Solid Waste Master Plan | Plan directeur des déchets solides

Long-Term Waste Management Needs

June 2021

Disclaimer

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Executive Summary

Introduction

With the thorough analysis of the City's current waste system completed in Phase 1, this technical memorandum identifies the City's future long-term waste management needs. To do this, the analysis considers long-term waste and population projections, policies and programs influencing waste management in the City of Ottawa, as well as best practices affecting solid waste management to help identify the future needs of the City's solid waste management system. These needs have been compared with the information collected in Phase 1 to identify gaps, challenges and opportunities within the existing system. The future needs identified align with the draft vision, guiding principles and goals that have been developed in support of the Solid Waste Master Plan (SWMP). Key risks and considerations that may impact long-term waste management have also been identified.

This assessment will serve as a natural stepping-stone for the next stage of Phase 2, which considers different options to meet these future needs and the recommendations that will underpin the SWMP. Options considered will address the needs identified in this memorandum, as well as align with the City's vision of "A Zero Waste Ottawa achieved through progressive, collective and innovative action", supported by guiding principles and goals for how waste will be managed in the future. This Technical Memorandum is current until January 21, 2021 and may not reflect subsequent changes to Canadian and Ontario policies, programs and legislation.

This Technical Memorandum consists of two parts; the first part documents and discusses the waste projections undertaken to estimate the future quantities of waste requiring management over the 30-year life of the SWMP and the second part documents the results of the needs analysis, which examines the status quo system and identifies gaps, constraints and opportunities related to waste management infrastructure, facilities, programs and existing third-party contracts.

Forecasting Future Needs

The City is faced with an increasing population, changing waste composition and industry trends that are impacting the quantities and composition of waste requiring management. By understanding how the City's population and waste management needs may change in the next 30 years, the City can make effective and efficient decisions about waste management programs and services, and plan for the proper supporting infrastructure and contracts to be developed or maintained.

A statistical model was developed to assist the City with projecting quantities of waste requiring future management based on historical tonnages of Curbside Residential and Multi-Residential/Containerized waste and the status quo system. There are many factors that affect waste generation which include changes to household composition, how packaging may change in the future, how consumers will spend their money, changes in demographics, etc., however, it is not possible to speculate on the impact of future waste generation rates with any degree of accuracy.

Traditionally, municipalities would calculate average waste generation per household over a designated time span, without any consideration to economic trends. Projections would be formed by multiplying the historic, average waste generation per household with the projected number of households. It has been more challenging of late to generate meaningful projections with the effects of changes to packaging (e.g., light-weighting), purchasing habits (e.g., more convenience foods, single use items, online shopping), and a shift from print media to electronic media (e.g. fewer newspapers and magazines being sold), to name a few. These changes have contributed to a decrease in waste generation, as this metric is primarily weight-based. The City will already have seen the impact of these changes to packaging and lifestyles in the tonnes of recycling managed over the last 10 years or so. This approach to estimating the amount of waste to be managed over time, which worked satisfactorily in the past, could cause current-day projections to be unrealistically high. However, by factoring economic trends into the modelling process, more realistic predictions are possible.

The approach taken to developing projections for the SWMP was to relate annual Curbside Residential (CR) and Multi-Residential/Containerized (MR/C) tonnage on a per household basis to annual socio-economic indicators (including household counts) specific to the City. These techniques were applied to identify which socio-economic indicators available from the City were the best predictors of future waste generation. Various available socio-economic indicators provided by the City were used to determine the best or optimal model which can predict annual tonnes generated per household separately for Curbside Residential (CR) and Multi-Residential Containerized (MR/C) sectors. The best model used annual CR and MR/C tonnage on a per household level as a function of lagged employment rate.

This model was used to project waste generation by waste stream from the single family and multi-residential sectors, and City facilities, as presented in the following figures. Note the shaded areas denote the high and low ranges in the estimates.

Single-family, Multi-residential and City Facility Waste Projections

Figure 1 presents the historical and projected tonnes of waste streams from the single-family sector. The LYW tonnages shown include total LYW generated (i.e. tonnage that is collected and sent to Convertus as well as tonnage collected and sent to Barnsdale). **Figure 2** presents the historical and projected tonnes of waste streams from the multi-residential sector, while **Figure 3** presents City facilities tonnages split by stream.

It is important to note that these projections do not include the impact of the proposed transition to individual producer responsibility for recycling.

Figure 1: Single Family Residential Tonnages by Waste Stream

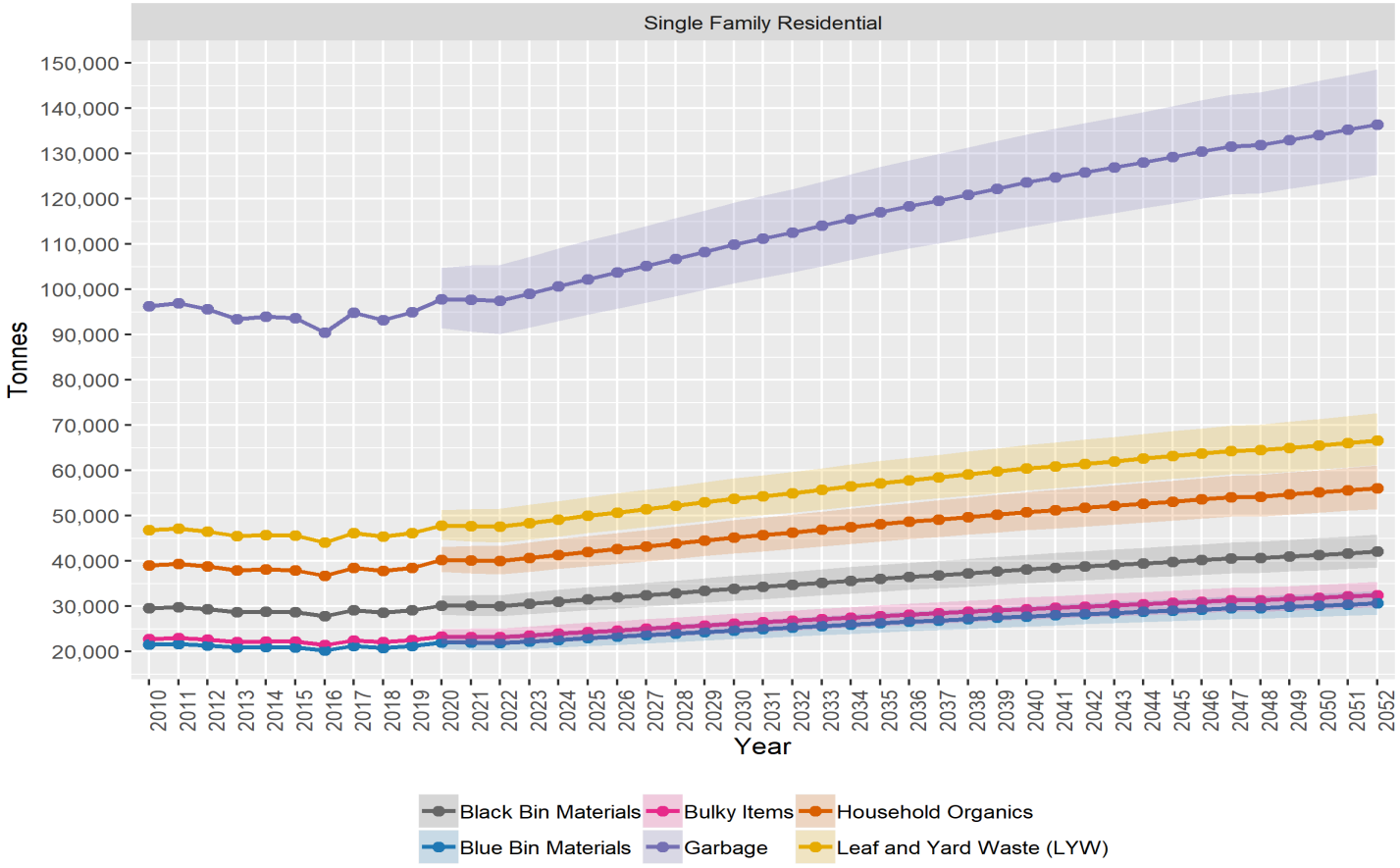


Figure 2: Multi-Residential Tonnages by Waste Stream

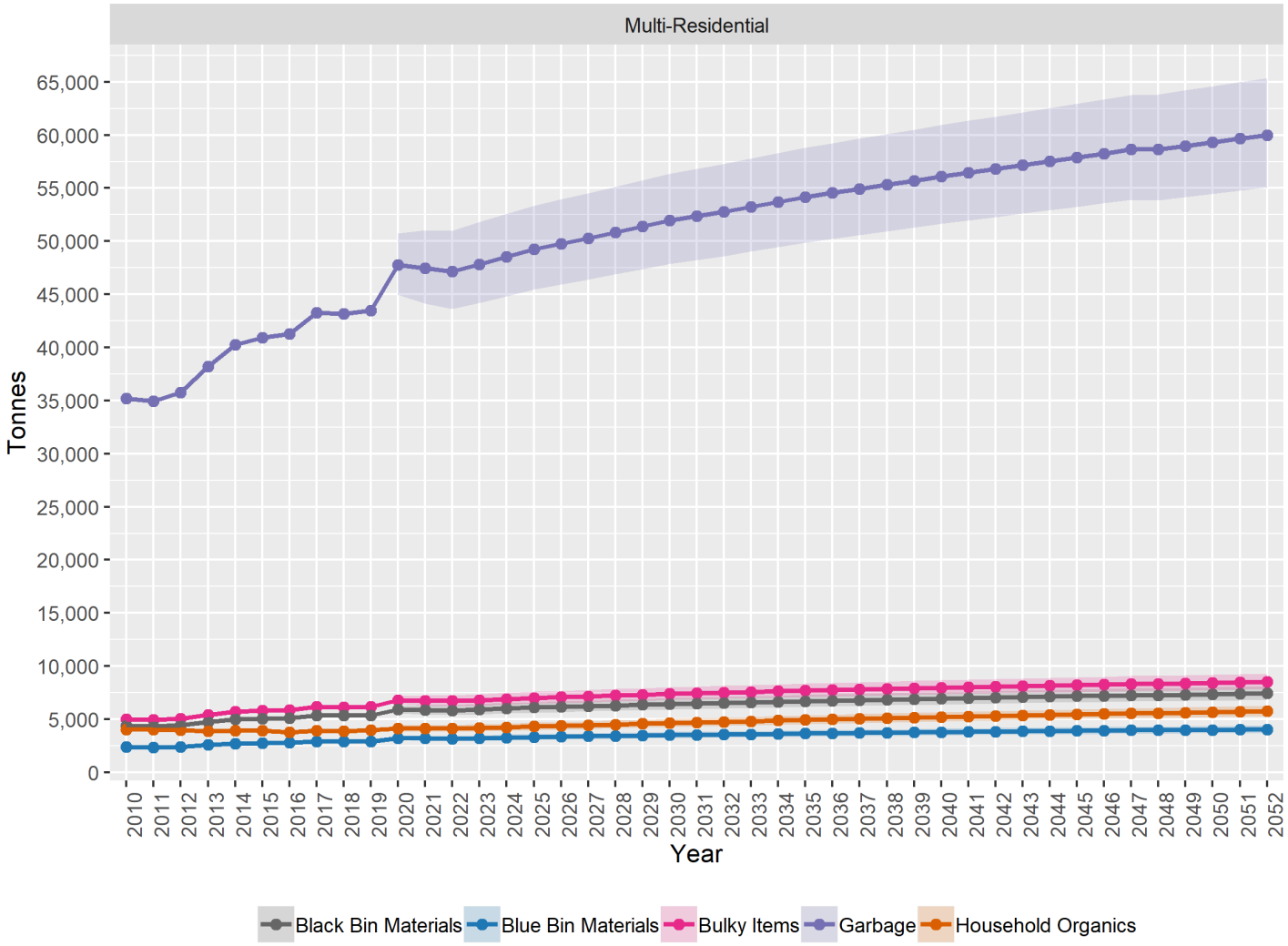
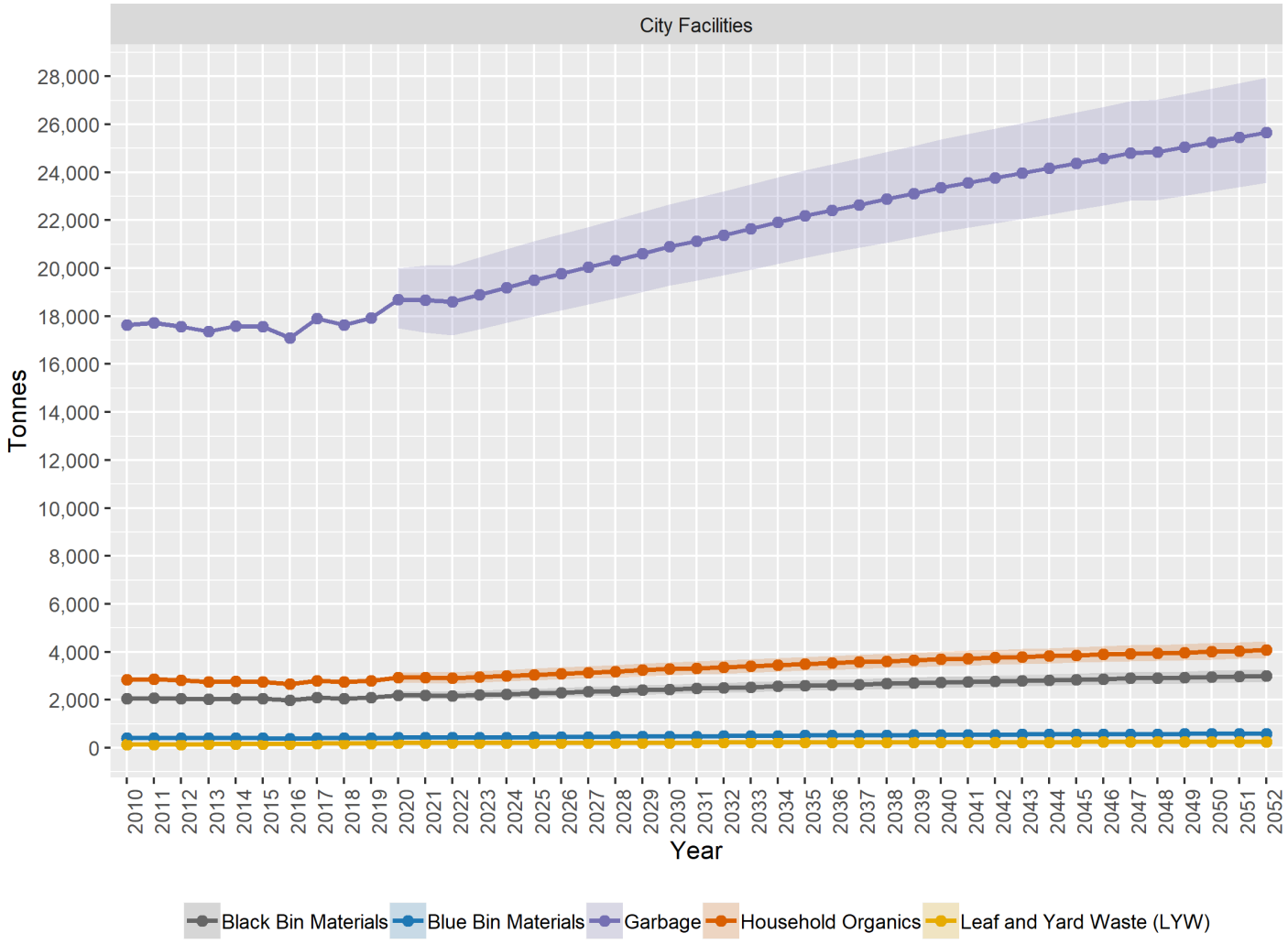


Figure 3: City Facilities Tonnages by Waste Stream



Parks and Public Space Waste Projections

Projections for waste managed at parks and public spaces were calculated based on historical information and per capita generation rates (using the City's projected population growth). **Table 1** presents the projected tonnes of garbage and recycling that would need to be managed in the future, based on the status quo system.

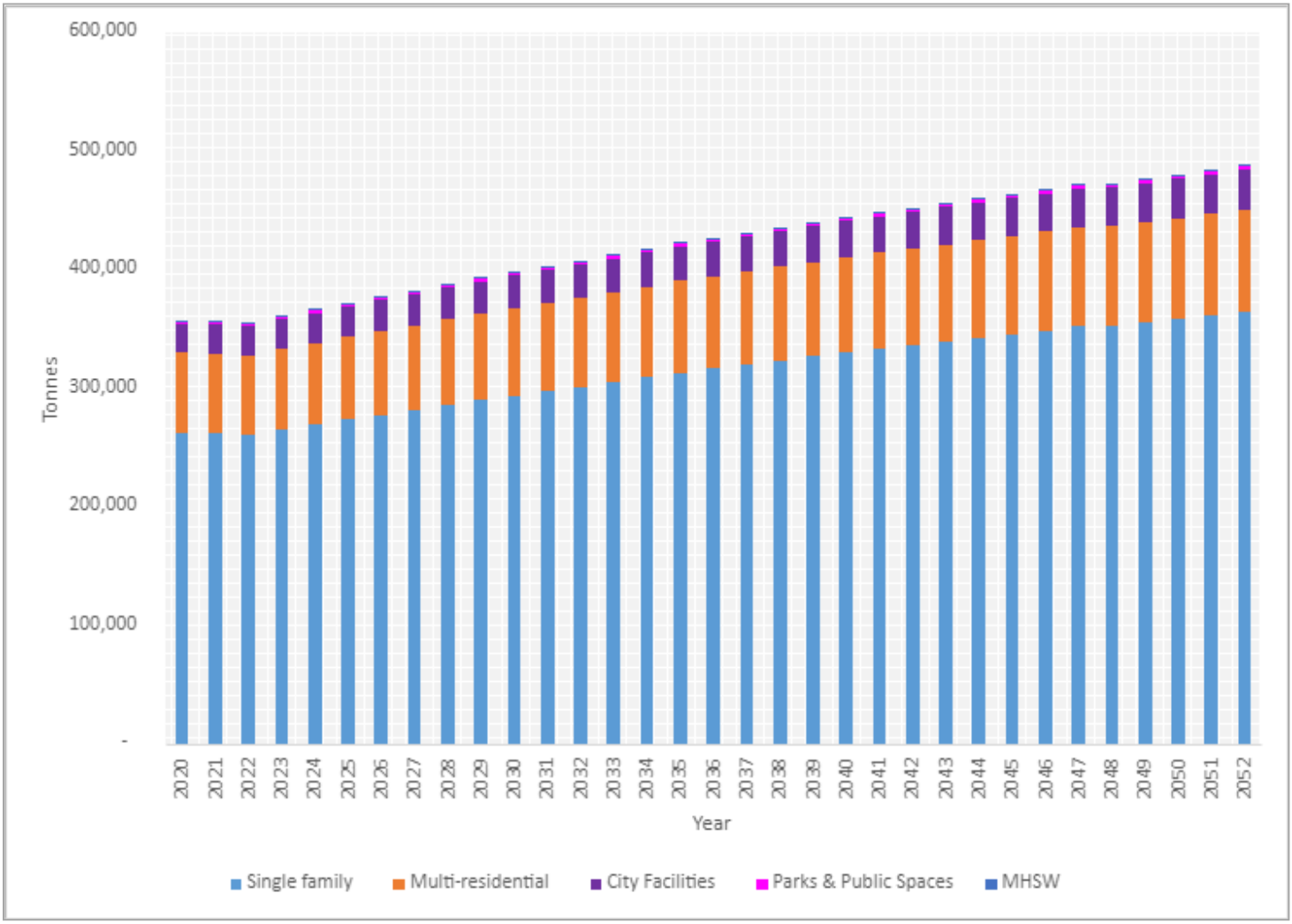
Table 1: Projected Tonnes of Garbage and Recycling Managed at Parks and Public Spaces

Year	Garbage (tonnes)	Recycling (tonnes)
2020	1,739	9.8
2025	1,874	10.5
2030	2,003	11.2
2035	2,125	11.9
2040	2,234	12.5
2045	2,328	13.1
2050	2,470	13.8
2052	2,518	14.1

Projected Tonnages required to be managed over the Next 30 Years- Broken Down by Material Stream

Figure 4 presents the total projected annual tonnes for all waste streams combined (garbage, bulky, recycling, household organics, LYW and MHSW) for single family, multi-residential, City facilities and Parks and Public Spaces managed by the City between 2020 and 2052.

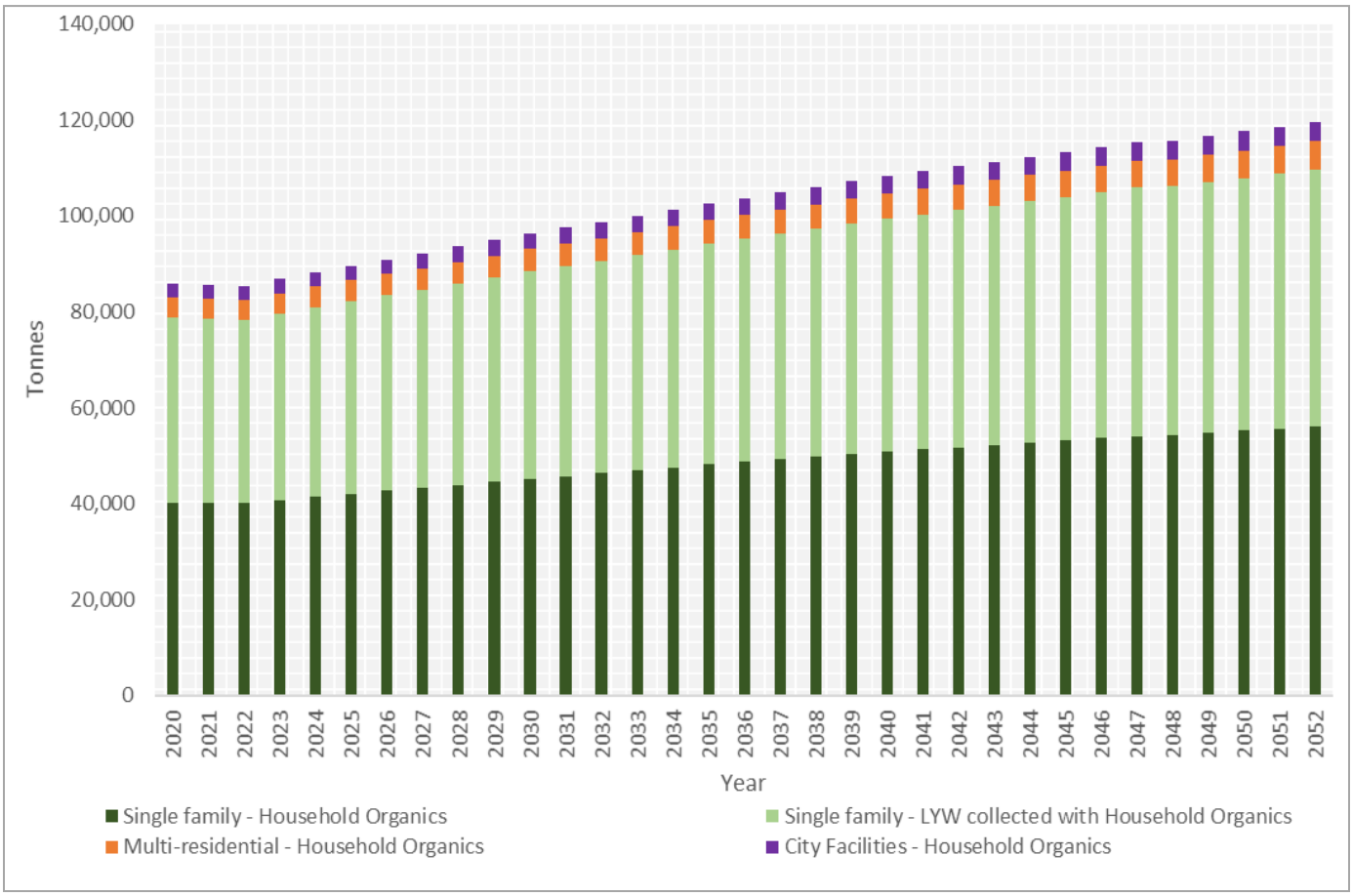
Figure 4: Total Projected Annual Waste for Single Family, Multi-residential, City Facilities, Parks and Public Spaces (2020 to 2052)



Projected Tonnes of Green Bin Organics

Figure 5 presents the projected tonnes of Green Bin Organics, which includes household organics from single family, multi-residential, and City facilities, as well as LYW collected at the curb from single family residences with household organics in the Green Bin, which will require management by the City.

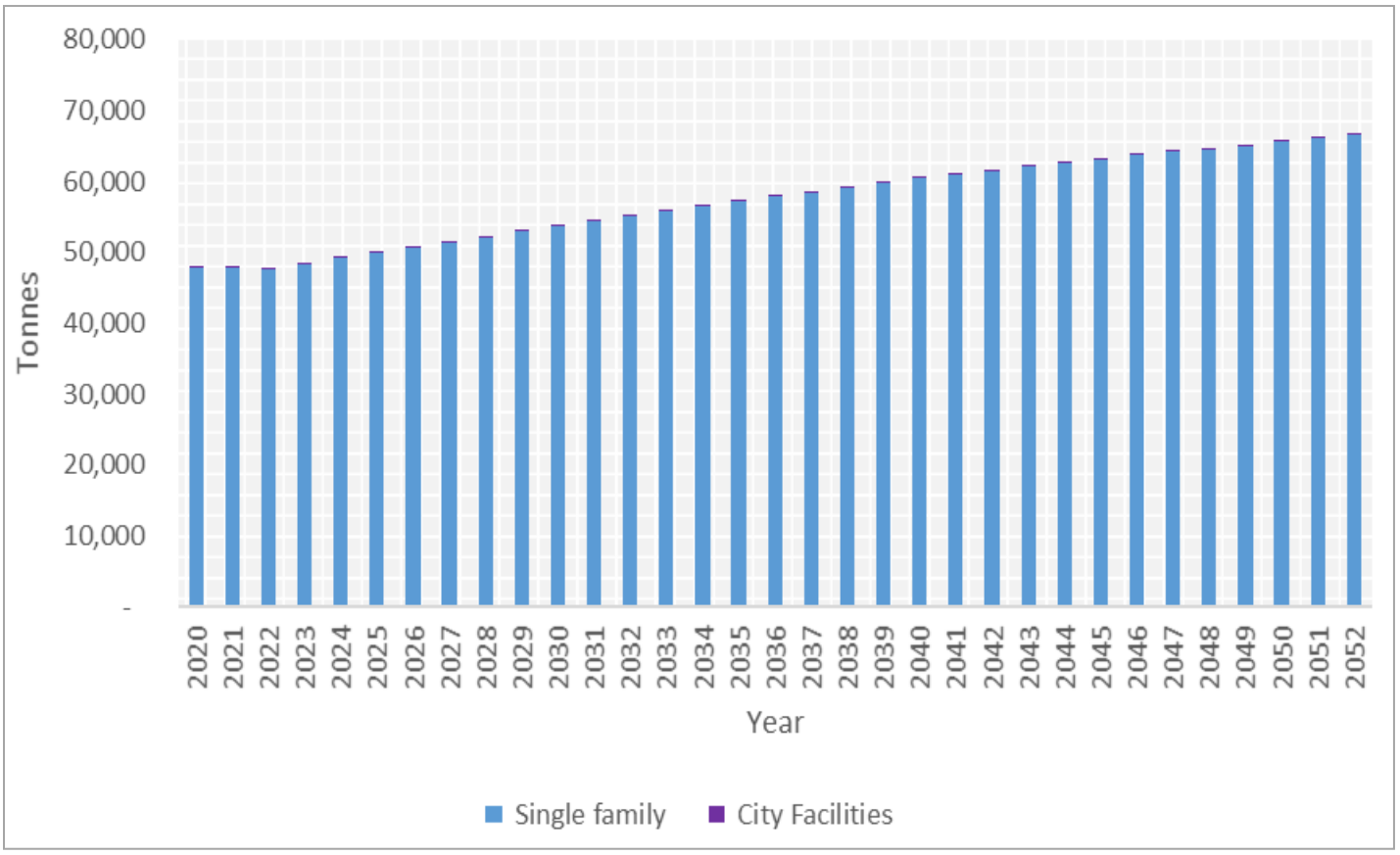
Figure 5: Annual Green Bin Organics Projections (2020 to 2052)



Projected Tonnes of Separately Collected Leaf and Yard Waste

Figure 6 presents projections for separately collected leaf and yard waste (LYW) from single family residences and City facilities that is sent to Barnsdale for processing, as well as LYW that is currently collected with household organics at the curb from single family homes and is sent to Convertus for processing. The City does not provide LYW collection to the multi-residential sector; any LYW generated is likely managed by private contractors (e.g. landscaping companies). While the quantities of LYW generated are very dependent on factors such as precipitation, it is estimated that LYW quantities will increase from around 48,000 tonnes in 2020 to 67,000 tonnes in 2052.

Figure 6: Annual Leaf and Yard Waste Projections (2020 to 2052)



Projected Tonnes of Blue and Black Bin Materials

Figure 7 and **Figure 8** present the projected tonnes of Blue and Black Bin materials generated by single family, multi-residential and City facilities. Note that these projections do not take into consideration any changes due to the transition of the Provincial Blue Box Program (includes

City's Blue and Black Bin recycling programs) to Individual Producer Responsibility (IPR), including additional materials that may be designated for inclusion in the new Provincial Blue Box regulations, which are yet to be finalized. It is unknown at this time what the full impact of the transition of the Provincial Blue Box program to IPR will have on these tonnages or on the Materials Recovery Facility (MRF) currently used to manage the City's recyclables.

Figure 7: Annual Blue Bin Materials Projections (2020 to 2052)

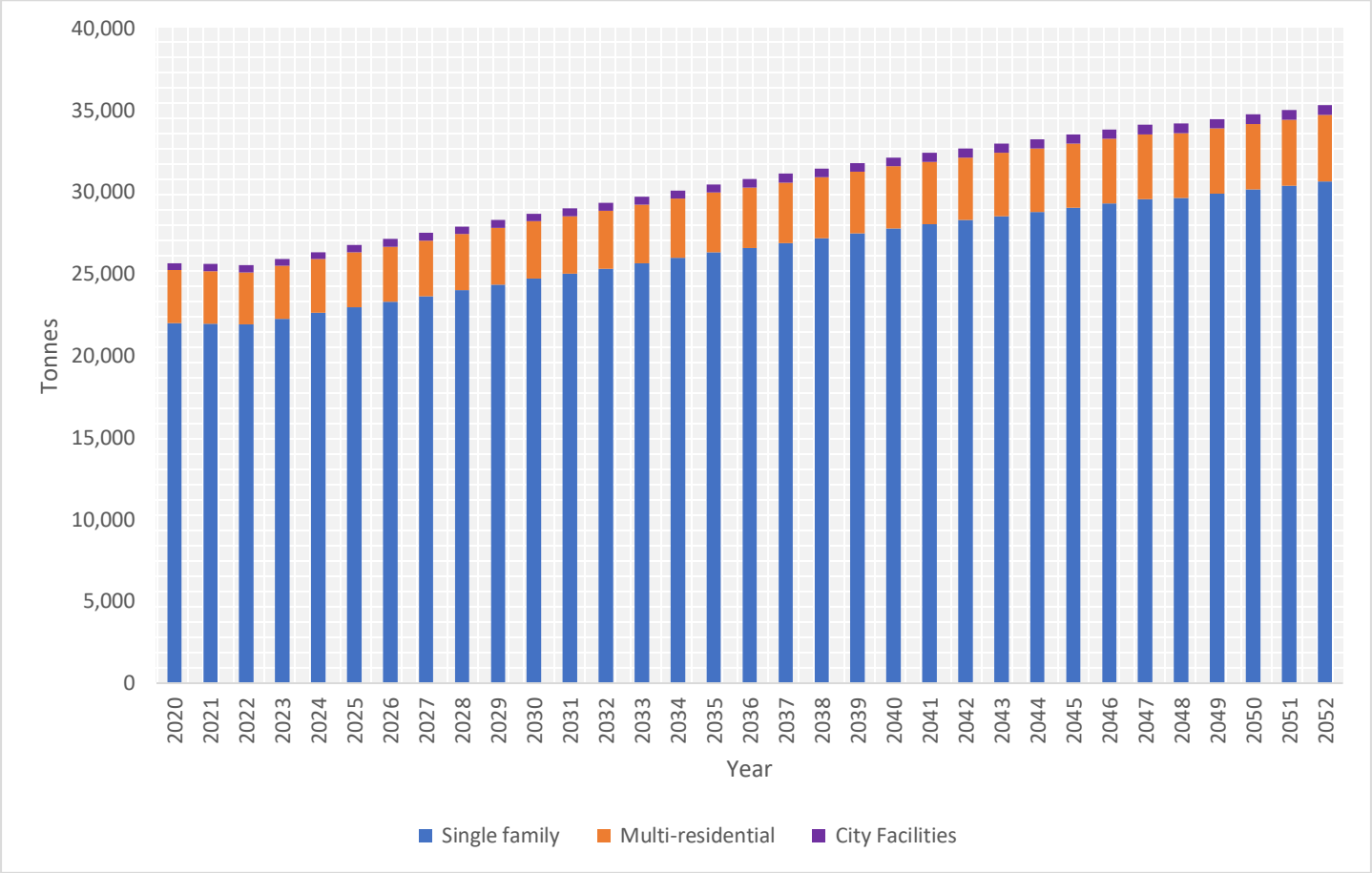
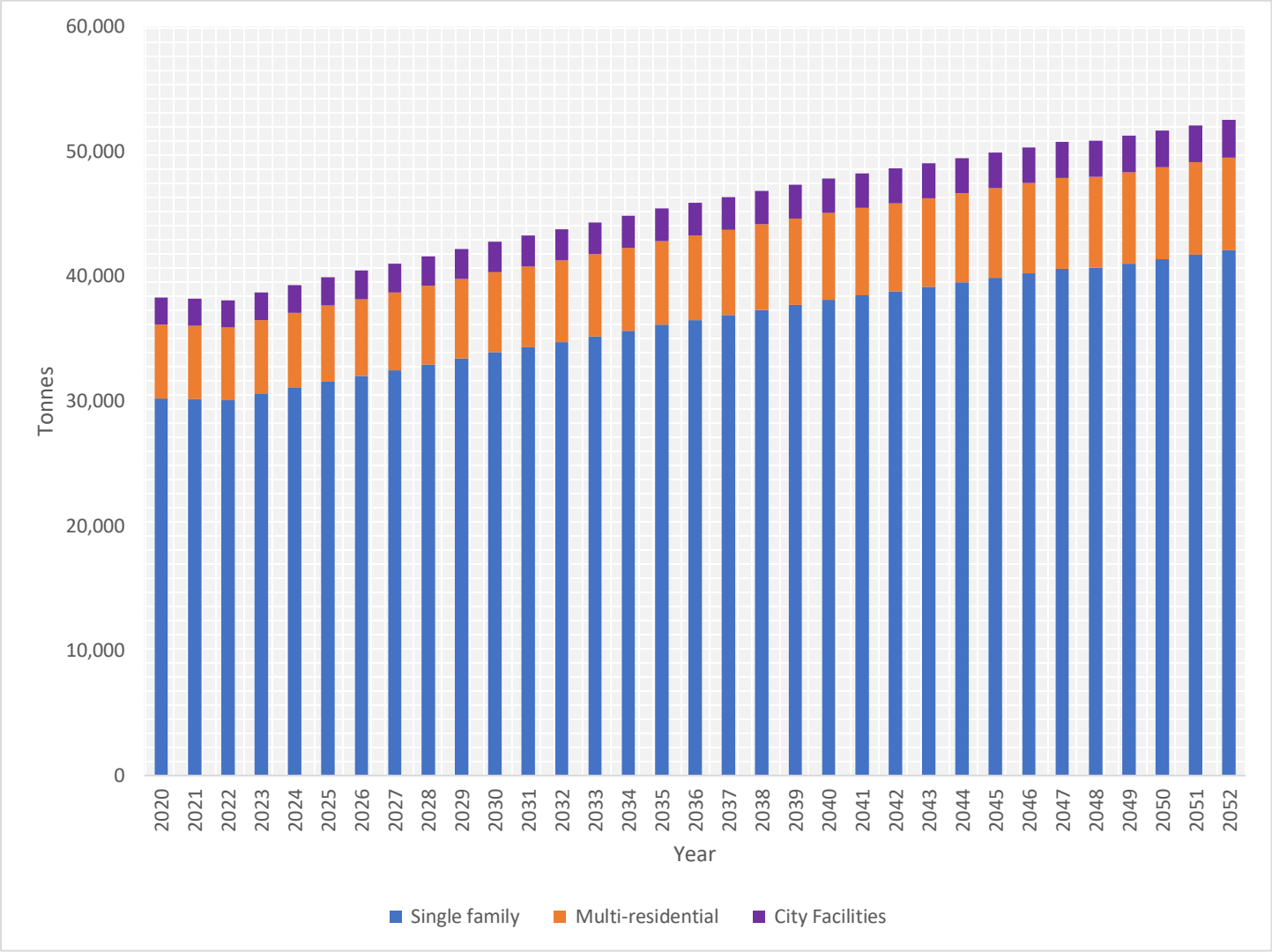


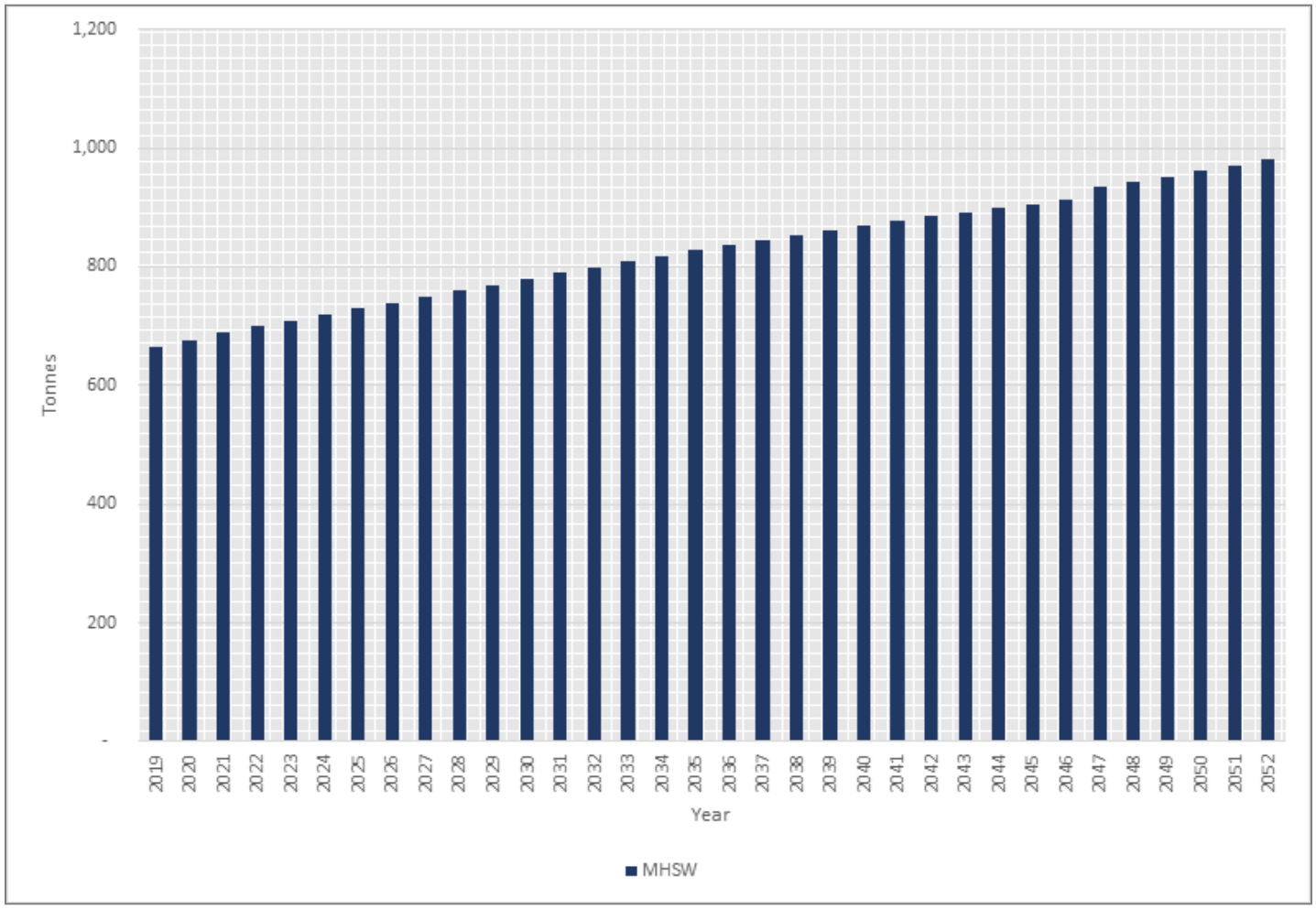
Figure 8: Annual Black Bin Materials Projections (2020 to 2052)



Projected Tonnes of Municipal Hazardous Special Waste

Figure 9 presents the projected tonnes of Municipal Hazardous Special Waste (MHSW) materials anticipated to be generated by single family homes and multi-residential buildings and is based on 2019 tonnages managed at the City's one-day mobile MHSW deports. Projections for MHSW were based on per capita generation rates and it is expected that approximately 980 tonnes of MHSW will be generated in 2052, based on the status quo system.

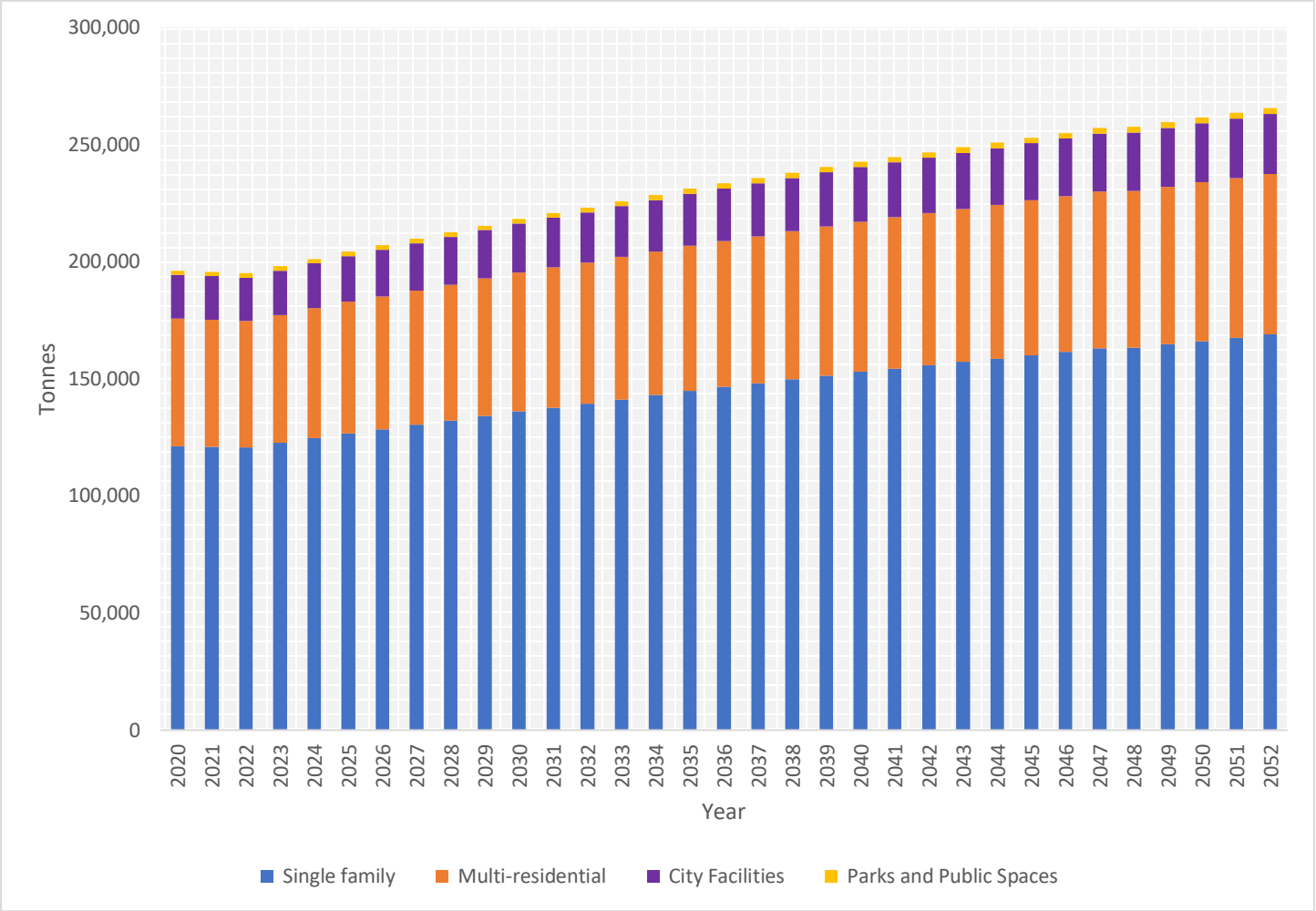
Figure 9: Annual Municipal Hazardous Special Waste (2020 to 2052)



Projected Tonnes of Garbage and Bulky Waste

Figure 10 presents the projections for the tonnes of garbage and bulky waste to be managed by the City from all three sectors, as well as from Parks and Public Spaces. In total, it is projected that all four sectors will generate approximately 265,600 tonnes of garbage in 2052, based on the status quo system.

