approximately 20%), and
    - EA documentation and project management (approximately 15%).
    - For example, a $3.5 million EA would be expected to breakdown into $350,000 for the EA Terms of Reference, $2 million for technical studies, $630,000 for consultations, and $473,000 for reporting. This example is for illustration purposes only; actual EA costs would need to be developed in detail based on the factors listed above.
- Should the City pursue the expansion of multiple landfill sites as an alternative site development method, the estimated cost could be 50% more per site. The rationale for the undertaking, alternatives to and consultation activities would be similar for multiple City sites; however, alternative methods for site development, technical studies and assessing potential effects and mitigation measures would be required for each site.

- Securing additional approvals and completing the engineering, design and construction are estimated to be in the order of $10 – $50 million depending on the size and complexity of the expansion. For a typical landfill cell including liner system and leachate collection, capital construction costs are estimated to range between $1.5 to $2.5 million per hectare.
- Purchasing of adjacent lands has not been considered.
- Changes to the annual operating costs will be determined based on the final approved design; however are expected to be minimal, as operations will continue in a similar manner to current operations. It is anticipated that no additional staff will be required. The City's current annual landfill operational costs are estimated at approximately $2.7 million dollars.
- Operational cost savings and efficiencies could be achieved if the majority of residual waste is managed at one landfill site compared to five sites.

8.2 Environmental Considerations:

- Current management and monitoring practices could be continued thus reducing new impacts to air quality, groundwater and surface water.
- Horizontally expanding a landfill may require clearing of trees and vegetation which could disrupt ecological species in the area.
- Several environmental investigations are anticipated to determine the suitability of the site for expansion (e.g., geotechnical, groundwater, surface water).

8.3 Social Considerations:

- Potential for concerns from the public and stakeholders with respect to the extension of the landfill site beyond its projected site life.
- The consultation program can provide input into additional mitigation measures required to address concerns from the public and stakeholders.
- An expansion to an existing site(s) would extend current operations resulting in minimal change in noise, odour and traffic impacts depending on the quantities of waste received at the site(s).

8.4 Technical and Operational Considerations:

- Minimal change would be required for City staff to operate an existing landfill site.
- Completion of a high level vertical and horizontal expansion air space estimate would help build an understanding of how much additional life span each landfill site could yield.
- Timing for securing EA and other approvals is unknown and unpredictable, depending on the level of community interest and the complexity of the undertaking.
- Any construction relating to expansion cannot start until the regulatory approvals are secured. It is estimated that a minimum of five years is required to implement an expansion of a City landfill site(s).

8.5 Regulatory Considerations:

- Depending on the extent and type of landfill expansion, an Individual EA and an amendment to the current E C A will be required.
- Based on other landfill expansions completed in Ontario over the past 20 years, vertical expansions typically take three to five years to complete the EA process and horizontal expansions closer to five years but have taken as long as 10 years in complex cases. Timing can be impacted by the environmental sensitivity of required lands, public and stakeholder feedback, etc.
- It is noted that the M E C P is undertaking a review of the EA process and looking for ways to modernize the approvals process which could involve changes to thresholds for screening and EA requirements. The timing for the EA modernization is unknown.

The process to expand a landfill is a lengthy one and could take between 8-12 years noting the major steps include submission and approval of the EA (4-6 years), obtaining additional approvals and completing the design (3-5 years) and construction of the new landfill cell(s) (1 year). Initiating the process soon is recommended to provide sufficient time to complete the process before the remaining landfill sites exhaust their capacities.

9.0 Next Steps

The initial evaluation results were presented to the M E C P at a pre-consultation meeting in August 2021 for information purposes and the intention is to meet again after the Study is presented to Council. On November 8, 2021, the preliminary results were presented to the Waste Management Committee and interested members of the Fenelon and Lindsay Ops Public Review Committees. After some discussion, the Waste Management Committee voted to receive the presentation of preliminary results.

The next steps are to seek Council approval on the preliminary results. It is proposed to then consult with key stakeholders and the general public on the process undertaken through this study, the evaluation approach and results and the preliminary preferred option to secure long term disposal capacity.

Should landfill expansion be pursued, then a Terms of Reference for an Individual Environmental Assessment would be undertaken which would assess several factors including the need for additional capacity, the different ways in which the City could achieve the necessary disposal capacity among its landfill site(s) and the potential effects with the proposed undertaking. The Terms of Reference will outline the proposed steps to take to complete the EA. Following M E C P approval of the Terms of Reference, the EA will begin to identify a preferred option.