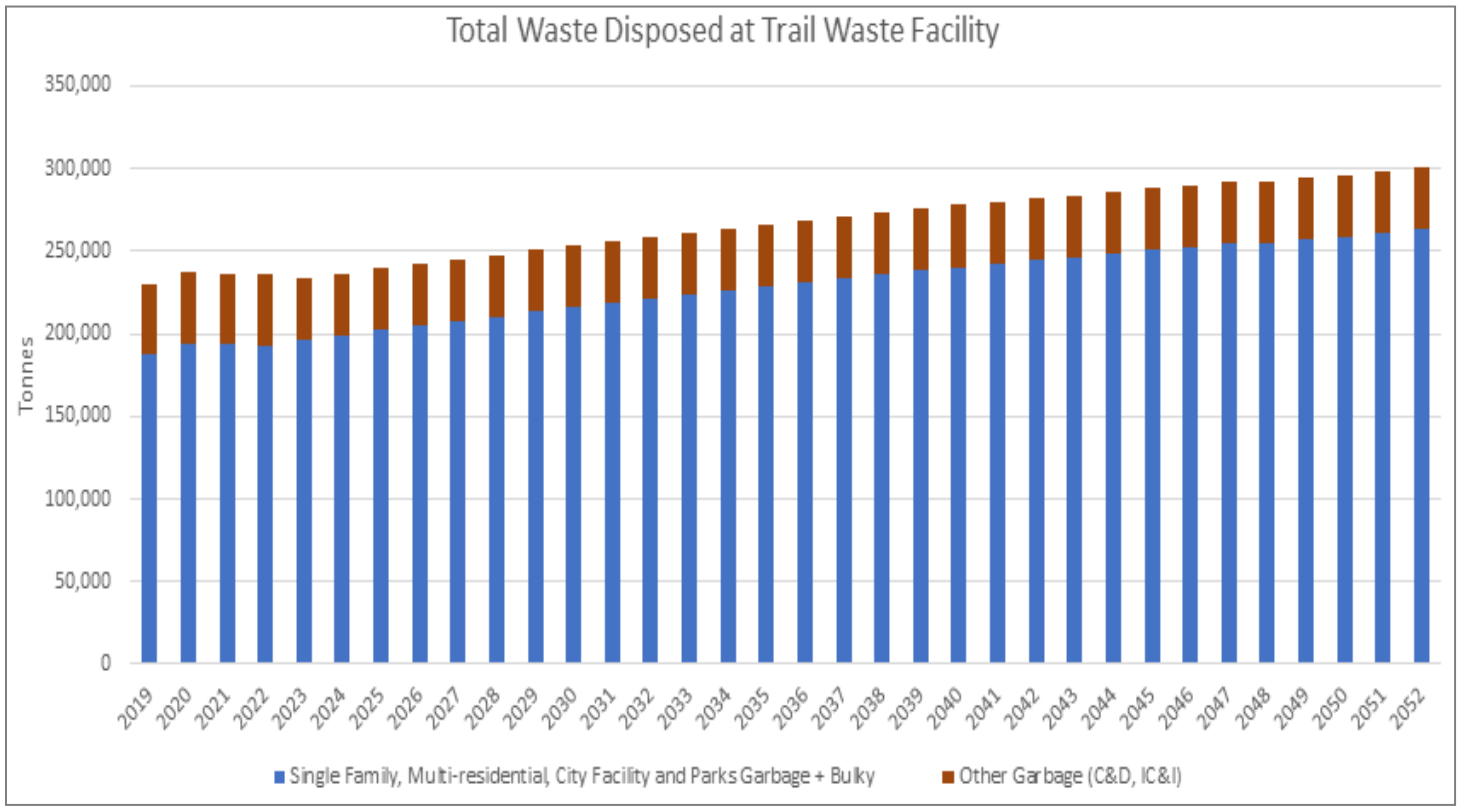
Figure 10: Annual Garbage Projections from all Sectors (2020 to 2052)



Projected Tonnes of Waste Disposed at the Trail Waste Facility Landfill

Figure 11 presents the projections for the tonnes of garbage disposed at the Trail Waste Facility landfill. These projections include garbage and bulky waste generated by single-family homes, multi-residential properties, City facilities and parks and public spaces that is transported to the landfill for disposal by the City i.e. the waste that is included in the projections shown above in **Figure 10**, plus other garbage i.e. IC&I and C&D waste that is brought directly to the landfill by the private sector. In total, it is projected that approximately 302,929 tonnes of garbage will be disposed at the Trail Waste Facility landfill in 2052, based on the status quo system.

Figure 11: Annual Projections for Waste Disposed at Trail Waste Facility Landfill (2020 to 2052)



Needs Analysis

A needs analysis was undertaken, considering the current system, existing components that have the potential for enhancement/ improvement, new opportunities and where contracts are expiring, offering the potential to do something different.

Gaps, constraints and/or opportunities were identified based on the consulting team's experience and review of the Current State System Summary technical memorandum prepared as part of Phase 1 of the SWMP, as well as knowledge and experience of staff. In addition, the waste projections and the key industry and regulatory trends identified in Phase 1 which will have an impact on the City's integrated waste management system were reviewed and considered when identifying the future needs. Feedback received from stakeholders through Engagement Series 1 was also considered when identifying these needs.

The analysis has been broken down into the following seven categories, **Table 2** provides an overview of the needs identified for the future City waste management system and the proposed implementation timeline.

Table 2: Overview of the Needs for the City's Future Waste Management System

Category	Sub-Category	Future Need	Timeline
Waste Avoidance, Reduction and Reuse	Waste Avoidance, Reduction and Reuse	Identify more ways to reduce and reuse waste generated by residents and in its own operations to decrease the amount of waste entering the City's solid waste management system.	Short, medium and long terms.
Waste Avoidance, Reduction and Reuse	Value of Food and Food Waste	Focus on the value of food to increase the prevention of food waste, which is higher in the waste hierarchy.	Short, medium and long terms
Waste Diversion Programs	Green Bin and Leaf and Yard Waste Program	Confirm the City has sufficient organics processing capacity prior to 2030 and secure capacity beyond 2030. Tied to the future Green Bin processing capacity needs, the City needs to consider potential options to manage future quantities of LYW, both in the short and medium term.	Short and medium terms
Waste Diversion Programs	Parks and Public Spaces	Decide if a comprehensive and consistent public spaces waste diversion program, including recycling and organics diversion, should be implemented.	Short and medium terms

Category	Sub-Category	Future Need	Timeline
Waste Diversion Programs	Curbside Waste Diversion Program Performance	Identify an approach to support increased curbside waste diversion performance by increasing participation in waste diversion programs.	Short-term
Waste Diversion Programs	Multi-Residential Waste Diversion Program Performance	Recognizing the inherent challenges that exist in increasing participation and the waste diversion rate in the multi-residential sector, actively work with stakeholders in this sector to improve multi-residential waste diversion performance.	Short, medium and long terms
Waste Diversion Programs	New Waste Collection and Diversion Programs	Identify specific waste streams that can be diverted from landfill disposal and develop new collection and diversion programs to capture these streams.	Short, Medium, and long terms
Waste Diversion Programs	Special Events	Waste management practices at special events should support and facilitate waste minimization and waste diversion.	Short-term
Collection and Drop-off of Materials	Collection (current systems, services and programs)	Building on the current systems, services and programs, identify more ways to efficiently collect materials, that are more convenient and accessible to residents and customers.	Short-term
Collection and Drop-off of Materials	Collection (fleet)	Progressively work towards a zero-emissions solid waste fleet.	Short, medium and long terms

Category	Sub-Category	Future Need	Timeline
Collection and Drop-off of Materials	Drop-off	Provide enhanced convenience and additional drop-off opportunities for residents to reduce, reuse and recycle.	Short to medium terms
Recovery of Waste and Energy	Technologies for Waste Recovery	Determine what, if any, waste recovery technologies or approaches will be employed to extend the life of the Trail Waste Facility landfill.	Short, medium and long terms
Recovery of Waste and Energy	Trail Waste Facility Landfill Gas Utilization	Identify an approach to utilizing landfill gas and producing energy once the current contract with PowerTrail expires in 2027.	Short-term
Recovery of Waste and Energy	Technologies for Energy Recovery	Determine what energy recovery technology/ies or approaches will be employed to recover as much waste as possible from the waste stream and create renewable energy from this waste.	Short-term
Residual Management	Trail Waste Facility	Being a key City asset, determine ways to extend the life of the Trail Waste Facility landfill to maximise the life of the asset and plan for new disposal capacity, when required.	Short-term
Residual Management	Future Use of Existing City Owned Waste Management Sites	Determine the future use of bufferland properties, including for operational, community use and or pilot/demonstration opportunities.	Short-term

Category	Sub-Category	Future Need	Timeline
Managing Waste Generated by City Facilities and Operations	No Sub-Category	Develop a strategy that identifies ways in which City facilities and operations can avoid, reduce and divert more waste from disposal.	Short-term
Supporting System Requirements	Promotion and Education	Expand and/or modify technologies and approaches used to reach the City's diverse customer base, to create the desired behavioural changes and to support program priorities.	Short-term
Supporting System Requirements	Regulations, Policies and By-Laws	Having appropriate regulatory tools in place can facilitate the prevention of waste entering the system and improve sorting practices and participation rates in the City's waste diversion programs.	Short-term
Supporting System Requirements	Financial Sustainability	Ensure long-term financial sustainability of the solid waste management system for effective operations and management of solid waste assets.	Short-term

Key Risks and Considerations That May Impact Long-term Waste Management in the City of Ottawa

There are many unknowns regarding the future of waste management, for municipalities in general, and for Ottawa specifically. The following are major considerations and risks that have the potential to impact long term waste management in the City of Ottawa. Each of these will need to be considered during the development of the current SWMP and will require the future SWMP to remain flexible and adaptable as these risks and considerations evolve.

- **Remaining Capacity of Trail Waste Facility Landfill** – Approximately 30% capacity remains at the Trail Road Facility landfill (5.1 million cubic meters), as of the end of 2019. The exact timeframe for when the landfill is expected to be at full is difficult to predict with a high level of accuracy, and is dependent on a number of factors, including tonnage, composition and volume of waste disposed, waste diversion rates, waste compaction rates, landfill operational efficiencies, regulatory changes and environmental issue mitigation.

  The landfill is a valuable asset and the City needs to decide how it wishes to utilize it most efficiently. If the City wants to preserve capacity over the remaining years in order to extend its life, more aggressive actions will be required to limit the amount of divertible material being placed in the garbage stream and being disposed, such as implementing policies and mechanisms to support increased participation in waste diversion programs, and banning or limiting materials accepted at the landfill. Increased efforts to reduce the amount of waste sent to the landfill should also be implemented. If the City decides to maintain the status quo, meaning that waste diversion rates remain the relatively the same and there are no new policies implemented that influence the amount and type of waste being disposed at the landfill , it will need to investigate alternative residual waste management capacity in the short-term in order to secure future waste disposal capacity.

- **Individual Producer Responsibility** - In Ontario, waste diversion responsibilities for five material categories, which have been traditionally managed by municipalities, have been or are in the process of being transitioned to an Individual Producer Responsibility (IPR) framework. Under the new framework, producers of products and packaging are 100 per cent responsible for the collection and processing of designated materials, all associated costs and program promotion and resident education. To date, used tires, batteries, electrical and electronic equipment waste have transitioned to IPR, with the

Provincial Blue Box and Municipal Hazardous and Special Waste programs set to transition over the coming years. While the City will no longer be responsible for managing these programs, the success of the new programs, including diversion rates, resident participation, as well as impacts on the City managed waste stream are still unknown.

- **Blue Box Program transition** – The transition of the Blue Box Program (which includes both the blue and black box programs in Ottawa) to individual producer responsibility arguably marks one of the most significant changes to the Provincial Blue Box program since its inception in the 1980s. No longer will the City be in control of or responsible for the management of this waste stream. At this time, in the absence of final regulations, there is uncertainty about the City's future role in this program. Based on the draft regulations, all recycling services currently managed by the City, with the exception of City facilities (except long term care facilities), the City's Yellow Bag program for small businesses and some on-street recycling outside of BIAs, will transition to IPR. The new Provincial Blue Box program will also see an expansion to the number of materials collected in the Blue Bin today to include problematic materials such as single-use items, candy wrappers, chip bags, etc., which currently make their way into the municipal waste stream or end up as litter.

  It remains to be seen what the overall financial implications will be on the cost of collecting, processing and disposal of material streams that the City will retain responsibility for and what residents will pay for their solid waste services in the future. While the changes may ultimately result in savings to the City and taxpayers, the true savings potential is currently unknown until further information is provided through the final regulations and analysis is undertaken by staff and Council decisions made regarding the City's involvement and future role in these programs.

- **Municipal Hazardous and Special Waste Program transition** – In the absence of final regulations, there is uncertainty about the City's future role in managing Municipal Hazardous and Special Waste (MHSW). Based on the draft regulations, only a select portion of MHSW will become the full responsibility of producers to manage and cover the full cost of properly recycling or disposing of these materials. A large portion of materials the City currently manages that are not covered by existing regulations will continue to be the responsibility of the City to collect, recycle, safely dispose of and financially cover the full cost associated with these select materials. While the Province

has signaled their intent to further expand the number of regulated materials that transition to IPR in the future, no details are included in the draft regulations and there is no indication as to when or how the regulation might be expanded in the future. This ultimately leaves municipalities with a status quo scenario and any expansion and associated costs will fall to municipalities.

There is a risk that in having two streams of MHSW; items that are covered under IPR regulation and those that remain the responsibility of municipalities, that the City will require its own system to collect the residual items alongside the system set up by producers, which could prove inconvenient and confusing to residents. Producers will be responsible to operate a collection network of their own and may coordinate collection at municipal depots, as the regulation allows them a variety of options to satisfy consumer accessibility requirements. The draft regulation gives producers 18 months post the July 1, 2021 transition date to set-up this network, so it is likely that the future MHSW collection system in Ottawa will be unknown until after the City approves the new solid waste master plan.

While work continues to prepare Council to make key decisions related to both the Blue Box and MHSW programs through the City's Individual Producer Responsibility component project, an unknown at this time is how the program changes will impact the waste stream managed by the City in the future. With the expected expansion of materials to be accepted in the Provincial Blue Box program anticipated to begin in 2026, it is expected that these changes will result in fewer items making their way to landfill, however, performance of the new Blue Box program, along with resident adaptability to program changes are unknown. The same applies to the impact of the new Provincial MHSW program.

There is a risk that the City will still see materials that have transitioned to IPR that the City is no longer in control of managing making their way into the City waste stream, specifically recyclables into the garbage stream that's being disposed at the Trail Waste Facility landfill. Key considerations for the City will be to determine how to manage recyclable materials regulated under IPR that continue to make their way into the City managed waste stream including how best to work with producers to prevent/reduce waste stream contamination. Furthermore, depending on how compostable packaging will be considered in the final Blue Box regulations, there is a risk that producers may

transition their packaging to compostable materials, which may result in further pressure being placed on the City to manage compostable packaging through the green bin program. This may increase the tonnage of material that needs to be processed, increasing the City's costs.

The City may want to consider mechanisms, such as material bans at the curb, landfill bans, enhanced enforcement, or policy mechanisms such as a clear bag program and even enhanced/coordinated education to residents to prevent recyclable materials from making their way into the garbage stream.

The transition to IPR is expected to impact some options being considered by the City as part of their future waste management system. The timing of the final regulations for both the Blue Box and MHSW programs and when producers will be organized and have a final system in place in the City is still unknown and as such, the master planning process will have to remain flexible to accommodate the need to potentially revisit the City's strategy on Blue Box and MHSW, as more details become available through final regulation and as producers finalize their future collection systems.

- **Food and Organic Waste Framework** – The framework provides two components, the Action Plan, which outlines provincial commitments on food and organic waste, and the Policy Statement, which under the Resource Recovery and Circular Economy Act, 2016, provides direction to municipalities, the IC&I sector, owners and operators of resource recovery systems and others to take action to reduce and recover food and organic waste. As such, the City needs to consider the impact of the Framework on its own operations, policies and programs, and through the development of the SWMP. The Food and Organic Waste Action Plan outlines strategic commitments to be taken by the province, including preventing food waste through education and innovative approaches, increasing resource recovery across the IC&I sector, supporting the recovery of food and organic waste in the multi-residential sector and promoting the reintegration of end-products into the economy, through efforts such as regulatory approaches related to soil amendments and supporting the development of renewable natural gas (RNG). The Action Plan also states that the province will develop, consult on, and implement a food and organic waste disposal ban regulation under the Environmental Protection Act, which could prohibit the disposal of food waste and organic waste at landfills. A recent announcement from the Province states that their priority is to move to phase out food and organic waste sent to landfill by 2030.

The Food and Organic Waste Policy Statement establishes targets for food and organic waste reduction and resource recovery by sector, including municipalities and multi-residential buildings. On September 30, 2020 proposed changes to the Statement were released that expand the categories of food and organic waste that municipalities should make efforts to reduce and recover, including compostable coffee pods, soiled paper food packaging, and certified compostable bags. Amendments also state that municipalities should support the use of pilot projects and research on the processing of compostable products and packaging and encourage municipalities to consider adopting technology to collect and process compostable products and packaging in their systems when they are planning for new processing technology.

Under the Resource Recovery and Circular Economy Act, the Policy Statement requires municipalities to ramp up diversion of organics to meet the 70 per cent target for curbside households by 2023 and 50 per cent target for multi-residential properties by 2025. Additional quantities of source separated organic material may need processing as curbside residences and multi-residential buildings increase diversion of organics. While this has the potential to drive diversion and help extend the life of the Trail Waste Facility landfill, it will have increased cost implications associated with processing more organic waste.

As more sectors introduce source separated organics programs to meet these provincial targets, and/or if organics are banned from landfill disposal by 2030, there will be increased competition for organics processing capacity locally and across Ontario. Should the City develop its own facility, there is potential to create a revenue stream from providing organics processing capacity to other municipalities or to the IC&I sector, and potentially creation of RNG if the City chooses to convert biogas from anaerobic digestion, as envisioned in the Energy Evolution Strategy.

Should the City develop its own organics processing facility, it would also assume the risk of designing, building, operating and maintaining the facility. The City would also take on responsibility for finding markets for end products such as compost, digestate or energy. When contracted out, the City does not incur these risks or costs.

- **Changes in lifestyles/consumer trends** – The COVID-19 pandemic has caused a shift in tonnes typically managed in the IC&I sector to the residential sector, with more people working and learning from home. To-date, the City has experienced an increase

of approximately 10 per cent% in residential tonnage managed by the City[1]. The pandemic has also caused an upswing in online shopping and delivery of groceries/meals to homes, which has also shifted the composition of waste managed by the City. It is unknown whether the trend of working from home will continue once the pandemic is over and whether the City will be permanently dealing with additional quantities and types of waste in the future, making this an area the City will have to continually monitor and adapt to.

- **Packaging** – Trends in packaging will continue to evolve in the future:
  - It is anticipated that the use of bioplastics and compostable packaging will continue to increase as producers try to make their packaging more sustainable. It is unclear at this time how these materials will be considered as part of the Blue Box Program transition or future requirements for organics processing.
  - Compostable packaging is not currently accepted in the City's Green Bin program. These materials behave very differently in organics processing facilities, depending on the technology – for instance, in a wet anaerobic facility, compostable materials are screened out and sent for disposal, typically in a landfill. As per the amendments to the Food and Organic Waste Policy Statement, the province is encouraging municipalities to find solutions to manage the anticipated increase in compostable packaging.
  - It is also anticipated that there will be a continued shift to plastics and light-weighting of materials. The shift to different packaging, while not always able to be recycled with current processes and technologies, has contributed to reductions in food waste, reductions in GHGs from transportation, reductions in the need for virgin materials, increased shelf life of perishable products, etc. It remains to be seen if the contributions to sustainability outweigh the lack of recyclability of these types of packaging.
  - It is unknown what the impact of the proposed ban on single-use items will have on the City's future waste stream composition and whether these items will be replaced with materials that may not be recyclable/compostable or compatible with the City's waste management programs.

1 Based on the net difference between tonnage collected over the same timeframe in 2019-2020 compared to 2020-2021.

- **Urban sprawl and densification** – The City's population is anticipated to increase 40 per cent by 2046. Potential implications of this growth may include:
  - More waste being produced, including more garbage requiring disposal at the Trail Waste Facility landfill.
  - Continued demand for single-family housing through intensification of existing neighbourhoods and undeveloped lands and more multi-residential housing. This may result in:
    - more waste collection vehicles required to service more residences which can contribute to increased GHGs and longer travel times from collection routes to waste facilities in the absence of fleet technologies that support GHG emission reductions.
    - limits on the land available to site future waste management facilities.
  - The need to adapt waste collection approaches and infrastructure to the City's changing needs, policies and initiatives. For example, 613 Flats, which aims to increase the density on re-developed residential lots.
  - Narrower streets in some developments, requiring alternative waste collection methods and/or smaller collection vehicles to service these denser neighbourhoods.
  - Changes to the Building Code for multi-residential buildings to improve waste diversion.
- **Transfer Capacity** – The City may require a transfer station/s in the future to realize collection efficiencies, depending on decisions regarding the location of future processing facilities for recycling (pending outcome of IPR), source separated organics and LYW, and whether the City will be collecting recyclables and the volume and type of waste requiring management in the future. The City could site, build and operate a new transfer station/s or contract out this capacity, as there are private waste management companies in Ottawa that own and operate these types of facilities. The implementation of a City-owned transfer station/s or use of a private sector transfer station/s would allow the City to consolidate and direct waste in transport trailers to alternative landfill sites, reducing travel times for those vehicles collecting waste. The use of transfer station/s in the City's waste collection network may also allow operational efficiencies to be realized.

- **Other City Plans and Strategies** – The City has, or is in the process, of developing other plans and strategies that need to be considered during development of the Solid Waste Master Plan and any future solid waste planning activities.
    - **Draft Official Plan** – In May 2020, a moderate growth strategy was approved that will require 51 per cent of new dwellings to be built in already developed areas (increasing to 60 per cent by 2046) and will add between 1,350 to 1,650 hectares of residential and employment land to Ottawa's urban area.
    - **Climate Change Master Plan** – This plan provides direction for addressing the impacts of climate change on the community and City operations. It includes initiatives to reduce greenhouse gas emissions and build climate resilience in Ottawa.
    - **Energy Evolution Strategy** – This Strategy, part of the Climate Change Master Plan, lays out pathways for getting to 100 per cent reduction of greenhouse gas emissions in Ottawa.
    - **Greenspace Master Plan, Draft Official Plan and Urban Forest Management Plan** – These documents provide direction on maintaining and increasing green space in the City and tree canopy protection policies, which can have an impact on quantities of LYW that the City will need to manage in the future.
- **Provision of waste collection services** – The City contracts with private sector waste management companies to collect from three of the five curbside collection zones and for collection of all containerized waste from multi- buildings and City facilities that are serviced under this contract. Waste collection costs may increase in the future, for several reasons, including if the City decides to increase levels of service or contract fully with the private sector for waste collection. These higher costs may be a reflection of a limited number of waste collection companies bidding on these contracts or overall increases in costs of providing this services, for example, maintenance, fuel and labour, or the additional of a new service or an enhanced level of service. In addition, many waste collection providers, including the City's in-house collection group, are experiencing on-going issues with attracting and retaining staff, which can impact service delivery. Should the City continue to provide waste collection services in the future using this approach, it would similarly be competing for staff.
- **Acceptance of new/emerging technologies (risk, cost, reliability)** - There is a tension between the desire to be innovative and to be a world leader in waste

management with the desire to use tried and true methods for the management of waste. New and emerging technologies are typically more expensive and generally riskier than more accepted technologies such as landfill and incineration/waste to energy. Historically, thermal treatment technologies have been met with resistance in North America for a variety of reasons (e.g., perceived health and environmental impacts, cost, being at odds with zero waste goals, etc.). These types of treatment technologies have been used for many years in Europe and Asia, for several different reasons, including legislation regulating landfill disposal, limited space available for landfills and increasing urbanization. Similarly, innovative collection fleet technologies that are successful in certain jurisdictions may not be feasible in the Ottawa context, for reasons including but not limited to Ottawa's winter climate.

- **Climate change** – On April 24, 2019, the City declared a Climate Emergency. This declaration provided direction for the expanded work on the Climate Change Master Plan and the Energy Evolution Strategy. From a waste perspective, to achieve the aggressive GHG reduction targets, the Strategy proposes the capture of virtually all organic material for production of biogas and conversion to renewable natural gas (RNG) through anaerobic digestion (in a landfill or organics processing facility) or gasification. It is prudent to note that the use of gasification of organic waste for conversion into RNG is not currently proven. The Strategy also proposes the use of agricultural residue and manure, IC&I food waste streams, and residential organic waste for anaerobic digestion and future development of gasification facilities where biosolid output from anerobic digestion is used as a source for gasification and RNG production. The drivers and options proposed for achieving the GHG reductions under the Energy Evolution Strategy may be drastically different to what is considered feasible/possible through the development of the SWMP.

  Climate change will also impact the probability of severe weather events such as floods and tornadoes, which can impact waste collection, transportation, processing and disposal of materials generated and impacted by these weather events. It may also impact waste collection staff, with summers predicted to get hotter, and waste generation rates and patterns, for example, a longer growing season may result in more LYW being generated.

- **Funding sources** - The City provides a number of other programs and services in addition to waste management services and there are ongoing pressures to minimize

tax increases and user fees. Competing municipal priorities for operating and capital budgets will influence the recommendations that are contained within the final Solid Waste Master Plan.

- **Data collection management** – The City has many databases and tools used by various service areas and departments to monitor the operation of different aspects of the integrated waste management system. With respect to the overall management of waste related data collected across the Corporation, there is no one individual or group responsible for this function. As such, data collection is fragmented and inconsistent. The City requires a streamlined process to collect, maintain and interpret data to feed into various decision-making processes as part of the implementation of the options recommended for the Solid Waste Master Plan.

  The City should continue to undertake participation and waste audit studies of different sectors on an annual basis and consider collecting data on specific sectors. It should also consider including more sorting categories for waste audits undertaken in the future (e.g. avoidable and non-avoidable food waste, diapers, C&D, etc.) and ensure the sorting categories are consistent for all sectors. In addition, the City should consider more robust data collection and monitoring systems, which could include truck weigh scales to provide more detailed data sets specific to each sector, Radio-frequency Identification (RFID) chips in containers, etc.

- **Performance Measures** – The City has historically relied on waste diversion as the primary metric to monitor performance and future direction of waste management systems. Municipalities have been expanding performance measures beyond waste diversion rates to include service level and efficiency measures. This allows municipalities to evaluate program data and costs to assess how well service models are working and make improvements to ensure services continue to be provided cost effectively and meet defined service expectations. The City should consider performance measures that are both qualitative (e.g., customer satisfaction) and quantitative (e.g., waste generation and disposal rates, remaining capacity of the Trail Waste Facility landfill). The City will need to develop and implement new metrics to measure waste management system performance to ensure services are meeting the established goals and of the Solid Waste Master Plan.

Next Steps

The next steps in the development of the SWMP will be to develop a long-list of options that are aligned with the SWMP's draft vision, draft goals and guiding principles identified through community and stakeholder consultation. These options will then be evaluated using an approach and tool specifically developed for the SWMP project. This includes doing a triple bottom line evaluation on options.

The options developed have been identified through a number of sources; by the consultant based on the extensive research conducted in Phase 1 and professional judgement and expertise, City staff based on their knowledge of the City and its needs, City Councillors based on their knowledge and feedback from constituents, and through consultations with various stakeholders and the public during Engagement Series 1. For each option, a description will be developed noting the alignment with the SWMP Guiding Principles and Goals, as well as future needs. Whether or not the option will be impacted by future IPR regulations will be identified, as well as high level capital and operating costs, determine if the option proceeds to the evaluation stage, or whether it will be held until more information is available and revisited at a future time during the Master Plan's development.

Following the evaluation process, options that best meet the City's needs will be identified and these short-listed options will undergo further consultation with the public and stakeholders.

1 Introduction

With the thorough analysis of the City's current waste system completed in Phase 1, this technical memorandum identifies the City's future long-term waste management needs. To do this, the analysis considers long-term waste and population projections, policies and programs influencing waste management in the City of Ottawa, as well as best practices affecting solid waste management to help identify the future needs of the City's solid waste management system. These needs have been compared with the information collected in Phase 1 to identify gaps, challenges and opportunities within the existing system. The future needs identified align with the draft vision, guiding principles and goals that have been developed in support of the Solid Waste Master Plan (SWMP). Key risks and considerations that may impact long-term waste management have also been identified.

This assessment will serve as a natural stepping-stone for the next stage of Phase 2, which considers different options and recommendations that will underpin the SWMP. Options considered will address the needs identified in this memorandum, as well as align with the City's vision of "A Zero Waste Ottawa achieved through progressive, collective and innovative action", supported by guiding principles and goals for how waste will be managed in the future. This Technical Memorandum is current until January 21, 2021 and may not reflect subsequent changes to Canadian and Ontario policies, programs and legislation.

This Technical Memorandum consists of two parts; the first part documents and discusses the waste projections undertaken to estimate the future quantities of waste requiring management over the 30-year life of the SWMP and the second part documents the results of the needs analysis, which examines the status quo system and identifies gaps, constraints and opportunities related to waste management infrastructure, facilities, programs and existing third-party contracts.

The analysis has been broken down into the following seven categories with 23 identified areas of focus:

- Avoidance, Reduction and Reuse
    - Waste Avoidance, Reduction and Reuse
    - Value of Food and Food Waste
- Waste Diversion Programs
    - Green Bin and Leaf and Yard Waste Program
    - Parks and Public Spaces
    - Waste Diversion Program Performance
    - Multi-Residential Waste Diversion Program Performance
    - New Waste Collection and Diversion Programs

    - Special Events
- Collection and Drop-off of Materials
    - Collection
    - Drop-off
- Recovery of Waste and Energy
    - Technologies for Waste and Energy Recovery
- Residual Management
    - Trail Waste Facility
    - Future Use of Existing City Owned Waste Management Sites
- Managing Waste Generated by City Facilities and Operations
- Supporting System Requirements
    - Promotion and Education
    - Regulations, Policies and By-Laws
    - Financial Sustainability

Lastly, key risks and considerations that may impact long-term waste management are identified and discussed. These include the remaining capacity of the Trail Waste Facility landfill, future changes to legislation, most notably the transition of the Provincial Blue Box recycling program to Individual Producer Responsibility, changes in lifestyles, consumer trends and packaging, urban sprawl and densification, transfer station capacity, other City plans and strategies, provision of waste collection services, acceptance of new/emerging technologies, climate change, funding and data management.

2 Forecasting Future Waste Management Facilities, Resources and Programs Required to Manage Projected Waste to 2052

Projections are a key element in any waste planning process, as they allow decision makers and planners to more accurately and effectively plan their municipal waste management programs. By understanding how the City's population and waste management needs may change over the next 30 years, the City can make effective and efficient decisions about waste management programs and services, and plan for the proper supporting infrastructure and contracts to be developed or maintained.

The City is faced with an increasing population, changing waste composition and industry trends that are impacting the quantities and composition of waste requiring management. As part of the work to determine the City's future waste management needs, HDR developed a statistical model that can assist the City with projecting future quantities of waste requiring management, based on historical tonnages of Curbside Residential and Multi-

Residential/Containerized waste collected. The terms Curbside Residential (CR) and Multi-residential/Containerized (MR/C) correspond to the City's waste collection contracts and the manner in which waste is collected. Of specific interest are the waste generation trends of single family and multi-residential households serviced under the CR and MR/C contracts, as together, they account for approximately 93 per cent of the waste currently managed by the City. The remainder is waste generated from City facilities.

Estimates of baseline waste tonnages generated in City facilities, parks and public spaces were also calculated, and waste projections were developed.

It is important to note that the waste projections are based on the current status quo programs and policies as of January 2021 and using 2019 data. Impacts of future Individual Producer Responsibility programs are not considered, as it is unknown what the City's future role will be in the provision of collection of recycling. The model developed for this project will require updating regularly as more information becomes available, impacts of the proposed Individual Producer Responsibility legislation and the COVID-19 pandemic and its impacts on the City's integrated waste management system are more fully realized.

It is also important to note that these projections are based on a statistical analysis of available historical information and how that data can be modelled and projected into the future. There are many factors that affect waste generation which include changes to household composition, how packaging may evolve in the future, how consumers will spend their money, changes in demographics, etc., however, it is not possible to speculate on the impact on future waste generation with any degree of accuracy. The model can only be based on historic and current information. As the City collects more information and additional economic indicators are available, future updates to the model will reflect the impacts of these issues on waste generation.

2.1 Approach to Developing Waste Projections

Waste generation by households is closely linked to factors such as the levels of economic growth, job security and opportunities, and disposable income, among other factors. For example, household income has been shown to impact waste disposal and recycling. Households with higher incomes tend to dispose of more waste.[2]

Traditionally, municipalities would calculate average waste generation per household over a designated time span, without any consideration to economic trends. Projections would be

[2] Household Behaviour and the Environment Reviewing the Evidence, Organization for Economic Co-operation and Development, 2008

formed by multiplying the historic, average waste generation rate per household with the projected number of households. It has been more challenging of late to generate meaningful projections with the effects of changes to packaging (e.g., light-weighting), changing purchasing habits (e.g., more convenience foods, single use items, online shopping), and a shift from print media to electronic media (e.g. fewer newspapers and magazines being sold) to name a few. These changes have contributed to a decrease in waste generation, as this metric is primarily weight-based. The City has already seen the impact of these changes to packaging and lifestyles in the tonnes of recycling managed over the last 10 years or so. This approach to estimating the amount of waste to be managed over time, which worked satisfactorily in the past, could cause current-day projections to be unrealistically high. However, by factoring economic trends into the modelling process, more realistic predictions are possible.

The approach taken to developing projections for the SWMP was to relate annual Curbside Residential (CR) and Multi-Residential/Containerized (MR/C) tonnage on a per household basis to annual socio-economic indicators, including household counts, specific to the City. **Section 2.2** and **Section 2.3** provide a description of the inputs to the projections. The means by which the sets of data were related together was through a statistical activity that used linear regression modelling techniques. These techniques were applied to identify which socio-economic indicators available from the City were the best predictors of future waste generation. Through the regression process, a final equation (that is, the model) was selected based on the best ability to predict the historical data, that has statistically significant coefficients and that has favourable statistical properties. The relationships (coefficients) between waste generation and socio-economic indicators estimated through the regression modelling process were used to project future annual waste generation based on forecasted future socio-economic variables.

This regression approach used historical data provided by the City to estimate future annual waste tonnages for the purpose of developing the SWMP. The model's future performance assumes that the City's waste collection policies, and the statistical relationships between annual waste generation and population and socio-economic trends observed over the period of 2010 to 2019 are maintained in the future. Changes to the City's policies or unanticipated shocks to the economy post 2019, or updates to the City's socio-economic and population forecasts could produce new relationships between waste generation trends and population and socio-economic indicator trends. Waste tonnage data in different formats, or different granularities or types of socio-economic indicators could produce different models with different annual waste projections. Based on the available data provided by the City, the

recommended regression model reflects past trends and relationships and provides projections suitable for planning purposes.

2.2 Waste Allocation Scheme

The City provided the tonnes of material collected in 2019, categorized as Curbside Residential (CR) or Multi-residential/Containerized (MR/C), according to whether material is collected curbside (i.e., in bags, containers, or bins/bins at the curb) or containerized (i.e., front-end load or carts). **Figure 7** depicts the following breakdown of the two types of categories used by the City for collection of materials:

Curbside Residential (CR) includes materials collected from:

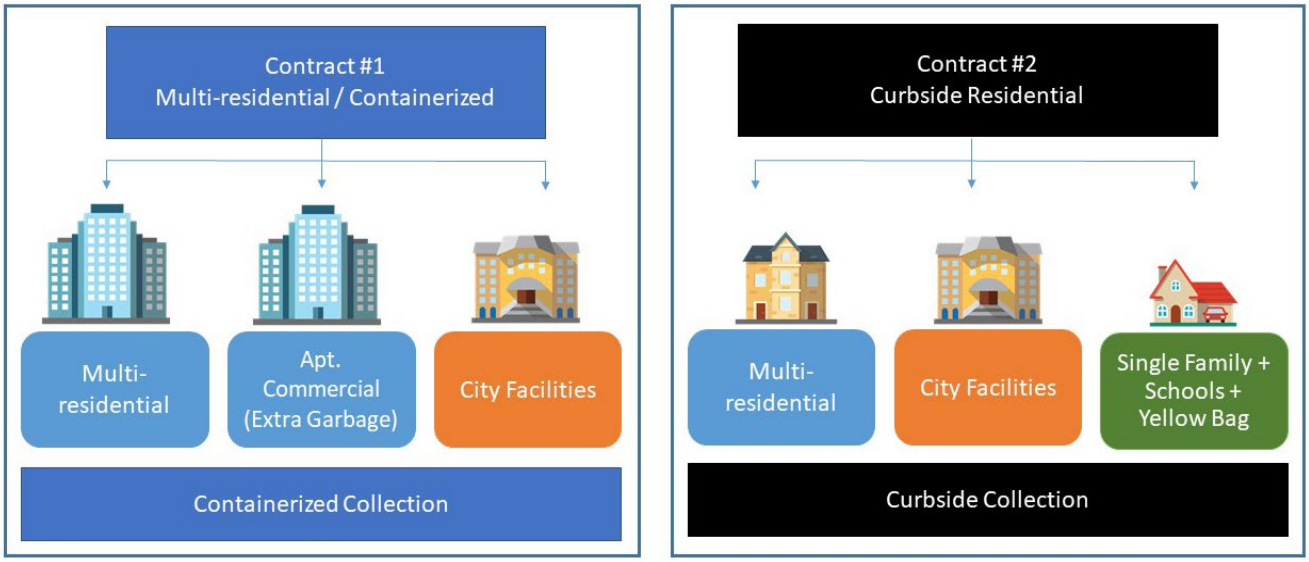
- Single family residences - garbage, recyclables, Green Bin (GB) organics, leaf and yard waste (LYW) and bulky items;
- Schools – Green Bin organics;
- Small businesses (i.e. Yellow Bag program) – garbage, recycling, Green Bin organics;
- City facilities – recyclables and Green Bin organics placed out in bags/bins; and,
- Multi-residential buildings – garbage and recyclables placed out in bins/bags, Green Bin organics placed out in carts and bulky items (regardless of how other materials are colle

Multi-residential/Containerized (MR/C) - includes materials collected from:

- Multi-residential buildings - garbage and recyclables placed in front end load containers and carts; and,
- City facilities – garbage, recyclables and LYW placed in front end load containers.

As presented in **Figure 7** below, each collection contract contains multiple waste generators and, since materials are collected together in the same truck, it is unknown how much each generator contributes to the totals reported under each contract. HDR, in collaboration with the City, allocated the tonnes collected from the CR and MR/C contracts to either single family, MR or City facilities, and by waste stream (garbage, Black Bin materials, Blue Bin materials, bulky items, leaf and yard waste and Green Bin organics).

Figure 12: Curbside Residential and Multi-residential/Containerized Contracts



This "tonnage allocation scheme" used waste audit results, household number estimates, and City facility data to allocate the tonnes collected to each of the three sectors. Table 4 to Table 10 presents the 2019 tonnage allocation by sector. A full description of the methodology used to derive these numbers can be found in **Appendix A**.

It is important to note that for the purpose of the tonnage allocation methodology, LYW was categorized in the following manner:

- Separately Collected LYW - this is LYW material that is bagged or bundled that is collected separately from the Green Bin during peak LYW seasons and taken to the City's Barnsdale outdoor composting facility.
- Green Bin Organics:
    - Household Organics and LYW in the Green Bin and sent to Convertus – this includes all material that is placed in the Green Bin and is taken to the Convertus indoor composting facility.
    - LYW collected with Green Bin setout and sent to Convertus – this is LYW material that is bagged or bundled that is collected in the same truck as the material in the Green Bin and is taken to the Convertus indoor composting facility.

Table 3: 2019 Tonnage Allocation by Sector

Sector	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus	Total	Per cent of Total Waste Managed
Multi-residential Containerized	42,109	6,914	3,213	5,867	0	0	0	58,104	0
Apartment Commercial Garbage (Extra Containerized)	5,663	0	0	0	0	0	0	5,663	0
Multi-residential Curbside	741	0	58	135	0	0	3,857	4,791	0
Multi-residential Total	48,513	6,914	3,271	6,003	0	0	3,857	68,557	20%
City Facilities Containerized	2,952	0	16	328	201	0	0	3,497	0
City Facilities Curbside	14,900	0	389	1,755	0	0	2,728	19,772	0
City Facilities Total	17,852	0	406	2,082	201	0	2,728	23,269	7%
Single family1	92,512	21,936	20,705	28,415	8,821	36,217	37,519	246,126	0
Single family Total	92,512	21,936	20,705	28,415	8,821	36,217	37,519	246,126	73%
Grand Total	**158,876**	**28,851**	**24,382**	**36,500**	**9,022**	**36,217**	**44,104**	**337,952**	**100%**

[1] Single family includes a small amount of waste from the Green Bins in Schools and Yellow Bag Programs.

Table 4 through **Table 7** presents the allocation of 2019 tonnes to the three sectors and by waste stream collected under the CR contract, as well as post-2019 tonnages. The post-2019 tonnages focus predominantly on waste generated by the single family sector (accounts for 90.9 per cent of the CR waste). It should be noted that the allocation was adjusted slightly post-2019 to account for the program change to allow plastic bags and dog waste in the Green Bin.[3] This program change was made mid-2019. As 2019 is the baseline year used for the projections, the tonnage provided for 2019 is not considered representative of the future tonnages that could be expected with this change.

Table 4: City Facilities Curbside Residential Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocation 2019	Tonnage Allocation Post 2019	Per Cent Allocations 2019	Per Cent Allocations Post 2019
Garbage	14,900	14,873	5.5%	5.5%
Blue Bin materials	389	389	0.1%	0.1%
Black Bin materials	1,755	1,755	0.7%	0.7%
Household Organics and LYW in Green Bin	2,728	2,755	1.0%	1.0%
Subtotal	**19,772**	**19,772**	**7.3%**	**7.3%**

Table 5: Multi-residential Curbside Residential Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocation 2019	Tonnage Allocation Post 2019	Per Cent Allocations 2019	Per Cent Allocations Post 2019
Multi-residential Curbside	741	703	0.3%	0.3%
Blue Bin materials	58	58	0.02%	0.02%
Black Bin materials	135	135	0.05%	0.05%
Household Organics and LYW in Green Bin	3,857	3,895	1.4%	1.4%
Subtotal	**4,791**	**4,791**	**1.8%**	**1.8%**

[3] Tonnages for household organics are assumed to increase by 1 per cent after 2019 due to new policy that allows dog waste. Hence a slight redistribution was required to accommodate this waste.

Table 6: Single family[1] Curbside Residential Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocation 2019	Tonnage Allocation Post 2019	Per Cent Allocations 2019	Per Cent Allocations Post 2019
Garbage	92,512	92,137	34.2%	34.0%
Bulky	21,936	21,936	8.1%	8.1%
Blue Bin materials	20,705	20,705	7.7%	7.7%
Black Bin materials	28,415	28,415	10.5%	10.5%
Separately Collected LYW	8,821	8,821	3.3%	3.3%
LYW collected with Green Bin Setout	36,217	36,217	13.4%	13.4%
Household Organics and LYW in Green Bin	37,519	37,894	13.9%	14.0%
Subtotal	**246,126**	**246,126**	**90.9%**	**90.9%**

[1] Single family includes a small amount of waste from schools and the City's Yellow Bag Program.

Table 7: All Streams Curbside Residential Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocation 2019	Tonnage Allocation Post 2019	Per Cent Allocations 2019	Per Cent Allocations Post 2019
City Facilities Curbside	**19,772**	**19,772**	**7.3%**	**7.3%**
Multi-residential Curbside	**4,791**	**4,791**	**1.8%**	**1.8%**
Single family[1]	**246,126**	**246,126**	**90.9%**	**90.9%**
Totals	**270,689**	**270,689**	**100.0%**	**100.0%**

[1] Single family includes a small amount of waste from schools and the City's Yellow Bag Program.

Table 8 though **Table 11** presents the allocation of 2019 tonnes collected through the MR/C contract to multi-residential and City facility customers. Multi-residential accounts for 94.8 per cent of the tonnage collected through this contract.

Table 8: City Facilities Containerized Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocations	Per cent Allocations
Garbage	2,952	4.4%
Blue Bin materials	16	0.02%
Black Bin materials	328	0.5%
LYW (collected separately)	201	0.3%
Subtotal	**3,497**	**5.2%**

Table 9: Multi-residential Containerized Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocations	Per cent Allocations
Garbage	42,109	62.6%
Bulky	6,914	10.3%
Blue Bin materials	3,213	4.8%
Black Bin materials	5,867	8.7%
Subtotal	**58,103**	**8.4%**

Table 10: Apartment Commercial Garbage (Extra Containerized) Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocations	Per cent Allocations
Garbage	5,663	8.4%

Table 11: Multi-residential/Containerized Per cent Allocation Scheme (based on 2019 tonnage allocations)

Stream	Tonnage Allocations	Per cent Allocations
City Facilities Containerized	3,497	5.2%
Multi-residential Containerized	58,103	8.4%
Apartment Commercial Garbage (Extra Containerized)	5,663	8.4%
Subtotal Multi-residential (Regular + Extra Containerized)	**63,766**	**94.8%**
Totals	**67,263**	**100.0%**

The 2019 allocation scheme provides a means to re-organize the tonnages, and hence percentages, per sector per waste stream to reflect the estimated contributions from single

family, multi-residential households and City facilities as distinct sectors. At the sector level, single family, multi-residential and City facilities generate 73, 20 and seven per cent of the 2019 total annual waste, respectively (see **Table 3** for details).

Figure 13 to **Figure 15** shows the resulting percentage breakdown by sector and waste stream based on the 2019 allocation scheme, adjusted for the introduction of plastic bags and pet waste in the organics stream that came into effect in July 2019. These percentages were then used to break down the modelled projections of CR and MR/C annual tonnages. The percent contributions by stream within each sector, as set by the 2019 allocation scheme, are assumed to remain constant over years 2020 to 2052. This is because information as to the impact from collection contract changes, future policy changes, responses to the current pandemic situation and future consumer preferences are not known at this time.

Figure 13: Single Family Residential Percent Allocation by Waste Stream

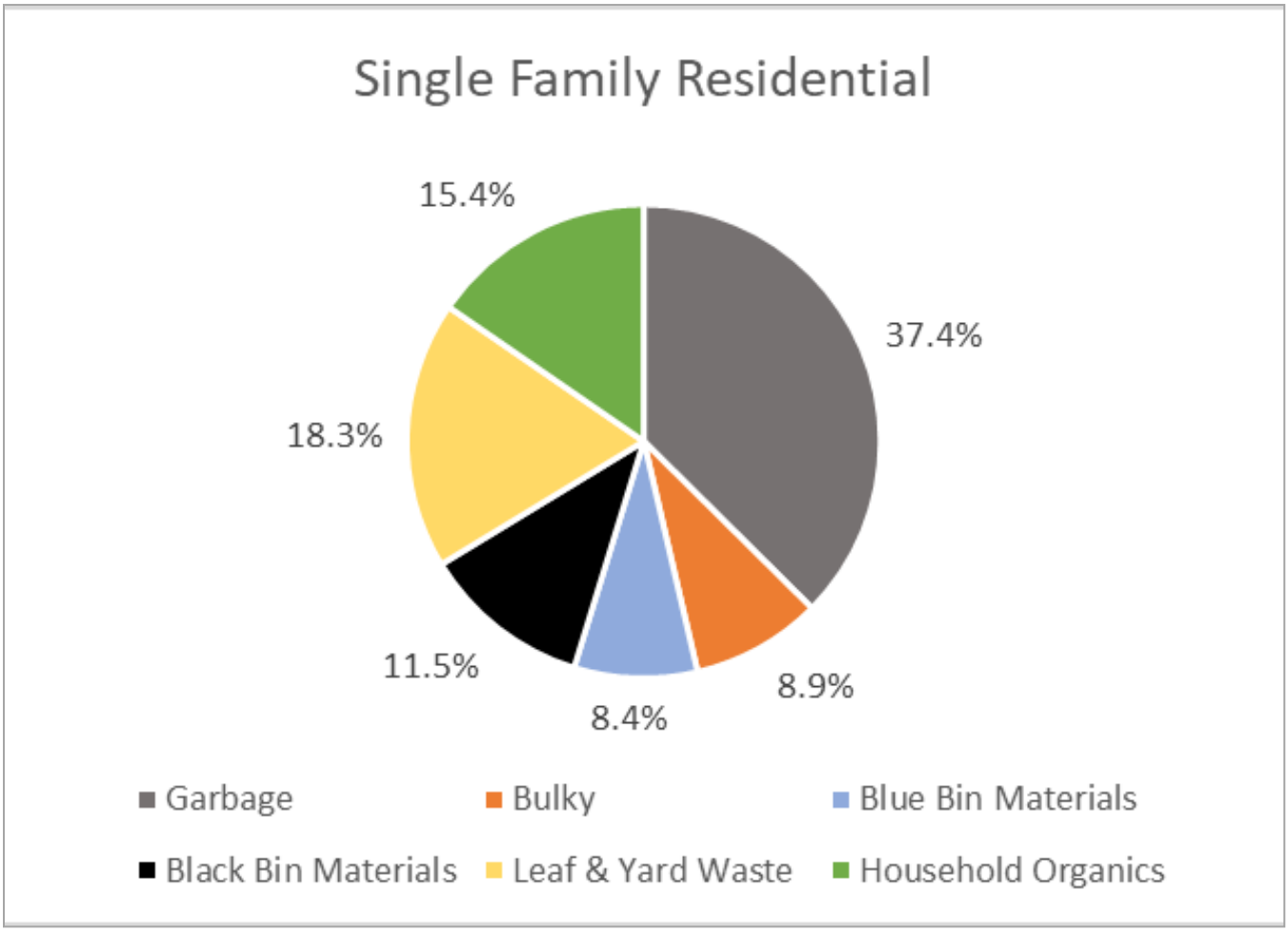


Figure 14: Multi-Residential Percent Allocation by Waste Stream

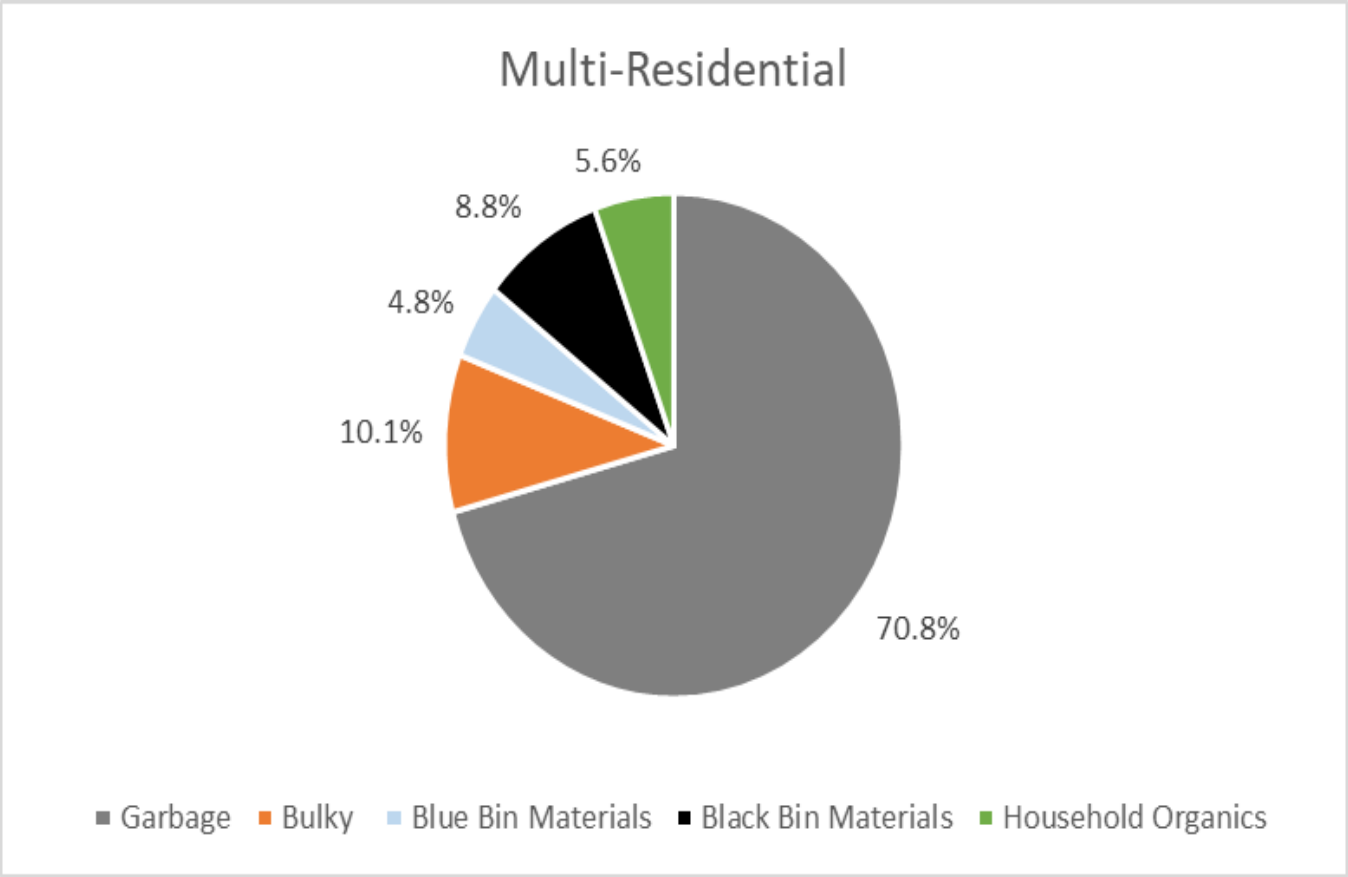
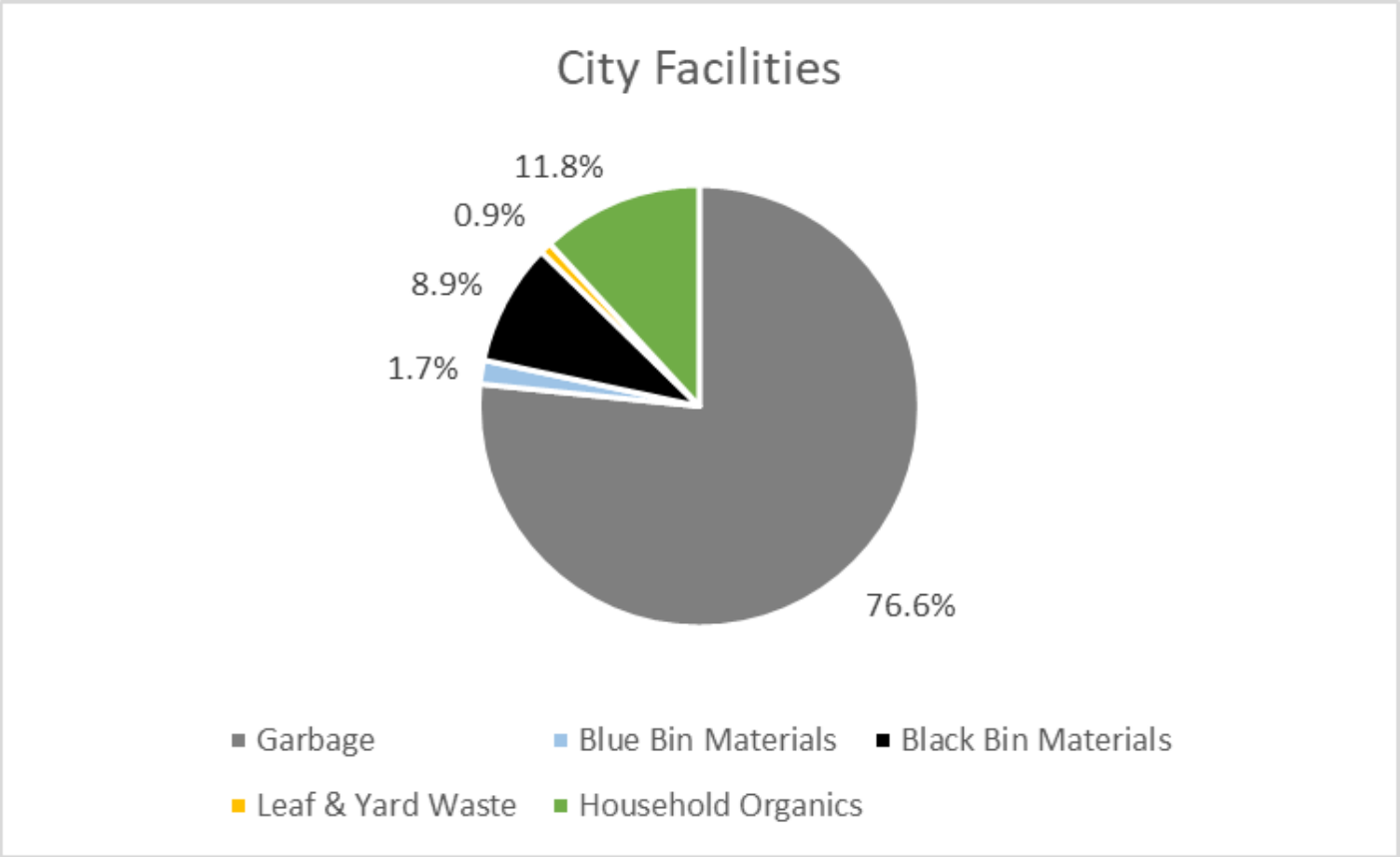


Figure 15: City Facilities Percent Allocation by Waste Stream



2.3 Data Used for Modelling

To estimate the regression model, data from the City and Statistics Canada was used. The City has access to the following set of forecasted socio-economic indicators (2021 to 2046) for the Census Metropolitan Area (CMA) for Ottawa-Gatineau and the Ottawa CMA[4] portion:

- Population 15+
- Participation Rate
- Labour Force
- Unemployment Rate
- Unemployed Persons

[4] The Ottawa CMA represents the Ontario part of the Ottawa-Gatineau Census Metropolitan Area and is defined by Statistics Canada as the City of Ottawa, the City of Clarence-Rockland, the Township of Russell & the Municipality of North Grenville starting in 2016.

- Employed Residents
- 5-Year Absolute Change
- Net Commuting
- Employment in Ottawa
- Multiple Jobholder Rate
- Multiple Jobholders
- Total Employment in Ottawa

The comparable historical indicators for years 2009 to 2019 were retrieved from Statistics Canada's Table 14-10-0096-01 Labour force characteristics by census metropolitan area, annual.

The City maintains a historical record of household units based on its taxation roster, split by units served under the Curbside Residential (CR) and Multi-Residential Containerized (MR/C) contracts for the following years: 2006 to 2014, and 2020. These values were used to represent the number of single family and multi-residential households, respectively. Missing values for 2015 to 2019 were imputed using a simple linear trend analysis. Table 1 in **Appendix B** provides the counts by type of dwelling for years 2006 to 2020.

Using the same growth rates the City used in Appendix 6 of its report Growth Projections from the New Official Plan: Methods and Assumptions for Population, Housing and Employment 2018 to 2046, November, 2019, annual household counts were forecasted for 2021 to 2046. Forecasts from 2047 to 2052 were based on a linear trend extrapolation. Forecasts are available for years 2021 to 2052 in Table 2 of **Appendix B**.

The City maintains a record of monthly waste generation separately for CR and MR/C collection contracts. As described in **Section 2.1**, CR consists of waste collected from single family residences (and a small amount of organics from schools and garbage, recycling and organics under the Yellow Bag program for small businesses), multi-residential curbside, and City facilities, while MR/C consists of multi-residential containerized and City facilities containerized waste, as well as additional garbage pickups from multi-residential, referred to as apartment commercial garbage. The exact amounts of all waste generated by the various customers per contract type are not separately recorded as the waste is combined during collection prior to weighing.

Because the City has historical single family and multi-residential unit counts based on residential taxation rosters as explained above, it was possible to standardize annual total waste collected under the CR and MR/C contracts on a per household basis. Specifically, annual CR tonnes were divided by the number of single-family residences and annual MR/C

tonnes were divided by multi-residential units for each year of interest (2010 to 2019), as shown in **Table 12**.[5]

Table 12: Historical City of Ottawa Curbside and Multi-residential/Containerized Total and Per Household Waste Tonnage (2010-2019)

Year	Curbside Residential Tonnes	Curbside Residential Households	Curbside Residential Tonnes/ Household	Multi-Residential / Containerized Tonnes	Multi-Residential / Containerized Households	Multi-Residential / Containerized Tonnes/ Household
2010	281,749	269,428	1.05	48,509	92,059	0.53
2011	283,690	269,151	1.05	48,143	91,767	0.52
2012	279,796	275,680	1.01	49,282	93,487	0.53
2013	273,522	276,506	0.99	52,781	97,639	0.54
2014	274,987	279,471	0.98	55,654	99,625	0.56
2015	274,034	282,125	0.97	56,537	103,894	0.54
2016	264,849	284,840	0.93	57,129	106,068	0.54
2017	277,583	287,555	0.97	59,861	108,242	0.55
2018	272,696	290,269	0.94	59,698	110,416	0.54
2019	277,804	292,984	0.95	60,148	112,590	0.53

Figure 16 and **Figure 17** below show how annual total waste for CR and MR/C tonnage has changed from 2010 to 2019. In each of the figures, the annual counts of households and the employment rate from the previous year (also called a lagged employment rate) are overlaid to demonstrate how these indicators can be used to forecast future tonnages.

[5] Household numbers provided by the City.

Figure 16: Historical Curbside Residential Tonnes of Waste, Single Family Households and Employment Rate (Lagged) (2010-2019)

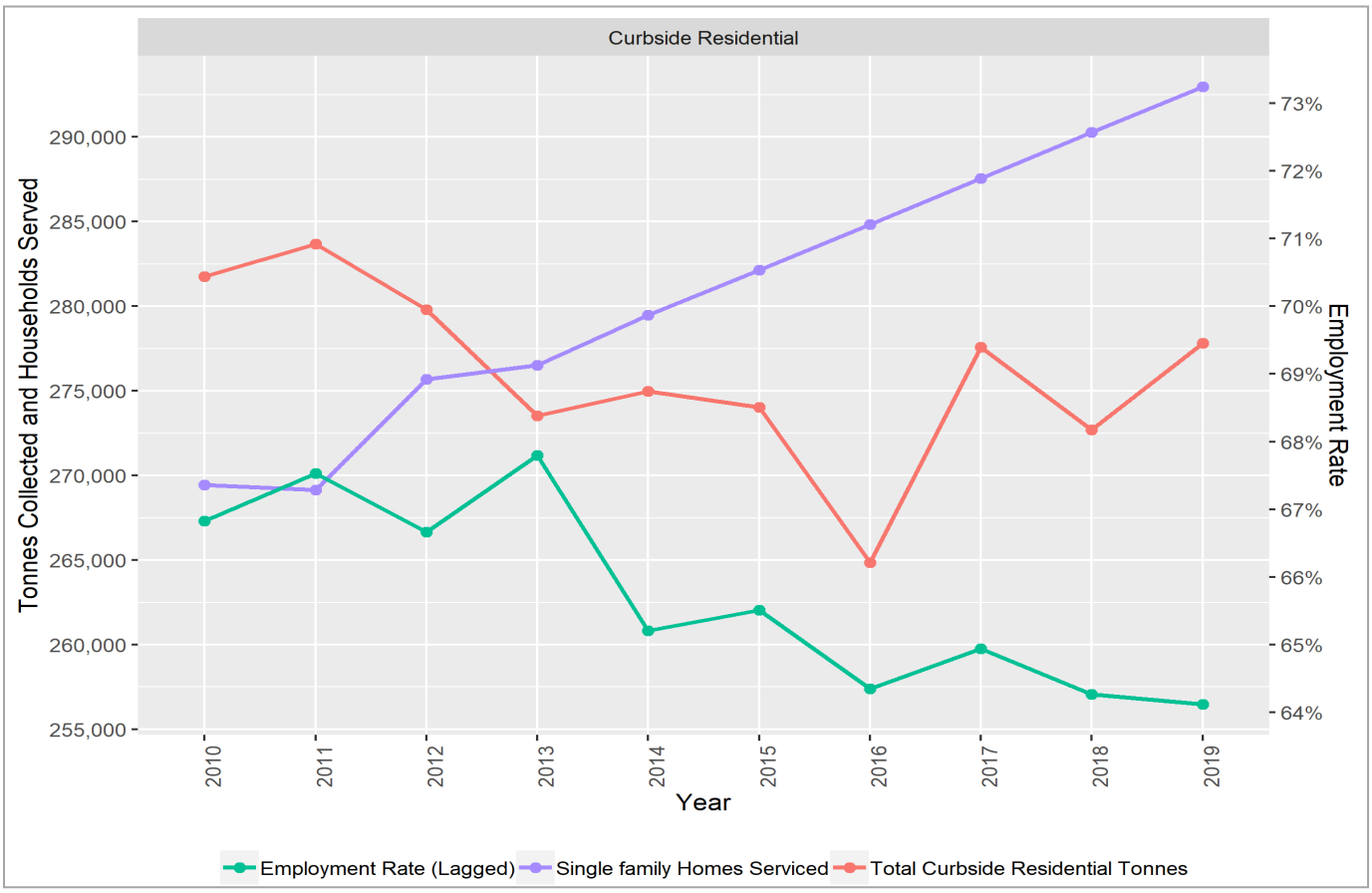
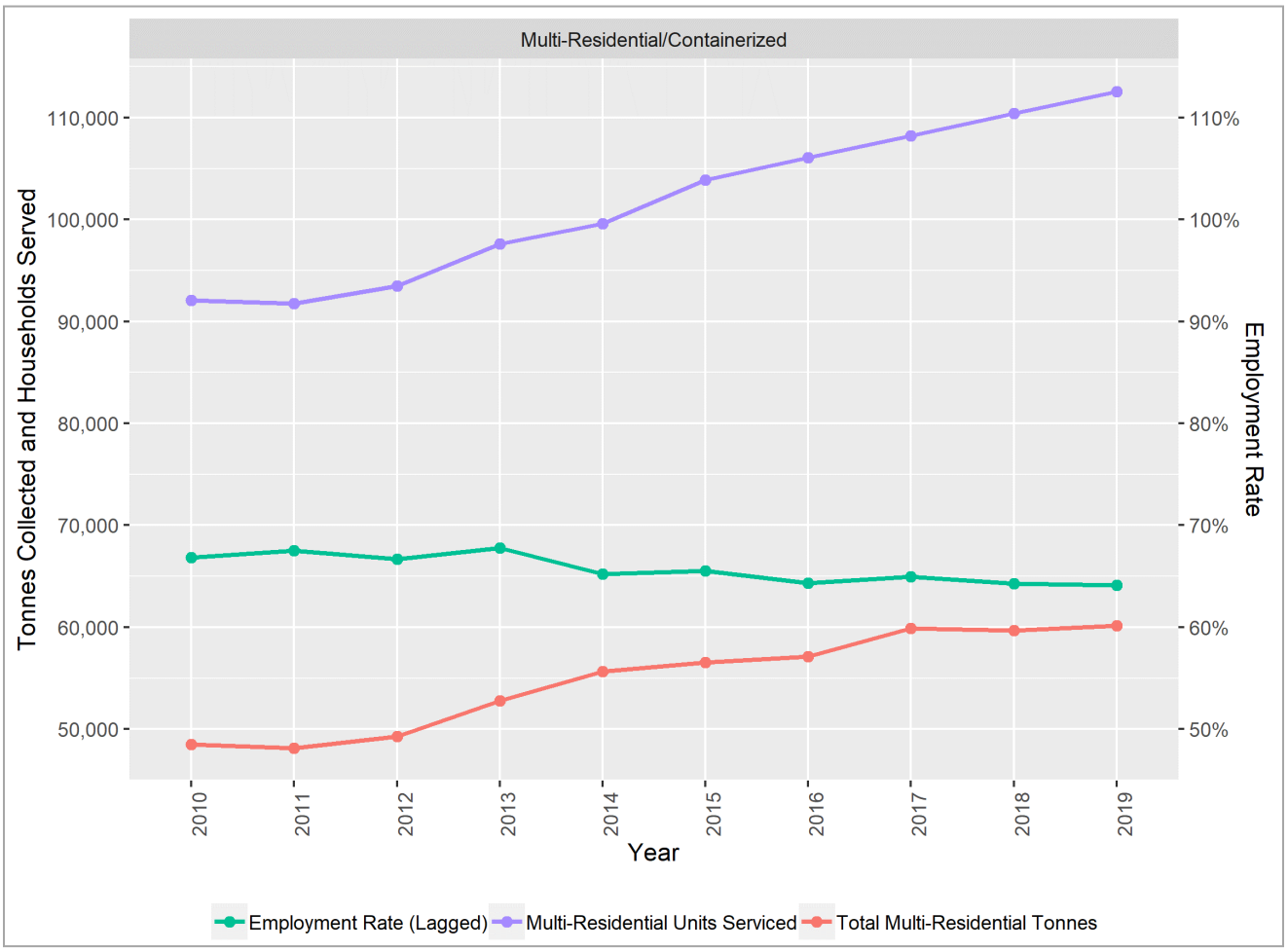


Figure 17: Historical Multi-residential/Containerized Tonnes of Waste, Multi-residential Households and Employment Rate (Lagged) (2010-2019)



With respect to CR annual waste, its trends are similar to the lagged employment rate variable, with a divergence in 2013 and 2019. The introduction of bi-weekly garbage collection in September 2012 may have influenced the reduction in tonnages in 2012 and 2013, and beyond. Annual curbside waste generation varies between a low of 265,000 tonnes in 2016 to a high of 285,000 tonnes in 2011 over the period 2010 to 2019, with no apparent average trend, however, the number of single-family homes shows a steady increase. The large decline in waste in 2016 is noted; however, it is unclear as to what contributed to this decrease in tonnage. There were no extreme weather events or socio-economic events which could fully explain the decrease.

Unlike the curbside trends, MR/C annual tonnage is steadily increasing over time and generally follows the growth rate in multi-residential households over the same time period, but

not at the same rate. By combining relevant measures of population and economic indicators in the calculations of predicted total waste generation, the projected rate of growth over time can reflect both the changes in the economy and in household waste generating behaviour.

As the data used for modelling did not include tonnages after December 2019, impacts from the COVID-19 pandemic could not be quantitatively assessed. As City waste data is collected in 2020 and beyond, a detailed assessment of the level of impacts due to COVID-19 over and above other influential factors in residential waste generation can be undertaken in future years.

A recent study[6] indicated that for residential routes from a sample of thirteen major Ontario municipalities (including Ottawa), there were increases in total residential waste generated in 2020 relative to the same time period from March 9 to April 27, 2019. Increases ranged from 4.3 per cent for garbage to 12.3 per cent for Green Bin, with an overall increase in waste generated of 5.3 per cent. Initially, at least, there appears to be some effect on residential waste generation from the provincial state of emergency due to COVID-19. At this time, it is unknown what the trends in residential waste generation will look like post-COVID-19.

2.4 Model Results

As noted previously, the linear regression modelling technique produces an equation that relates annual changes in waste generation as a function of certain socio-economic indicators. The equation or the coefficients are used to project future annual tonnages.

HDR validated certain statistical assumptions and criteria to ensure that the model was suitable for projecting annual tonnages. This included technical measures such as:

1. Goodness of fit - This refers to how well the model can explain the variation in tonnes over time. The statistic used to assess the goodness of fit is called the R2 statistic, which ranges between zero and one. R2 measures the proportion of the variance in tonnes that is predictable from the socio-economic variables. The closer the value is to one, the better the model.
2. Independence of observations - For a regression analysis to be reliable, the amount of tonnes in any given year should not be directly related to observations in other years. When observations are related to each other over time, they are said to be serially correlated and require additional technical adjustments.

[6] Paul van der Werf, Rob Cook & Peter Hargreave, “COVID 19 Waste Generation Report” (May 12, 2020)

3. Statistical significance of coefficients - For the equation to be reliable for projections, the coefficients must be statistically significant. Formal statistical tests were applied to determine that the coefficients were statistically significant or "reliable".

The equation, or model, which best satisfied the above three technical measurements for the purpose of this document is referred to as the 'best' model.

Various available socio-economic indicators provided by the City were used to determine the best or optimal model which can predict annual tonnes generated per household separately for Curbside Residential (CR) and Multi-Residential Containerized (MR/C) sectors. The best model used annual CR and MR/C tonnage on a as per household level as a function of lagged employment rate.[7] See Tables 4 and 5 in **Appendix B** for a description of historical and forecasted labour force characteristics pertaining to employment rates.

Weather or policy change events which could explain shifts in waste generation were tested in the regression model in the form of indicator variables (also called dummy variables). These events included introduction of bi-weekly garbage pick-up in 2012, the spring floods of 2017 and 2019, and the major tornado event of 2018.

These indicators, from a statistical perspective, did not satisfy the three technical measurements of goodness of fit, independence of observations, and statistical significance of coefficients for a sound model. In other words, these indicators were not as strong in explaining trends in annual tonnes per household as changes in employment rate alone. The final equation is summarized in Table 1 of **Appendix C**, including the outcomes of the technical measurements.

As mentioned in **Section 2.1**, both CR and MR/C include some fraction of waste generated at City facilities. According to the tonnage allocation scheme, City facilities comprise a small fraction of less than seven per cent of the combined collection contracts. This is not viewed as a significant issue from a modelling perspective. While household size and economic well-being have a direct effect on waste generation, their impact on City facilities waste generation is weaker, but nonetheless, still not negligible. As City facilities are provided to serve the public, a changing public in terms of population size and disposable income will have some relationship to changes in tonnages managed from City facilities. In addition, the manner in which waste from City facilities is combined with CR and MR/C contracts does not allow for a separate statistical analysis to be done for City facilities.

[7] The reason annual employment rate was lagged one year is that often an increase or decrease in economic activity takes time to translate into new or fewer purchases, which ultimately translates into more or less waste.

Figure 18 and **Figure 19** below compare the actual waste tonnage per household, by contract type, to the model's prediction. The shaded areas denote the variability in the model's expected predictions and represent the 95 per cent confidence intervals around the annual predictions (blue line). The model has a high level of prediction accuracy. For the CR series in **Figure 18**, the per cent difference is as low as 0.1 per cent in 2015 to a high of only 4 per cent in 2013. With respect to predicted annual tonnage per household for the MR/C series in **Figure 19**, the model predicts within 0.5 per cent of actual for years 2012, 2016 and 2017. Its largest deviance is only five per cent from actuals for 2010.

Figure 18: Curbside Residential Actual versus Predicted Tonnes of Waste per Household (2010-2019)

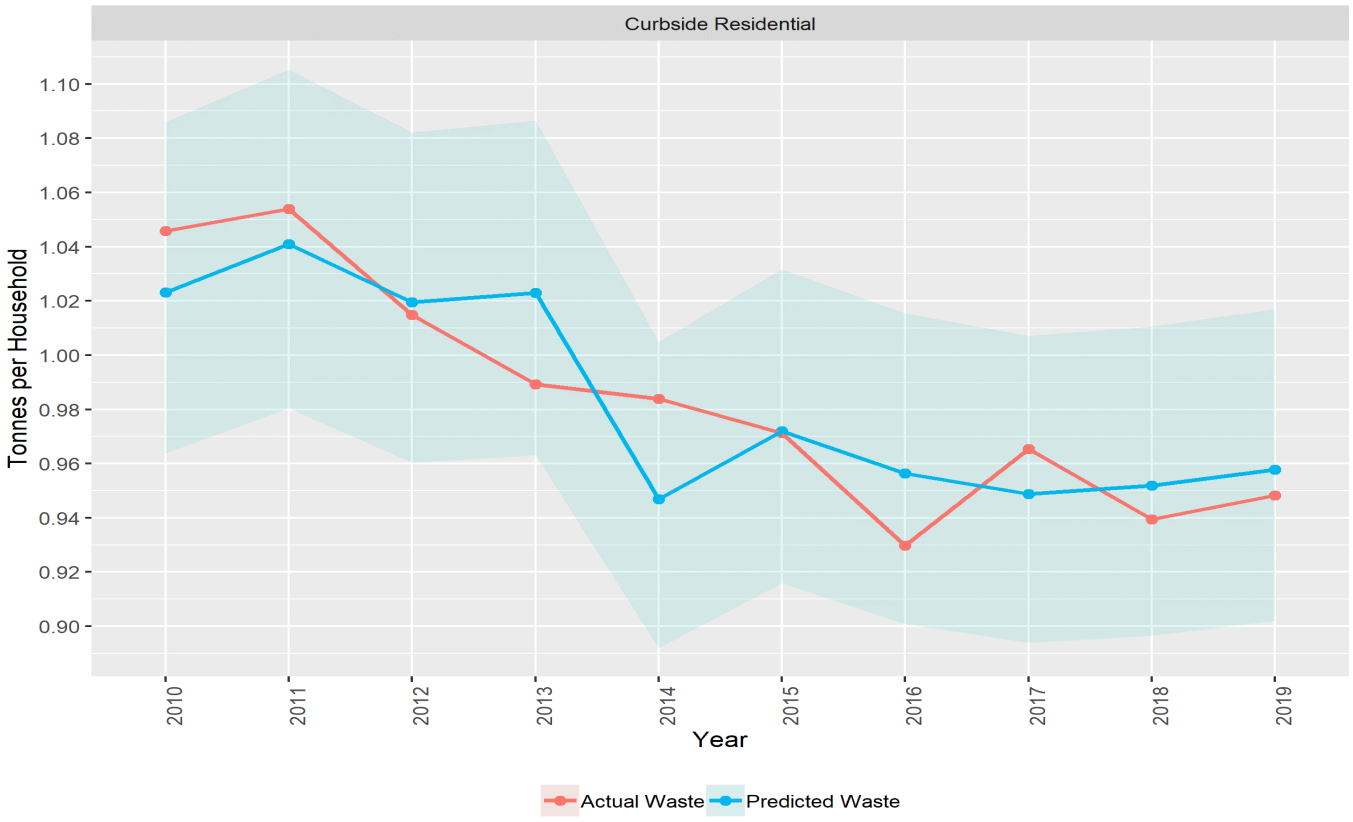


Figure 19: Multi-residential/Containerized Actual versus Predicted Tonnes of Waste per Household (2010-2019)

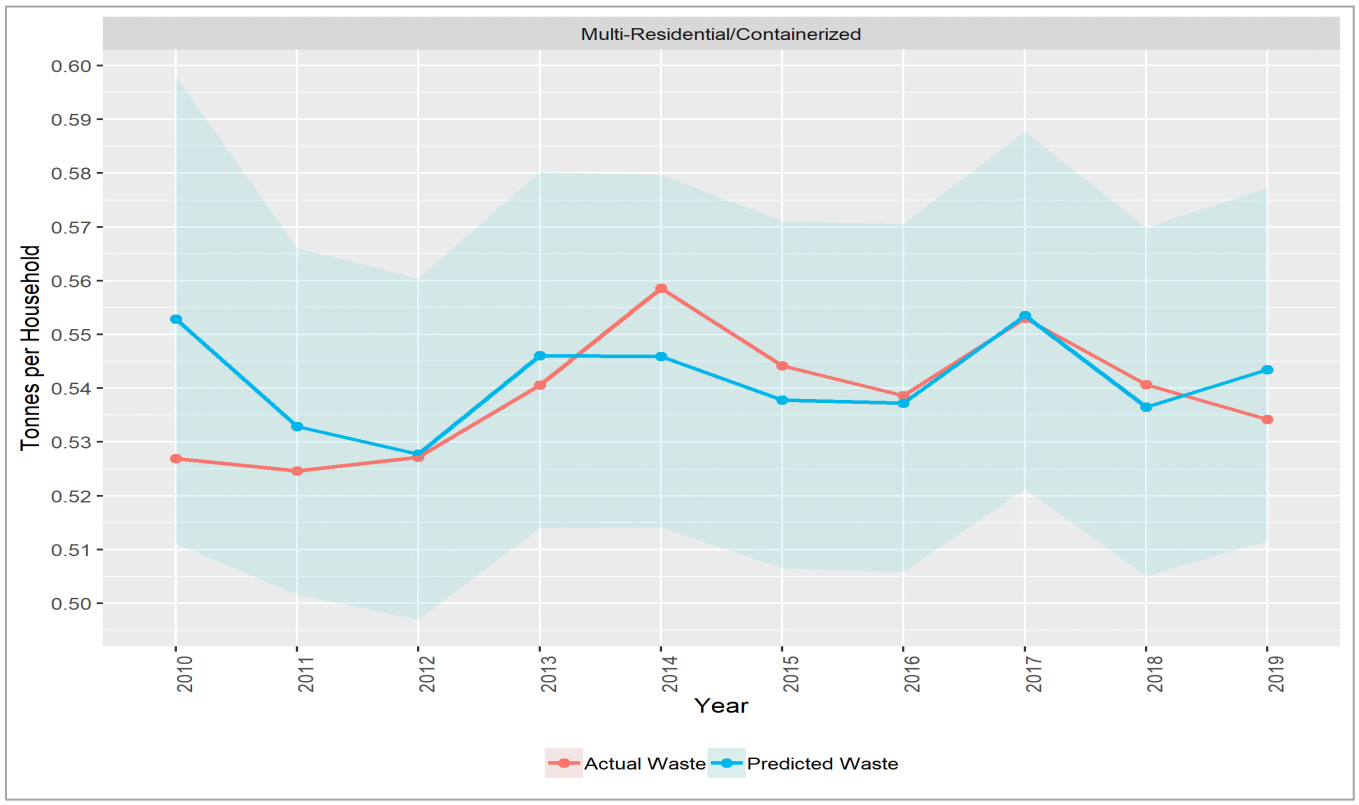


Figure 20 and **Figure 21** have the actual and predicted waste per household converted to a total waste basis for CR and MR/C contracts, respectively. For example, total waste = annual waste per household multiplied by total households serviced. Since total waste predictions are derived directly from the model output, the per cent differences between predicted versus actual annual tonnages are identical to those observed on an annual tonnes per household basis. For example, the curbside series in **Figure 20** shows that the model's estimated 2015 value of 274,220 tonnes is only off by 0.1 per cent from the actual total of 274,034 tonnes. Similarly, the MR/C series in **Figure 21** shows that its best performance in predicting actual observed tonnages is for years 2012, 2016 and 2017, where it predicted 49,282, 57,129, and 59, 861 tonnes respectively, while the actual were 49,337, 56,985, and 59,914, respectively. Overall, the model predictions over the period of 2010 to 2019 are sound and give confidence that predictions based on forecasted annual employment rates and household counts by service type will be reasonable and realistic.

Figure 20: City of Ottawa Curbside Actual versus Predicted Total Tonnes of Waste (2010-2019)

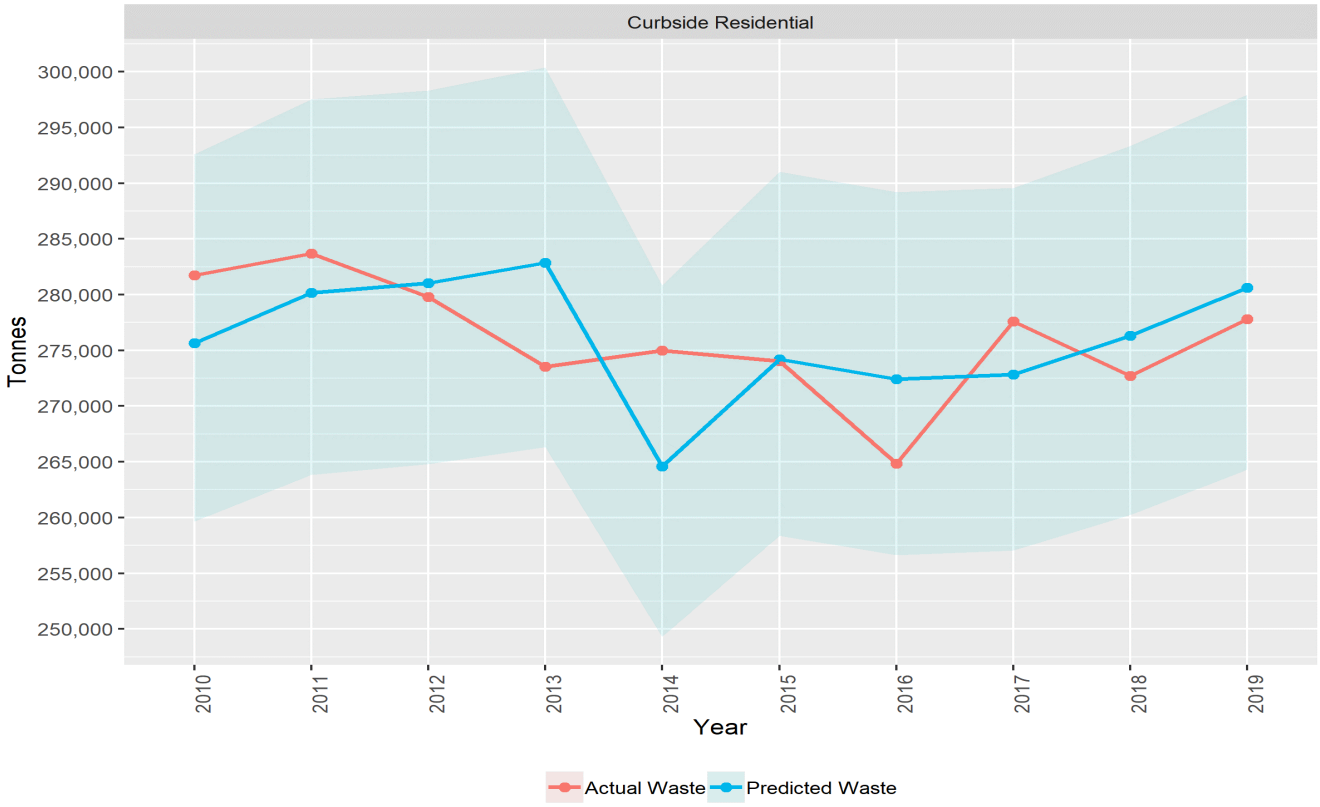
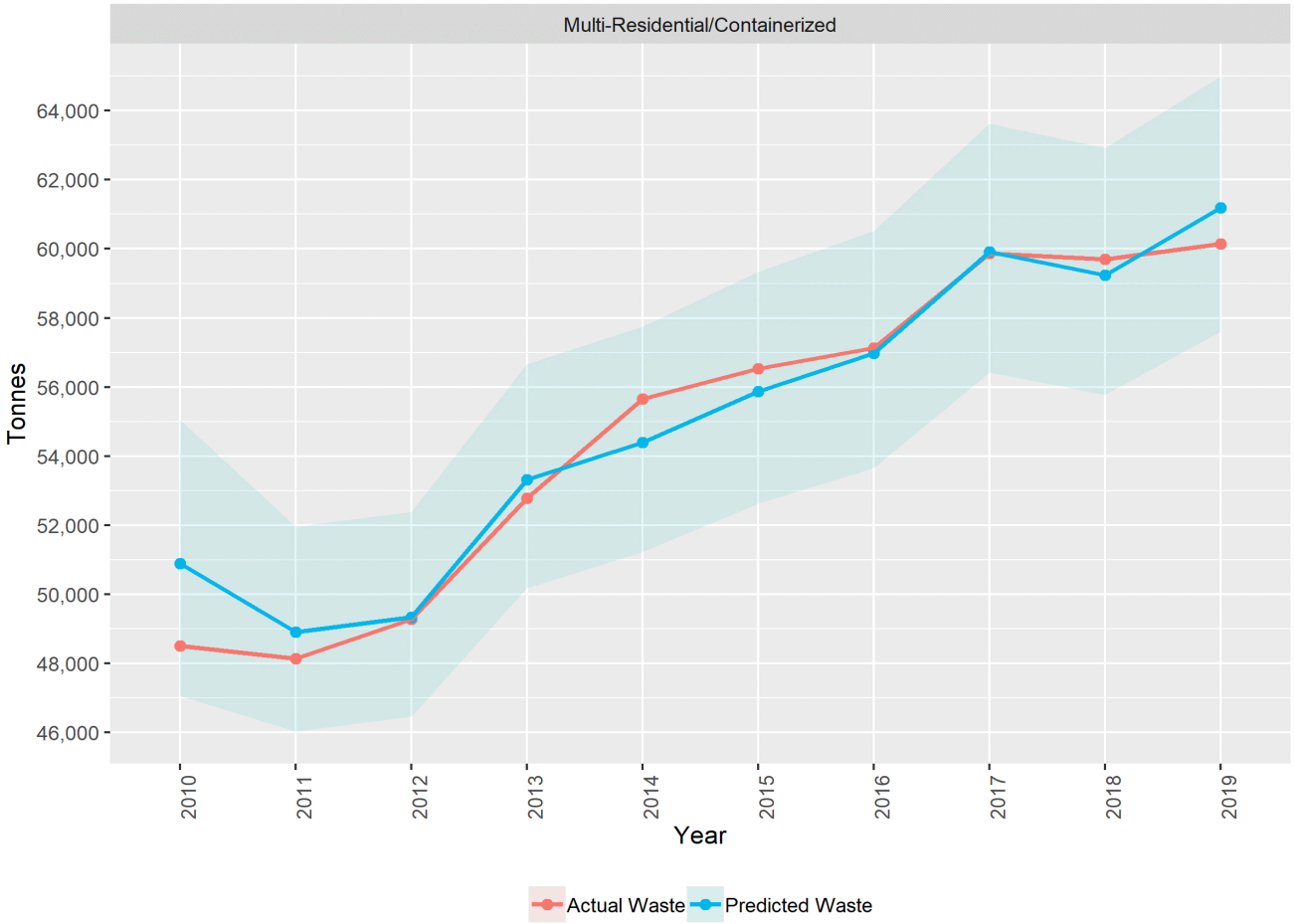


Figure 21: City of Ottawa Multi-residential/Containerized Actual versus Predicted Total Tonnes of Waste (2010-2019)



2.5 Curbside Residential and MR/Containerized Waste Projections

The regression model described in **Section 2.4** was used to project expected annual Curbside Residential (CR) and Multi-Residential Containerized (MR/C) tonnes per household for each year from 2020 to 2052. The model's inputs were projected using annual employment rates, lagged by one year, for the Ottawa portion of the Ottawa-Gatineau Census Metropolitan Area (CMA). Two model outputs were created: one for projected tonnes per household for CR tonnage and one for projected tonnes per household for MR/C tonnage. The regression analysis uncovered that MR/C tonnages on a per household basis were only half as much compared to CR tonnages on a per household basis. Each projected CR and MR/C annual

tonnes per household was then multiplied by projected single family and multi-residential households to estimate total annual waste generation, respectively.

Figure 22 and **Figure 23** show the trends in the projections for CR and MR/C contracts as follows:

- Waste increased from 2019 to 2020, mainly due to the growth in employment numbers for 2019;
- The projected lowering of employment rates contributes to the drop in projected tonnes in 2021 and 2022. Based on Statistics Canada Labour Force data, the projected employment rate drops in 2021 by 6 per cent; and
- From 2023 onwards, waste gradually increases to 2052. The growth in the number of households has a greater impact on total projections as the change in dropping employment rates holds steady at one per cent year over year, and the trend in total tonnes begins to steadily increase starting in 2023.

Overall, the model estimates that from 2020 to 2052, waste generated from the CR sector (primarily single-family residences) is expected to rise from 287,550 tonnes per year to just over 400,000 tonnes per year, an increase of 40 per cent. With respect to MR/C annual tonnes, waste is predicted to increase by 26 per cent, from 66,205 tonnes in 2020 to 83,017 tonnes in 2052. Table 1 and Table 2 of **Appendix D** provides the lower and upper statistical limits of the projections for each year by contract type.

The statistical projections per contract type are provided in **Figure 22** and **Figure 23** below. Their summation provides an estimate for future total tonnes requiring management by the City. On this combined basis, the City could potentially expect to manage about 37 per cent more waste by 2052, from about 353,755 tonnes of waste generated in 2020 to 483,748 tonnes in 2052.

Figure 22: Historical and Projected Annual Curbside Waste Generation (2010-2052)

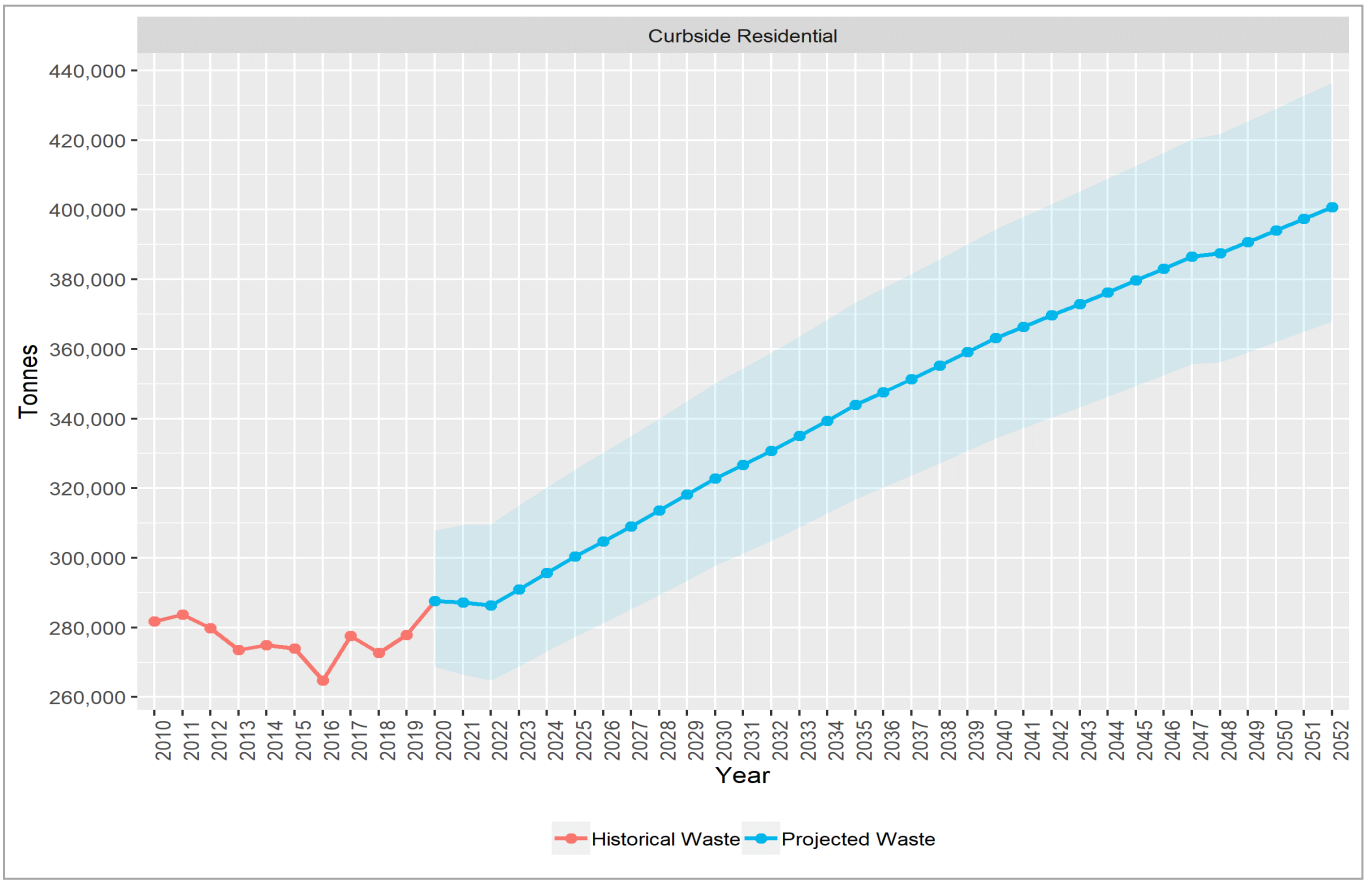


Figure 23: Historical and Projected Annual Multi-residential/Containerized Waste Generation (2010-2052)

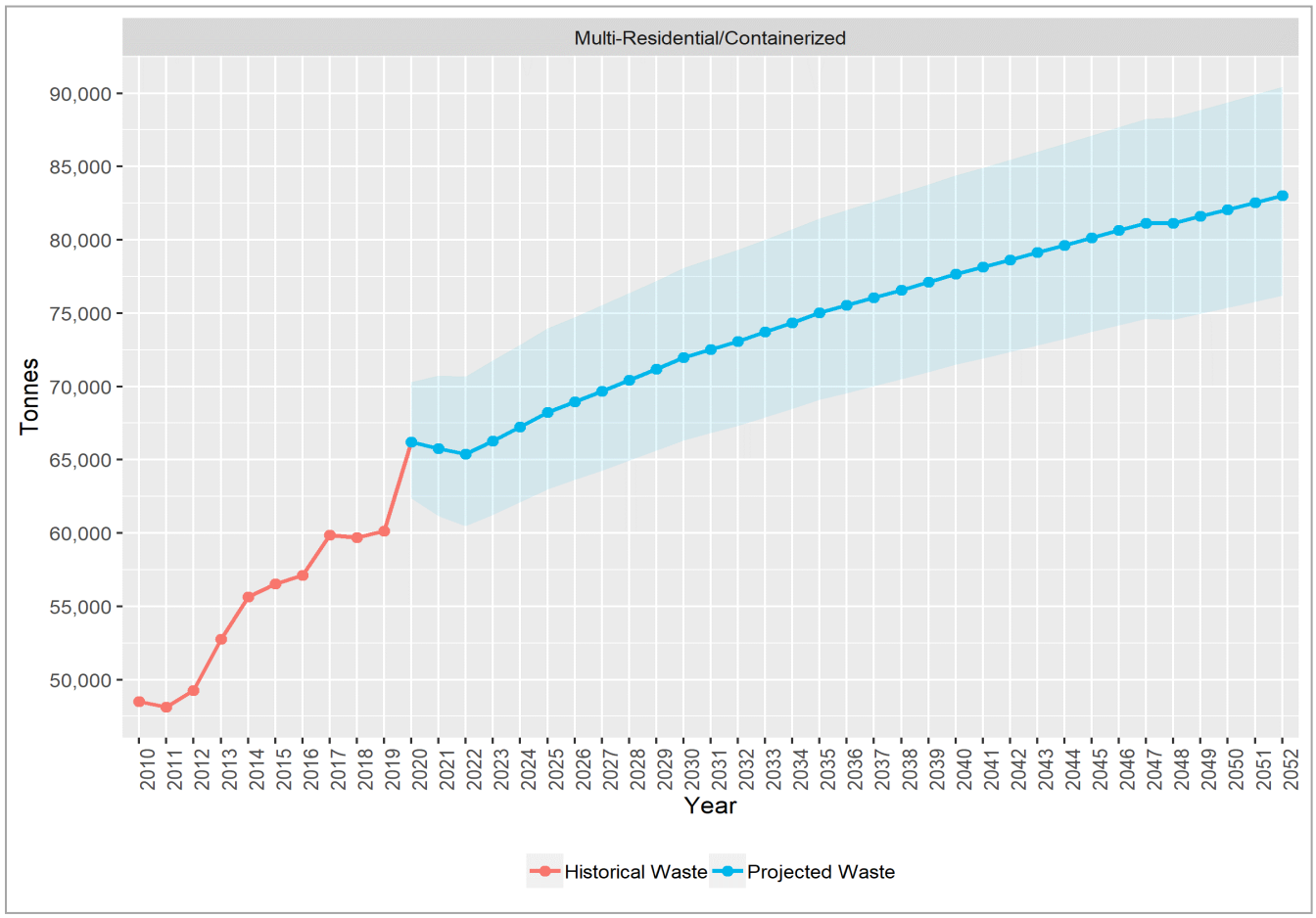


Table 13: Projected Curbside, Multi-residential/Containerized Tonnages and Combined Totals (2020-2052)

Year	Curbside Residential	Multi-residential/Containerized	Total
2020	287,550	66,205	353,755
2025	300,397	68,251	368,649
2030	322,872	71,960	394,832
2035	343,902	75,012	418,914
2040	363,126	77,663	440,789
2045	379,694	80,135	459,829
2050	394,066	82,071	476,137
2052	400,731	83,017	483,748

2.6 Waste Generation Projections for Single Family and Multi-residential

For each annual Curbside Residential (CR) and Multi-Residential Containerized (MR/C) projection described in **Section 2.5**, a fixed portion of each amount was assigned to single family residential and multi-residential waste sectors, based on the 2019 allocation scheme presented in **Table 3**. Note that the single family tonnage within the curbside contract type includes contributions from schools (organics only) and the Yellow Bag program; however, these tonnages are not significant, and for simplification of the projections process, their contributions are included in the single family forecasted quantities.

The following presents information related to waste generated by the single family and multi-residential sectors. **Figure 24** and **Figure 25** present the trends in single family residential annual waste and multi-residential annual waste for years 2010 to 2052. The blue shaded areas reflect the variability in the model's projections and represent the 95 per cent prediction intervals for each annual projection (blue dots). Single family projections grow from a predicted 261,457 tonnes in 2020 to 364,368 tonnes in 2052, an increase of 39 per cent. In 2020, the multi-residential projection is expected to be in the range of 67,853 tonnes and grow by 26 per cent to reach a predicted value of 85,794 tonnes in 2052. Table 3 to Table 5 in **Appendix D** presents the projections along with the lower and upper limits.

Figure 24: Historical and Projected Single-Family Residential Waste Generation (2010-2052)

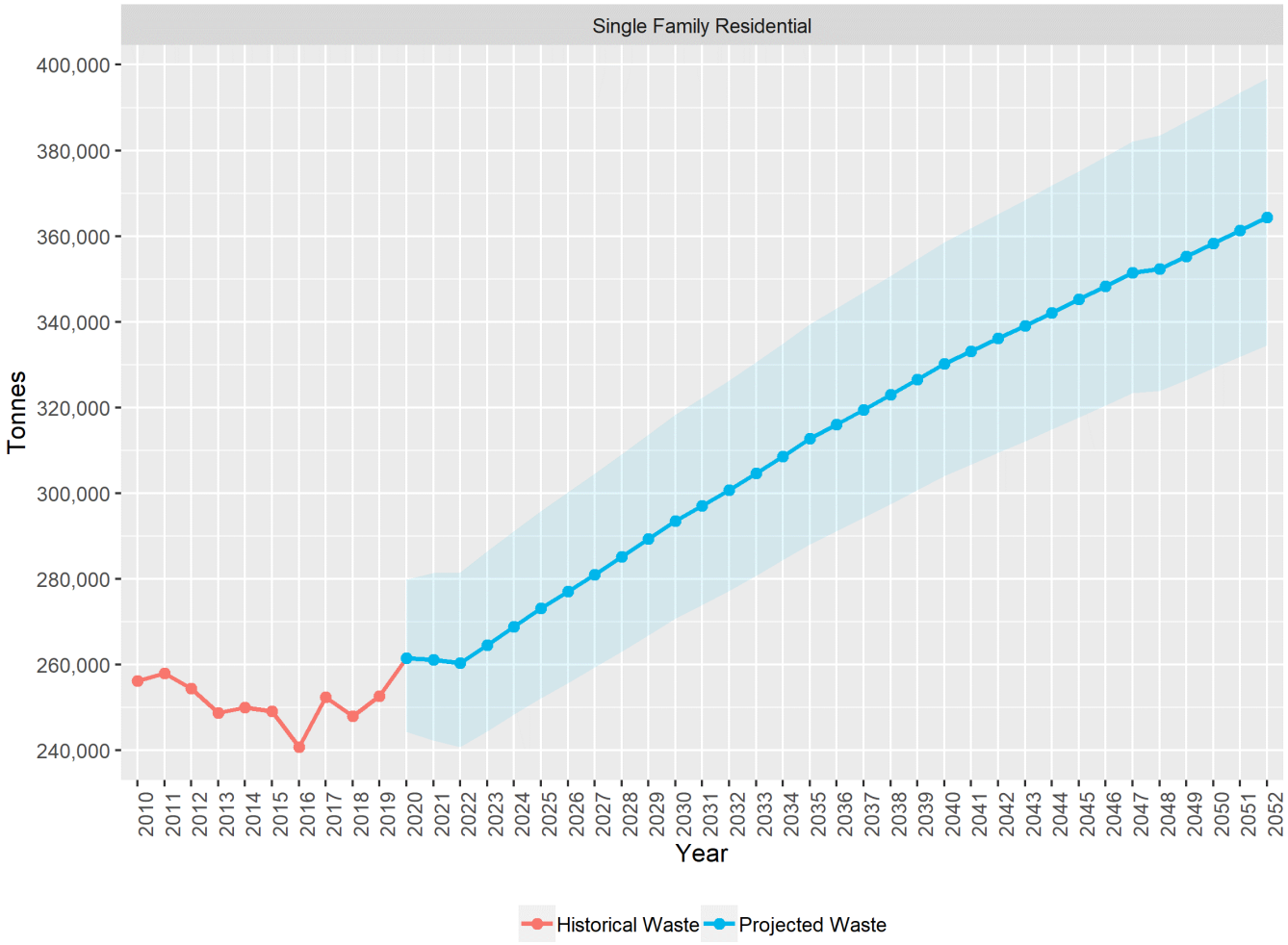
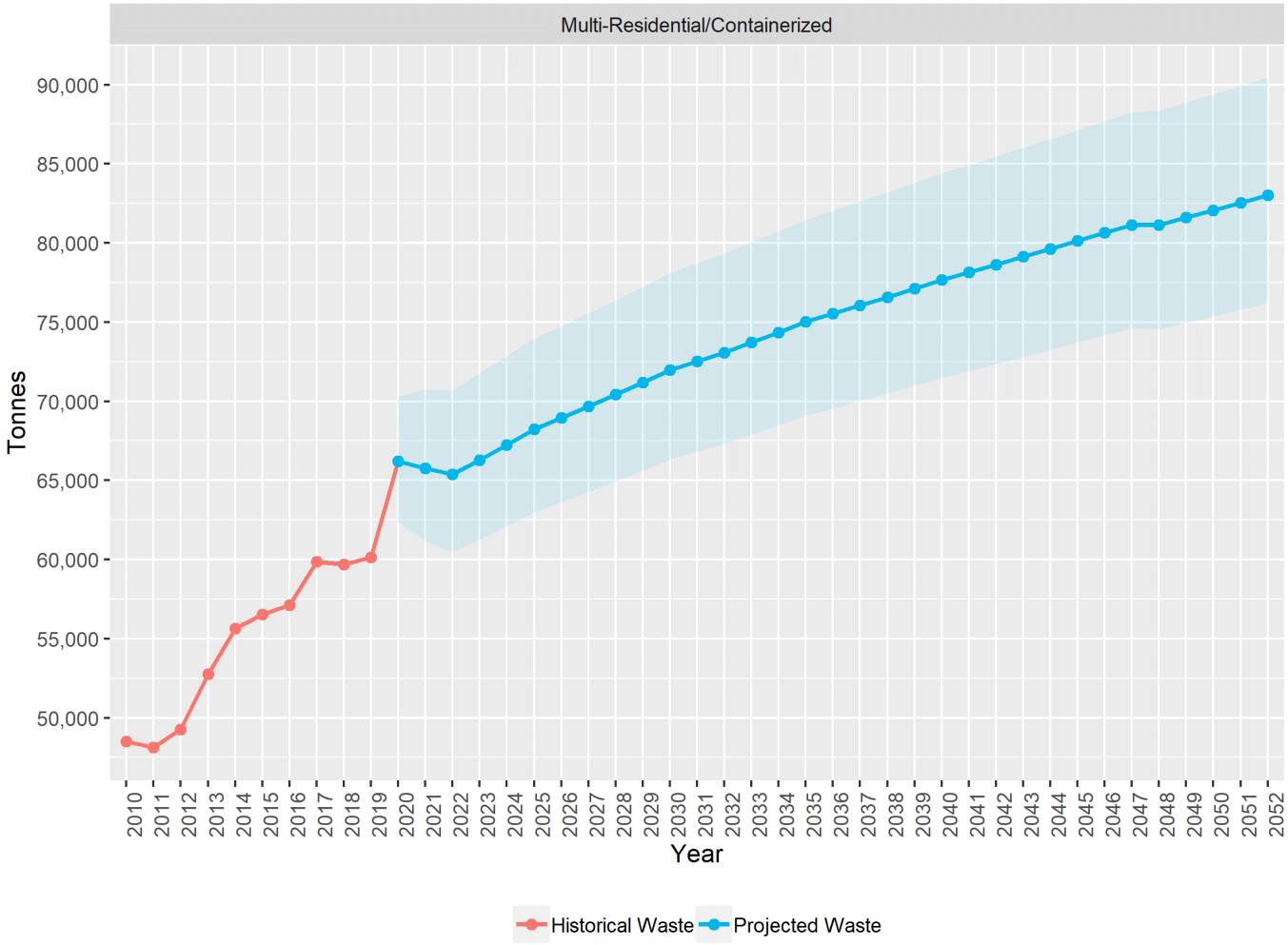


Figure 25: Historical and Projected Multi-Residential Waste Generation



2.7 City Facilities – Amount and Type of Waste

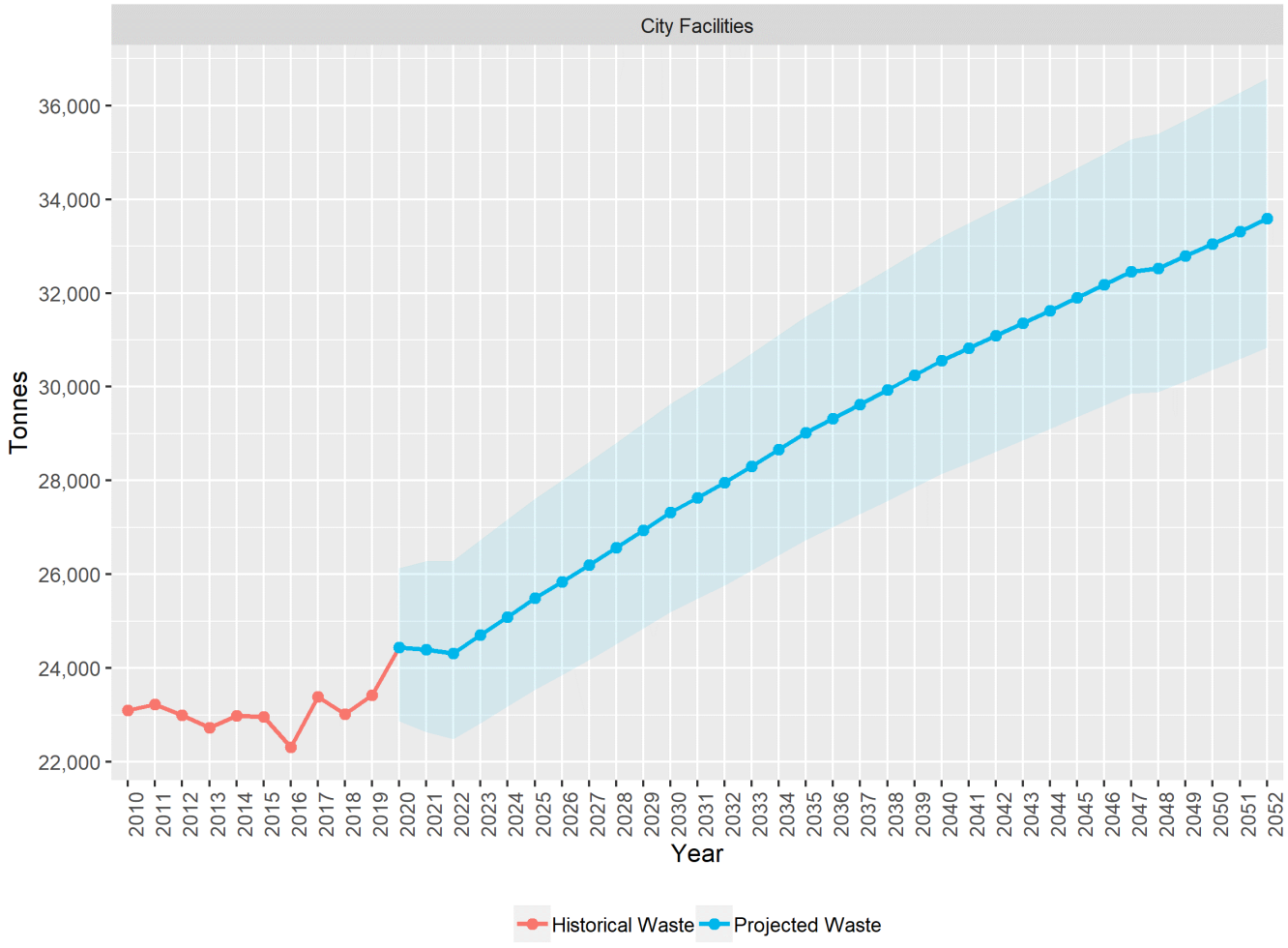
The City collects garbage, Blue Bin and Black Bin materials, household organics, LYW and scrap metal from City facilities. As explained previously, the City does not track tonnages from these facilities separately. A number of assumptions were developed to estimate the tonnage from these facilities and are documented in **Appendix A**.

Tonnages attributed to City facilities were assumed to be approximately seven per cent of curbside tonnes and five per cent of Multi-Residential Containerized (MR/C) tonnes, based on the 2019 allocation scheme. It should be noted that there are many more variables associated

with waste generation at City facilities, as compared to residential homes, which makes developing future estimates less precise. Variables can include the number and type of facilities, operational and public facing hours, activities undertaken in facilities (e.g. administrative versus recreational), number and type of visitors (e.g. City staff versus residents in long-term care facilities), etc. Care should be taken with reliance on these estimates.

Figure 26 shows the historical and future forecasted amount of waste to be managed from City Facilities.

Figure 26: Historical and Forecasted City Facilities Waste Generation



Overall, annual City facilities waste generation is projected to grow from 24,446 tonnes in 2020 to 33,587 tonnes by 2052, an increase of 27 per cent. These projections assume that the manner in which City facilities waste is collected from each of the two contracts remains constant and that there is a consistent relationship between Curbside Residential (CR) and Multi-Residential Containerized (MR/C) tonnes per household and the portion of which is generated from City facilities (see **Section 2.4**). Future changes to the collection program, or changes to operating or budget plans at City facilities will have a greater influence on future waste generation totals than changes in employment rates as forecasted by the regression model. There is less certainty about waste generation at City facilities compared to the single family or multi-residential sectors due to the number of assumptions that had to be made to estimate the tonnes of waste managed by the City from this sector.

2.8 Single-family, Multi-residential and City Facility Waste Projections Over 30 Year Planning Horizon

Using the allocation scheme presented in **Section 2.2**, fractions of total single family and total multi-residential annual waste were redistributed across waste streams and projected out using the model described above. It should be noted that these projections are based on status quo system and policies, and that future implementation of new policies, programs, collection approaches etc. will impact these projections. The purpose of developing these projections is to illustrate the status quo, that is, if no further waste diversion efforts are undertaken in the future.

The projections assume a consistent per cent allocation of materials by sector over the planning period, as presented in **Section 2.2**. These projections also include the current management of Blue and Black Bin materials by the City and do not assume any responsibility by producers of this material, as details of this transition are unknown at this point in time. It is expected that in 2023, producers of packaging and printed paper (materials collected in the City's recycling program) will be responsible for collection and processing of these materials from the residential sector under Provincial new legislation.

The waste streams analyzed are as follows:

- Blue Bin materials (glass, metal and plastics);
- Black Bin materials (fibres);
- Green Bin organics (includes both household organics and leaf and yard waste placed in the Green Bin that is sent to Convertus for processing);
- Leaf and Yard waste (collected with Green Bin setouts that is sent to Convertus for processing);

- Leaf and Yard waste (LYW that is not placed in the Green Bin and that is currently collected separately on a seasonal basis that is sent to Barnsdale for processing);
- Garbage; and,
- Bulky items.

Figure 27 presents the historical and projected tonnes of waste streams from the single-family sector**.** The LYW tonnages shown include total LYW generated (i.e. tonnage that is collected and sent to Convertus, as well as tonnage collected and sent to Barnsdale). **Figure 28** presents the historical and projected tonnes of waste streams from the multi-residential sector. The tabulated tonnes, per capita and percentage breakdowns by sector and stream can be found in Table 3 to Table 5 of **Appendix D.**

Figure 27: Single Family Residential Tonnages by Waste Stream

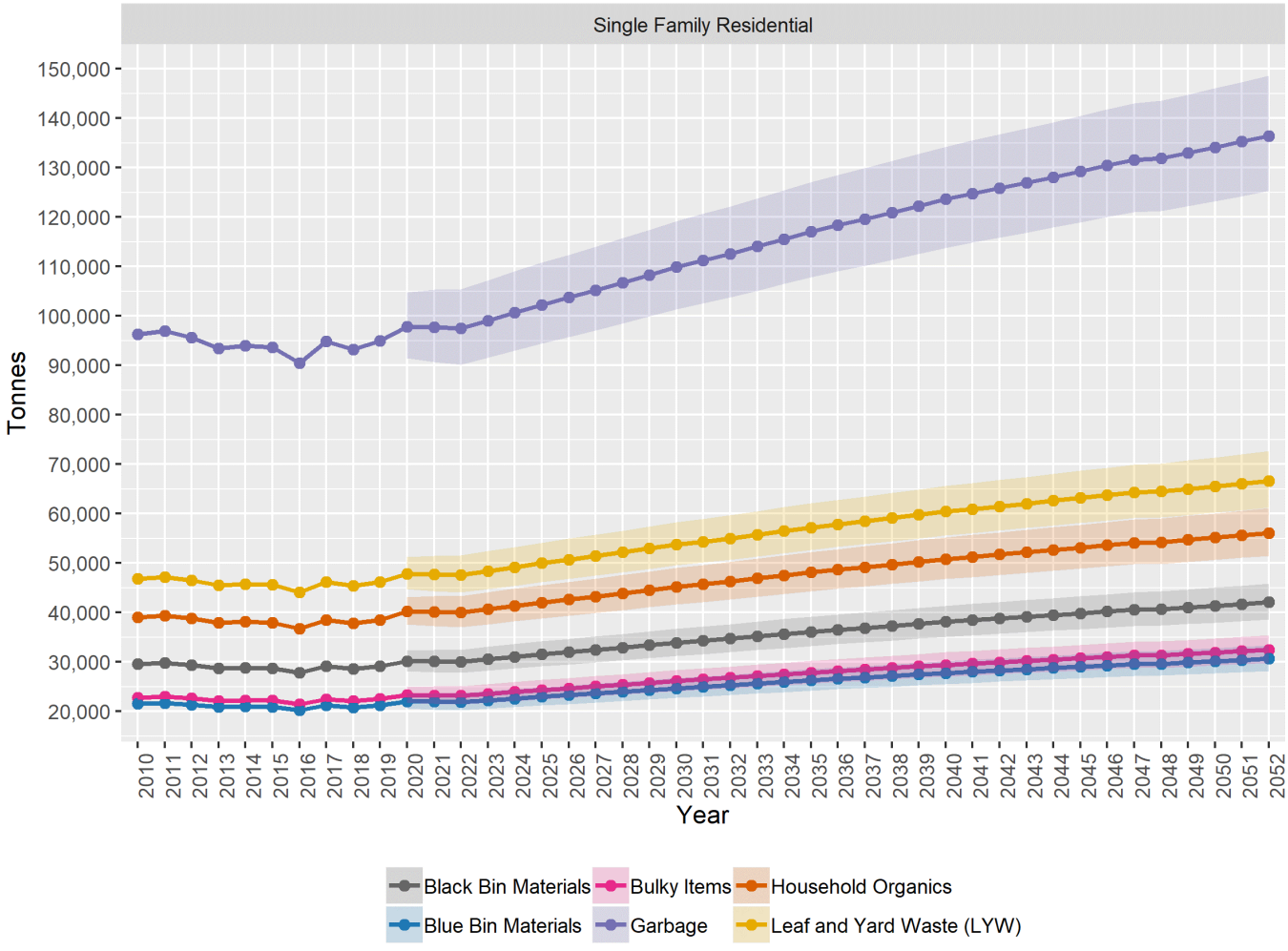
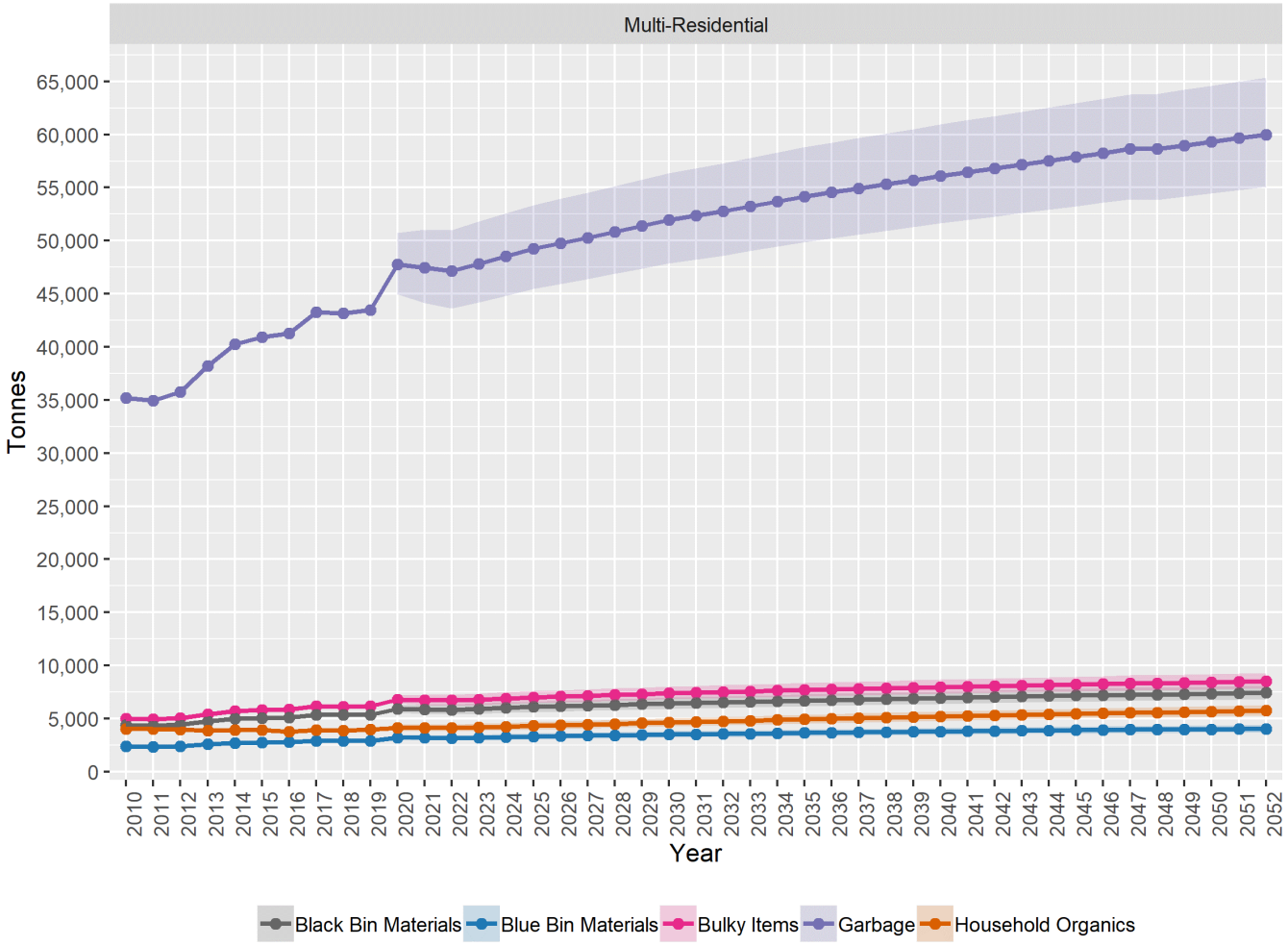
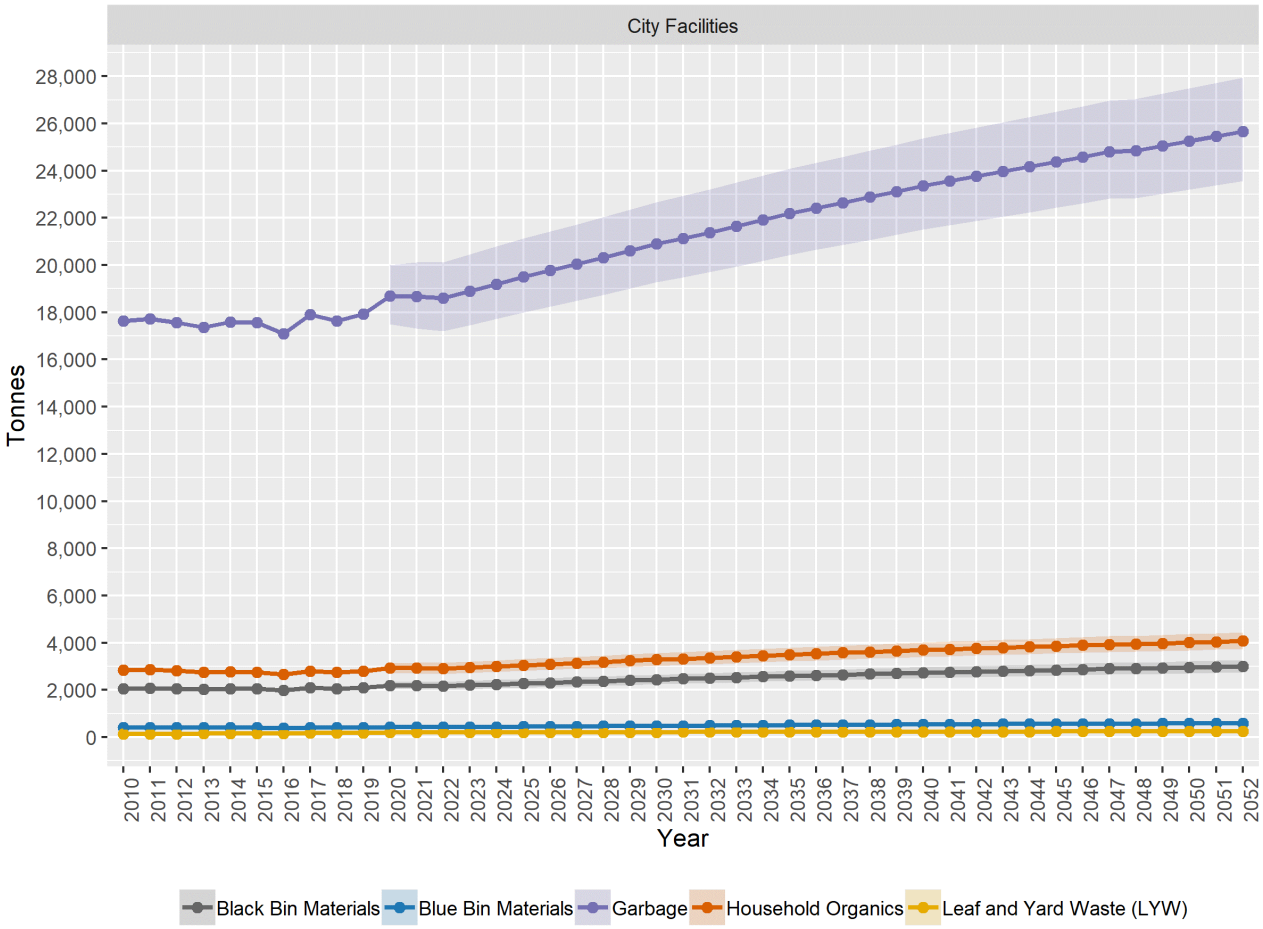


Figure 28: Multi-Residential Tonnages by Waste Stream



Annual projected City facilities tonnages split by stream are displayed in **Figure 24**. These projections were based on the tonnes presented in **Table 4** and **Table 8**, and on the status quo programs and policies. Again, it is important to note that these projections do not include the impact of the proposed transition to individual producer responsibility for recycling. At this time, it is unknown how this program may be rolled out, and if the City would still be responsible for management of recycling at City facilities. The City facilities projections segmented by stream, as shown in the **Figure 29** below and in Table 18 to Table 22 of **Appendix D**, represent the best estimates based on historical trends and confirmed 2019 allocations by sector and streams. Changes from historical trends, impacted by factors such as changes in operating hours, public access, number and type of facilities or the manner of collection, and 2019 allocations by sector and streams, will impact actual future tonnages.

Figure 29: City Facilities Tonnages by Waste Stream



2.8.1 Single Family and Multi-residential Tonnes per Capita Projections

The 2020 to 2052 projected annual tonnes by waste stream for the single family residential and multi-residential sectors shown in **Figure 27** and **Figure 28** above were divided by the number of persons living in single family residential and multi-residential dwellings, respectively, to produce per capita values. For the purpose of this study, single family residential dwellings include single-detached, semi-detached, row, duplex, and apartments less than five storeys, and multi-residential includes units which belong to apartments with five or more storeys. This is done to align to the types of dwellings collected under the CR and MR/C contracts. The City estimated that on average there are 2.65 people per household in single family residential dwellings and 1.57 people per household in multi-residential dwellings. These numbers multiplied by their respective projected number of dwellings. See Table 2 of **Appendix B** for yield dwelling appropriate projected total populations.

Figure 30 and **Figure 31** show the projected per capita tonnes for single family residential and multi-residential sectors, respectively. For both sectors, garbage has the highest per capita values for 2020 at 0.125 and 0.254 tonnes per capita, respectively. As expected, multi-residential dwellers produce more garbage per capita, at twice the rate as persons living in single family residential units, due to their lower diversion rates for recycling and organics. Projected annual per capita values for the two sectors by waste stream can be found in Tables 23 and 24 of **Appendix D**.

Generally, the slight decline in garbage per capita rates from 0.125 tonnes per capita in 2020 to 0.114 tonnes per capita in 2052 for single family residents (nine per cent decline), and similarly for the multi-residential sector, going from 0.254 tonnes per capita in 2020 to 0.229 tonnes per capita (10 per cent decline) in 2052 is due to the combined effects of increasing household counts with decreasing employment rates. There are a number of factors that can contribute to this decline, however, it is anticipated that with the projected decline in employment rate numbers (projected to decline from 64.4 per cent in 2020 to 58.2 per cent in 2052) it is likely that decreasing consumer purchasing power causes less waste, including packaging, to be generated.

Figure 30: Single Family Residential Tonnes Per Capita by Waste Stream

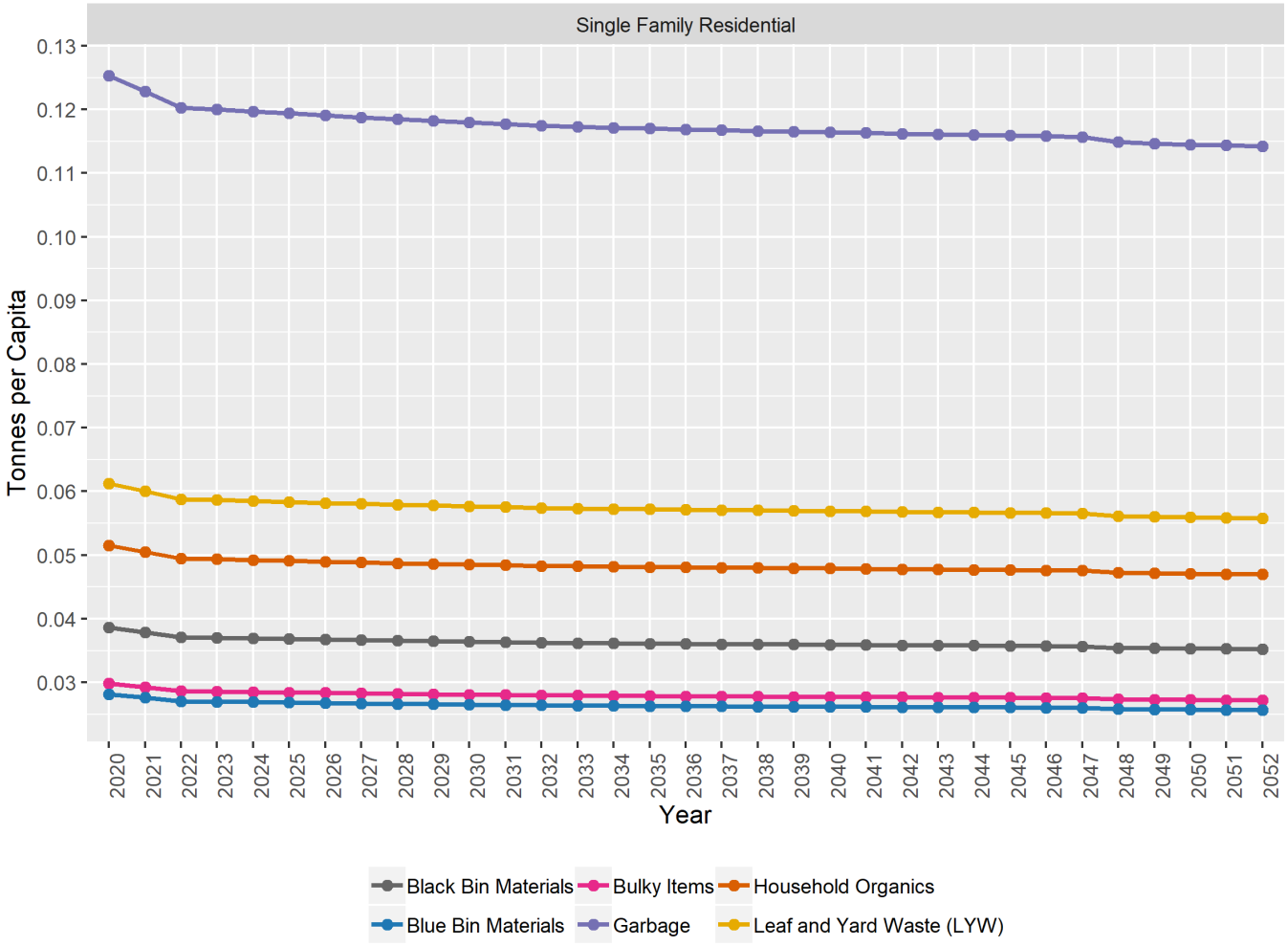
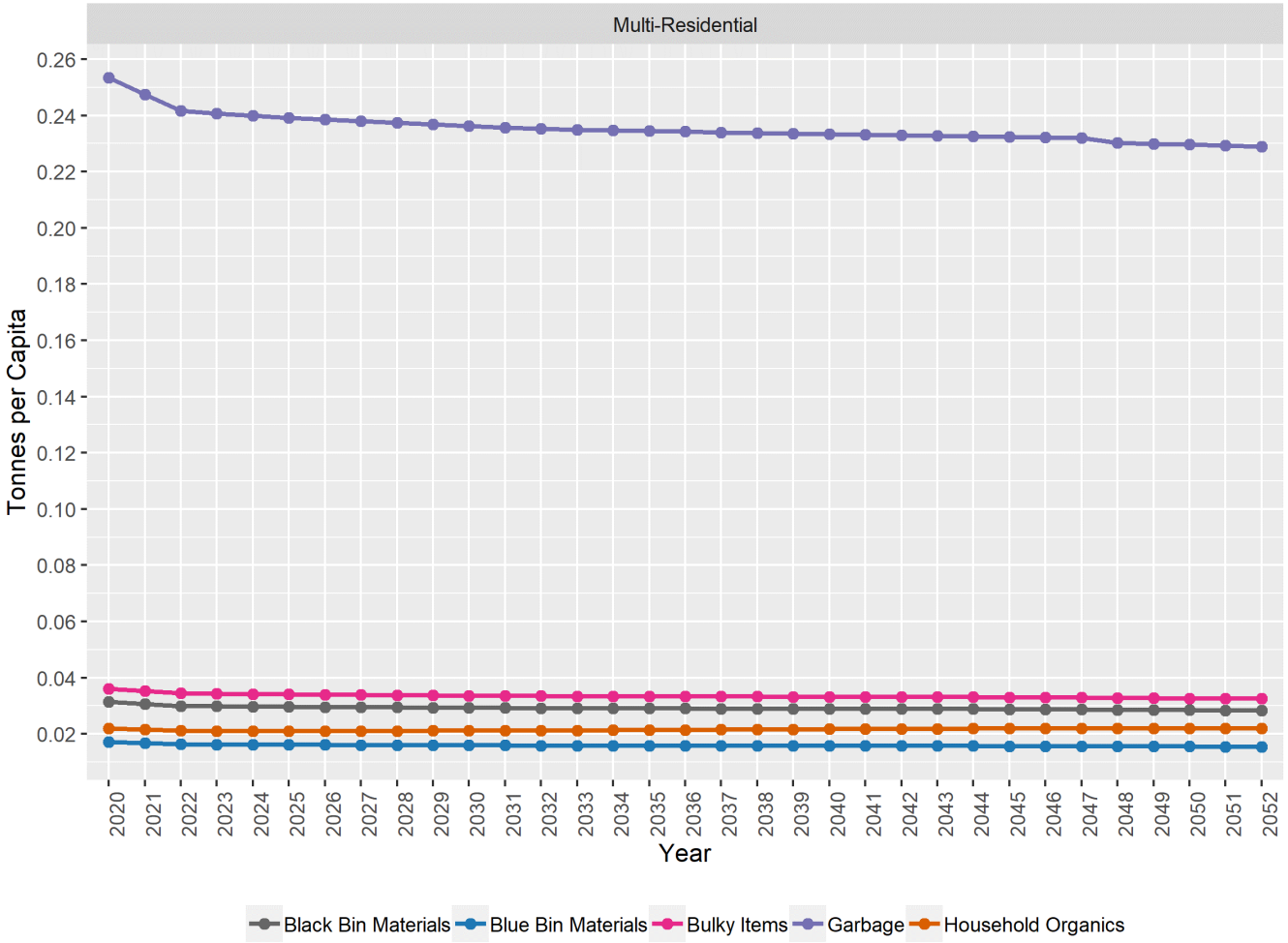


Figure 31: Multi-residential Tonnes Per Capita by Waste Stream



2.9 Parks and Public Space Waste Projections

The City collected 1,708 tonnes of garbage and 9.6 tonnes of recycling from parks and public spaces in 2019.[8,9] Based on a 2019 population of 1,026,263, the generation rate for garbage is 1.66 kg per capita and the generation rate for recycling is 0.01 kg per capita. Projections for parks and public space waste were based on per capita generation rates. Based on these generation rates and the projected population growth, and assuming the same level of service

[8] Information provided by the City to HDR in an email from L. Coates dated September 2, 2020.
[9] Waste managed at OC Transpo locations is not included as this information was not available at the time of undertaking the projections.

and number/type of receptacles, the City could expect to manage the following tonnes of garbage and recycling as presented in **Table 14**.

Table 14: Projected Tonnes of Garbage and Recycling Managed at Parks and Public Spaces

Year	Garbage (tonnes)	Recycling (tonnes)
2020	1,739	9.8
2025	1,874	10.5
2030	2,003	11.2
2035	2,125	11.9
2040	2,234	12.5
2045	2,328	13.1
2050	2,470	13.8
2052	2,518	14.1

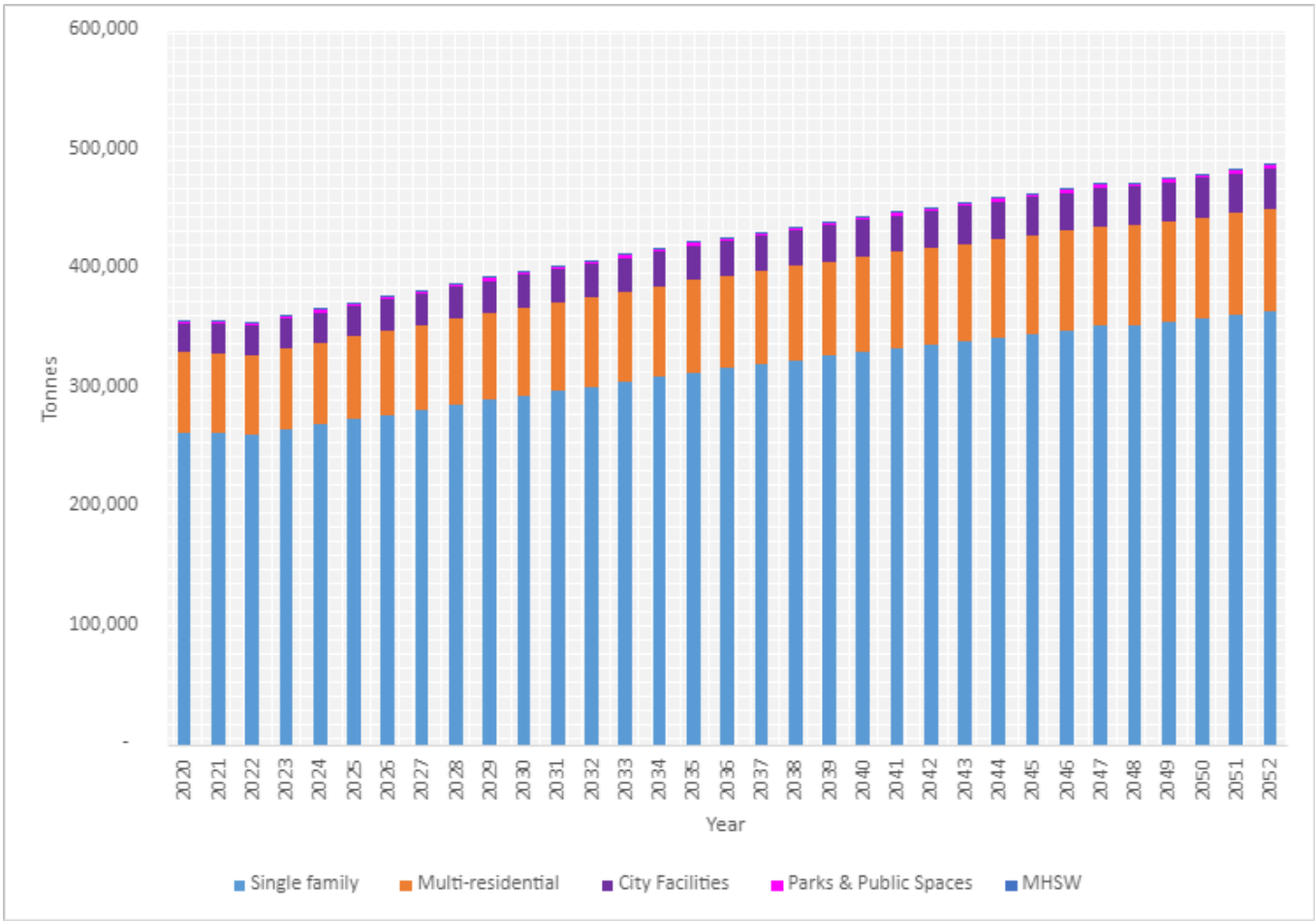
2.10 Projected Tonnes of Waste to be Managed Over the Next 30 Years

The following are a series of figures that consolidate the projected tonnes generated by single family, multi-residential, City facilities and parks/public spaces, for the various material streams, from the information in the previous sections.

2.10.1 Projected Total Tonnes of Waste Generated

Figure 32 presents the total projected annual tonnes for all waste streams (garbage, bulky, recycling, household organics, LYW and MHSW) for single family, multi-residential, City facilities and Parks/Public Spaces to be managed by the City between 2020 and 2052.

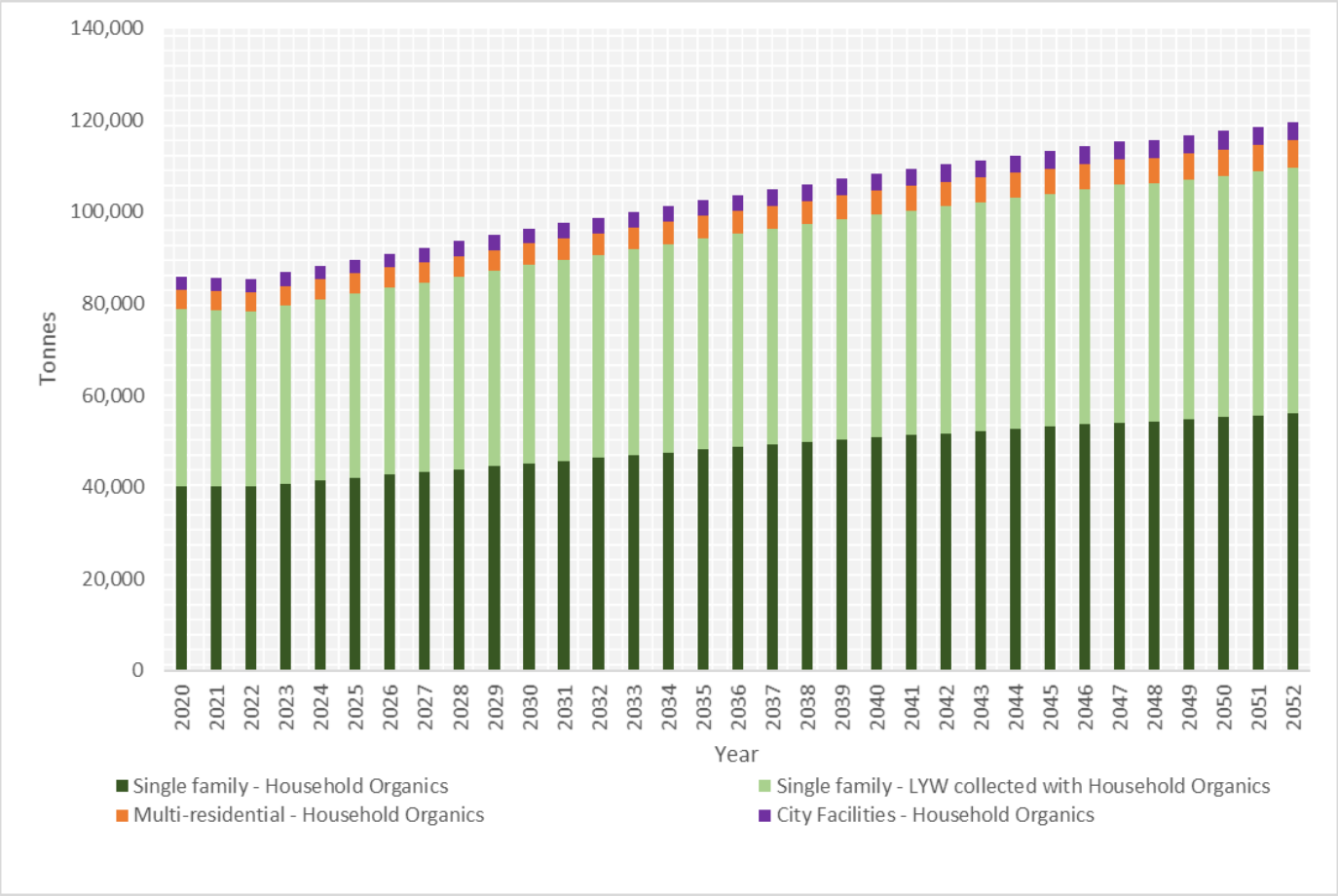
Figure 32: Total Projected Annual Waste for Single Family, Multi-residential, City Facilities, Parks and Public Spaces (2020 to 2052)



2.10.2 Projected Tonnes of Green Bin Organics

Figure 33 presents the projected tonnes of Green Bin Organics, currently managed at Convertus, which includes household organics from single family, multi-residential, and City facilities and LYW collected at the curb with household organics in the Green Bin from single family residences, up until 2052 which will require management by the City. The tonnage of Green Bin Organics is projected to increase from 85,793 tonnes in 2020 to approximately 119,561 tonnes in 2052

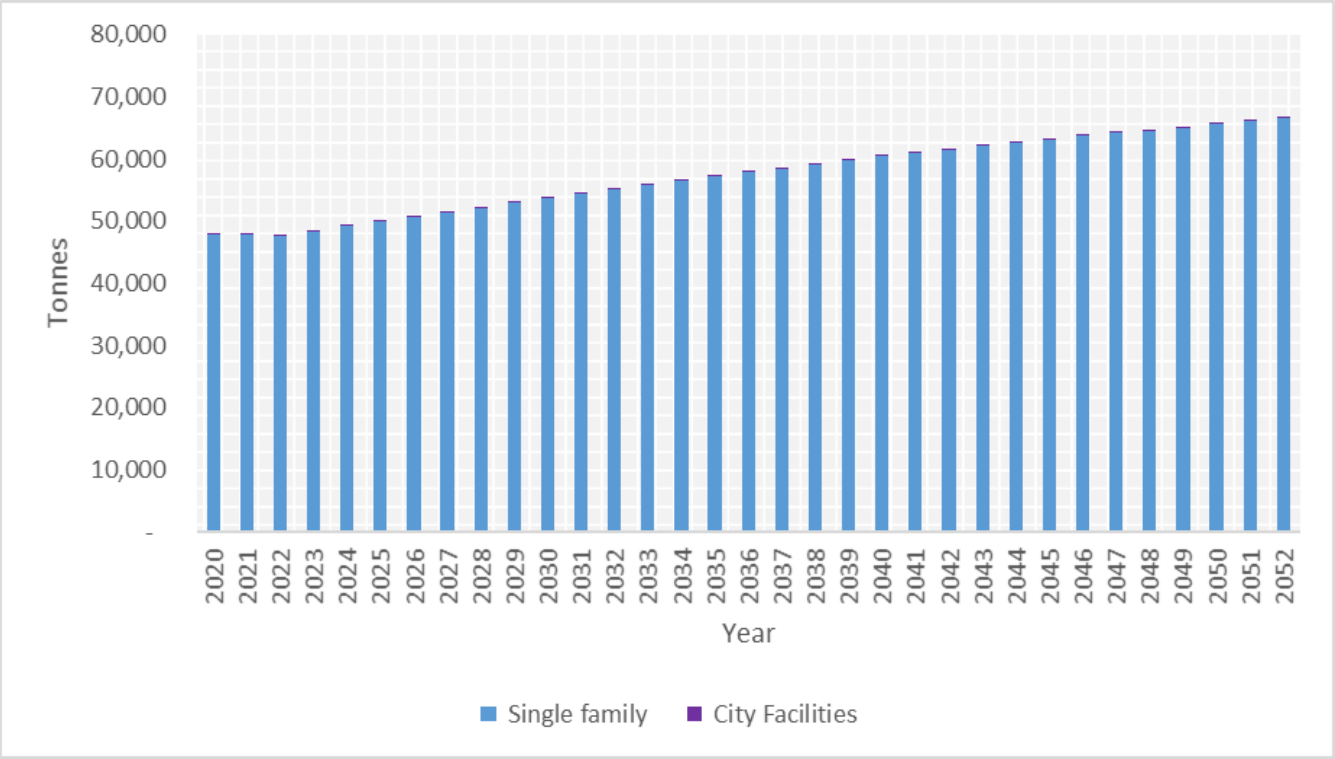
Figure 33: Annual Green Bin Organics Projections (2020 to 2052)



2.10.3 Projected Tonnes Leaf and Yard Waste

Figure 34 presents the projected tonnes of LYW from single-family homes and City facilities. The City does not provide LYW collection to the multi-residential sector; any LYW generated is likely managed by private contractors (e.g. landscaping companies). It represents the total amount of LYW generated i.e. LYW that is placed in and set out separately from the Green Bin. While the quantities of LYW are very dependent on factors such as precipitation, it is estimated that LYW quantities will increase from around 48,000 tonnes in 2020 to 67,000 tonnes in 2052.

Figure 34: Annual Leaf and Yard Waste Projections (2020 to 2052)

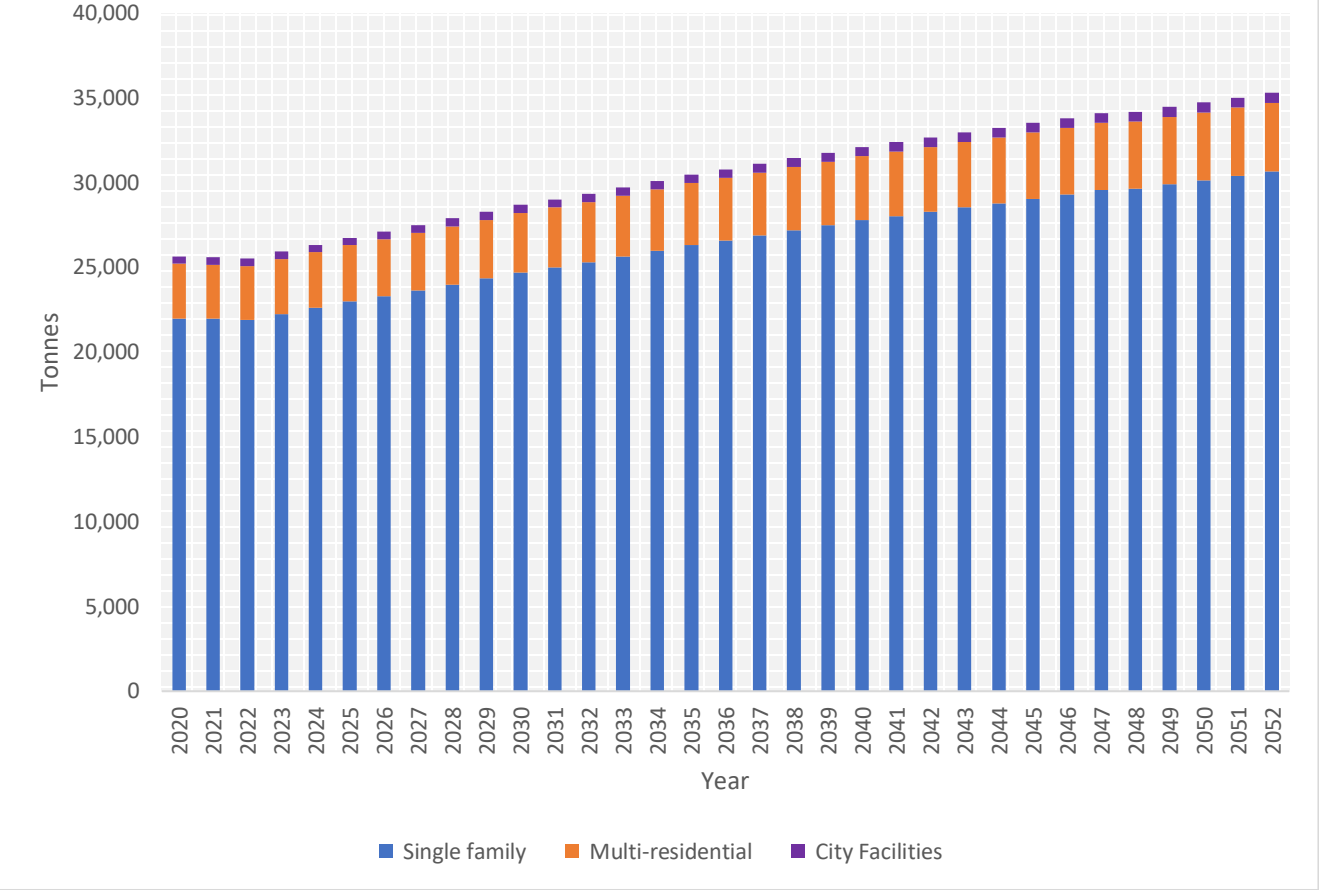


2.10.4 Projected Tonnes of Blue Bin Materials

Figure 35 presents the projected tonnes of Blue Bin materials generated by single family, multi-residential and City facilities. It shows that the tonnage of Blue Bin materials is projected to increase for all three sectors, increasing the total generation from 25,648 tonnes in 2020 to 35,299 tonnes in 2052.[10] Note that these projections do not take into consideration any changes due to the transition of the Provincial Blue Box Program (includes City's Blue and Black Bin recycling programs) to Individual Producer Responsibility (IPR), including additional materials that may be designated for inclusion in the new Provincial Blue Box regulations. It is unknown at this time what the full impact of the transition of the Provincial Blue Box program to IPR will have on these tonnages or on the Materials Recovery Facility (MRF) currently used to manage the City's recyclables.

[10] Tonnes of recycling from Parks is expected to increase from approximately 10 tonnes in 2020 to 14 tonnes in 2052 based on the status quo system.

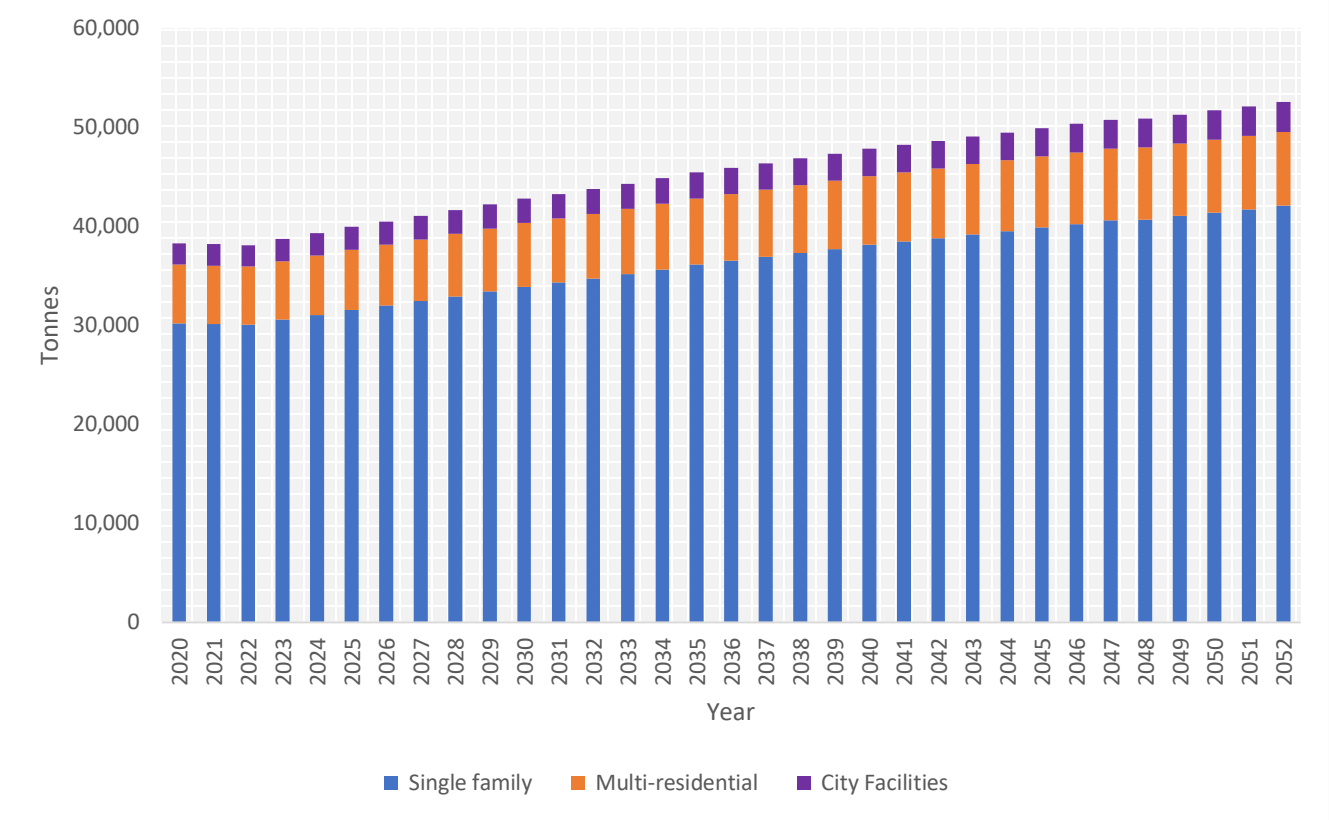
Figure 35: Annual Blue Bin Materials Projections (2020 to 2052)



2.10.5 Projected Tonnes of Black Bin Materials

Figure 36 presents the projected tonnes of Black Bin materials generated by single family, multi-residential and City facilities. It shows that the tonnage of Black Bin materials is projected to increase for all three sectors, increasing the total generation from 38,290 tonnes in 2020 to 52,510 tonnes in 2052. Similar to the Blue Bin materials, note that these projections do not take into consideration any changes due to the transition of the Provincial Blue Box Program (includes City's Blue and Black Bin recycling programs) to Individual Producer Responsibility (IPR), including additional materials that may be designated for inclusion in the new Provincial Blue Box regulations. It is unknown at this time what the full impact of the transition of the Provincial Blue Box program to IPR will have on these tonnages or on the Materials Recovery Facility (MRF) currently used to manage the City's recyclables.

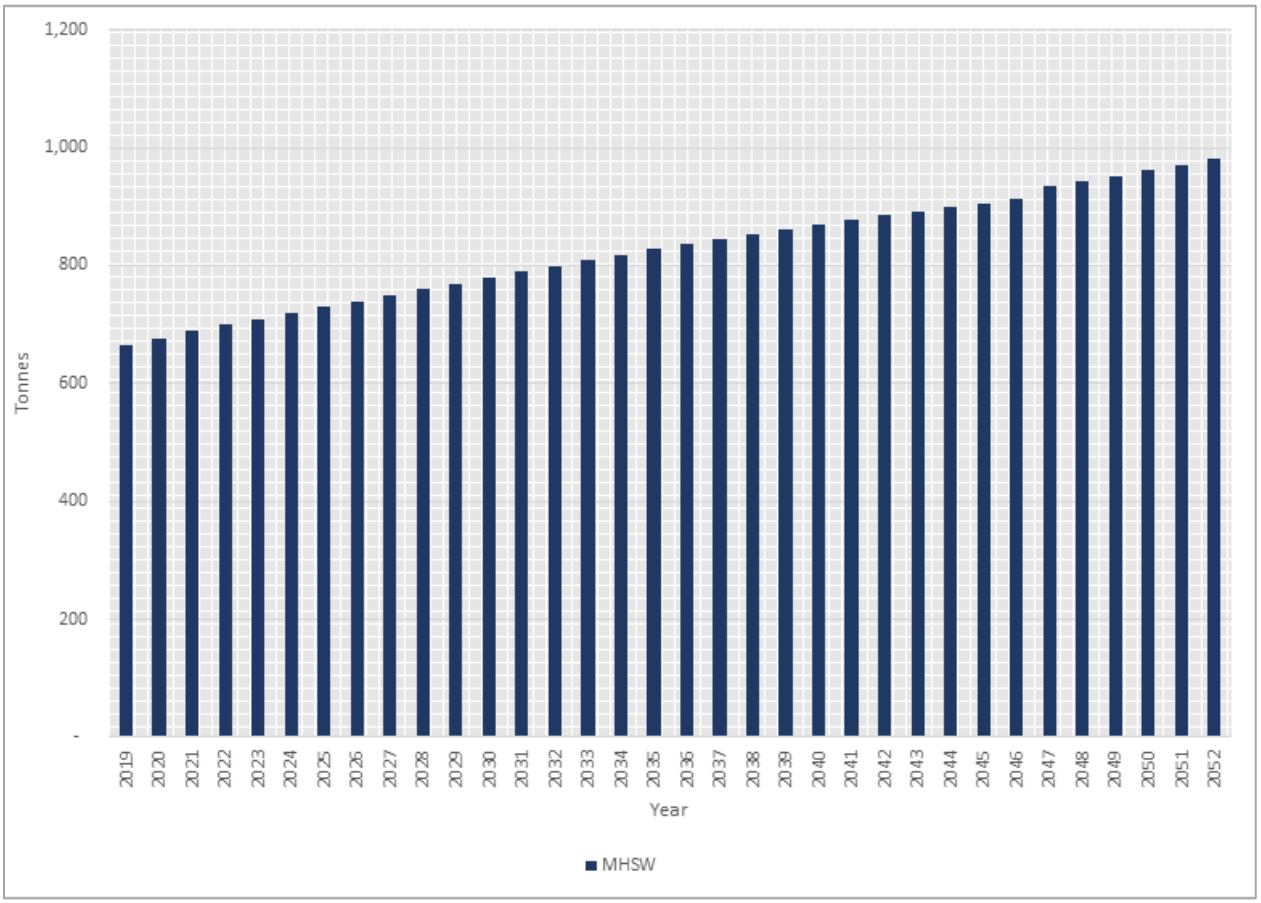
Figure 36: Annual Black Bin Materials Projections (2020 to 2052)



2.10.6 Projected Tonnes of Municipal Hazardous Special Waste

Figure 37 presents the projected tonnes of Municipal Hazardous Special Waste (MHSW) materials anticipated to be generated by single family homes and multi-residential buildings and is based on 2019 tonnages managed at the City's one-day mobile MHSW deports. Projections for MHSW were based on per capita generation rates. Based on these generation rates and the projected population growth, and assuming the same level of service is provided and the same materials are collected, it is expected that MHSW quantities will increase from 665 tonnes in 2020 to 980 tonnes in 2052. These projections do not take into consideration any changes due to the transition of the Provincial MHSW Program, to Individual Producer Responsibility (IPR), including additional materials that may be designated for inclusion in the new Provincial MHSW regulations. It is unknown at this time what the full impact of the transition of the Provincial MHSW program to IPR will have on these tonnages or on the currently mobile drop-off depot approach used to manage residential MHSW.

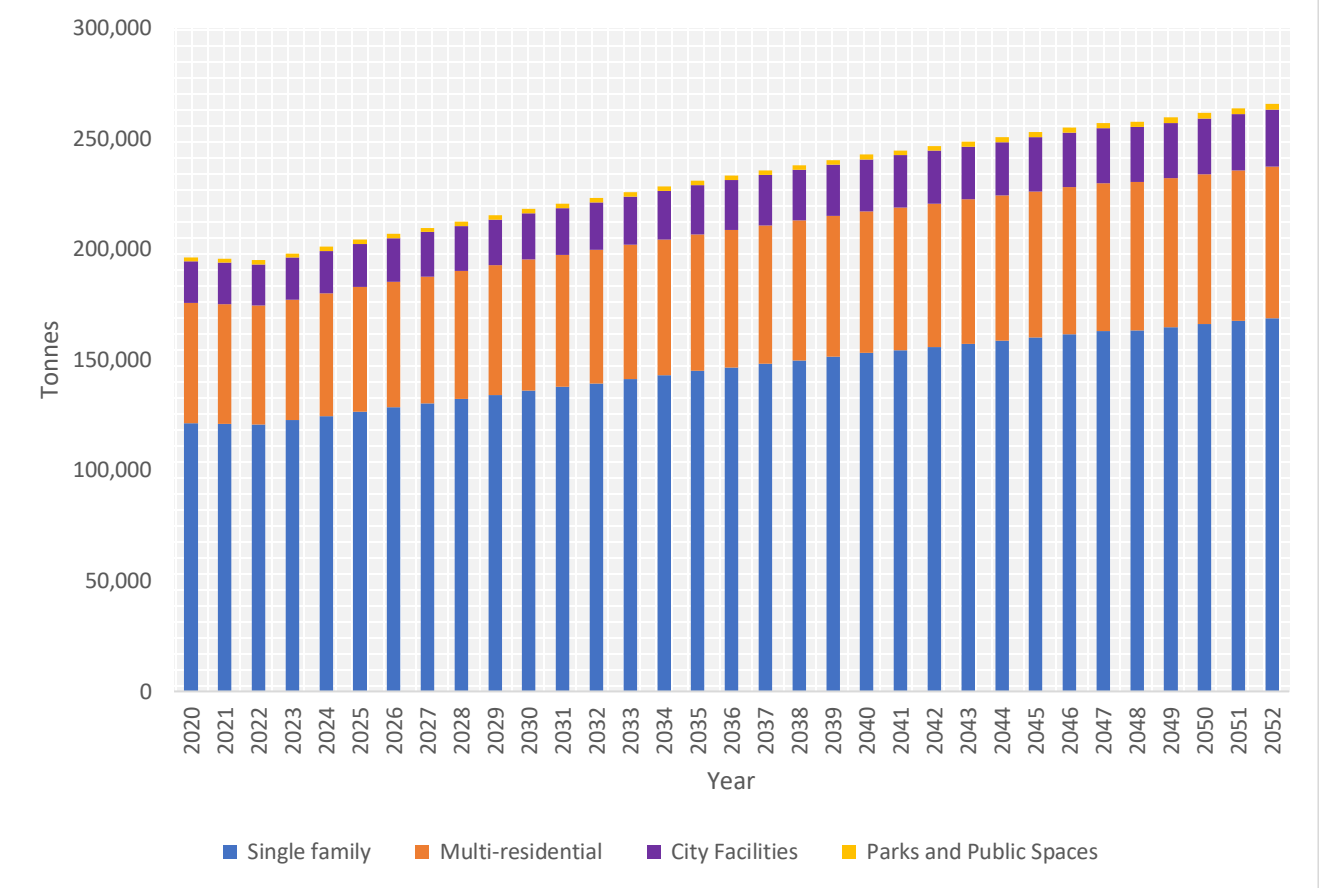
Figure 37: Annual Municipal Hazardous Special Waste Projections (2020 to 2052)



2.10.7 Projected Tonnes of Garbage and Bulky Waste

Figure 38 presents the projections for the tonnes of garbage and bulky waste managed by the City from all three sectors, as well as from Parks and Public Spaces. In total, it is projected that all four sectors will generate approximately 265,589 tonnes of garbage in 2052, based on the status quo system. In total, it is projected that the amount of Garbage and Bulky Waste generated by all four sectors will increase from 196,194 tonnes in 2020 to approximately 265,589 tonnes in 2052, based on the status quo system.

Figure 38: Annual Garbage Projections from all Sectors (2020 to 2052)



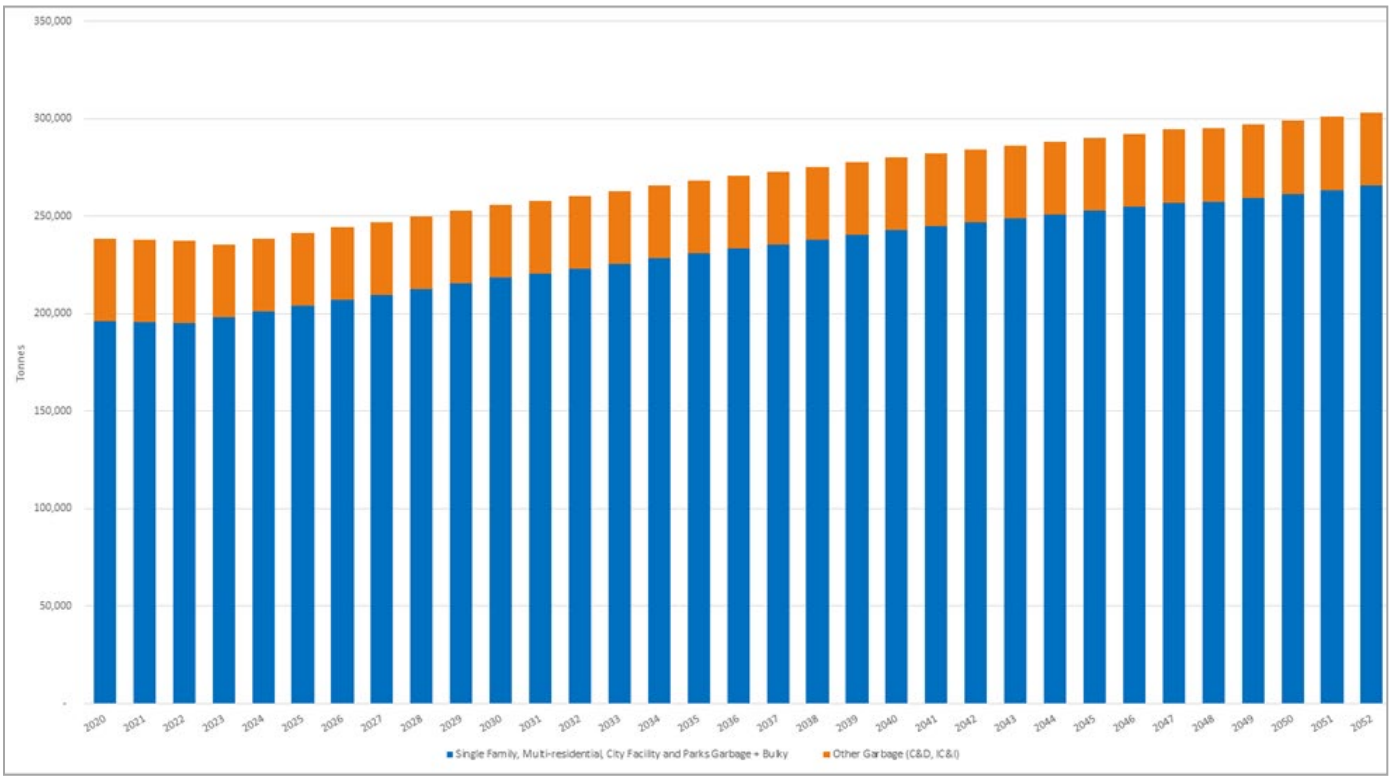
2.10.8 Projected Tonnes of Waste Disposed at the Trail Waste Facility Landfill

Figure 39 presents the projections for the tonnes of garbage disposed at the Trail Waste Facility landfill. These projections include garbage and bulky waste generated by single-family homes, multi-residential properties, City facilities and parks and public spaces that is transported to the landfill for disposal by the City i.e. the waste that is included in the projections shown above in Figure 26, plus other garbage i.e. IC&I and C&D waste that is brought directly to the landfill by the private sector. In total, it is projected that approximately 300,411 tonnes of garbage will be disposed at the Trail Waste Facility landfill in 2052, based on the status quo system.

For the purpose of estimating the future amounts of other garbage disposed at the Trail Waste Facility landfill, the following assumptions were made:

- A total of 224,954 tonnes of garbage was disposed at the Trail Waste Facility landfill in 2019, per the Trail Road Landfill Site 2019 Monitoring and Operating Report, May 2020, Dillon Consulting;
- A total of 187,727 tonnes of the total tonnes of garbage disposed at the Trail Waste Facility landfill in 2019 noted above is garbage that was generated by single-family homes, multi-residential properties, City facilities and parks and public spaces and brought to the landfill for disposal by the City;
- The difference between the two amounts i.e. 37,227 tonnes is IC&I and C&D garbage disposed at Trail Waste Facility landfill in 2019;
- Tonnes of IC&I and C&D garbage disposed at Trail Waste Facility landfill for the years 2020 to 2022 is assumed to be 42,406 tonnes and is used to represent the status quo with respect to the availability of local private sector landfill capacity. This tonnage amount represents the 11-year average amount of IC&I and C&D garbage disposed at the Trail waste Facility landfill;
- Tonnes of IC&I and C&D garbage disposed at Trail Waste Facility landfill for the years 2023 to 2052 is 37,340 tonnes annually. This amount represents the annual average amount of IC&I and C&D garbage disposed at the Trail Waste Facility landfill between 2016 and 2019 i.e. the four-year average amount over this timeframe. The rationale for using this timeframe is 2016 was the year that additional local private sector landfill capacity to dispose of IC&I and C&D waste became available. This lower amount (compared to the 11-year average) is considered more appropriate to use after 2022, as additional local private sector landfill capacity is expected to be available in 2023 and based on previous experience and trends, once additional local private sector landfill capacity becomes available, the Trail Waste Facility landfill is expected to see a decrease in the amount of garbage received.

Figure 39: Annual Projections for Waste Disposed at Trail Waste Facility Landfill (2020 to 2052)



The Trail Waste Facility landfill accepts a small amount of IC&I and C&D garbage for disposal relative to the amount of garbage the City collects and disposes of at the landfill. This trend is expected to continue over the next 30-years. IC&I waste is typically managed by private sector haulers and waste management companies. C&D waste is produced by construction, renovation and demolition projects and waste generation in each of these sectors varies significantly depending on economic activity from one year to another and development trends.

3 Description of Variables Affecting Estimates

As described above, there are a number of variables that can affect the estimates of waste requiring management by the City in the future. This includes reliance on historical data, the level of uncertainty about future events, and data quality and quantity. As the future is unknown, the margin of error around each subsequent projection becomes larger over time. The following describes some of the variables that can affect the estimates developed for the Solid Waste Master Plan.

Reliance on Historical Data

- Model rules rely on historical trends and since the future is unknown, future values may diverge from projections;
- Trends in waste generation have altered significantly over the last few years; and,
- Historical events such as economic downturns (e.g., 2009 recession) and weather events (floods, tornadoes (e.g. 2018), ice storms) can impact waste generation trends.

Future Events

- Residential waste generation trends will continue to change as a result of the COVID-19 pandemic (e.g., more people working from home). At this time, it is unknown whether this trend will continue, and whether residential waste generation will continue to increase;
- Future policy changes and legislative requirements regarding packaging and acceptable waste materials cannot be anticipated;
- Severe climate events can generate waste tonnages, which diverge from forecasts;
- Quantities of LYW affected by climate variations (e.g. quantities of rainfall, extended growing season) and dwelling types, and,
- Future changes to the economy, which have an impact on quantities of waste generated, are difficult to predict.

Data Quality and Quantity

- Availability of monthly tonnes is ideal, however, the mixing of different sectors and waste streams into an overall total causes loss of valuable waste stream specific trends;
- Annual or quinquennial (i.e. every five years) economic and demographic indicators can only explain general tendencies in tonnage trends;

- Allocation of tonnage by sector and waste stream is based on current and assumed consumer behaviour (and not actual tonnes) collected from waste audit studies taken at one point in time;
- Limited data was available for City facilities. Assumptions were made about the density of material managed, fullness of containers, etc. and were made to estimate waste tonnages for City facilities;
- Limited data was available for parks and public spaces; and
- Not all streams are represented in the existing data, e.g., IC&I waste that the City manages, such as waste from the Yellow Bag and Green Bin in Schools programs, as well as City facilities.

It is recommended that as part of the next update of the City's Solid Waste Master Plan, the projections be updated with new information. While annual updates to the projections would be ideal, every five years is the standard industry best practice. Prior to the update, the City could subscribe to proprietary databases which contain forecasted economic and demographic indicators for the City of Ottawa. While there are several companies that can provide this information, it is recommended that the City utilize one that can provide estimates on a quarterly basis for both the historical and forecast periods the City requires. In addition, the databases should have a high variety of different variables such as, but not limited to, household income, labour force attachment (i.e., employment status), population, number of households by dwelling type, number of persons per household, education levels, and gross domestic product (overall and by industry), etc.

Having timely tracking of these indicators improves a model's accuracy, as some of these indicators can be related to property size and consumer purchases, which in turn generate different levels of waste. The quarterly indicators improve forecasts as more detail can better explain impacts of economic shocks, policy changes or even climate events, for example, severe floods, if such events impact the economy. Ultimately, this detailed information will provide the City with a better handle on the economic and demographic factors which impact waste management.

By the time the next update of the Solid waste Master Plan is undertaken, more information will be available regarding the impact of COVID-19 on residential waste generation trends. This information can be considered in the update to the model.

4 Needs Analysis

4.1 Gaps, Constraints and/or Opportunities with Waste Management Infrastructure, Facilities, Programs and Existing Third-Party Contracts

This section of the memorandum is intended to identify short, mid and long-term gaps, constraints and opportunities in the City's waste management system. The analysis that was undertaken looked at the current system and includes existing components that have the potential for enhancement/ improvement, new opportunities and where contracts are expiring, offering the potential to do something different.

The gaps, constraints and opportunities provided in the sub-sections below have been identified based on the consulting team's experience and review of the Current State System Summary technical memorandum prepared as part of Phase 1, as well as knowledge and experience of staff. In addition, the waste projections (presented in **Section 2.0**) and key industry and regulatory trends identified in Phase 1 which will have an impact on the City's integrated waste management system were reviewed and considered when identifying the future needs. Feedback received from stakeholders through Engagement Series 1 was also considered when identifying these needs.

The analysis has been broken down into the following seven categories, with 17 identified areas of focus (each is discussed in more detail in the sub-sections below):

- Avoidance, Reduction and Reuse
    - Waste Avoidance, Reduction and Reuse
    - Value of Food and Food Waste
- Waste Diversion Programs
    - Green Bin and Leaf and Yard Waste Program
    - Parks and Public Spaces
    - Special Events
    - Waste Diversion Program Performance
    - Multi-Residential Waste Diversion Program Performance
    - New Waste Collection and Diversion Programs
- Collection and Drop-off of Materials
    - Collection
    - Drop-off
- Recovery of Waste and Energy

  - Technologies for Waste Recovery
  - Technologies for Energy Recovery
- Residual Management
  - Trail Waste Facility
  - Future Use of Existing City Owned Waste Management Sites
- Managing Waste Generated by City Facilities and Operations
- Supporting System Requirements
  - Promotion and Education
  - Regulations, Policies and By-Laws
  - Financial Sustainability

For each area of focus noted above, the following information is included:

- Background information on the current state;
- Statement on the future need;
- Brief descriptions of the associated gaps (i.e., areas within the current system that are missing to achieve desired outcomes), constraints (i.e., limitations of the current system) and opportunities (i.e., potential areas where improvements, enhancements, additions or changes to current programs, policies or facilities could be made or new programs, policies or facilities could be implemented);
- Potential timeline considerations, which are categorized into the following:
  - Short-term – 1 to 5 years;
  - Medium-term options – 6 to15 years; or
  - Long-term options – 16 to 30 years.

4.2 Avoidance, Reduction and Reuse

4.2.1 Waste Avoidance, Reduction and Reuse

Background

Development of the City's Solid Waste Master Plan (SWMP) is based on the 5Rs waste management hierarchy (reduce, reuse, recycle, recover, residual disposal). The City's Garbage and Recycling information on ottawa.ca has a dedicated page on Waste Reduction and Education that provides tips on how to avoid and reduce waste (rethink, reduce, reuse).

The City promotes the reuse of waste in its P&E materials and typically coordinates two Give Away Weekends each year, where residents place unwanted and gently used items at the

curb for other residents to take and reuse. COVID-19 has impacted the programming for 2020 and 2021.

The City's Take It Back! program encourages local businesses to take back materials (e.g., garden supplies, clothing and textiles, electronics, paint) that they sell for reuse, recycling or proper disposal, and currently has around 550 active retailers and charities registered. In addition, non-profit organizations and for-profit businesses have clothing donation boxes placed across the City, however it is noted that these boxes are not part of a City-run diversion program or partnership.

Within the City's corporate offices, redundant office furniture is reused as much as possible and the internal "Green Exchange" initiative provides a forum for staff to reuse, swap or buy used items and post "green" related advertisements. Lastly, the Trail Waste Facility accepts and beneficially reuses solid non-hazardous waste soil generated within the city.

There are also numerous local business, organizations and websites that, by their very nature, support waste avoidance and reduction. Examples include Boomerang Kids, the Ottawa Tool Library and websites such as Kijiji, loan or giveaway websites and social media groups.

Both the federal and provincial governments are moving towards developing a Circular Economy, which involves moving away from a linear model (take - make - dispose) and finding ways to keep resources and materials in use through increased waste avoidance, reduction, reuse and recycling opportunities. As examples, the federal government is looking to reduce and eliminate certain single-use plastics and the province is setting targets to reduce and increase capture of food waste and use it to create renewable energy. In addition, municipal governments are forming their own circular economy committees that include staff from different areas and external stakeholders, with the goal of working towards achieving their internal targets and goals.

A waste audit conducted in 2019/2020 of representative City facilities showed that overall, single use items comprise approximately 8 per cent of the garbage generated, however this will vary by type of City facility.

FUTURE NEED

Identify more ways to reduce and reuse waste generated by residents and in its own operations to decrease the amount of waste entering the City's solid waste management system.

The following presents the gaps, constraints and opportunities in addressing waste avoidance, reduction and reuse:

Gaps:

- No formal waste avoidance/reuse strategy – either for residents or the Corporation of the City of Ottawa.
- Currently, there are limited reuse and reduction programs offered by the City.
- Limited P&E around waste avoidance and reduction by the City.
- No current resources or strategy dedicated to moving Circular Economy forward in the City.
- Only two Give Away days currently held by the City.

Constraints:

- Lack of municipal control over consumer behaviour and purchasing habits, product manufacturing and packaging.
- Lack of data on effectiveness of non-City managed waste reduction and reuse programs.
- Lack of data on measuring the effectiveness of waste reduction P&E initiatives and programs.
- Lack of data to measure the effectiveness of the City's Take it Back! Program.
- Limited P&E budget and outreach staff to promote waste avoidance and reduction.

Opportunities:

- Develop a Single-Use Items (SUIs) Reduction Strategy (by request, bans, mandatory fees, require reusable) for different single-use items, such as cups, takeout containers, straws and utensils. Consider starting with City facilities to act as a model for what could be achieved in the IC&I sector.
- Promote waste avoidance and reduction (i.e. the notion of zero waste) through enhanced P&E efforts, including the significance of waste avoidance, reduction and

reuse on the environment (including Climate Change targets), social and financial pillars.

- Develop a waste avoidance and reuse strategy for the City that would include both what residents and the Corporation could do to avoid, reduce and reuse waste.
- Use different tools and tactics to encourage waste avoidance, reduction and reuse (e.g., financial incentives for less waste set-out at the curb, bylaws to discourage use of single-use items, increasing access to reusable goods, provide subsidies, rebates or grants, focus on food waste reduction).
- Host reuse drop-off events or create specialized reuse centres, both of which could be done in collaboration with not for profit or for profit organizations.
- Support more programs for waste reduction, including lending libraries, repair cafes, sharing spaces, etc., reuse drop-off events or create specialized reuse centres, both of which could be done in collaboration with not for profit or for profit organizations.
- Partner with, support and/or promote reuse activities and businesses (e.g., Ottawa Tool Library lends and hosts repair cafes, Habitat for Humanity, community swaps, food delivery companies to provide reusable packaging).
- Creation of a Circular Economy working group that could comprise internal City departments, industry specialists, general public and other stakeholders to find opportunities to keep using materials, that would otherwise be disposed.
- Complete a material flow analysis of waste generated at City facilities and through City operations to identify potential hotspots and interventions to create circular economy opportunities. This would allow the City to lead by example with regards to becoming a circular city.
- Develop and implement a Circular Economy strategy (e.g., development of a strategy, update green procurement requirements) to create closed-loop systems, maximize recycled content, increase waste avoidance, reduction and reuse of goods, and reduce Greenhouse Gas (GHG) emissions.
- Set targets and timelines to reduce waste generation to track and communicate progress.
- Support and/or collaborate with local businesses, non-profit organizations, innovators and/or organizations that design for the environment, reduce and upcycle waste, reuse and/or recycle waste into new products.

- Work with local colleges, universities and business support organizations to host interactive workshops to explore the latest trends in collaboration, social innovation and sustainability.

Potential Timeline

Waste avoidance, reduction and reuse is at the top of the waste hierarchy and therefore should be consistently considered throughout the **short, medium and long terms**.

4.2.2 Value of Food and Food Waste

Background

Food waste is either unavoidable (cannot be sold or eaten, such as bones, vegetable peelings, egg shells, tea bags, and coffee grounds) or avoidable (edible food that could have been eaten but was thrown out because it went bad, was no longer wanted, went past best before/eat by/expiry dates, etc.). Food is often wasted when consumers find they have bought more than they could use, cook more than they can reheat/freeze or food spoils due to incorrect storage. In 2017, the National Zero Waste Council conducted research on household food waste in Canada.[11] The results showed that 63 per cent of the food Canadians throw away could have been eaten. For the average Canadian household, this amounts to 140 kilograms of wasted food each year – at a cost of more than $1,100 per year. That amounts to 2.2 million tonnes of edible food wasted each year in Canada, i.e., avoidable food waste, at a cost of $17 billion.

All types of food are wasted, but in Canada the most prominently wasted foods are:

- vegetables - 30 per cent;
- fruit - 15 per cent;
- leftovers - 13 per cent;
- bakery - nine per cent; and
- dairy and eggs – nine per cent.[12]

Getting food from farm to table, and then managing or disposing of food as waste also has a significant carbon footprint, contributing to Canada's GHG emissions. Canada's 2.2 million

[11] Love food hate waste Canada, 2020: https://lovefoodhatewaste.ca/about/food-waste/#:~:text=%202017%cent20National%20Zero,more%20than%20%241%2C100%20per%20year!
[12] Love food hate waste Canada, 2020: https://lovefoodhatewaste.ca/about/food-waste/#:~:text=In%202017%20the%20National%20Zero,more%20than%20%241%2C100%20per%20year!

tonnes per year of avoidable household food waste is equivalent to 9.8 million tonnes of CO_2 or having 2.1 million cars on the road.[13] This is equivalent to roughly double the emissions in the City of Ottawa[14].

In the City of Ottawa, residents can place their organic waste, such as food waste and leaf and yard waste, in the Green Bin. In 2019, over 80,000 tonnes of Green Bin organics (which included 69 per cent food waste, 12 per cent LYW and 19 per cent other acceptable green bin materials such as tissue/towelling) and LYW collected with the Green Bin was sent for processing and beneficial reuse. Based on 2018/2019 waste audit results, approximately 46,000 tonnes of food waste was sent to the Trail Waste Facility landfill from curbside, multi-residential, City facilities and parks, which could have been reduced or diverted.

The most recent waste audit data from the City's 2018-2019 Four Season Curbside Waste Audit Study and the Fall 2019 multi-residential waste audit shows that of the garbage sent to the Trail Waste Facility landfill, Green Bin organics comprised 45 per cent and 39 per cent from the curbside residential and multi-residential customers, respectively. Considering both the amount of food waste that is collected through the Green Bin program that is sent for processing and what is collected in the garbage stream, a significant component of the overall waste stream contains wasted food and as such, it is important to focus on ways to recognize the value of food and reduce the amount of food waste.

A recent City of Toronto food waste study that was completed in August 2020 found that single family households disposed an average of 4.22 kg/week of food waste, with 70 per cent of the food waste placed in the green bin, and the remainder, 30 per cent, placed mostly in the garbage. The most common types of avoidable waste found in both green bin and garbage from highest to lowest were fruit and vegetables, dried food, bakery, meat and fish and dairy. The study suggests that food waste data can be used to develop avoidable food waste reduction interventions. For Toronto, the value of the avoidable food waste found disposed ranged from $630–$847/year per single family household[15].

Less food waste can be beneficial to governments, companies, and households – financially, environmentally and socially. Contribution to sustainability goals (including the City's Climate Change goals) can be achieved by preventing and reducing food waste and focusing on

[13] Love food hate waste Canada, 2020: https://lovefoodhatewaste.ca/about/food-waste/#:~:text=In%202017%20the%20National%20Zero,more%20than%20%241%2C100%20per%20year!
[14] City of Ottawa Energy Evolution Strategy - https://app05.ottawa.ca/sirepub/mtgviewer.aspx?meetid=7925&doctype=agenda&itemid=402444
[15] How Neighbourhood Food Environments and a Pay-as-You-Throw (PAYT) Waste Program Impact Household Food Waste Disposal in the City of Toronto by Paul van der Werf, Kristian Larsen, Jamie A. Seabrook and Jason Gilliland. Published Aug 28, 2020.

innovations in the food supply chain (although it is recognized that a municipality does not have control over the entire supply chain). Measurement on where waste is generated in the food system and looking at opportunities based on highest and best use can support approaches to reducing food waste. The value of food waste hierarchy, from highest to lowest is:

- preventing waste and loss;
- redistribution to people;
- animal feed;
- biomaterials and chemistry;
- fermentation;
- composting;
- combustion; and
- landfill.

The higher up the value ladder, the higher the value.[16]

Diversion of food waste from the Trail Waste Facility landfill plays an integral role in helping the City achieve its Climate Change objectives, by decreasing fugitive emissions from methane production at the landfill and creating an opportunity to increase landfill capacity. There are a number of efforts that the public can make at home before food is put into the waste stream, including things such as making it into jams, soups, freezing for later use or donating, effectively eliminating the need for disposal or processing. But even without efforts such as these, all residents need to fully participate in the City's Green Bin program, with an understanding that food waste creates value through end products such as quality grade compost or biogas.

The City recently recognized the importance of food waste reduction and proclaimed April 14, 2020 Food Rescue Day, which was an initiative led by the Parkdale Food Centre that piloted an online food donation platform. Second Harvest, Canada's largest food rescue organization, also operates within the city.

FUTURE NEED

[16] https://economics.rabobank.com/publications/2018/march/from-food-waste-to-future-value. Accessed September 2020.

Focus on the value of food to increase the prevention of food waste, which is higher in the waste hierarchy.

The following presents the gaps, constraints and/or opportunities to increasing the value of food and reducing food waste.

Gaps:

- No current performance metric or approach to measuring food waste reduction.
- Currently no data on the proportion of avoidable versus unavoidable food waste in the City's waste streams.
- Food waste generation is high, but food waste currently has a modest capture rate in the green bin, meaning a significant percentage being sent to the Trail Waste Facility landfill, consuming landfill capacity.
- Limited/no promotion and education around the benefits of reducing avoidable food waste.

Constraints:

- Limited understanding of where food waste occurs and the associated financial impacts of food waste generation, such as "ugly food."
- Lack of City jurisdiction over the food supply chain's largest waste generators (restaurants, grocers) and getting unused food to potential end users (foodbanks, soup kitchens).
- City has no control over how consumers purchase or manage food in their homes.
- City has no control over how manufacturers label food with "best before", "use by", etc. Labels can be confusing and misleading to consumers.
- The perishable nature of food means it is harder to find reuse options in a limited amount of time to limit risks to public health.

Opportunities:

- Develop a Food Waste Reduction Strategy, which would align the City with the province's direction on preventing food from becoming waste in the first place.
- Education and outreach on food waste and food waste reduction, with a focus on increased awareness on the value of food, proportion of unavoidable to avoidable food

wasted, climate change impacts, food supply chain and environmental footprint of food production. An example of this is the Love Food, Hate Waste campaigns.

- For internal City departments to collaborate together (waste management, social services, public health), along with non-profit organizations such as community gardens, food donation and recovery programs, for example, Second Harvest, Canada's largest food rescue organization, as well as other levels of government on a combined approach to reduce food waste.
- Support/partner with organizations and business on food waste avoidance and reduction, as well as circular economy initiatives.
- Future waste audits should categorize food waste into avoidable and unavoidable to support measurement and messaging around the value of the amount of food being wasted in Ottawa.
- Collaborate with City departments to align with applicable strategies (e.g., Climate Change, Energy Evolution, Ottawa Public Health food access and insecurity).
- Research and data collection to understand why food is wasted, for example, food preparation and grocery purchasing habits, to better understand the factors that contribute to food waste, with view to tailoring messaging to address these.
- Investigate supporting/joining initiatives that support food waste reduction such as the Food Rescue Canadian Alliance.

Potential Timeline

Given the emphasis of food waste reduction in the global realm, in addition to the provincial direction and the increased benefit of preventing food waste generation and proper waste reduction with respect to environmental impacts, this need should be addressed in the **short-term and carried on in the mid and longer terms.**

4.3 Waste Diversion Programs

Waste diversion programs play a critical role in helping extend the life of the Trail Waste Facility landfill and may play a role in achieving the City's climate change targets by reducing the amount of organic material being sent to the landfill and creating renewable energy. The following provides the future needs as they relate to waste diversion programs.

4.3.1 Green Bin and Leaf and Yard Waste Program

The City of Ottawa has two different approaches to collecting and processing source separated organics at the curb:

1. **The Green Bin program** - which accepts household organics including food waste, leaf and yard waste (LYW), soiled paper products and pet waste. Materials can be placed in paper or plastic bags and then in the Green Bin for collection; and
2. **Bagged and bundled LYW** – this material is set out separately from the LYW placed in the Green Bin and is typically generated during the spring and fall months. LYW is placed in either paper yard waste bags, reusable containers and/or bundled and tied (e.g., branches).

For on-site management of organics, the City encourages the use of backyard composters, but does not allow the use of in-sink garburators to dispose of food waste, as it is prohibited per the City's Sewer Use Bylaw.

The following sub-sections discuss these two source separated organic streams.

4.3.1.1 Green Bin Organics Management

Background

The City of Ottawa provides collection of source separated organic materials, including household organics and LYW, in the Green Bin program to single family households, residential units above commercial establishments, low and high rise multi-residential buildings, places of worship, schools, Yellow Bag program customers, City facilities and special events. The program began in January 2010 and provides weekly year-round collection. Approximately 7,500 tonnes of organic material is being collected per month under the curbside collection contract, while an average of approximately 60 tonnes per month is being collected under the containerized collection contract.[17]

The City also has a Special Considerations Program, where residents sign up to receive bi-weekly collection of source-separated diapers and/or incontinence products. There are currently about 7,500 customers participating in the program and the collected materials are sent to the Trail Waste Facility landfill for disposal.

Organics that are placed in the Green Bin are taken to a facility for processing, which uses an accelerated aerobic indoor tunnel composting system to process both household organics and LYW that is placed in the Green Bin. The technology does not allow for the generation of

[17] Based on monthly average data from – January to October 2020 for curbside contract and June to October 2020 for multi-residential contract.

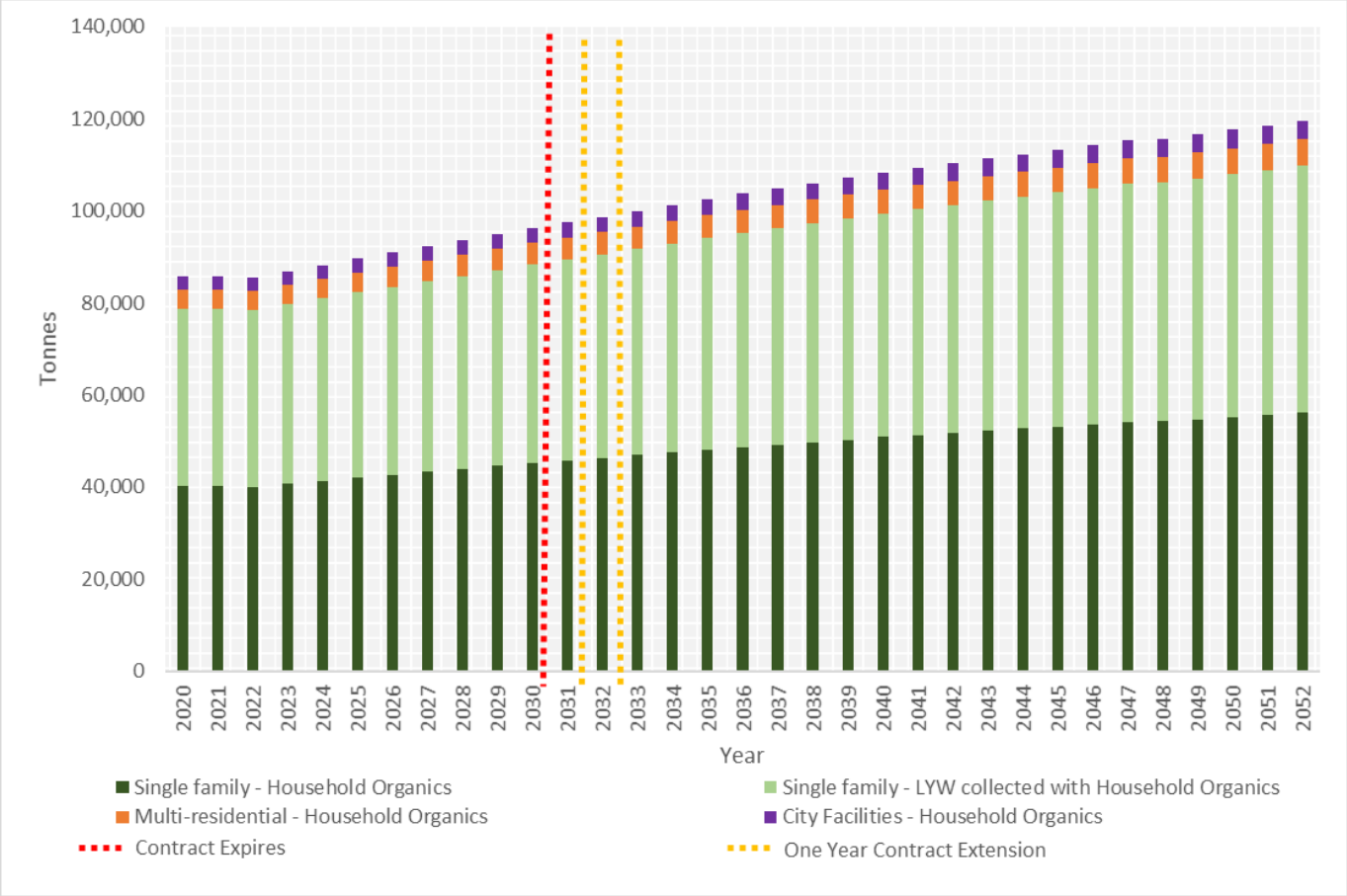
energy. The facility is owned and operated by Convertus[18], who is also responsible for marketing the finished product. The City is in a 20-year contract with Convertus, which ends March 31, 2030 and has two one-year contract extension options. There is a Put or Pay provision of 75,000 tonnes per year, which the City currently meets, and the maximum annual amount of organics the City can send to the facility under the contract is 100,000 tonnes. There is also a maximum weekly amount of material that the City can send for processing, which is currently 2,700 tonnes/week.

A large proportion, just under 50 per cent, of the organic material that is currently sent to Convertus for processing to meet the annual minimum put or pay guarantee of 75,000 tonnes is LYW. Should quantities of household organics increase significantly, the City could reduce the amount of LYW sent to Convertus to free up processing capacity. This would necessitate ensuring that sufficient LYW processing capacity is available and that this material is able to be collected separately from material placed in the Green Bin.

Figure 40 presents the projected tonnes of Green Bin Organics, currently managed at Convertus, and includes household organics from single family, multi-residential, and City facilities and LYW collected at the curb with household organics in the Green Bin from single family residences, up until 2052, which will require management by the City. The figure also shows contract expiry date and potential extension dates.

[18] Convertus was created in 2019 after the merger of the City's previous operator, Renewi Canada Ltd., with Waste Treatment Technologies North America. Prior to that, Renewi merged with Orgaworld which was the company that the City originally signed the processing contract with in 2010.

Figure 40: Projected Tonnes of Green Bin Organics to Be Managed



As presented in **Figure 40**, based on the status quo system and diversion rates, and the projected tonnes of household organics and LYW managed at Convertus, it is estimated that the City will not exceed the annual contracted capacity of 100,000 tonnes until 2034, which is after the contract expiry date of March 2030, as well as the two optional one-year extensions.

Based on the 2018/2019 Four Season Curbside Waste Audit Study, 45 per cent of the garbage sent to the Trail Waste Facility landfill consisted of organic materials. The audit also showed that the participation rate for the Green Bin program was approximately 50 per cent, with an organics capture rate of almost 44 per cent.

About a quarter of multi-residential buildings in the City are registered in the Green Bin program, however it is not known how many of these buildings actually set out bins on a regular basis. According to the Multi-Residential Waste Audit conducted in November 2019, almost 40 per cent of the garbage sent to the Trail Waste Facility landfill was composed of organic materials. City facilities, schools and Yellow Bag participation and waste quantity data

is not currently tracked. The majority of waste generated in parks that participated in the Green Bin pilot project consisted of organic materials (by weight). This indicates that with increased efforts spent on P&E, enforcement and other policy tools, there is potential for additional organic waste to be captured for diversion through the City's Green Bin program.

The City's Energy Evolution Strategy, which was approved by City Council in October 2020, includes extremely aggressive organics waste diversion targets in its Organics Resource Recovery Strategy project – calling for diversion of 98 per cent of organic materials from all landfills within the city's boundaries by 2024, with 100 per cent being diverted from landfills by 2040. Also, Energy Evolution's Renewable Natural Gas Strategy project notes that to achieve the 100 per cent GHG reduction target in the City's Climate Change Master Plan, virtually all organic material, including residential source separated organics and LYW, needs to be processed to produce biogas and most biogas needs to become renewable natural gas (RNG). Additional details on these two projects can be found in **Section 4.9.1**. In addition, the City is currently undertaking a Biogas Optimization Study (anticipated completion June, 2021), which in part is looking at the potential for source separated organic material to be processed using anaerobic digestion technology at ROPEC, the City's wastewater treatment facility. Although multiple uses for the biogas generated are being evaluated during this study through a triple bottom line-based analysis, at the time of writing, RNG is the lead candidate for processing the biogas produced.

If the City was to divert 98 per cent of organics found in the curbside, multi-residential and City facility garbage, as is targeted in the Energy Evolution Strategy, Convertus would not have capacity to manage this additional tonnage with the existing facility infrastructure. Based on the status quo, projected tonnes of garbage generated and assuming 98 per cent capture of organics found in the garbage, around 117,000 tonnes of organics would require management in 2025, 126,000 tonnes in 2030 and 156,000 tonnes in 2052. The facility has a design capacity of 150,000 tonnes per year (tpy), however, would require upgrades to be able to process this capacity. If the facility was able to manage this quantity of organics, it would be at capacity in 2048 (with 98 per cent of organics recovered from curbside, multi-residential and City facility sources).

The timelines required to establish new waste management facilities, including organics processing facilities, can take several years, depending on the complexity of the processing technology, site location, ability to secure funding and/or partnerships, etc. and as such, sufficient time must be allowed to accommodate the planning through commissioning stages of implementing a new waste management facility for organics processing.

On September 30, 2020, the Ministry of Environment, Conservation and Parks (MECP) provided further policy direction to municipalities, multi-residential building owners and the Industrial, Commercial and Institutional (IC&I) sector to prevent and reduce food waste, efficiently collect and process food and organic waste and reintegrate recovered resources back into the economy, by proposing amendments to its Food and Organic Waste Policy Statement. The proposed amendments clarify and expand the categories of food and organic waste to be included in resource recovery efforts and update direction on the management of compostable products and packaging. Of note, there are varying requirements for recovery efforts for additional types of organic wastes:

- Efforts shall be made to recover pet food waste (in additional to food waste);
- Efforts should be made to also recover soiled paper and food packaging, compostable bags and compostable coffee pods;
- Efforts are encouraged to recover harder to manage materials like diapers (in addition to pet waste); and,
- Municipalities should support the use of pilot projects and research on the processing of compostable products and are encouraged to examine the feasibility of updating existing processing technology to process these products.

It is noted that the City does not currently accept compostable products in the Green Bin program, as they do not break down in the standard processing times at the facility where the City processes its organic waste.

Additionally, the Province has announced that it will be moving to phase out food and organic waste sent to landfill by 2030. This represents a change from their earlier proposal to ban organics from landfill across the Province by 2022. No further details about the potential ban are known at the time of writing.

FUTURE NEED

Confirm the City has sufficient organics processing capacity prior to 2030 and secure capacity beyond 2030.

The following presents the gaps, constraints and opportunities when it comes to securing Green Bin processing capacity:

Gaps:

- Lack of data surrounding participation levels and quantities of organic material collected from certain customers (e.g., City Facilities, schools, Yellow Bag program participants, parks and public spaces) and the resulting uncertainty on potential quantities to be managed into the future.
- Uncertainty around when the Province may implement a ban on the landfilling of organics.
- It is not currently known what mid and long-term processing capacity is required.
- The current processing facility likely does not have the capacity to process 98 per cent of the organic material generated by the residential sector, which is the target from the City's Energy Evolution Strategy.
- Current processing approach does not create renewable energy, which does not align with the Energy Evolution's Renewable Natural Gas Strategy.

Constraints:

- Ability to plan for future organic waste tonnages with changing regulatory conditions (e.g., organics disposal ban, implementation of reduction and diversion targets with the Food and Organic Waste Policy, unknown impacts of compostable products and packaging on the feedstock and what technologies can handle these materials) and increased awareness surrounding food waste reduction.
- Limited data on participation rates and assessing effectiveness of P&E and enforcement efforts can impact planning for future Green Bin waste quantities.
- Less flexibility with use of a privately owned processing facility for program and material changes, given lack of control over decision making, however may be able to achieve required flexibility through contracting.
- Locating a suitable future processing site due to public pressures.
- Financing a future processing facility, should the City decide to pursue a City-owned organics processing facility.
- The processing capacity of the current contracted organics processing facility may not be enough to meet the City's needs if the amount of organics sent for processing increases significantly between 2021 and 2030.
- The City has less than 10 years to study, plan, design, site and build a new organics processing facility, if this is determined to be the preferred approach.

- The current aerobic processing approach does not offer the potential to generate biogas from organic waste.
- The City has a contract with Convertus until 2030.

Opportunities:

- Potential to revise, renew and/or extend the Convertus contract to suit the future organics processing needs of the City.
- Development of a new organics processing facility could have a similar or different ownership and operating structure from the City's current arrangement, depending on the City's needs.
- A new facility could be sized to accommodate organics generated from other municipalities and/or the non-residential sector in Ottawa, which could generate additional revenue to the City to help offset organics processing costs, if the facility was City-owned.
- Exploration of other technologies to manage organics that also generate energy, biogas and/or recover materials for further recycling and/or reuse e.g., anaerobic digestion, which would align with Energy Evolution's Renewable Natural Gas Strategy and help in achieving the City's Climate Change reduction targets.
- Undertake a study, including a detailed business case to understand the benefit of reducing the amount of LYW sent to Convertus to free up processing capacity for household organics, including consideration of the cost to separately collect LYW.
- Leverage the work being undertaken on the City's Biogas Optimization Study to identify opportunities to process SSO using anaerobic digestion at the City's wastewater treatment facility.
- Anaerobic digestion at the Trail Waste Facility or ROPEC could have synergistic benefits. The production of additional biogas at either of these locations could create economy of scale opportunities. Additionally, blending biogas from anaerobic digestion at the Trail Waste Facility could boost methane concentrations in a combined gas stream, thereby improving the technical and economic feasibility of RNG production.
- Ability to accept and divert additional material streams from disposal and/or process new streams using different technologies to create biogas e.g., diapers and sanitary products, compostable products and packaging.

- Investigate the feasibility and impacts of accepting compostable products and packaging into current and future program (i.e. post 2030 Green Bin program).
- Confirm short, medium and long term processing capacity requirements for source separated organics, considering sources that are not currently included in the Green Bin program, for example, organics from parks and public spaces and City facilities, as well as compostable products and packaging and other material streams such as diapers and sanitary products.

Potential Timeline

The City's organics processing contract with Convertus expires in less than 10 years (March 31, 2030). Given the time required to establish organics processing capacity, it is recommended to begin addressing this need in the **short-term and concurrent to the development of the City's SWMP.**

4.3.1.2 Leaf and Yard Waste Management

Background

The City collects leaf and yard waste (LYW) year-round. Acceptable materials include branches, twigs, hedge trimmings, leaves, plants, weeds, grass clippings and Christmas trees. LYW can be placed in the Green Bin and any excess can be placed in either paper yard waste bags, reusable containers and/or bundled and tied (e.g., branches). The City does not accept LYW in any type of plastic bag. During the Spring and Fall peak LYW generating seasons, excess LYW that is set out separately from the Green Bin can be collected separately, over a combined period of 10 weeks. Christmas trees are co-collected with green bin organic material and brought to Convertus for processing.

LYW set out at the curb is typically collected along with organic material in the Green Bin and sent to the Convertus organics processing facility to meet the put or pay requirement of 75,000 tonnes per year. During peak LYW seasons (spring and fall), when the amount of LYW collected may exceed the City's weekly processing limit, separately collected excess LYW is taken to the City's Barnsdale Road outdoor windrow composting facility, where it is aerobically composted in outdoor windrows. This facility is only used to process LYW that is collected separately by the City and is not open to the public.

Many of the City's Roads and Parks Yards located throughout the city have LYW roll-off containers that are used for tree clippings and branches from roadways and parks. Roll-off

containers are supplied and collected through the containerized collection contract, managed by Solid Waste Services.

The Trail Waste Facility accepts LYW material that is dropped off by residents, as well as commercial customers such as landscapers and tree trimmers. This material is stored in a segregated area, then is ground up by a contractor and used beneficially as landfill cover.

In 2020, over 85,000 tonnes of household organic waste and LYW was processed at Convertus. In addition, just over 17,500 tonnes of LYW was processed at the Barnsdale Road facility in 2020, with approximately 5,000 cubic metres of finished compost being generated.

Based on the LYW projections in **Figure 29**, if the City no longer sent LYW to Convertus, the quantities of LYW requiring management would be approximately 54,000 tonnes by 2030, 61,000 tonnes by 2040 and 67,000 tonnes by 2052, based on 2019 estimated tonnes. Given that the Barnsdale Road facility processed approximately 17,500 tonnes of LYW in 2020, additional processing capacity to manage increased quantities of LYW would be required. In addition, LYW would need to be collected separately year-round to accommodate the separate processing of LYW from household organics. It is anticipated that additional collection costs would be incurred and are anticipated to be significant given the City's geographic size.

FUTURE NEED

Tied to the future Green Bin processing capacity needs, the City needs to consider potential options to manage future quantities of LYW, both in the short and medium term.

The following presents the gaps, constraints and opportunities in addressing the management of future LYW quantities:

Gaps:

- Total quantity of LYW collected is unknown, as the material is collected with household organics. The City has only waste audit data which provides estimates on the proportion of LYW collected.
- It is difficult to accurately forecast tonnages of LYW, as it is very dependent on climatic conditions such as drought or rainfall. It is unknown how climate change and climate change events (e.g., flooding, ice storms, tornados) will impact future quantities of LYW.
- Other City departments also utilize the Barnsdale site for various operational needs.

- The current Put or Pay requirement in the contract with Convertus necessitates the co-mingling of household organics and some LYW during collection, limiting the amount of LYW that can be processed separately.
- The current curbside collection contract only allows for up to ten weeks of separate LYW collection.

Constraints:

- LYW forms a large proportion of the City' Green Bin tonnage processed at Convertus - estimated at almost 50 per cent. Should the City not send LYW to Convertus during the current contract period, it would still need to pay for the minimum Put or Pay tonnage.
- High cost of separately collecting LYW year-round, if separate collection is required.
- The City's curbside collection contract is set to expire mid-2023 and the containerized contract (multi-residential) mid-2025.
- Identifying future sites and acquiring land to process LYW.
- Some organics processing technologies that the City may be considering (e.g. anaerobic digestion) are less suitable for managing LYW. Therefore, separate technologies may be required to process LYW and household organics.
- It is unknown if decentralized processing of LYW at different sites across the City would realize operational and collection efficiencies.

Opportunities:

- Potential to reduce processing costs at Convertus by redirecting LYW from the Green Bin to the City's Barnsdale Road LYW outdoor windrow composting facility, however consideration must be paid to the overall cost once the cost of separately collecting LYW is included.
- Develop increased processing capacity at the Barnsdale Road facility in the event that a future organics processing facility does not require significant amounts of LYW and/or if the City increases capture of household organics and wishes to send less LYW to Convertus.
- Assess alternatives to the current approach to collecting and processing LYW separately from household organics, including decentralized LYW outdoor composting sites at strategic locations across the city.

- Source separating all LYW from household organics could generate a more homogenous material stream which could have a potentially greater contribution to the City's GHG emission reduction targets and/or increase revenue to the City (e.g., sell finished compost to landscaping companies).
- Exploration of other technologies to process LYW, beyond composting, that may also generate energy and/or biogas. The Energy Evolution Strategy identified using gasification by 2030.

Potential Timeline

The City's contract with Convertus expires in 10 years and as such, the timeline to implement this option aligns with the Green Bin processing capacity needs discussed in **Section 4.3.1.1** for the **short term**. It also aligns with the **short-term** need to undertake a Curbside Collection Efficiency Study.

4.3.2 Parks and Public Spaces

Background

The City provides waste collection services in various parks, as well as and public spaces including light rail, O-Train and Transitway routes, Business Improvement Areas (BIAs) and at sports fields. Currently, not all parks, including dog parks, and public spaces have recycling programs, which can be confusing and challenging for residents. The City also does not provide dog or other parks with Green Bins specifically for dog waste.

There is not one common look and feel to waste receptables across the city at large, with many different bin types and signage installed. In January 2018, a performance evaluation was conducted by the City on four different waste receptacles over a period of one year. Once the evaluation was completed, two waste receptacle units were recommended, which will eventually replace some of the existing receptacles.

In the core area of the city, including traditional main streets and BIAs, there are approximately 650 municipally owned on-street waste receptacles that are collected by the City's contracted service provider. Approximately 250 locations have only a garbage bin and about 400 locations have 3-stream bins for garbage, blue box material (glass, metal, plastic) and black box material (paper, cardboard), which align with the City's residential recycling program. Servicing of waste receptacles in other parts of the city is not centralized, as there are a mix of City and privately owned and serviced waste receptacles.

An on-street waste receptacle waste audit was completed during the fall of 2019. The results showed significant contamination levels in both the glass, metal, plastic (54 per cent contamination) and paper-cardboard (74 per cent contamination) recycling streams, as well as an opportunity to divert organic and dog waste from the garbage stream. Of importance to note, when high levels of contamination are present, the quality of the recyclable stream is poorer. This results in the recyclable materials having less or no market value and can lead to less revenue from the sale of the recyclables, or the market not accepting the recyclable material, making it destined to landfill for final disposal.

The City operates and maintains roughly 4,300 hectares of parkland at more than 1,300 sites across the city. There are approximately 900 City parks that have garbage receptacles, with an average of six garbage receptacles per park. This works out to approximately 5,400 garbage receptacles that typically require collection (which can vary from daily, to weekly or bi-weekly) on a seasonal basis, typically from May to November. Some receptacles are serviced year-round. Material from City parks garbage receptacles is mixed with waste from other City Parks Services clean-up projects and therefore tonnages from these garbage receptacles are not tracked separately.

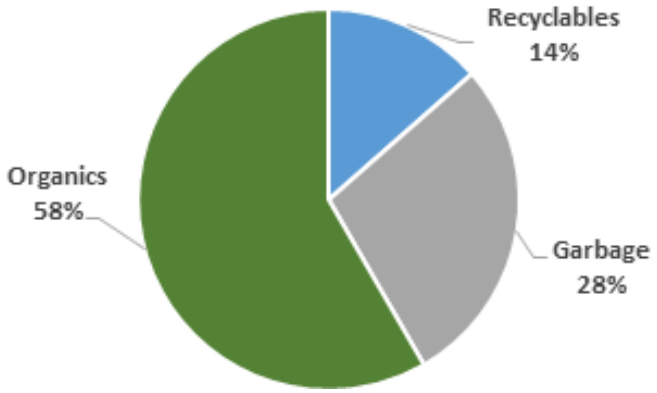
Solid Waste Services recently completed a one-year pilot project where Green Bins were installed alongside recycling and garbage receptacles in 10 parks across the City. The 4 season waste audit results include the following[19]:

- Approximately 7,500 kg of material was audited over 4 seasons;
- The overall waste diversion rate was determined to be 63 per cent;
- The capture rate for recyclables was 75 per cent and 79 per cent for the organics stream; and,
- The recycling stream had an overall contamination rate of 39 per cent, while the organics stream had a contamination rate of 7 per cent.

Figure 41 presents the composition of audited Parks waste material and shows that organics comprised almost 60 per cent of the total waste.

[19] Parks Pilot Waste Audit Services for the City of Ottawa, September 2020, Waste Reduction Group

Figure 41: Composition of Parks Waste from Pilot Project



As presented in **Table 14**, based on the status quo system (i.e. no expanded waste diversion program in parks and limited recycling in some public spaces), by 2052, it is expected the City may be disposing over 2,500 tonnes of garbage generated in Parks and Public Spaces, while only diverting 14 tonnes of recyclables. The diversion rate, based on the status quo system, would be less than one per cent at 0.6 per cent.

FUTURE NEED

Decide if a comprehensive and consistent public spaces waste diversion program, including recycling and organics diversion, should be implemented.

The following presents the gaps, constraints and opportunities in expanding diversion services in parks and public spaces:

Gaps:

- No formal waste diversion program for parks currently exists and is fragmented in other public spaces across the city.
- Limited waste diversion options in City parks, and inconsistent receptacle type, signage and location of existing recycling receptacles can lead to confusion for residents on what can and cannot be diverted at different locations across the city.
- Monitoring and reporting on the frequency of public space waste collection services and associated waste quantities collected is limited.
- There are a number of different City departments/divisions that are involved in parks and public space waste collection, so access to consistent and reliable data is limited.

- A lack of reliable, available and consolidated information for waste receptacles including type, size, location, collection frequency, tonnage collected and diversion rates to assess current performance and future potential diversion.
- The type and style of bins currently installed across the City varies widely, as does the accompanying signage and labelling attached to the bins.
- Diverted waste collected in parks and public spaces tends to have higher levels of contamination compared to material collected from the residential diversion programs.

Constraints:

- Significant capital and operating costs associated with the provision of additional and/or new receptacles and collection of waste from all of Ottawa's parks and public spaces.
- Potential for a City-wide approach may be limited until agreements for contracted collection services expire.
- The transition of the provincial Blue Box program to individual producer responsibility (IPR) is expected to impact recycling in parks and some public spaces. In absence of the final regulations, the uncertainty surrounding the responsibility of producers, makes it challenging to plan for future parks and public spaces diversion programs at the moment. Based on draft regulations and pending confirmation in final regulations, beginning in 2026, producers could be responsible for implementing, operating and fully financing recycling programs in the City's municipal parks and some public spaces.

Opportunities:

- Continue to monitor the status of the Blue Box regulation development as it relates to parks and public spaces.
- Gain knowledge from the City's on-going pilot project on Green Bin and Recycling in parks to guide decision-making related to implementing a waste diversion program for parks. For example, Blue Box material collected in parks tends to be the higher value materials such as aluminum and PET. Therefore, the revenue per collected tonne of parks material could potentially be higher than that of the residential Blue Box program, depending on the level of contamination.
- Explore green bin/dog waste collection for on-street waste diversion program.
- Expand and consolidate the collection and reporting of parks and public space waste receptacle data (e.g., receptacle type, size, location, collection frequency, fullness of

receptacle) to assist the City with on-going assessment of performance and to inform the development of programs and policies.
- Standardize the collection of waste tonnage data from parks and public spaces.
- Explore the use of technology to optimize collection (e.g., bin sensors, solar compaction, RFID tags).
- Study the optimization of municipal collection of public space waste.

Potential Timeline

Given the need for long-term data to monitor performance and the unknown impacts the Provincial transition to IPR will have on parks and public space recycling, it is suggested collection of data from parks and public spaces be implemented in the **short-term** and programs introduced in a staged approach in the **short to medium-term**, as more insight is gained.

4.3.3 Waste Diversion Program Performance

4.3.3.1 Curbside Waste Diversion Program Performance

Background

The City's Solid Waste By-law currently includes provisions to support improved curbside waste diversion, specifically, a six-item garbage limit every two weeks, which includes a combination of garbage bags, garbage cans and bulky items. The 2018/2019 Four Season Curbside Waste Audit Study results show that curbside households set out on average four garbage and bulky waste items every two weeks.

While this provision is a mechanism that is available to the City, the historical and current approach to support improved curbside waste diversion has been to educate residents rather than enforce, meaning that they can currently place as much garbage as they want at the curb and it will be collected.

Participation rates in the Green Bin program are sitting around 50 per cent and a large proportion, almost 50 per cent, of the curbside garbage sent for disposal at the Trail Waste Facility landfill consists of organic materials that could be diverted through the Green Bin program. In addition, waste audit results show that recyclable materials are also being placed in the garbage, which is also disposed of at the City's Trail Waste Facility landfill.

The curbside waste diversion rate has remained relatively stable year over year since the introduction of bi-weekly garbage collection in November 2012, with annual rates typically sitting around 45 per cent, however there was a notable increase in 2020, up to 52 per cent.

This diversion rate is well below the 74 per cent of what could be diverted through the City's waste diversion programs if correctly sorted at the source20. These lower diversion rates are despite the fact that the Green Bin program has been in place since 2010 and that promotion and education on the benefits of and how to divert waste takes place on a continuing basis year over year.

In addition, the Province has signaled its intent to ban the landfilling of organics by 2030. Mechanisms that support increased source separation of organic material will be required if the City is to successfully adhere to this upcoming ban.

To support improved waste diversion at the curb, there are a number of different alternatives that many other municipalities across Canada and internationally have implemented successfully. These include:

- Reduced garbage limit and enforcement of set-out limits;
- Clear bags for garbage;
- Bans on different waste streams or material types;
- Pay As You Throw (PAYT) for garbage; and
- Garbage carts.

FUTURE NEED

Identify an approach to support increased curbside waste diversion performance by increasing participation in waste diversion programs.

The following presents the gaps, constraints and opportunities related to implementing a new approach to increase participation in curbside waste diversion programs.

Gaps:

- The current Solid Waste By-law includes mechanisms to increase curbside waste diversion, however these are not enforced.
- The current curbside garbage set-out limit is higher compared to other jurisdictions and higher than the average number of items placed at the curb for collection.
- All curbside garbage, even those above the set-out limit, is currently collected.

[20] City of Ottawa, 2019 4-Season Single Family Residential Curbside Waste Composition Study, 4-season Garbage Stream

- Significant quantities of divertible materials are being disposed unnecessarily in the Trail Waste Facility landfill.

Constraints:

- The current approach focuses on education to achieve compliance, which has not yielded adequate results, as demonstrated by the lower than achievable waste diversion rate.
- One-on-one resident education requires more time by the City's Waste Inspectors to conduct multiple visits and follow up, with the scale of enforcement limited by current staffing levels.
- Current staffing levels of Waste Inspectors will not allow for enhanced enforcement efforts without additional staffing supports.

Opportunities:

- Determine which approach/es will be implemented to increase participation in curbside waste diversion programs, such as:
    - Adhering to the current six bag/item limit every two weeks for curbside garbage;
    - Reducing the garbage bag/item limit (and corresponding multi-residential garbage allocation) based on waste audit data;
    - Requiring that garbage be placed in clear bags to allow for inspection to determine if divertible materials are in the garbage and if so, leaving the bag at the curb;
    - Implementing a full or partial PAYT approach for garbage;
    - Adhering to the City's mandatory separation of recyclables and organics from garbage;
    - Collecting garbage in carts, which effectively places a limit on the amount of garbage that can be disposed of. Can also be used in conjunction with a PAYT approach to manage excess garbage that does not fit into the cart; and
    - Consider new/additional bans for items, including those that are now/will become the responsibility of producers under the Provincial Individual Producer Responsibility (IPR) regulatory framework.
- Based on current waste audit data, organics represent the biggest opportunity to divert waste going to the Trail Waste Facility landfill and efforts should initially be focused on this waste stream.

- Targeted enforcement blitzes (e.g., focus on Green Bin program) that are promoted in advance to increase awareness of what and why enforcement and compliance is needed.
- Increase P&E budget to allow for increased education on the importance of source separating waste.
- Hire new full-time staff to support any future enforcement efforts.
- Should material bans be implemented, there will be a need to have the mechanisms in place to enforce, for example, clear garbage bags.
- Exercise the provisions in the curbside collection contract that allow for the contractor to leave bags behind at the direction of the City.
- Set targets and timelines to track and communicate progress.

Potential Timeline

Implementing enhanced approach/es to increasing participation in curbside waste diversion programs should be an ongoing mechanism to improve waste management program performance. As such, it is recommended that this begin in the **short-term and continue in the mid and long-terms.**

4.3.3.2 Multi-Residential Waste Diversion Program Performance

Background

The City of Ottawa provides collection of garbage, recycling, Green Bin organics, LYW and bulky items to multi-residential properties. Properties are serviced using front end loading containers and carts, and collection is referred to as ‘containerized collection’. Approximately 1,700 buildings (115,000 units) are currently serviced, which equates to approximately 90 per cent of all multi-residential buildings in the City. The multi-residential sector is regulated by the Province as IC&I and although the City is not required to service this sector, Council agreed a number of years ago to provide waste collection services to the sector. Multi-residential properties included under the containerized waste collection service are properties that have six or more residential units and are a mix of different property types: townhouse communities, low rise apartments, units above commercial properties and high-rise buildings. There are a small number of multi-residential properties that do not receive municipal waste collection because they do not meet site plan or operational collection requirements, or they have a collection method preference and/or perceived cost savings by using private sector waste

collection services. Therefore, there is a small portion of multi-residential waste that the City does not track, nor does it currently have control over as it is managed by the private sector.

There are unique challenges to achieve similar diversion rates in multi-residential properties compared to single-family curbside households, such as the ability to recycle and dispose waste at any time, anonymity in diversion program participation (i.e., neighbours don't see if you participate each week), lack of convenience, especially in buildings with garbage chutes on each floor and diversion bins located in a less convenient location such as on a main level, in the basement or outside, and the need to undertake more frequent P&E for the more transient residents that tent to live in multi-residential properties.

Eighty-four per cent of all multi-residential properties receiving City waste collection were constructed before the implementation of the City's 2012 Solid Waste Collection Guidelines for Multi-Unit Residential Development, which sets the requirements for waste management planning at all multi-residential properties receiving City collection services. Many of these properties have limited space to store waste bins and face difficulty in expanding or introducing new waste diversion programs with requirements for new carts and/or bins.

A waste audit completed in November 2019 on the multi-residential waste stream shows that of the 74 per cent of garbage sent to the Trail Waste Facility landfill, 58 per cent could have been diverted (Green Bin organics at 39 per cent, Blue Bin materials at 12 per cent and Black Bin materials at seven per cent). The current waste diversion rate for the multi-residential sector is 17 per cent, or approximately one-third the curbside waste diversion rate.

A notable change implemented in the current multi-residential collection contract is the collection of Green Bin organics on-site at multi-residential properties, which was transferred from the curbside collection contract to the containerized collection contract in June 2020. Prior to this, multi-residential properties participating in the Green Bin program were required to place Green Bins at the curb for collection by curbside collection vehicles, whereas all other waste streams were collected on-site. Including on-site Green Bin collection under the containerized collection contract removed the requirement for Green Bins to be placed at the curb, which was previously cited by property management staff as one of the main barriers to participating in the Green Bin program. Under the new multi-residential collection contract, trucks drive on to each property to collect the material if it cannot be placed at the curb for collection.

FUTURE NEED

Recognizing the inherent challenges that exist in increasing participation and the waste diversion rate in the multi-residential sector, actively work with stakeholders in this sector to improve multi-residential waste diversion performance.

The following presents the gaps, constraints and opportunities with respect to improving waste diversion performance in multi-residential buildings:

Gaps:

- Lack of participation and incentive for this sector to implement or improve diversion collection programs without sufficient regulatory requirements, enforcement and incentives.
- Decision to expand diversion programs at multi-residential properties resides with property management staff, not residents, meaning that residents that want to divert various waste streams are not permitted to do so if property management staff do not approve.
- Outdated development guidelines or standards requiring developers to integrate waste diversion considerations and best practices into new multi-residential developments.
- Waste diversion bins are often located in basements or outside, whereas garbage chutes or bins are conveniently located inside the building.
- Lack of space for additional bins for waste diversion.

Constraints:

- Multi-residential buildings typically have high turnover of residents, which makes education of building-specific programs more challenging.
- It is challenging to educate multi-residential building stakeholders (e.g., property managers, landlords, building managers and residents) on proper solid waste management practices, including the importance of using waste diversion programs.
- There is significant effort needed among multi-residential building stakeholders to achieve desired performance levels in waste diversion programs, including a significant shift in behavior from residents to start to participate or more fully participate in waste diversion programs.
- Challenges with the amount of space available both in-unit and on property for waste management bins, which varies among the different building types.

- Many older high-rise multi-residential properties dispose of their garbage through a single-stream chute. This makes waste diversion more challenging, as additional effort is required to place recyclables and organics in bins that are often housed in the basement, parking garage or outside.
- Effective capture of recyclables from the multi-residential sector is challenging and based on current multi-residential waste audit data, the Blue Bin program has a 15 per cent contamination rate and the Black Bin has an eight per cent contamination rate.

Opportunities:

- Partner with the City's planning department to update existing waste management requirements for new development applications, for example, the new High-Performance Development Standards, to facilitate optimal convenience and waste diversion in new buildings.
- Review the current garbage allocation limits for the amount of garbage collected by the City through the current waste collection contract to align with any future revised curbside garbage bag limits.
- Based on current waste audit data, organics represent the biggest opportunity to divert waste going to the Trail Waste Facility landfill and efforts should initially be focused on this waste stream.
- Develop a P&E diversion strategy and campaigns targeted to the multi-residential sector, which could include:
    - Work with property owners, managers, residents and tenants to increase effective participation in waste diversion programs, including expanding the Green Bin program to more buildings;
    - Develop solutions to make waste diversion programs more accessible and convenient for residents to participate in; and
    - Create a Multi-Residential Waste Strategy recommending specific policies, programs, and initiatives to support diversion in this sector, while aligning with the direction of the Solid Waste Master Plan;
- Explore different technologies that could increase waste diversion in the multi-residential sector, including:

  - the option for a facility to process garbage collected from this sector that could extract organic materials, recyclable materials and any other divertible materials; and
  - co-digestion of sewage and food-based organics at ROPEC, the City's wastewater treatment facility from multi-residential buildings.
- Work with building owners to retrofit existing garbage chutes to facilitate waste diversion.
- Set targets and timelines to track and communicate progress.

Potential Timeline

Given the importance of increasing participation in waste diversion programs and therefore waste diversion rates in the multi-residential sector, it is recommended that ways to increase waste diversion in this sector are examined in the **short-term and continue in the mid and long-terms.**

4.3.4 New Waste Collection and Diversion Programs

Background

The City of Ottawa is required, under the Environmental Protection Act, to collect, transport, process and dispose of waste from the single-family residential sector, which includes curbside collection of garbage (including bulky items), LYW and designated Blue and Black Bin materials, as well as the drop-off events to collect Municipal Hazardous Special Waste (MHSW). While source separated organics and Christmas trees are collected through the City's Green Bin program, they are not currently mandatory to collect.

There are many regulatory changes coming with respect to Individual Producer Responsibility (IPR) for the used tires, electronics, Blue Box and MHSW programs and the Province is setting targets to divert more organic waste from disposal. They have also signalled their intent to ban the disposal of organics in landfill by 2030.

In addition to the waste collection services provided directly by the City, residents also have access to several waste diversion drop-off programs to further divert waste from the Trail Waste Facility landfill. The following are a combination of contracted City-managed programs and individually privately-run operations:

- Household hazardous waste events and the Orange Drop Program, which is a Provincial-wide program that provides a network of drop-off sites for four MHSW materials (pressurized cylinders, antifreeze/coolant, empty oil containers and oil filters);

- Take it Back! Program, where retailers and charities accept MHSW and household items, including textiles, for reuse, recycling or disposal;
- Electrical and electronic equipment (EEE)[21] drop-off events;
- Used tire drop-off;
- Giveaway weekends; and
- Scrap metal, tires, Blue Bin material, cardboard, brush and yard waste, electronic waste drop-off at the Trail Waste Facility.

Gently used clothing can also be taken to clothing donation boxes located throughout the City (managed by both for-profit and not-for-profit organizations. Material tonnages and participation rates are not tracked for these non-curbside collection programs. Residents may also place textiles for disposal in their regular garbage.

Waste audit data from both the 2018/2019 Four Season Curbside Waste Audit Study and the Fall Multi-Residential Waste Audit Study indicate that the garbage sent to the Trail Waste Facility landfill included material that could be diverted through existing drop-off diversion programs in the community. Textiles, EEE and MHSW represented approximately seven per cent of the total amount of garbage that was sent for landfill disposal from curbside households and eight per cent for multi-residential properties, with textiles accounting for approximately five per cent of each waste stream.

Approximately 11 per cent of curbside households set out bulky items during the above-mentioned study, with each household generating, on average, 74 kilograms of bulky items over the year[22]. While many of these items could be reused or recycled, these materials are currently collected as garbage and are not diverted.

The collection of bulky items from multi-residential properties receiving containerized garbage collection was added as a responsibility under the new 2020-2025 multi-residential collection contract, which also collects waste from City facilities. Under this new contract, there is no limit on the number of bulky items collected from multi-residential properties, however, City facilities are no longer eligible to receive collection of these items. City facilities must make their own arrangements to dispose of their large bulky items by either dropping them off at a City yard with a garbage roll-off container or bringing them directly to the Trail Waste Facility for landfill disposal.

[21] Formerly known as WEEE – Waste Electrical and Electronic Equipment
[22] Based on the 4-season average of 1.43kg/household/week as reported in the 2019 4-Season Single Family Residential Curbside Waste Composition Study Summary Report, September 2019.

Under the curbside collection program, large amounts of garbage generated as a result of construction and demolition (C&D) or renovation activities is not accepted, however, small quantities of renovation waste are accepted provided the material is properly packaged and does not exceed the current six-item curbside limit.

C&D waste is currently accepted at the Trail Waste Facility, at a tipping fee of $116.50/tonne. This includes unsorted C&D loads, ceiling tiles, carpet, plastic pipe, wood waste and a number of other materials. Certain source separated materials, such as asphalt, masonry and concrete without rebar, are accepted at a lower tipping fee of $56/tonne, however loads must be free of garbage. Brush and yard waste and cardboard can be dropped off at a cost of $39.50/tonne and $56/tonne respectively. Source separated scrap metal, electronic waste, blue box materials (glass, metal and plastic) and tires are accepted at the Trail Waste Facility free of charge.

Under the draft regulations for Blue Box IPR, the list of acceptable items includes many items in addition to what is required under current legislation and beyond what the City currently accepts in its Blue and Black Bin programs. Notably, collection of “packaging-like products” and certain single-use items are proposed, making programs consistent across the entire province. The expansion of materials to be accepted in the Blue Box, if there are no changes to what’s currently being proposed in the draft Blue Box regulations, is expected to result in the diversion additional problematic packaging that currently makes its way into the City’s waste stream.

There is the potential for the City to implement new waste diversion programs or partner with existing organizations offering these services to increase diversion for waste streams or materials not currently included in the City’s current waste diversion programs. However, as new diversion programs or partnerships are contemplated to capture additional materials for diversion, careful planning needs to occur, including the identification of end markets, a cost-benefit analysis, identification of potential partnerships and collection options. It is also important to understand what divertible materials are being placed in the garbage stream and the quantities of each in order to determine what materials should be targeted for removal as a priority.

FUTURE NEED

Identify specific waste streams that can be diverted from landfill disposal and develop new collection and diversion programs to capture these streams.

The following presents the gaps, constraints and opportunities in implementing new waste collection and diversion programs:

Gaps:

- Lack of policies, incentives and markets to support diversion of C&D and renovation waste.
- Limited waste audit data on the different waste streams that could be diverted, as well as data on quantities generated.
- Lack of availability to locations with year-round access for public drop-off of waste streams such as C&D and renovation waste, mattresses/box springs, MHSW, carpet, appliances, metals, large plastics (i.e., lawn furniture, pails, toys), bulky items, including appliances and furniture, etc.
- Lack of local recycling options and infrastructure to support new waste diversion programs (e.g., for C&D materials, carpets and mattresses).

Constraints:

- Residents' own transportation method may limit their options for proper disposal and/or recycling/reuse options for bulky items, MHSW or C&D waste (e.g., a small car or public transit use).
- Participation in new waste diversion programs can take some time for residents to become aware of and/or change behaviour from previous sorting and disposal practices.
- Timing uncertain for anticipated legislative changes for future designated materials (e.g., mattresses, textiles) in Ontario under IPR programs.
- Partnerships with non-profit and for-profit organizations and the private sector to collect materials may limit access to data regarding participation rates and quantities collected, diverted and disposed.
- Potential for contamination of materials if not separated at the source and challenges with separating at drop-off facilities (e.g. C&D waste).
- Additional waste inspectors above current staffing complement may be required to ensure proper education and resident participation in programs.
- Additional planning efforts and time will be required for the development of new waste diversion programs, which is beyond current staffing complement.
- Waste diversion programs are typically more costly to operate than simply disposing of material in landfill.

Opportunities:

- Utilize waste audit study data to determine the potential amount of divertible material available in the waste stream that currently has no local diversion program to determine what streams should be targeted.
- Quantify the amount and type of bulky waste placed out for curbside and multi-residential collection to determine alternative ways to collect and identify opportunities where these items could be reused or recycled.
- Conduct research (surveys, interviews, observation, etc.), including residents and City staff, to identify opportunities for reuse and potential end markets for materials that are currently landfilled (e.g., textiles, carpets, mattresses, C&D materials).
- Explore opportunities to facilitate circular economy interventions (e.g., take material that would have been disposed for use as a raw material in a manufacturing process).
- Determine what existing, non-City waste diversion programs are currently offered by organizations and businesses (e.g., when a new mattress is purchased and delivered, the old mattress is taken away for recycling) and see if there are mutually beneficial opportunities to form partnerships (e.g., City P&E, provision of data to City by partners).
- Determine if/how existing textile recycling programs offered by businesses and not-for-profit organizations could be enhanced (e.g. curbside collection, add bins to multi-residential neighbourhoods and City facilities, consistent branding of program, City P&E).
- Investigate the feasibility of providing mobile or multiple drop-off locations/events throughout the City that accept a wide range of materials for diversion, offered throughout the year.
- Explore opportunities to provide year-round access to dispose of MHSW.
- To encourage waste diversion and support source separation, supporting mechanisms should also be rolled out at the same time, or shortly after, new waste diversion programs are implemented (e.g., bans, increased tipping fees).
- Set targets and timelines to track and communicate progress.

Potential Timeline

Given that there are materials that could be diverted that are currently taking up valuable space in the Trail Waste Facility landfill, planning for new programs should begin in the **short-**

term and implementation in the medium and long terms, with consideration given to timing of collection contract expiration dates.

4.3.5 Special Events

Outdoor special events are governed by the Special Events on Public and Private Property By-law No. 2013-232 (for events of at least 500 people on private and City property other than highways) and the Special Events on City Streets By-law No. 2001-260 (for events on City highways). Currently, management of waste and disposal requirements for special events are not required for permit issuance under these by-laws, however both by-laws require permit holders to comply with all City by-laws (e.g. the Solid Waste By-law) , as well as Provincial and Federal laws, and comply with any special conditions that may be placed on the permit. In addition, By-law 2001-260 specifically requires the permit holder to pick up any refuse generated by the special event.

Garbage collection and waste diversion for all special events is the responsibility of and at the expense of the event organizer. For outdoor special events, environmentally friendly waste management practices, such as the use of recycling stations and organics collection, are strongly encouraged through the comprehensive event guide that the City's Event Central Office provides to organizers and as part of the Special Events Advisory Team (SEAT) review. The event guide also outlines best practices and tips for greening an event. Although the use of recycling stations and organics collection is strongly encouraged, at this time recycling/diversion is not a mandatory requirement as part of the special event permit approval process. The City does not track the number of large special events that promote waste avoidance/reduction or provide waste diversion at their events.

In support of improving access to waste diversion, the City's Solid Waste Services branch currently supplies and delivers Green Bins for special events with fewer than 500 participants.

In September 2019, City Council approved the by-law review work plan, which included By-law 2013-232: Special Events on Public and Private Property, which was to include review and consideration of recycling and organic waste collection options and solutions for large special events. On June 27, 2018, Council also approved Motion No 72/4, which outlined that City staff engage with special event organizers to encourage the adoption of waste management best practices and to determine what resources may be available to support special events with waste collection. This by-law review has been put on hold due to the Covid-19 pandemic and the shut-down of special events due to pandemic restrictions. It is unknown when this by-law review will progress.

FUTURE NEED

Waste management practices at special events should support and facilitate waste minimization and waste diversion.

The following presents the gaps, constraints and opportunities in reducing waste generated and increasing the diversion of the remaining waste at special events:

Gaps:

- Currently, there is no requirement for recycling/diversion as part of permit issuance for large or small outdoor special events.
- Waste collection is the responsibility of event organizers, which results in inconsistent diversion programs and receptacle types available at events.
- No specific waste avoidance/reduction policy or mandatory requirements for special events.
- Concerns about the costs associated with recycling and waste diversion/ waste sorting at events[23].

Constraints:

- Measurement on the effectiveness of collection/diversion programs at special events can be challenging to obtain.
- The City has limited ability to control consumer and business purchasing decisions and therefore has very limited ability to control the types and amounts of waste generated at special events.
- Costs to provide waste diversion will likely be a barrier for most event organizers, who will likely expect support from the City to engage in or improve upon current practices.

Opportunities:

- Develop a plan to phase-in additional waste management requirements at small and large events over the short, medium and long term. These could include:
    - Creation of a waste management toolkit for special event organizers that covers topics such as best practices for waste avoidance and reduction, for example, water refilling stations, deposit return systems, reusable dishware and cutlery, recycling and organics management;

[23] Based on preliminary consultation with event organizers in early 2020 conducted by Emergency and Protective Services staff.

- Exploring opportunities for the City to partner with event organizers to promote waste avoidance, reduction, reuse and recycling;
- Encouraging event organizers to recruit volunteers to assist with on-site source separation of waste at events and education around the benefits of doing so;
- Identify a Solid Waste representative to sit on the Special Events Advisory Team;
- Exploring the opportunity to introduce by-law requirements addressing how materials are collected, processed and disposed of at special events and festivals;
- Investigating the City providing collection of recycling, organics and garbage from small special events;
- Review the City facility rental agreement to determine how best to integrate waste avoidance, reduction and recycling into small and large events held at City facilities; and
- Exploring the opportunity to require special event organizers to submit a waste management plan for each special event that could include such things as:
    - demonstrating recycling and diversion efforts if event is over a certain number of anticipated participants
    - details of hauler and waste sorting station information
    - submission of waste avoidance, reduction and diversion data to track overall waste management practices at special events

Potential Timeline

To create the desired changes to support waste management practices at special events, a plan identifying appropriate short, medium and long-term opportunities at special events to support enhanced waste management practices should be initiated in the **short-term.**

4.4 Collection and Drop-off of Materials

4.4.1 Collection

Background

The City operates an integrated waste collection system, servicing curbside homes, multi-residential buildings, City-owned facilities, small businesses and places of worship through the Yellow Bag program and schools (green bin collection only), as well as parks and other public spaces. Single-family homes, small businesses and schools are serviced through the curbside collection contract, while multi-residential buildings and City facilities are serviced through either the curbside or multi-residential collection contract, depending on operational requirements, such as size of bins and frequency of collection. Parks and other public spaces are serviced through a mix of City and private collection services. The City also offers mobile MHSW depots for the collection of hazardous household waste.

All waste materials collected by the City are delivered directly to processing (for recyclables, organics and MHSW) or disposal (for garbage) facilities. The City's current waste collection system does not include the requirement to use transfer stations, which are used in collection systems to maximize efficiency by minimizing off-route time and distance travelled when vehicles are full. They can also provide an opportunity to screen garbage and recover recyclable and organics material prior to it being transferred to a disposal facility. It is noted that although it was not a contract requirement under the current curbside contract, the City's current private sector contractor uses a private transfer station in Ottawa to transfer Green Bin materials and recyclables.

The Solid Waste Services branch currently manages several collection contracts, most notably the curbside, multi-residential/City facilities collection contracts. These contracts are typically in place for five to seven years, with options to extend for up to two additional years. Historically, the requirement for data collection and waste tracking has been minimal and centered around invoicing. Data used to track program performance has not typically been a requirement of these collection contracts.

In advance of collection contracts being awarded, it is standard practice for the City to examine different aspects of service delivery and operation in order to determine if any changes need to be included in the upcoming contract. Different aspects that can be looked at, include, but are not limited to the following:

- Customers to be serviced;
- Material streams to be collected;
- Frequency of collection of garbage, bulky items, recycling and organics;

- Whether it makes sense to collect two different material streams together in the same truck (co-collection) or a single truck;
- Contractor requirements, such as distributing new or broken recycling bins and green bin carts and enforcement of City by-law requirements;
- Collection vehicle requirements, for example, GPS units and on-board scales;
- New ways of collecting materials that may be appropriate for the City, for example, vacuum collection systems for new developments;
- Requirement to transfer waste; and
- Opportunities for delivering service in a more efficient or customer-centric manner.

There is currently no requirement in either the curbside or multi-residential collection contracts that speaks to reducing the use of fossil-based fuel or other requirements related to reducing greenhouse gas emissions from the collection fleet. With the approval of the City's first Climate Change Master Plan and the Energy Evolution Strategy, opportunities to reduce greenhouse gas impacts from collection vehicles, including Waste Inspector vehicles, need to be examined in advance of new collection contracts being awarded. While opportunities to reduce greenhouse gas emissions from collection vehicles is being explored, it would also be worthwhile to explore opportunities for the heavy equipment fleet at the Trail Waste Facility landfill. In addition, with the expiry of the current organics processing contract in 2030, the City may wish to explore alternative options for the separate collection and processing of LYW, including the feasibility of decentralized LYW processing.

Given that the current curbside collection contract will expire in mid-2023 and the need to award the new contracts in 2021, which is prior to the completion of the Solid Waste Master Plan, the City is currently analyzing potential options for inclusion in the next contract, including those related to the transition of the Blue and Black bin program to producers as part of IPR. As such, this section focuses on exploring efficiencies, convenience and accessibility related to the collection of waste, including methods to increase participation, as well as opportunities that could align with the subsequent competitive curbside collection contract.

Changing operational requirements, advances in technology, the growth of the City, including intensification, changes in Provincial legislation, including the move to IPR, new local waste management infrastructure becoming available, changes in residents expectations and new City Plans, policies or strategies, for example, reducing the City's GHG impact/carbon footprint are just some of the considerations that warrant investigation to determine if any changes should be made to the current collection approach to improve efficiency, address operational issues and/or enhance service delivery.

FUTURE NEED

Building on the current systems, services and programs, identify more ways to efficiently collect materials, that are more convenient and accessible to residents and customers.

The following presents the gaps, constraints and opportunities in addressing more ways to efficiently collect materials, that are more convenient and accessible to residents and customers.

Gaps:

- Future changes to the Blue Box Program as a result of IPR are unknown at this time and will have an impact on future residential collection programs and contracts.
- It is not understood if/when it would be appropriate for the City to start using a transfer station(s) as part of the collection system.
- Given the uncertainty as to whether the City will be responsible for the collection and processing of Blue and Black Bin materials from non-residential sources, the need for collection of these materials is unknown.

Constraints:

- The Put or Pay requirement under the organics processing contract is 75,000 tonnes/year of source separated organics. This necessitates the collection of household organics and LYW during collection, limiting the amount of LYW that can be processed separately up to 2030, which is the final year of the contract.
- Collection contracts are currently in place and expire at different times.
- What materials the City will be responsible for collecting after the Blue Box program transitions to IPR are unknown.
- Potential for financial implications should the City change the terms of any of its collection contracts or wish to implement certain approaches mid-contract.
- As the City grows and traffic increases, travel time to waste facilities for residential waste collection vehicles will increase, resulting in increased collection costs and GHG emissions.
- Finding a suitable location to site a City-owned transfer station and the associated costs.

Opportunities:

- Explore different alternatives to collecting bulky items, including separately collected, call-in or fee for service options.

- Investigate the feasibility and cost implications of separate collection of LYW, considering the future processing technology for organics post-2030.
- Conduct a curbside collection efficiency study, including a business case review, to determine contract requirements in advance of the 2030 curbside collection contract being awarded. The study should consider costs, servicing the collection needs of a growing City and how to reduce GHG emissions related to collection of waste.
- Review acceptable collection container(s) and collection methods in conjunction with policies and financial incentives to encourage waste diversion (e.g., clear bags, automated carts for curbside collection, pay-as-you-throw).
- Investigate equipping containers with radio-frequency identification (RFID) capabilities to collect information on collection services and performance.
- Conduct a review of the Yellow Bag program.
- Investigate expanding the list of materials that are collected at the curb.
- Explore the feasibility of single stream recycling for the remaining customers that the City would service after the recycling program transitions under IPR.
- Investigate the use of clear bags for curbside garbage, in conjunction with a policy shift to support increased waste diversion.
- Investigate the use of semi or fully automated curbside garbage cart collection.
- Explore mobile collection of materials, including MHSW and others.
- Explore the feasibility of in-ground collection containers in areas where space is limited e.g. new developments where streets are narrow or alternate collection methods are desired, in parks, at multi-residential buildings or City facility locations.
- Investigate the use of Optibags, which are colour-coded bags corresponding to different waste streams that residents can place their separated waste in.
- Explore the feasibility of installing vacuum collection systems for new multi-residential buildings or single-family developments. This is often combined with the Optibag approach.

Potential Timeline:

Given the subsequent multi-residential contract expires as soon as 2025 and the subsequent curbside collection contract is anticipated to be up for renewal at the earliest in 2030, it is recommended that future collection contract requirements are examined and confirmed in the **short-term**, before each tender is awarded.

FUTURE NEED

Progressively work towards a zero-emissions solid waste fleet.

The following presents the gaps, constraints and opportunities in working towards a zero-emissions solid waste fleet:

Gaps:

- No reasonable lower carbon alternatives to diesel at this time. Biodiesel can only be used in warmer months in Ottawa, while renewable diesel is expensive and hard to get into the supply chain.
- Based on experience, after-market hybridization technologies have not shown success in reducing fuel usage.
- There are no viable low or no emission vehicles currently available, either hybrid or fully electric, that meet operational requirements for waste collection or Trail Waste Facility landfill operations.

Constraints:

- Significant investment will be required for infrastructure to support electrification of a future waste collection fleet.
- Higher vehicle capital costs of low or zero emission collection vehicles when compared to traditional diesel vehicles. At the time of writing, the difference in cost is in the order of two and a half to three times.
- Infrastructure requirements, such as charging and/or refueling stations, adds additional complexity and costs to the initial implementation.
- The City does not currently own or have contractual agreements with private sector transfer stations, which may be required to support a fully electrified collection fleet.
- Operational requirements may pose challenges to implementing certain technologies, for example, the stop/start nature of waste collection may not yield the same level of fuel savings as for highway driving.
- Slower than anticipated development of technology for alternatives to heavy diesel vehicles and equipment, including compactors used in landfill operations.
- The Energy Evolution projects related to waste management are currently not funded and will be subject to future updates of the City's Long-Range Financial Plan, as well as consideration in the Solid Waste Services branch long-range financial plan, pending outcomes of the Solid Waste Master Plan.

Opportunities:

- Ability to request latest technology for green collection fleet in future collection contracts and reduce GHG emissions to align with the City's Climate Change Master Plan, Energy Evolution and Green Fleet Plan.
- Replacing cars, pickups and light SUV vehicles for City staff such as Waste Inspectors and Parks waste collection vehicles with hybrid or electric models once current vehicles are at the end of their lifecycle, provided they are available and meet operational requirements.
- Realize savings through lower operating costs associated with low or zero emission vehicles. These vehicles are also quieter.
- Trialling proven technologies and alternative fuels to determine their applicability to Ottawa and the City's operational needs.
- Determining requirements for greener fleet for future waste collection contracts, including curbside, multi-residential and other collection contracts the City has with the private sector.
- Through a collection efficiency study, consider how transfer stations could be leveraged in a system that utilizes electric collection vehicles.
- Exploring options to offset landfill compactor GHG emissions, given that advances in greening this type of equipment are slower than those being made for waste collection vehicle GHG reductions.
- Potential to reduce City facility electrical costs. The increased electrical load from having electrically powered vehicles charging at a specific location can result in electrical accounts shifting to lower priced account category.
- Continuing investigations into options for lower carbon alternatives for vehicles and fuel types for the City's waste collection and landfill fleet.

Potential Timeline:

Given that transition to a zero-emissions solid waste fleet will occur over time, that collection contracts are issued periodically, and other fleet vehicles and equipment are replaced at the end of their lifecycle, requirements for greener vehicles should be determined over the **short-, medium- and long—term**, as contracts come up for renewal and vehicles reach the end of their useful life.

4.4.2 Drop-off

Background

In addition to the residential waste collection contracts, the City's Solid Waste Services branch also manages the contract for the Municipal Hazardous Special Waste (MHSW) mobile drop-

off depots. As highlighted earlier, there are approximately nine one-day mobile events held each year between April and October, which are hosted at various locations throughout the city. While these events are successful in terms of diverting significant amounts of MHSW from the Trail Waste Facility landfill, they do not provide year-round access and are more geared towards people who have their own transportation. In addition to these depots, residents can also take their MHSW to participating retailers through the City's Take it Back! Program and the industry-funded participating drop-off sites listed on the Orange Drop website. Residential waste audit studies conducted in 2018 and 2019[24] indicate the following:

- Most MHSW is being disposed of correctly. Just 0.1 per cent of the curbside garbage stream (excluding bulkies) contained batteries, with 0.31 per cent of the blue box stream containing batteries. No batteries found in the multi-residential garbage that was audited.
- Similarly, all other MHSW products i.e. except batteries combined only accounted for 0.22 per cent of curbside garbage and 0.31 per cent of blue box, while the multi-residential garbage contained no other MHSW products.
- Slightly more electronic waste was found overall in the garbage during both the curbside and multi-residential waste audits. A very small amount (0.2 per cent) of the curbside garbage stream (excluding bulkies) contained either Phase 1 or 2 EEE, while almost 12 per cent of material in the multi-residential garbage stream was either Phase 1 or 2 EEE.
- Curbside garbage contained 1.4 per cent recyclable metals, while metals accounted for 3.1 percent of the multi-residential waste stream.
- C&D materials made up 1.4 per cent of the curbside garbage stream and 4.7% of the multi-residential garbage stream.
- Textiles accounted for approximately five per cent of the garbage stream in both the curbside and multi-residential waste audits.

Unlike MHSW, EEE, textiles and scrap metal, local waste diversion programs for C&D materials are understood to be very limited to non-existent in Ottawa.

While there are many informal and more formal reuse initiatives and opportunities in place across Ottawa for residents to donate a range of reusable items, the City is currently involved in just two – the spring and fall Giveaway Weekends and the Take It Back! program. The City does not own or manage any drop-off depots, aside from the one at the Trail Waste Facility, which accepts a limited number of items for drop-off that are recycled.

[24] 2018/2019 4 Season Curbside Waste Audit Study and November 2019 Multi-residential Waste Audit Study

FUTURE NEED

Provide enhanced convenience and additional drop-off opportunities for residents to reduce, reuse and recycle.

The following presents the gaps, constraints and opportunities to providing enhanced convenience and additional drop-off opportunities for residents to reduce, reuse and recycle.

Gaps:

- The current mobile drop-off depot approach to disposing of MHSW is not available year-round or convenient for all residents.
- It is unknown what MSHW materials will be included in the transition of this program to producers under IPR and what materials the City would be responsible for managing in the future once the program is transitioned.
- Data on the amount and type of materials that are dropped off for reuse or recycling is typically not tracked.

Constraints:

- Potential for significant financial implications associated with some options, specifically those that require infrastructure such as facilities or vehicles, and associated staffing.
- The unknowns around the transition date and level of involvement of the City in the provision of MHSW services impacts future planning.
- While some opportunities may offer greater convenience to residents, they may also lead to increased GHG emissions from transportation emissions.

Opportunities:

- Expand the number of existing MHSW mobile one-day depots, including the potential to offer year-round depots.
- Leverage and support existing reuse networks and initiatives.
- Explore the feasibility of hosting reuse drop-off events, including partnering with local charities or other not-for-profit groups.
- Investigate the feasibility of specialized reuse centres, which could be temporary or permanent, and involve partnerships with community or charitable reuse organizations for personal and household goods that can be reused, such as art and craft supplies, office supplies, building/renovation materials, furniture, clothing etc.
- Temporary or permanent neighbourhood drop-off depots for divertible materials that have existing locally available processing or disposal capacity, including scrap steel, MHSW, paper, organics, textiles etc.

- Expand the current drop-off area at the Trail Waste Facility to include divertible C&D materials, such as drywall, concrete and asphalt, provided that there are markets for the materials and it is cost effective to do so.

Potential Timeline:

Given the upcoming changes to IPR for the **MHSW program**, it is recommended that any drop-off opportunities related to this program be examined in the **medium-term**, once the new producer program is well established, while **other drop-off opportunities** could be explored in the **short to medium-term**.

4.5 Recovery of Waste and Energy

4.5.1 Technologies for Waste and Energy Recovery

Background

At present, energy is recovered from the Trail Waste Facility landfill through an agreement with PowerTrail Inc. to manage landfill gas (methane) and turn it into electricity. This agreement expires in January 2027, with the possibility of two 5-year extensions based on City Council approval and pending the ability of PowerTrail to secure a Power Purchase Agreement with the Province. The Landfill Gas Utilization Agreement with PowerTrail provides them with exclusive rights to all landfill gas generated at the Trail Waste facility landfill. Throughout the term of the agreement, the City has a contractual requirement to not take any action to unnecessarily reduce the quality or quantity of the gas, with respect to the landfill. For instance, if the City plans on removing organic waste (above and beyond Provincial regulatory requirements), it would have to seek permission from PowerTrail Inc. before doing so. The City, through the agreement, generates a 5.5 per cent royalty based on the sale of electricity produced at the landfill gas utilization facility. The partnership generates approximately $200,000 in annual revenue for the City. Any methane that's not used at the PowerTrail facility to create electricity is destroyed via flaring. The City does not generate any other form of energy from its waste management processes, i.e. through its Green Bin organics program or through any other forms of waste-to-energy technologies.

A large proportion of residential (single-family and multi-residential) garbage disposed at the Trail Waste Facility landfill consists of material that could be diverted through the City's existing diversion programs. The single-family garbage stream consists of 57 per cent divertible material (13 per cent recyclable, 42 per cent Green Bin organics, two per cent LYW, 0.2 per

cent MHSW),[25] while the multi-residential garbage stream consists of 60 per cent divertible material (19 per cent recyclable, 39 per cent organics, 1.7 per cent Take it Back! materials).[26]

It is assumed that City facilities dispose of higher quantities of divertible materials compared to the residential sector. In a 2019 City facility waste audit, diversion rates ranged from a low of four per cent to a high of 85 per cent, meaning that almost all divertible material was being sent to the Trail Waste Facility landfill from some facilities, while others were only sending small amounts of divertible material to the landfill.[27] Overall, there is ample opportunity to further divert various types of waste from the City's landfill, especially those that have existing re-use/recycling programs in place.

The City currently has 30% remaining capacity available at the Trail Waste Facility Landfill.[28] As such, there is limited time for the City to confirm its approach to managing residual waste, both the short and long-term, given the length of time required for permitting and approvals related to expanding the Trail Waste Facility landfill or securing new disposal capacity, making diversion of waste from the landfill an important priority in order to extend the life of the Trail Waste Facility landfill.

In addition to various regulatory tools and diversion policies and programs the City could consider, as highlighted previously, alternative technologies can also be used to capture more materials from the garbage stream and divert them from final disposal, thus extending the life of the Trail Waste Facility landfill. Some of these technologies also provide the opportunity to generate energy and have the potential to generate revenue from the sale of energy produced, which can help offset the cost of the operational costs of alternative technologies. This would also allow the City to amortize current and future required capital investments in the Trail Waste Facility over a longer period.

Some alternative technology options to recover waste and/or energy include:

- Landfill mining;
- Chemical recycling;
- Anaerobic digestion, including co-digestion;
- Mechanical/chemical processing;

[25] City of Ottawa, 2019 4-Season Single Family Residential Curbside Waste Composition Study, 4-season Garbage Stream
[26] City of Ottawa, 2019 Solid Non-hazardous Multi-Residential Waste Audit
[27] City of Ottawa, 2019 Facility Operations Waste Audit
[28] Based on an approved capacity of 16.9 million cubic meters, per the *Trail Waste Facility Landfill Optimization/Expansion Environmental Assessment*, March 2002, with approximately 5.1 million cubic meters, per the*Trail Road Landfill Site 2019 Monitoring and Operating Report*, May 2020, Dillon Consulting

- Co-digestion of sewage and organics at a wastewater treatment plant;
- Mechanical/biological processes (includes mixed waste processing); and
- Thermal processes (mass combustion, gasification, pyrolysis, waste to liquid fuel, hydrolysis).

Some of the above technologies are commonly used, performance is reliable and achieves environmental compliance for the municipal solid waste stream (e.g., mass combustion (incineration/waste to energy), anaerobic digestion, co-digestion of organics with sewage).

As noted in the City's Energy Evolution Strategy, starting in 2021 it is expected that an increase in greenhouse gas emissions will be observed at the Trail Waste Facility landfill as a result operational practices implemented to meet Provincial regulatory requirements related to reducing the contaminating lifespan of the landfill in the future.

Waste and energy recovery are directly tied to the City's climate change goals and targets, as well as the Energy Evolution Strategy, which identified the opportunity to recover as much organic waste from the waste stream as possible and creating renewable energy from this waste stream as key ways the City could meet it's greenhouse gas reduction targets.

There are three main needs related to waste and energy recovery, each of which are outlined below.

FUTURE NEED

Ddetermine what, if any, waste recovery technologies or approaches will be employed to extend the life of the Trail Waste Facility landfill.

The following identifies the gaps, constraints and opportunities to determining future waste recovery technologies or approaches will be employed to extend the life of the Trail Waste Facility landfill.

Gaps:

- The Trail Waste Facility has an estimated 30 percent remaining capacity, and if minimal efforts are made to extend its useful life, there will be very little time to implement an alternative technology.
- How waste recovery technologies will count towards diversion are currently unknown from a Provincial regulatory perspective.
- It is unknown whether future collection of Blue Box materials under and IPR model may assist producers with achieving waste diversion targets through the development of facilities using alternative technologies such as chemical recycling.

- Will still require landfill disposal capacity for some technologies (e.g., mass burn incineration creates fly ash, which requires specialized hazardous landfill disposal and, bottom ash and non-combustibles that will require landfill disposal).
- The previous Trail Waste Facility landfill mining pilot project in the early 2000s did not show much success in terms of diverting additional materials. It is unknown if a new pilot would yield similar or different results.

Constraints:

- Some waste recovery technologies are unproven at the scale required for the City's needs.
- Some technologies are better suited to a more homogeneous waste stream compared to municipal solid waste.
- There is the potential for lengthy and uncertain regulatory approval and permitting processes for some technologies, plus time required for facility siting, design, and construction, with many taking upwards of 10 years. Given these potential lengthy timeframes, employing an alternative technology to assist the City in achieving the levels of waste diversion required to help extend the life of the Trail Waste Facility landfill considerably beyond its current life expectancy may not be feasible in comparison to options such and regulatory tools, policies, enforcement and public education that can be implemented in the short-term.
- Capital and operating costs, net of revenues, for alternative technologies are very high when compared to the cost of landfilling.
- May be difficult to site these types of facilities with public perception / concerns with various recovery technologies.
- Still require landfill disposal capacity for some technologies (e.g., fly ash from mass burn incineration requires specialized hazardous landfill disposal and bottom ash requires regular landfill disposal).
- Programs or policies that impact the quantity and composition of waste being managed at these types of facilities will impact their feasibility.

Opportunities:

- Conduct a study to determine if waste recovery technologies or approaches should be employed to extend the life of the Trail Waste Facility landfill and if so, confirm the preferred technology and/or approach to recover waste.
- Explore potential for funding or partnership opportunities.
- Potential to generate revenue from larger facilities by processing non-City waste.

- Potential to recover materials which can be marketed (e.g., metals from incineration or landfill mining), generating a revenue.

Potential Timeline

Given the time required to site and permit a waste recovery facility, it is recommended to begin **studying** in the **short-term,** through a business case or feasibility study. It is anticipated that **siting and permitting** of a facility would not occur until the **medium term** and **facility operation** may begin in the **medium-long term**.

FUTURE NEED

Identify an approach to utilizing landfill gas and producing energy once the current contract with PowerTrail expires in 2027.

The following identifies the gaps, constraints and opportunities to identifying an approach to utilizing landfill gas and producing energy once the current contract with PowerTrail expires in 2027.

Gaps:

- Timing of the implementation of more aggressive measures for diversion of organics is unknown, including the Provincial ban on sending organics to landfill, which has been pushed out from 2022 to 2030.

Constraints:

- The future capacity of the Ontario electrical grid is unknown.
- Modeling done through the Energy Evolution Strategy requires combustion–based electricity generation to be phased out, unless it is required for redundancy and/or resilience.
- Power procurement is a Provincial responsibility and it is unclear whether the Province will renew PowerTrail Inc's power purchase agreement when it expires in 2027.
- More aggressive diversion of organics at the source will significantly reduce the quantities of organic material disposed of in the Trail Waste Facility landfill and will reduce future quantities of landfill gas generated, possibly making future energy production from landfill gas at the site non-viable.
- The City may have to negotiate with PowerTrail Inc. if a program, policy and/or facility is implemented before the current contract expires in 2027 that would reduce the amount

of organics going to the Trail Waste Facility landfill, reducing the quality or quantity of landfill gas.

- PowerTrail Inc. has first rights of refusal for any gas utilization at the site during the term of the contract and own all benefits associated with the management of any landfill gas, including carbon credits.
- Starting in 2022, based on Provincial regulatory requirements, the Trail Waste Facility landfill is expected to generate increased amounts of GHGs, which will not be captured and therefore available to convert into renewable energy i.e. they are fugitive emissions that will be released into the atmosphere.
- It is not completely known how much energy (gaseous, electrical or thermal) would be available, once generated.
- Landfill gas could be used as a part of a leachate management solution for the Trail Waste Facility site, using the gas as part of an evaporative process. This could impact the amount of landfill gas available for conversion into energy.

Opportunities:

- The City owns the existing gas collection and flaring infrastructure in place for the management of landfill gas, which will be available for after the current agreement with PowerTrail expires in 2027.
- Develop a Landfill Gas Management Strategy. Part of this work would involve the City deciding on an overall approach to managing organics, given this has the highest potential to impact future quantities of landfill gas, emissions, energy production and adherence to contractual obligations with PowerTrail. Estimates of future quantities of landfill gas can then be made to assist with determining how the City will manage the gas from the Trail Waste Facility landfill, including determining if the City wishes to extend the current contract with PowerTrail once it expires in 2027 or undertake an different approach to manage landfill gas.
- The City could investigate alternative uses for landfill gas generation (e.g., renewable natural gas (RNG)). In the short and medium terms, the City will have a better understanding of how organics will be managed and the potential impact on landfill gas generation.
- Converting landfill gas from the Trail Waste Facility may provide an opportunity to reduce greenhouse gas emissions, if it is used locally, which would count towards the community greenhouse gas reduction targets in the City's Climate Change Master Plan.
- If the PowerTrail generation system no longer runs steady state because landfill gas is directed to other uses, it may be able to bid into the capacity market and run periodically, with good economic returns.

- Explore opportunities to capture the increased amounts of greenhouse gases that are expected to be generated at the Trail Waste Facility landfill from 2021 onwards.
- Investigate co-locating some anaerobic digestion capacity at the Trail Waste Facility to achieve economies of scale and to boost methane concentrations of a combined biogas/landfill gas stream, which will help to ensure the long-term feasibility of energy production options.
- Carbon pricing, should it continue, has the potential to improve the market economics of energy produced from organics.

Potential Timeline

Given that the PowerTrail contract expires in 2027, a Landfill Gas Management Strategy should be developed in the **short-term** to determine how the City wishes to manage landfill gas after 2027.

FUTURE NEED

Determine what energy recovery technology/ies or approaches will be employed to recover as much energy as possible from the waste stream and create renewable energy from this waste.

The following identifies the gaps, constraints and opportunities to determining what energy recovery technology/ies or approaches will be employed to recover energy from waste and create renewable energy from this waste.

Gaps:

- The current organics processing technology does not produce renewable energy and the contract is in place until 2030.
- The Energy Evolution Strategy calls for all organic waste generated within the city's boundaries be routed to anaerobic digestors or gasification by 2030.
- Currently, less than 50% of organics waste is captured through the Green Bin program, while the Energy Evolution Strategy calls for 98% of organics to be diverted by 2024 and 100% by 2040.
- Under the current collection approach, household organics and LYW are generally co-mingled in the same truck, with the exception of 10 weeks each year, where LYW is separately collected.
- All residential garbage is currently disposed of at the Trail Waste Facility landfill, which has limited opportunity to generate renewable energy from this waste.

Constraints:

- The magnitude of behavioural change required to divert close to 100% of organic material is significant and takes time to achieve.
- There is less than 10 years to confirm the new organics processing technology and procurement approach, and either contract out the processing or design and commission a new organics processing facility/ies.

Opportunities:

- Explore the range of technologies that are available to recover energy from waste to identify suitable options, including technologies to create renewable energy from household organics. For some more common energy recovery technologies, performance is reliable and achieves environmental compliance for the municipal solid waste feedstock (e.g., mass combustion (incineration/waste to energy), anaerobic digestion, co-digestion with sewage).
- Identify technologies that may reduce greenhouse gases and produce offsets, which would assist the City in meeting its greenhouse gas reduction targets.
- Build off of the experience the City has with some of these technologies (e.g. anaerobic digestion of sewage) and recent studies completed e.g. the ROPEC Biogas Optimization Study. This study has generated a list of emerging technologies which should be reviewed and investigated for applicability at the Trail Waste Facility.
- Explore technologies to manage LYW, beyond composting, that may also generate renewable energy.
- Explore opportunities for co-digestion of household organics or co-location of an anaerobic processing facility specific to food waste at ROPEC.
- Explore opportunities to include forestry waste from City operations as a supplemental waste stream to generate energy.
- Explore different opportunities for partnerships for a future energy recovery facility/ies, including Public Private Partnerships, other municipalities and the private sector for the ownership and/or operation of a facility.
- Explore opportunities for generating renewable energy/fuel to be used within City operations.
- Works towards achieving the greenhouse gas reduction targets noted in the City's Climate Change Master Plan.
- Explore opportunities to align with the Renewable Natural Gas Strategy project identified through the City's Energy Evolution Strategy.
- Explore potential opportunities for funding.

- Explore and leverage opportunities that future Provincial regulations such as an organics disposal ban, may create to more cost-effectively develop larger facilities to manage materials from other municipalities and potentially the IC&I sector s (e.g. partnerships, contracts).
- Explore opportunities to process non-City waste to generate revenue that would off-set capital and operating costs of such a facility.

Potential Timeline

Given there is less than ten years left to confirm the City's approach to processing source separated organics collected through the Green Bin program and the Trail Waste Facility landfill is currently estimated at having approximately 30% capacity remaining, it is recommended to confirm the future energy recovery technology/ies or approaches will be employed to create renewable energy from the waste stream in the **short-term**.

4.6 Residual Management

4.6.1 Trail Waste Facility

Background

The Trail Waste Facility is a key City asset and consists of several components, including an engineered landfill, leachate management system, the PowerTrail landfill gas to energy facility, administration and storage buildings, a soils management area, a public drop-off area for items such as EEE, leaf and yard waste, recyclables and scrap metals, and surrounding bufferlands. It is designed to protect the environment from the disposal of solid waste, employing composite liners, impermeable caps, and leachate and landfill gas collection systems to mitigate impacts on the environment.

The Trail Waste Facility landfill is permitted to accept solid, non-hazardous waste generated within the boundaries of the City of Ottawa. The Trail Waste Facility has a total site area of 153 hectares, of which 85 hectares are approved for landfilling and the remaining 68 hectares are considered bufferlands, which are designed to attenuate landfill impacts on the surrounding area and local communities.

The Trail Waste Facility landfill began receiving waste in May of 1980, and at this time, was estimated to provide waste disposal for residents for approximately 20 years[29]. In 2005, it received Environmental Assessment Act approval for a vertical and horizontal expansion within the existing property boundary, and as noted in the Environmental Assessment, the expansion

[29] https://www.ontario.ca/page/trail-waste-facility-landfill-optimization-project

was intended to provide capacity for an additional 10 to 40 years, depending on factors such as diversion and growth rates. With this additional capacity, the Trail Waste Facility landfill has a total approved capacity of 16.9 million cubic meters, with approximately 30 per cent capacity[30] (5.1 million cubic meters) remaining, as of the end of 2019. The estimated timeframe in which the landfill will be at capacity is difficult to predict with a high degree of certainty as it is dependent on a number of factors, including tonnage, composition and volume of waste disposed, waste diversion rates, waste compaction rates, landfill operational efficiencies, regulatory changes and environmental issue mitigation. Historically, the City has relied on landfill life estimates developed as part of the City's annual compliance report to the Ministry of the Environment, Conservation and Parks, which is based on a compliance methodology that uses lagging indicators. Specifically, the estimated remaining years is determined on an annual basis by dividing the remaining airspace at the site (as determined by aerial surveys) by the 5-year rolling average of annual waste volumes. The purpose of this calculation is to demonstrate that a site closure plan is not yet required as per Ministry requirements, and although this approach is recognized as an accepted best practice for compliance purposes, this method of calculation is not a best practice for forward looking planning purposes.

Eastern Ontario is home to a number of landfills, with several other landfill sites in and near Ottawa that are owned and operated by the private sector (e.g., Waste Connections of Canada, Waste Management, GFL Environmental, Taggart Miller). While this presents a unique opportunity for the City to consider these as alternative disposal facilities, some of these facilities are not currently operating and others have restrictions on the type of waste received, which may impact the ability of the City to utilize these facilities as alternative disposal facilities in the short- to medium term.
Disposal capacity in the Province is quickly diminishing, with a recent study released by the Ontario Waste Management Association indicating that the province's landfill capacity (both private and public landfills) is estimated to be depleted in the next 14.5 years[31]. The process involved in securing disposal capacity can be lengthy and expensive. The City is in a fortunate position to have its own disposal facility and as such, every effort needs to be made to preserve the remaining capacity at the Trail Waste Facility landfill, including diverting as much waste as possible from the landfill and exploring the option to use alternative local private sector disposal facilities to reduce the amount of waste sent to the Trail Waste Facility landfill.

[30] Based on an approved capacity of 16.9 million cubic meters, per the *Trail Waste Facility Landfill Optimization/Expansion Environmental Assessment*, March 2002, with approximately 5.1 million cubic meters, per the *Trail Road Landfill Site 2019 Monitoring and Operating Report*, May 2020, Dillon Consulting
[31] State of Waste in Ontario: Landfill Report, January 2021

FUTURE NEED

Being a key City asset, determine ways to extend the life of the Trail Waste Facility landfill to maximise the life of the asset and plan for new disposal capacity, when required.

The following presents the gaps, constraints and opportunities in extending the life of the Trail Waste Facility landfill and planning for new disposal capacity:

Gaps:

- Uncertainty around the estimated date the landfill will be at capacity because of the many factors that impact landfill life and in part due to the fact that the current methodology used for landfill life assessment does not consider forward-looking factors such as projected population growth, waste generation and estimated diversion rates.
- Uncertainty with timing associated with permitting and approvals for the development of new disposal capacity.
- There is currently a lot of change occurring in the waste management industry which will impact future quantities of waste to be disposed (e.g., regulations, waste composition changes). The impact of these changes on the landfill capacity is uncertain at this point in time.

Constraints:

- An additional horizontal expansion of the landfill could be difficult to accomplish with the existing roads and adjacent woodlot. The woodlot serves as an important groundwater attenuation area for Stages 1 and 2 of the landfill, and expanding it into this area could disrupt this attenuation process. The woodlot could also be considered a significant woodlot (i.e., a defined natural heritage system) and a natural heritage review would have to be completed as a minimum as part of a feasibility study.
- Although the Ottawa area contains several large landfill sites, the Province as a whole has limited landfill capacity remaining. This could result in waste coming from other areas of Ontario to be disposed of in Ottawa area landfill sites, potentially reducing the opportunity to dispose of some or all of the City's garbage at these sites.
- Type of residual waste requiring disposal may change over the coming years as a result of legislative and policy changes such as organics bans, which could impact future waste quantities to be managed and the types of waste sent for disposal, for example, bulky and C&D waste, which typically have higher waste densities and take up more capacity in the landfill.

- Landfill compaction and operations may be affected by collecting bulky items with garbage.
- Public resistance to alternative future landfill locations in the City.
- Associated costs for the development of a new landfill site.
- No future sites earmarked by the City as having the potential for future landfill development. It can take a decade to secure approvals and permits for new or expanded landfills in Ontario.

Opportunities:

- Adopt a calculation methodology for landfill life planning and reporting purposes that includes forward-looking considerations such as population growth, waste generation, and estimated diversion rates.
- Develop a residual disposal strategy in the short term that considers options to extend the life of the Trail Waste facility which may include the use of alternate local landfill disposal options in the short and medium terms, increased diversion strategies and limiting the type of waste accepted at the facility to name a few
- Minimize materials being landfilled to increase the capacity of the Trail Waste Facility landfill through tools such as material bans, new waste diversion programs and increased participation in existing waste diversion programs. Examples include, but are not limited to:
    - Consider banning certain materials found in the residential waste stream that have diversion options currently available, for example, organics, recyclables, textiles, MHSW and scrap metals; and
    - Consider banning any IC&I or C&D waste at the Trail Waste Facility landfill.
- Potential to adjust and upgrade landfill operations to maximize the capacity of the landfill, reduce greenhouse gas emissions and enhance energy production (e.g., use of shredders, optimize compaction rates, enhanced landfill cover technology, landfill mining etc.).
- Explore potential options to expand the landfill vertically (i.e. increase approved contours vertically and/or horizontally (e.g., through the valley between Stages 4 and 5).
- Explore other possible geographical locations for a future City-owned landfill, including both in the City and outside City boundaries.
- Acquire or contract out disposal to another landfill/s in anticipation of the Trail Waste Facility landfill reaching capacity. This could be done as part of a larger residual disposal strategy.

Potential Timeline

Given the time required to plan for the approval, construction or procurement of new landfill disposal capacity or expanding the Trail Waste Facility, it is recommended to begin addressing this need in the **short-term** as the remaining capacity of the Trail Waste Facility is approximately 30% and the ability to extend the life of the landfill is highly dependent on the short-term implementation of strategies aimed at extending its useful life.

4.6.2 Future Use of Other Existing City Owned Waste Management Sites

Background

As previously mentioned, the City owns a number of properties abutting or in the vicinity of the Trail Waste Facility site and the closed Nepean Landfill, which are commonly referred to as 'bufferland' properties. These properties serve as contamination attenuation for the two waste management facilities and act as a visual barrier for the Trail Waste Facility. Some of these bufferlands properties are woodlots that are currently undeveloped.

The following is a list of the Trail Waste Facility bufferlands and their approximate size:

- Dewatering Pond, approximately 32 ha;
- West of Moodie, approximately 25 ha over three individual properties;
- Former White Pit, approximately 15 ha;
- Noel Property, approximately four ha;
- Aggregate Extraction Properties, approximately 150 ha over two individual properties;
- South of Barnsdale Road, approximately 45 ha;
- Trail Waste Facility also has a woodlot onsite which is used as contaminant attenuation for Stages one and two of the landfill, approximately 38 ha.

Some of the bufferland properties are currently being used for City operations other than waste management, for example, bus storage and fire training facilities. Given the size of these bufferlands, there may be other potential uses for these sites that the City may wish to consider, including future waste management sites, community use or for innovation pilot/demonstration opportunities. The City is currently reviewing a number of different potential options for the future use of the bufferlands through the Trail Road and Nepean Landfills – Bufferlands Assessment report by Dillon Consulting Limited, dated April 2020.

The small loads area and the soils management facility currently located at the Trail Waste Facility will need to be relocated in the near future to accommodate the filling of Stage 5 of the landfill. In addition, the City may also require additional sites for the outdoor processing of LYW in the future. The bufferlands should be considered as potential future sites for these activities.

The City also owns the Springhill Landfill and the corresponding Environmental Compliance Approval (ECA), and through a Management Agreement signed in 1996 between the former Township of Osgoode and Tomlinson Waste Management (TWM), the landfill is operated by TWM. Construction and Demolition (C&D) material is the primary type of waste disposed of in the landfill and it is estimated that the landfill has approximately 350,000 cubic metres of capacity remaining.

The site operates as a natural attenuation landfill and it is located adjacent to a Provincially Significant Wetland. Groundwater and surface water contamination issues have been identified at the site, and waste management activities at the site have been suspended until these issues have been addressed.

Under the current Management Agreement, Tomlinson may operate the site until such time as the available capacity is exhausted. In light of the issues identified above, it is not presently known when the site's capacity will be exhausted or when the site is closed and responsibility for it returned to the City, so that future alternative uses of the site might be considered. Consequently, Springhill has not been included in the analysis.

FUTURE NEED

Determine the future use of bufferland properties, including for operational, community use and or pilot/demonstration opportunities.

The following presents the gaps, constraints and opportunities for the bufferland properties:

Gaps:

- Past investigations have indicated that some of the bufferlands soils have been impacted by historical uses. Depending on the proposed future use of an individual property, additional investigations or permits may need to be obtained.

Constraints:

- Each of the bufferland properties have their own constraints (e.g., available area) that would need to be examined further prior to determining potential future uses.
- Bufferland properties that are currently used as contamination attenuation areas are limited in what they could be developed into, as the development would need to allow for the continued use as an attenuation area.
- Some of the bufferlands serve as a visual barrier for the Trail Waste Facility and this would need to be considered as part of any change in use of these properties.
- Committing a bufferland property to community use may exclude its use for operational needs or pilot/demonstration opportunities.

Opportunities:

- Various bufferland properties could be considered in support of solid waste operations, including:
    - for use as potential soil management locations in response to the Provincial Excess Soils Management regulations;
    - relocation of the Small Loads Facility in preparation for the landfill development of Stage five of the Trail Waste Facility landfill;
    - potential location for a leachate treatment facility to serve Stages 3, 4 and 5 of the Trail Waste Facility landfill;
    - larger bufferland properties could be used for a new LYW processing facility, adding additional LYW capacity as required in the future;
    - could be used for future waste management demonstration/pilot opportunities that align with the City's circular economy and zero waste vision and goals and
    - could be used for various community/recreational uses, such as a BMX park, bird observatory, or nature trails.

Potential Timeline

With Stage 5 of the Trail Waste Facility landfill anticipated to be developed for landfilling by 2024, it is suggested that options for optimizing the uses of the bufferlands be looked at in the **short-term**.

4.7 Managing Waste Generated by City Facilities and Operations

Background

While the City is responsible for the management of waste from the residential sector, it is also a generator of waste through its various operations. There are approximately 375 City facilities including, but not limited to, recreation facilities, community centers, daycares, client service centers, long-term care homes, offices, libraries, works yards, emergency service stations/posts, transit and fleet facilities and garages that support City operations. The hours of operation of these facilities varies widely, as does the amount and type of waste generated by each facility. Waste diversion programs have been implemented across the Corporation, with various degrees of success.

Vendors are located in different City facilities, depending on the nature of the facility, including those selling food and drinks. Vending machines that sell bottled water and other beverages are also installed at numerous City facilities.

There are various waste reduction approaches taken across the Corporation, including an informal Green Exchange program, printer toner return program, double-sided printing on all City printers as a default, as well as the retreading of tires in OC Transpo's fleet. Since 2012, 208 drinking water fountains have been installed at various indoor and outdoor locations, reducing the need to purchase water in plastic bottles.

The City's Solid Waste Services branch is responsible for the collection, transportation, processing and disposal of the typical waste streams (garbage, recyclables, household organics and leaf and yard waste) from City facilities, and efficiencies and cost savings have been achieved by servicing these facilities through the two residential waste collection contracts. However, there are additional waste streams that are generated and managed by other City departments under separate waste management programs, contracts and services. These materials include electronic equipment such as computers; waste oil, used filters, antifreeze and used tires from fleet vehicles; surplus office furniture, hazardous materials used by City facilities such as pool chemicals; fluorescent bulbs/tubes and uniforms, as well as medical supplies and equipment.

The City has adopted a variety of instruments such as guidelines and policies to support the sustainable provision of goods and services across the Corporation, including the Sustainable Procurement Guideline developed in 2013 and the Green Building Policy. The Green Building Policy requires all newly constructed buildings with a footprint greater than 500 square metres be designed, constructed and certified by the Canada Green Building Council as being Leadership in Energy and Environmental Design (LEEDTM - Canada) certified at minimum.

Under O. Reg 102/94: Waste Audits and Waste Reduction Work Plans, City office buildings (or a group of office buildings in close proximity) that have at least 10,000 square metres of floor area used as office space must complete annual waste audits and waste reduction work plans aimed at increasing waste diversion. The owner of the property is responsible under the regulations to comply with these requirements. OC Transpo and City Hall fall under these requirements. Recent waste audits found City Hall to have a waste diversion rate of 67 per cent and OC Transpo 74 per cent[32].

FUTURE NEED

Develop a strategy that identifies ways in which City facilities and operations can avoid, reduce and divert more waste from disposal.

[32] City Hall waste audit conducted in 2019 and OC Transpo waste audit in 2015.

The following presents the gaps, constraints and opportunities in addressing the need to further avoid, reduce and divert the amount of waste generated from City facilities and operations:

Gaps:

- There is currently no comprehensive and consistent waste diversion program in place across the City facilities and operations.
- Lack of standardized waste receptacles, labelling and promotional messaging to encourage waste diversion at City facilities and in City operations.
- Lack of P&E on waste reduction and diversion for City employees and occupants of buildings leased by the City
- Lack of data available on the types and amounts of waste generated and diverted from disposal (e.g., electronics, waste oil, surplus office furniture, MHSW, single-use plastics) from City facilities and operations.
- The City does not currently have a waste reduction and diversion strategy specific to its facilities or operations.
- Currently, there are no requirements for waste avoidance or reduction in vendor or contractor contracts.
- No one department or service area is responsible for waste collection or implementing and monitoring the performance of internal Corporate waste diversion programs.

Constraints:

- Decentralized approach to the management of waste across the Corporation, leading to lack of standardization in waste management programs, contract requirements and services.
- Varied types of City facilities and buildings have different waste management needs and service levels.
- No policy mandating waste diversion in City facilities or operations.

Opportunities:

- Develop a Corporate waste reduction and reuse strategy, which could include, but not be limited to the following:
    - Elimination of single use items (SUIs) at City facilities and operations, including a policy to phase out the sale and distribution of bottled water in City facilities.
    - Continue to fund the installation of internal and external water fountains across the city.

- Review opportunities to advance waste reduction and circular economy best practices and principles throughout all City operations.
- Enhance promotion and education program for City-owned facilities and operations to reduce the amount of waste generated by employees and visitors, and to increase waste diversion rates.
- Use existing waste audit data to target specific waste streams or items for each City facility. For example, plastic water bottles accounted for 42 per cent of the overall waste stream at City fire stations.
- City has the opportunity to lead the way in municipal waste reduction and diversion strategies. Can share successes and learning to influence industry and the public.
- Utilize the City's purchasing power to advance waste reduction, reuse and circular economy principles.
- Examine existing procurement guidelines to identify areas for improvement with respect to waste avoidance, reduction and diversion. Consider including the lifecycle of a product or service in the procurement process, such as increasing the amount of goods and services that are repairable by design, contain recyclable material or can be easily recycled and rely less on raw material extraction/consumption.
- Enhance operating policies and procedures to reduce waste generated within City facilities and operations.
- Fund and/or partner with like-minded organizations to incubate innovative technologies and business concepts that support circular economy/zero waste initiatives to implement at City facilities or in operations.
- Set waste diversion performance targets/goals for City facilities and operations.
- Leverage building and construction specifications to support a circular economy.
- Implement a mandatory waste diversion policy in City facilities and operations.
- Implement a consistently branded waste management program in all City facilities e.g. same waste bin containers, signage and labelling at all City facilities, providing waste management stations that have recycling, organics and garbage bins.
- Consolidate data management for all waste-related data across the Corporation for performance measurement and continuous improvement.
- Fund and conduct regular waste audits for City facilities and operations.
- Include requirements in vendor contracts for waste reduction and reuse for items such as packaging.
- Set targets and timelines to track and communicate progress.

Potential Timeline

Developing a strategy to further avoid, reduce and divert waste, demonstrating how the City will lead by example, can occur in the **short-term**.

4.8 Supporting System Requirements

4.8.1 Promotion and Education

Background

The City offers comprehensive promotion, educational tools and resources to its customers through on-line and printed resources, social media, advertisement and outreach activities. Promotion and education (P&E) activities are conducted throughout the year by two dedicated staff. In addition, support is also provided by the City's Public Information and Media Relations group, including graphic design and ad placements.

In 2019, the City spent approximately $292,000 on communication activities related to solid waste promotion and education, including $163,000 for the Green Bin campaign to inform residents about the changes to the program that came into effect on July 1, 2019.

Currently, the waste management program with the least participation and greatest opportunity for focused P&E efforts is the Green Bin program. In a market research telephone survey completed in late 2018 for the Enhanced Source Separated Organics Program, it was found that 24 per cent of residents were "disconnected" from solid waste management services, meaning that they do not divert much waste, are unsure of programs and are only moderately satisfied with the educational information that is provided by the City. Among this group, 69 per cent of multi-residential and 51 per cent of single-family residents did not divert organics from the garbage stream. In addition, the 2018/2019 Four Season Curbside Waste Audit Study estimated the average participation rates for curbside residents was 48 per cent for the Green Bin program, meaning less than half of the homes in the study set out a green bin. Information from City databases indicate that 784 multi-residential properties, representing approximately 46 per cent of total properties receiving City waste collection services.[33]

The 2018/2019 Four Season Curbside Waste Audit Study also revealed that of the total amount of waste that was generated, 47 per cent was garbage that was sent to the Trail Waste Facility landfill, with the remaining 53 per cent being waste that was placed in either the Blue, Black or Green Bins. Within the garbage that was sent to landfill, 42 per cent was actual garbage and the rest could have been diverted (45 per cent Green Bin organics, eight per cent

[33] Based on 1,700 properties are registered as receiving Green Bin collection as of March 1, 2021.

Black Bin materials and five per cent Blue Bin materials). The average number of garbage items (including bulky materials) set-out per household during the audit was approximately four items every two weeks.

A waste audit on the multi-residential waste stream completed in November 2019 shows that of the 74 per cent of garbage sent to landfill, 58 per cent could have been diverted (39 per cent Green Bin organics, 12 per cent Blue Bin materials and seven per cent Black Bin materials).

In summary, there are opportunities to engage with residents and other stakeholders to change behaviour related to their current waste management practices, with the goal of reducing the total amount of waste produced and increasing the amount of waste diverted from the Trail Waste Facility landfill. Communicating on how to use the City's waste diversion programs properly is a core system requirement, and communication materials and media should be designed based on the desired user behaviour. The level of P&E required is determined by the complexity of the desired behavioural change. When significant behavioural change is required, communication needs to be approached from different aspects to ensure the different customer bases are reached. The following provides examples of the different behavioural changes required, along with some of the approaches that can be used to achieve the desired changes:

- Awareness (i.e., that there is something different to be done) - communications, marketing.
- Desire (i.e., user is motivated to change but also understands what will happen if they don't change) - communications, enforcement, marketing.
- Knowledge (i.e., user knows what they need to do) - communications, marketing, education, outreach.
- Ability (i.e., user can actually implement the change) – social marketing to understand and overcome barriers to change.
- Reinforcement (i.e., user gets feedback and doesn't fall back on old behaviours) - reminders, enforcement, rewards, recognition for performance.

As previously mentioned, the City already utilizes outreach, marketing and communication tools, and education, but will need to build on, and expand the initiatives to create the desired behavioural change(s) and to support program priorities.

FUTURE NEED

Expand and/or modify technologies and approaches used to reach the City's diverse customer base, to create the desired behavioural changes and to support program priorities.

The following presents the gaps, constraints and opportunities to expanding and/or modifying the current approach to promotion and education campaigns a to create behavioural change:

Gaps:

- The Solid Waste Services branch does not have its own social media account, as the City uses one account for social media platforms (Twitter, Facebook, Instagram, LinkedIn) to promote all City departmental news. While this broadens the audience, waste management updates compete with updates from City other departments.
- Lack of dedicated communications staff, including graphic designers.
- Limited number of dedicated staff resources for waste-related P&E and outreach.
- Provision of P&E materials, including website only available in English and French.
- Lack of budget for sustained market research on waste programs and the effectiveness of targeted educational campaigns.

Constraints:

- Behavioural change is very slow and requires significant and sustained financial and staff resources.
- Limited P&E and outreach budget and staff.
- Difficulty measuring the impact of education and engagement campaigns on waste management program performance.
- Adapting P&E to evolving communication channels and distributing information that caters to the different customer preferences of how they want to receive information.
- Seeking desired behavioural changes could result in extensive, prolonged and frequently updated P&E efforts.
- Resourcing the monitoring of social media channels to the desired levels (e.g., information out, two-way communication).
- Competition with other City departments in messaging to customers.
- There are other challenges associated with increasing participation in diversion programs in multi-residential buildings that are unrelated to P&E efforts (e.g., infrastructure, collection areas, and anonymity).

Opportunities:

- The use of new technology or enhanced use of existing technology to reach broader audiences.
- Conduct market research and behavioural analysis as required to inform future P&E efforts.

- Use of behavioural change approaches and tools to increase effective participation in waste management programs.
- Create and deliver tailored, specific messaging and outreach tactics that align with market research findings to raise awareness of diversion programs and promote behavioural change.
- Incorporate messaging that that waste diversion doesn't only deal with waste, it also helps to address climate change.
- Develop targeted P&E campaigns for new and/or priority programs and/or policies and for program performance improvement, based on waste audit and program performance data to identify priority materials and sectors to focus P&E efforts on (e.g., Green Bin program, multi-residential sector).
- Introduce new P&E campaigns to support Solid Waste Master Plan recommendations (e.g. waste reduction, regulatory changes, circular economy initiatives).
- Complete door-to-door visits with customers who are repeat offenders of curbside courtesy tag violations and provide answers to their questions and focused P&E materials.
- Rewarding customers for good waste management behavior/practices (e.g., Gold Star program).
- Accommodating cultural diversity through the delivery of multi-language campaigns and resources.
- Enhanced P&E, including focus on the importance of diverting organics from disposal and the tie-in to achieving the City's Climate Change targets.

Potential Timeline

Promotion and education should be on-going and evolving. Therefore, options to enhance current P&E activities should be considered in the **short-term and throughout the planning period.**

4.8.2 Regulations, Policies and By-Laws

Background

Avoiding and reducing the amount of waste generated and increasing the diversion of the remaining waste is a core goal of the Solid Waste Master Plan. In the context of waste management, the City of Ottawa takes on two roles:

1) Waste producer; and
2) Owner or operator of waste management systems.

Therefore, it is important to consider the regulatory requirements within which the City must operate, both as an organization that generates waste and as a municipality, including what levers it has at its disposal to influence waste management in terms of these two roles.

Notwithstanding, all levels of government are involved to some degree in the way waste is managed in Ontario. The federal government intends to move forward on reducing/eliminating single-use plastics. The provincial government establishes guidelines, policies, targets and direction for municipalities and the City of Ottawa's waste management programs are strongly influenced by these Provincial requirements. The Province also has legislation in place to transition existing provincial waste diversion programs to IPR, including the Blue Box recycling program.

At the local level, the City establishes policies, guidelines, standards and by-laws to ensure the effective operation of its solid waste management system and the services that are provided. The City has developed a set of strategic plans (e.g., previous Integrated Waste Management Master Plan, Climate Change Master Plan, Infrastructure Master Plan, Green Fleet Plan) that guide the provision of waste management services and operation of its solid waste management system.

The City's Official Plan (OP) influences waste management infrastructure (e.g., waste processing and disposal facilities) with regards to policies on land use designation and siting of waste management facilities, although there is no specific section regarding waste management in the Plan. The City is in the process of updating the Plan and the draft Official Plan was tabled in late 2020 and Council will vote on the new Official Plan in Fall 2021. Following the anticipated adoption by Council, the Plan will be sent to the Ministry of Municipal Affairs and Housing for approval (anticipated late 2021). One of the Plan's cross-cutting issues, "healthy and inclusive communities", outlines the intention to promote health through sustainability by promoting sustainable waste management through the reduction and reuse of waste, diversion and resource recovery of materials such as food and organic waste, and environmentally responsible residual management.

A High-Performance Development Standard (HPDS) is being proposed through the OP. While the HPDS proposes options to increase C&D waste diversion and waste storage requirements at new multi-residential properties, planning and development guidelines, standards and by-laws that encourage waste diversion in the OP are currently limited.

To support the City's strategic plans, a number of guidelines (e.g., site plan control for multi-residential development solid waste collection, sustainable procurement), policies (e.g., Asset Management Policy, Green Building Policy for the Construction of Corporate Buildings, Public Private Partnership Policy) and municipal by-laws (e.g., Solid Waste By-law 2012-370,

Business Licensing By-law 2002-189, Special Events on Public and Private Property By-law 2013-232, Procurement By-Law 2017-362, Property Maintenance By-law Property Maintenance By-law 2005-208 and Property Standards By-law 2013 - 416) have been implemented by the City. There are currently no specific City policies or guidelines around reducing and avoiding waste or supporting a circular economy.

The Solid Waste By-law 2012-370 sets out specific requirements for all aspects of the residential solid waste management system. This includes waste collection services (e.g., curbside, multi-residential, City facilities, Yellow Bag Program and the Green Bin in Schools program) and the operation of the Trail Waste Facility. There are mandatory source separation requirements in the by-law for recyclable material, yard waste and organic material, aimed at increasing the life of the Trail Waste Facility landfill. There is also a setout limit for curbside homes on the number of garbage items that can be placed at the curb, which is currently six items every two weeks. None of these by-law requirements are currently enforced on a proactive basis. The by-law will need to be updated in the future to reflect the changes resulting from IPR, including how materials are collected and what materials are collected or accepted in the City's waste management system.

Under the Solid Waste By-law, small quantities of residential C&D waste are collected under both the curbside and containerized collection contracts, provided it is packaged properly. This material is collected with garbage and is disposed at the Trail Waste Facility landfill. Larger quantities of C&D waste can be taken directly to the Trail Waste Facility landfill or to private sector waste management facilities for a fee. Under the by-law, the City also collects from a small number of IC&I establishments, such as those registered in the Yellow Bag and Green Bin in Schools programs, and also accepts IC&I waste at the Trail Waste Facility landfill.

With regards to waste diversion in multi-residential buildings, the City's Site Plan Control By-law 2014-256 ensures new development is designed appropriately and is safe, functional and minimizes potential impacts on neighbouring properties. The City's Solid Waste Collection Design Guidelines for Multi-Residential Development, approved by Council in 2012, complements the Site Plan Control By-law. Solid Waste Services staff review applications and floor plans to ensure there is sufficient space for the storage and collection of the different waste streams and will not approve otherwise.

In addition to its by-law making powers, Council may also choose to influence the disposal and diversion of waste through the development review process, governed under the Planning Act and further guided by the City's Official Plan. The Planning Act enables a municipality to require as a condition of approval of site plans, "vaults, central storage and collection areas and other facilities and enclosures for the storage of garbage and other waste material". While

this provision is sufficiently broad, currently, the City's Solid Waste Collection Guidelines for Multi-Unit Residential Development serves only as a guide to ensure that designers, planners, developers, owners and property managers of multi-residential buildings are familiar with and have considered these guidelines in the design and development review of all new multi-unit residential projects. They are not mandatory requirements. In the event that the City wishes to implement a more comprehensive condition respecting diversion and source separation, it is recommended that a policy is established, in consultation with the City's Planning, Infrastructure and Economic Development Department.

The City has established a system of business licensing for various types of businesses, including food premises, amusement places, rooming houses and salvage yards. The Business Licensing By-law 2002-189 allows the City to regulate, with a few exceptions, any business wholly or partly carried on within the city, and includes certain trades, occupations, exhibitions, festivals, and the sale or hire of goods and services. Through a business licensing by-law, conditions can be imposed as a requirement of obtaining, continuing to hold, or renewing a license.

Similarly, the City has established a system of permits and licenses for various types of events, on public and private property. The Special Events on Public and Private Property By-law 2013-232 allows the City to regulate cultural, recreational and educational events, including public fairs. Through this by-law, Council may prohibit certain activities or impose conditions for obtaining, continuing to hold and renewing permits, including requiring the submission of plans. Currently, the by-law applies to special events such as fairs, festivals, beach events, or a social, recreational, educational, community or similar event having an expected attendance of at least 500 persons.

Multi-residential properties are required to provide recycling collection under the Provincial O. Reg 103/94 Industrial, Commercial and Institutional Source Separation Programs. The City of Ottawa requires all multi-residential properties receiving City garbage collection to also participate in the City's recycling program. Green Bin collection is implemented at the discretion of the property owner. As of March 2021, 46 per cent of multi-residential properties receiving City waste collection are registered in the Green Bin program.

Under the Municipal Act, 2001, the authority to pass by-laws for the environmental well-being of the municipality, including climate change, appears sufficiently broad to include by-laws that address the regulation, management and collection of waste or by-laws that prohibit or regulate certain types of waste, such as single-use plastics. In recent years, various municipalities across Canada have enacted by-laws to regulate, and in some instances to prohibit, the sale of single-use plastic items at the retail level. These include the Town of Leaf

Rapids, Manitoba, which was the first municipality in Canada to impose a ban on single-use plastic shopping bags in April 2007, City of Thompson, Manitoba, City of Montreal, Quebec and the City of Vancouver, British Columbia. The City of Toronto has recently conducted consultations in order to inform the implementation of a regulatory regime for single-use plastic and takeaway items and are is currently developing a Single-Use & Takeaway Item Reduction Strategy.

In terms of imposing fees and fines, under its broad by-law making powers, a municipality may impose fees or charges for services or activities provided by the City, costs payable by the City for the provision of these services or activities and the use of City property. Costs included in a fee or charge may include costs incurred by the municipality related to administration, enforcement and the establishment, acquisition and replacement of capital assets. There are, however, provisions in the Municipal Act, 2001 that limit the City's ability to impose fees and charges and it is unlikely that Council could successfully impose a fee on the use of single-use items to influence waste management and diversion, unless such a fee is in accordance with these specific provisions. However, this does not mean that businesses themselves cannot impose fees for the sale of single-use items, as has been done by many grocery retailers, as an example, for single-use plastic grocery bags.

The imposition of fines may also be an effective mechanism in terms of influencing habits and behavioural change pertaining to waste management. The Municipal Act, 2001 authorizes a municipality to establish a system of fines for offences under a by-law of the municipality. Since fines serve to deter, they are not subject to the same restrictions as fees. Therefore, Council may consider enacting by-laws to restrict the consumption or distribution of certain types of waste, along with fines to be imposed for the violation of such by-laws. In accordance with the Municipal Act, 2001, any fines collected will be remitted to the City's general revenue account.

FUTURE NEED

Having appropriate regulatory tools in place can facilitate the prevention of waste entering the system and improve sorting practices and participation rates in the City's waste diversion programs.

The following presents the gaps, constraints and opportunities associated with having appropriate regulations, policies and by-laws in place to support improved waste management practices:

Gaps:

- Lack of enforcement of current curbside garbage setout limits defined in the Solid Waste By-law.
- Lack of requirements in Site Plan Control By-law to regulate and incentivize diversion of C&D waste.
- Use of development and planning-related tools to encourage the incorporation of waste diversion design in new developments and redeveloped properties is currently limited (e.g., Planning applications, development standards, guidelines and by-laws). For example, there is no specific language in the Site Plan Control By-law related to the diversion of recycling and organic materials in multi-residential buildings or provision of space for waste diversion bins inside individual residential units.
- No mandatory requirement for City facilities to implement waste diversion programs, including recycling and green bin programs, regardless of size, function or amount of waste generated.
- Unknown timing for implementation of federal ban on single-use items.

Constraints:

- The Ontario Building Code does not currently include any requirements for waste diversion.
- Measurement on the effectiveness of policies can be challenging to obtain.
- The City has limited ability to control consumer and business purchasing decisions and therefore has limited ability to control the amount of waste generated by residents.
- The Province has announced its intention to ban the landfilling of organics, but not until 2030. The City will need to determine what policy mechanism, if any, it wants to implement in support of increasing the diversion, including organics, in the meantime or if the proposed ban is delayed or abandoned.
- The City derives revenue from the disposal of IC&I and C&D waste. Banning these materials would mean a loss of this revenue stream.

Opportunities:

- Update the Solid Waste By-law to reflect IPR changes to ensure designated materials that producers are responsible for are not accepted in the City's waste management system.
- Update Site Plan Control by-law with specific language to plan for the storage, collection and/or diversion of different waste streams.
- Implement planning and development guidelines, policies and by-laws to support the updated Solid Waste Master Plan and Official Plan (e.g. in-unit requirements, requirements to separate C&D materials, waste and recycling storage areas, etc.).

- Consider imposing conditions on some or all licensed businesses in order to influence waste management and diversion, for example, requirements for source separation, implementation of waste management and diversion plans or restricting the distribution of certain types of retail shopping bags or single-use items.
- Consider policy mechanisms that support increased curbside waste diversion.
- Undertake a review of regulating single-use plastic product(s) and takeaway items, including an evaluation of imposing a restriction or ban on the distribution of certain single-use products, consistent with the authority granted under the Municipal Act, 2001.
- Investigate banning materials such as single-use plastics and Expanded Polystyrene (EPS) at City Facilities and in City operations.
- Explore the possibility of making waste diversion mandatory in all City facilities.
- Implement disposal bans at the Trail Waste Facility landfill (e.g., organics, recyclables, IC&I, C&D waste) to encourage increased participation and diversion of materials, considering a phased-in implementation for compliance.
- Provide policy incentives to support growth of profit driven sorting centres that accept unwearable textiles, such as textiles from the IC&I sector and textile waste from charitable organizations.
- Consider imposing conditions on special events permits in order to influence waste management and diversion, for example, conditions for source separation or implementation of waste management and diversion plans, considering a phased-in implementation for compliance.
- Determine policy approaches that are in alignment with the Solid Waste Master Plan's vision, guiding principles and goals, that may support waste avoidance and reduction and increase diversion of waste at the collection source (e.g., pay-as-you-throw, use of clear bags for garbage and reduced garbage set out limits).
- Lobby provincial and federal governments to reduce the amount of packaging, as well as the types of packaging being used to make them more recyclable.
- Performance monitoring for waste diversion programs and reporting of this performance to inform those using the programs.
- Requirements for new materials that are introduced into the City's waste management system to be compatible with the processing infrastructure and processes that are used.
- Implement financial mechanisms to promote sustainable building design and provision of diversion containers.

Potential Timeline

Given the potential impact to decrease the amount of waste generated and increase waste diversion rates, **new regulatory tools** should be considered in the **short-term** to create the desired changes.

4.8.3 Financial Sustainability

Background

The City's waste management programs and services are funded through a combination of user fees, recoveries from other City departments, general tax levy and provincial funding. Solid Waste Services does not currently have a long-range financial plan, however, a detailed interim plan is currently being developed by City staff and will be updated to consider outputs of the Solid Waste Master Plan.

The 2021 Solid Waste Services approved operating budget is $94.9 million (gross) and the capital budget is $19.9 million. The net operating budget, funded by general property taxes, is $29.3 million, with revenues of $63 million, including stewardship funding ($5.8 million), recycling markets ($9 million), Solid Waste User Fees ($40.3 million), tipping fees ($7.9 million), and other ($0.8 million). It should be noted that with the transition to IPR, there will be impacts on the capital and operating costs, as well as revenues received.

Currently, all of the funding for the capital program comes from the Solid Waste Capital Reserve Fund. However, at the current rate of annual contributions, the fund is not anticipated to sufficiently cover all capital costs, given the significant capital needs between 2021 and 2029. Sources of revenue to increase the reserve fund will be explored by staff as part of the development of the long range financial plan noted above.

The current funding model for waste management was introduced in 2005 to more fairly distribute the costs for waste management services provided by the City and encourage waste diversion. Garbage and landfill/disposal services, long-term planning, debt costs as well as a contribution to various reserve funds are funded by a flat rate applied to each residential unit based on the collection service provided by the City. Waste diversion services are funded separately through the tax base and are charged to all property classes, regardless of whether or not these services are provided. This charge is based on the value of the property

In terms of the cost of City-provided waste management charges that property owners pay, the 2021 solid waste user fee for garbage and landfill/disposal services is $106 per property

(curbside) and $71.50 per multi-residential unit (containerized)34, while the property tax levy is approximately $45 per year for the average household35. This individual fee is visibly presented on the tax bill and is levied on all residential properties across the city. Businesses participating in the City's Yellow Bag program are able to purchase Yellow Bags in packages of four for $16.40 (January 1, 2021 rate).

FUTURE NEED

Ensure long-term financial sustainability of the solid waste management system for effective operations and management of solid waste assets.

The following presents the gaps, constraints and opportunities in addressing the long-term financial sustainability for the solid waste management system:

Gaps:

- The absence of a long-range financial plan for Solid Waste Services.
- Funding sources for future capital program needs, including increasing the Solid Waste Reserve Fund.

Constraints:

- Uncertainty around the timing and cost implications for transition of the Blue Box Program and Municipal Hazardous Solid Waste programs to IPR.
- Competing priorities for limited tax dollars (e.g., other City strategies, impacts of COVID-19).
- Demonstrating value for money of services provided by Solid Waste Services.
- Increasing and on-going capital budget pressures for the operation and post-closure of the Trail Waste Facility landfill.
- Commitments made through the City's Climate Change Master Plan and Energy Evolution Strategy in order to meet the City's GHG reduction targets may require more costly waste management technologies to be implemented compared to those that would otherwise be implemented.

Opportunities:

- Expanding current user rates to cover more costs, including the potential for a full rate-based service, similar to water and wastewater.

[34] Each residential unit pays a flat rate depending on the collection service provided by the City. This fee appears on the tax bill each year
[35] Based on the 2021 average urban resident with an average property assessment of $415,0000

- Reallocation of any surplus funds currently spent on Provincial producer responsibility programs (e.g., Blue Bin) to future waste management system needs identified in the Solid Waste Master Plan or to assist in funding the upcoming capital needs.
- On-going monitoring of grants available for capital projects.
- Public/Private Partnerships for construction of future capital projects.
- Exploring opportunities to partner with other municipalities to offset operating and capital costs of new facilities (e.g., anaerobic digestion).
- Undertaking a review of Solid Waste Services service delivery levels and performance to ensure approaches are optimized and continue to deliver value at a reasonable cost.
- Expanding performance measures, to include acquiring the appropriate data on financial, service levels and efficiencies, in addition to traditional waste management metrics such as waste reduction and diversion.
- Develop a long-range financial plan in support of the Solid Waste Master Plan recommendations and short-term implementation plan, including the potential of using debt financing for larger capital projects.
- Identification of other revenue generating and/or cost saving opportunities which are being explores as part of the Solid Waste Master Plan.

Potential Timeline

The Solid Waste Master Plan will identify costs associated with the recommendations to address the future waste management system needs of the City, which will provide the basis for the Solid Waste Services long-term (10-year) financial plan. Actions will be required in the **short-term** to ensure sustainable funding and implementation of the SWMP.

4.9 Other

4.9.1 City's Commitment to Reduce GHG Emissions Related to Waste Management

Background

The City is committed to reducing its carbon footprint. It declared a Climate Emergency in April 2019 and approved its first Climate Change Master Plan in December the same year. The City tracks greenhouse gas (GHG) emissions through annual inventories. Waste (both solid waste and wastewater treatment) is one of the four sectors reported on. In 2019, the waste sector emitted seven per cent of Ottawa's total GHG emissions, (buildings were at 45 per cent, transportation at 44 per cent, agriculture accounted for three per cent and wastewater accounted for one percent).

The Climate Change Master Plan is the City's overarching framework to reduce GHG emissions and respond to the current and future effects of climate change. The Plan has targets to reduce GHG emissions by 100 per cent below 2012 levels – by 2040 as a Corporation and by 2050 as a community. It includes the Energy Evolution Strategy, Ottawa's Community Energy Transition Strategy, which aims to take unprecedented collective action to transition Ottawa into a clean, renewable and resilient city by 2050, with an action plan for how Ottawa as a city will meet its Corporate and community GHG reduction targets. The Strategy includes:

- What efforts will be required to reduce emissions in Ottawa by 100 per cent by 2050;
- The benefits of reducing GHG emissions and transitioning to a low carbon future;
- 20 community and municipal projects to accelerate action towards achieving the targets and identification of the required investment over the short-term, to 2025); and
- The potential risks to implementation and how these risks will be mitigated.

On October 28, 2020, Council unanimously approved the Energy Evolution Strategy. Work has begun on developing and implementing the 20 projects identified, in collaboration with the community.

Specific to waste management, the Energy Evolution Strategy assumes that achieving GHG reductions within the waste sector hinges on two aspects:

1) eliminating organics from landfill; and
2) converting all available waste organic material into usable energy using anerobic digestors or gasifiers to generate renewable natural gas (RNG).

As noted previously, while the Province has proposed banning organic waste from landfills by 2030, no formal strategy or plan for how this will roll-out has been released.

The diversion of organics from landfill and using this material to make RNG is one of the most impactful actions identified in the Strategy to achieve the 100 per cent GHG reduction target. Modelling done through the Strategy indicates that the minimum requirements to meet the 100 per cent GHG reduction scenario are:

- All leaf and yard waste is gasified to displace natural gas after 2030;
- Anaerobic digester gas and landfill gas are predominantly used as renewable natural gas and displace natural gas use;
- 98 per cent of organics diverted are from landfill by 2024; and
- 100 per cent of paper waste is diverted from landfill by 2042.

Three of the 20 projects identified in the Energy Evolution Strategy to move the City towards achieving the 100 per cent GHG reduction target have a tie-in to waste management:

1. Municipal Green Fleet Plan Update;
2. Organics Resource Recovery Strategy; and
3. Renewable Natural Gas Strategy.

Municipal Green Fleet Plan Update

The City's Green Fleet Plan looks broadly at opportunities to reduce the GHG impact of the City's fleet, which includes the City's in-house curbside collection and the Trail Waste Facility landfill fleet.

The City's Fleet Services keeps abreast of developments in the waste industry, has trialed alternate fuels, implemented devices and technologies that reduce greenhouse gas emissions, and purchased low- and no-emission vehicles and equipment where they are available and meet operational needs. In addition to the continued conversion of the light fleet to hybrid and electric vehicles across the Corporation, Fleet Services trials vehicles and technologies that reduce greenhouse gases and implements they provided they are effective in our climate and for our operations, and available at a reasonable cost per tonne of CO2e emissions avoided. Specific to Solid Waste Services, Fleet Services continues to:

- undertake industry research on technologies available to reduce GHG emissions, particularly those that are being tested in climates similar to that of Ottawa, for example, Calgary's recently announced electric waste collection vehicle pilot;
- trial technologies that may improve fuel efficiency of waste collection vehicles to determine if they meet operational needs; and
- explore ways to increase the low-carbon fuel content in diesel fuel.

The updated Municipal Green Fleet Plan will support the target for the City's municipal fleet to be 60 per cent zero emission by 2030 and 100 per cent by 2040. This includes all City-owned curbside collection vehicles and operational fleet. The updated Plan will be brought forward in 2021. It is important to note that the City has an in-house collection fleet that services two out of the five curbside collection zones. The other three zones are contracted out to the private sector. The Municipal Green Fleet Plan only applies to City-owned vehicles.

In addition to the work being undertaken through the Green Fleet Plan, the Solid Waste Services branch may also wish to explore future system-wide opportunities for reducing the GHG impact from City waste collection operations, such as waste transfer stations in the context of facilitating a zero-emission waste collection fleet. This work could be tied to future studies being contemplated for solid waste collections.

Organics Resource Recovery Strategy

As noted in the Energy Evolution Strategy, source separated organics can provide a significant opportunity for carbon reductions, as it can be converted into compost and/or renewable natural gas (RNG).

Based on recent waste audit data[36], approximately 44 per cent of curbside Green Bin organics, 23 per cent of multi-unit residential Green Bin organics[37] and 97 per cent of leaf and yard waste is currently being diverted from the Trail Waste Facility landfill through the City's residential green bin organics program. This material is composted at either the Convertus indoor composting facility or, for separately collected LYW, at the Barnsdale outdoor LYW composting facility. No energy is currently generated through the processing of this material. What is not diverted is disposed as garbage at the Trail Waste Facility landfill.

It is estimated that approximately 24 per cent of the IC&I waste stream in Ottawa is food waste and there is approximately 133,000 tonnes of organic material (crop residue and manure) generated in the agricultural sector in Ottawa[38] . It is not known how much food waste from the IC&I sector is currently diverted and it is generally understood that organic materials generated by farms are typically managed on-site.

Combined, there is significant potential to capture organic materials from both the residential and IC&I sectors that are currently being disposed is landfill and utilize this material, as well as the organic material that is currently being diverted through organics programs, to generate a renewable source of energy in Ottawa.

The Energy Evolution Strategy's 100 per cent GHG reduction scenario set targets based on what is required to hit a 100 per cent GHG reduction by 2050. In relation to the management of solid waste, the relevant targets are:

- 98 per cent of organic materials diverted from all landfills within the city's boundaries by 2024;
- 100 per cent of organic materials generated within the city's boundaries are diverted from landfills by 2040; and
- All organic waste generated within the city's boundaries is routed to anaerobic digestors or gasification by 2030.

[36] City of Ottawa, 2019 4-Season Single Family Residential Curbside Waste Composition Study, 4-season Garbage Stream and City of Ottawa, 2019 Solid Non-hazardous Multi-Residential Waste Audit
[37] Where a Green Bin program is in place
[38] Industrial, Commercial and Institutional, Construction and Demolition and Agricultural Waste Projections for Ottawa - Final Report, November 2020, Kelleher Environmental and Miller Environmental

One of the 20 projects put forward in the Energy Evolution Strategy is the development of an Organics Resource Recovery (ORR) Strategy, with the purpose of investigating the potential diversion of all residential and IC&I organic waste generated in Ottawa from landfills within the city boundary for conversion into RNG. While the ORR Strategy contemplates the conversion of organics to RNG, the generation of RNG is captured under the Renewable Natural Gas Strategy project, details of which are provided below. The ORR Strategy will include both residential and IC&I sources of organic waste.

As part of the ORR Strategy, opportunities to be considered through the Solid Waste Master Plan and its component projects, as they relate to residential sources of organic waste, include:

- Explore the possibility of banning organics from disposal at the Trail Waste Facility landfill.
- Explore opportunities to improve the diversion of organic waste from curbside homes, such as different policy alternatives such as reduced bag limits with enforcement.
- Explore opportunities to improve the diversion of organic waste from multi-residential properties through the development and implementation of the Multi-Residential Waste Diversion Strategy.
- Explore at a high-level, alternative technology options that would be required to remove organics from the garbage stream, such as mixed waste processing for residential waste, as well as alternative organics processing technology options that would support RNG generation, including anerobic digestion and gasification.
- Explore different opportunities, such as user fees and incentives/disincentives (e.g. pay-as-you-throw, clear bags) to help further encourage organics diversion of residential waste.
- Investigate the limited options available to the City as authorized through its powers under the Municipal Act, 2001 to influence how waste is managed in the IC&I sector, for example, by-laws, fees and fines, business licensing, and the development review process.

The Energy Evolution Strategy recognized that the magnitude of eliminating all organics from landfill is large and complex and will require significant public behavioral change and investment from the City and private industry. Without a strong shift in public behaviour, it is unlikely that the magnitude of change required to achieve the short-term objectives related to this action and the City's 100 per cent GHG reduction targets will be possible. The ability to achieve them in the longer term has a higher degree of possibility when considering different technologies, including those that have the potential to remove additional organics from garbage and that behavioural change to get more people participating in the City's Green Bin

will take program take time. These technologies, however, do come at high capital and operating costs and take considerable time to put in place given planning, consultation, approvals, design, construction, and commissioning and provincial regulatory approval processes that are out of the City's control.

However, there are opportunities for the City to explore the different mechanisms within the City's influence and control that will help support increased levels of organics diversion, as well as opportunities to generate renewable natural gas from organics.

It is important to note that in the context of the ORR Strategy, the City would only be responsible for achieving the organics diversion targets as they relate to the residential source separated organics and the limited amount of non-residential organics that is currently collected from City facilities, and through the Yellow Bag and Green Bin in Schools programs. In terms of the development of the ORR Strategy, the Solid Waste Services Branch will be the lead on the residential portion of the Strategy, while the Planning, Infrastructure and Economic Development (PIED) department is the lead on the IC&I portion of the Strategy.

Renewable Natural Gas Strategy

The Renewable Natural Gas (RNG) Strategy seeks to influence, coordinate and align key Corporate and community projects to support the development and optimization of RNG in Ottawa. The scope includes using biogas and power to gas to generate RNG, displacing fossil-sourced natural gas in the gas grid.

Biogas is gas derived from processing organic material such as municipal wastewater, solid waste, and agricultural waste. Most biogas generated in Ottawa is currently used to create electricity and sometimes heat. Corporately, biogas is already captured and collected at ROPEC, the City's wastewater treatment facility and Trail Waste Facility, with the Trail Waste Facility's landfill gas to electricity plant having been operating since 2007.

As noted in the Energy Evolution Strategy, development of the RNG Strategy will progress in two stages. The first stage will consist of several separate Corporate projects that have started (e.g., ROPEC Biogas Optimization Study, Solid Waste Master Plan), or will soon be underway (e.g., ROPEC Site Master Plan). The second stage will build on the information and recommendations generated in the first stage to develop a community wide RNG Strategy, including key Corporate opportunities.

The City's Planning, Infrastructure and Economic Development (PIED) department is the lead on developing the RNG Strategy, however through the Solid Waste Master Plan, initial opportunities to create renewable energy from source separated organics collected through the City's Green Bin program will be explored, along with investigating future RNG

opportunities associated with landfill gas produced by the Trail Waste Facility landfill. It is important to highlight, however, that as the City chooses to focus its efforts on diverting organics from landfill, there is a risk that the potential viability of producing RNG from landfill gas may diminish.

These three Energy Evolution Strategy projects related to waste management were considered during the development of the future waste management needs and their associated opportunities.

4.10 Summary

The following table presents a summary of the 17 areas of focus within the seven categories and the proposed implementation timeline.

Table 15: Summary Table of Future Needs and Associated Timelines

Category	Sub-Category	Future Need	Timeline
Waste Avoidance, Reduction and Reuse	Waste Avoidance, Reduction and Reuse	Identify more ways to reduce and reuse waste generated by residents and in its own operations to decrease the amount of waste entering the City's solid waste management system.	Short, medium and long terms.
Waste Avoidance, Reduction and Reuse	Value of Food and Food Waste	Focus on the value of food to increase the prevention of food waste, which is higher in the waste hierarchy.	Short, medium and long terms
Waste Diversion Programs	Green Bin and Leaf and Yard Waste Program	Confirm the City has sufficient organics processing capacity prior to 2030 and secure capacity beyond 2030. Tied to the future Green Bin processing capacity needs, the City needs to consider potential options to manage future quantities of LYW, both in the short and medium term.	Short and medium terms
Waste Diversion Programs	Parks and Public Spaces	Decide if a comprehensive and consistent public spaces waste diversion program, including recycling and organics diversion, should be implemented.	Short and medium terms

Category	Sub-Category	Future Need	Timeline
Waste Diversion Programs	Curbside Waste Diversion Program Performance	Identify an approach to support increased curbside waste diversion performance by increasing participation in waste diversion programs.	Short-term
Waste Diversion Programs	Multi-Residential Waste Diversion Program Performance	Recognizing the inherent challenges that exist in increasing participation and the waste diversion rate in the multi-residential sector, actively work with stakeholders in this sector to improve multi-residential waste diversion performance.	Short, medium and long terms
Waste Diversion Programs	New Waste Collection and Diversion Programs	Identify specific waste streams that can be diverted from landfill disposal and develop new collection and diversion programs to capture these streams.	Short, Medium, and long terms
Waste Diversion Programs	Special Events	Waste management practices at special events should support and facilitate waste minimization and waste diversion.	Short-term
Collection and Drop-off of Materials	Collection (current systems, services and programs)	Building on the current systems, services and programs, identify more ways to efficiently collect materials, that are more convenient and accessible to residents and customers.	Short-term
Collection and Drop-off of Materials	Collection (fleet)	Progressively work towards a zero-emissions solid waste fleet.	Short, medium and long terms
Collection and Drop-off of Materials	Drop-off	Provide enhanced convenience and additional drop-off opportunities for residents to reduce, reuse and recycle.	Short to medium terms
Recovery of Waste and Energy	Technologies for Waste Recovery	Determine what, if any, waste recovery technologies or approaches will be employed to extend the life of the Trail Waste Facility landfill.	Short, medium and long terms
Recovery of Waste and Energy	Trail Waste Facility Landfill Gas Utilization	Identify an approach to utilizing landfill gas and producing energy once the current contract with PowerTrail expires in 2027.	Short-term

Category	Sub-Category	Future Need	Timeline
Recovery of Waste and Energy	Technologies for Energy Recovery	Determine what energy recovery technology/ies or approaches will be employed to recover as much waste as possible from the waste stream and create renewable energy from this waste.	Short-term
Residual Management	Trail Waste Facility	Being a key City asset, determine ways to extend the life of the Trail Waste Facility landfill to maximise the life of the asset and plan for new disposal capacity, when required.	Short-term
Residual Management	Future Use of Existing City Owned Waste Management Sites	Determine the future use of bufferland properties, including for operational, community use and or pilot/demonstration opportunities.	Short-term
Managing Waste Generated by City Facilities and Operations	No Sub-Category	Develop a strategy that identifies ways in which City facilities and operations can avoid, reduce and divert more waste from disposal.	Short-term
Supporting System Requirements	Promotion and Education	Expand and/or modify technologies and approaches used to reach the City's diverse customer base, to create the desired behavioural changes and to support program priorities.	Short-term
Supporting System Requirements	Regulations, Policies and By-Laws	Having appropriate regulatory tools in place can facilitate the prevention of waste entering the system and improve sorting practices and participation rates in the City's waste diversion programs.	Short-term
Supporting System Requirements	Financial Sustainability	Ensure long-term financial sustainability of the solid waste management system for effective operations and management of solid waste assets.	Short-term

5 Key Risks and Considerations That May Impact Long-term Waste Management in the City of Ottawa

There are many unknowns regarding the future of waste management, for municipalities in general, and for Ottawa specifically. Many of these risks have been articulated in **Section 4.0** as part of the Needs Analysis. The following are key risks and considerations that have the potential to impact long term waste management in the City of Ottawa and that need to be considered during the development of the Solid Waste Master Plan. These will also require consideration in future Solid Waste Master Plan updates in order for the City to remain flexible and adaptable as these risks and considerations evolve.

5.1 Remaining Capacity of Trail Waste Facility Landfill

The City's landfill has an estimated 30 percent remaining capacity (5.1 million cubic meters) remaining, as of the end of 2019. The landfill is a valuable asset and the City needs to decide how it wishes to utilize it most efficiently. If the City wants to preserve capacity over the remaining years in order to extend its life, more aggressive actions will be required to limit the amount of divertible material being placed in the garbage stream, such as implementing policies and mechanisms to support increased participation in waste diversion programs, and banning or limiting materials accepted at the landfill, etc. Increased efforts to reduce the amount of waste sent to the landfill should also be implemented. If the City decides to maintain the status quo, the City will need to investigate alternative residual waste management capacity in the short-term in order to secure disposal capacity beyond this date.

5.2 Individual Producer Responsibility (IPR)

In Ontario, waste diversion responsibilities for five distinct material categories, which have been traditionally managed by municipalities, have been or are being transitioned to an Individual Producer Responsibility (IPR) framework. Under the new framework, producers are 100 per cent responsible for the collection and processing of designated materials, including all associated costs, and program promotion and resident education. To date, used tires, batteries and electrical and electronic equipment waste have transitioned to IPR, with the Blue Box and Municipal Hazardous and Special Waste programs set to transition in the next few years. While the City will no longer be responsible for managing these programs, the success of the new programs, including diversion rates, resident participation and impacts on the remaining City managed waste streams are still unknown.

5.3 Blue Box Program Transition

The transition of the Blue Box Program to IPR arguably marks one of the most significant changes to the Provincial Blue Box program since its inception in the 1980s. No longer will the City be in control of or responsible for the management of this waste stream. At this time, in the absence of final regulations being issued by the Province, there is uncertainty about the City's future role in the delivery of the Blue Box Recycling Program. Based on the draft regulations, all recycling services currently managed by the City, with the exception of City facilities (except long-term care facilities), the City's Yellow Bag program for small businesses and some on-street recycling outside of business improvement areas (BIAs), will transition to IPR. In addition to the change in responsibility for the Program, under IPR, new Provincial Blue Box program will also see an expansion of materials collected in the Blue Bin to include problematic materials such as single-use items, candy wrappers, chips bags, which currently make their way into the City's garbage stream.

It remains to be seen what the overall financial implications of transition of the Program will be on the cost of collecting, processing and disposal of the remaining material streams that the City will retain responsibility for and what residents will pay for their solid waste services in the future. While the changes may ultimately result in savings to the City and taxpayers, the true savings potential is currently unknown until further information is provided through the final regulations and analysis is undertaken by staff and Council decisions regarding the City's involvement and future role in these programs.

5.4 Municipal Hazardous and Special Waste Program transition

In the absence of final regulations, there is uncertainty about the City's future role in managing Municipal Hazardous and Special Waste (MHSW). Based on the draft regulations issued by the Province, only a select portion of MHSW will become the full responsibility of producers to manage and cover the full cost of properly recycling or disposing of these materials. A large portion of materials the City currently manages through its MHSW program that are not covered by existing regulations will continue to be the responsibility of the City to collect, recycle, safely dispose of. This responsibility means that the City will need to cover the full cost associated with managing these select materials.

While the Province has signaled their intent to further expand the number of regulated MHSW materials that transition to IPR in the future, no details are included in the draft regulations and there is no indication as to when or how the regulation might be expanded in the future. This ultimately leaves municipalities with a status quo scenario and any future expansion and associated costs will fall to municipalities.

There is a risk that in having two different bodies responsible for the management of MHSW i.e. producers and municipalities, that the City will require its own system to collect the items not covered under IPR alongside the system set up by producers, which could prove inconvenient and confusing to residents. Producers will be responsible to operate a collection network of their own and may wish to coordinate collection at municipal depots, as the regulation allows them a variety of options to satisfy consumer accessibility requirements. The draft regulation gives producers 18 months after the October 1, 2021 transition date to set-up the collection network, so it is likely that details on the future MHSW collection system in Ottawa will not be known until after the completion of the Solid Waste Master Plan.

While work continues to prepare Council to make key decisions related to both the Blue Box and MHSW programs through the City's Individual Producer Responsibility Component project, an unknown at this time is how the program changes will impact the waste stream managed by the City in the future. With the expected expansion of the types of materials accepted in the Provincial Blue Box program beginning in 2026, it is expected that these changes will result in fewer items making their way to the Trail Waste Facility landfill, however, performance of the new Blue Box program, along with resident adaptability to program changes are unknown. The same applies to the impact of the new Provincial MHSW program.

There is a risk that materials that have transitioned to IPR that the City is no longer in control of managing making their way into the City-managed waste stream. Key considerations for the City will be to determine how to manage these recyclable materials regulated under IPR, including how best to work with producers to prevent/reduce waste stream contamination. Furthermore, depending on how compostable packaging will be considered in the final Blue Box regulations, there is a risk that producers may switch their packaging from recyclable to compostable materials, which may result in further pressure being placed on the City to manage compostable packaging through the Green Bin program.

The City may want to consider mechanisms, such as material bans at the curb, landfill bans, enhanced enforcement or policy mechanisms such as a clear bag garbage program and enhanced/coordinated promotion and education to residents to prevent these recyclable materials from making their way into the waste stream.

The transition to IPR is expected to impact some options being considered by the City as part of their future waste management system. The timing of the final regulations for both the Blue Box and MHSW programs, and when producers will be organized and have an operational collection system in place in Ottawa is still unknown and as such, the master planning process will have to remain flexible to accommodate the need to potentially revisit the City's strategy on

Blue Box and MHSW as more details become available through final regulations and as producers organize and finalize their future collection systems.

5.5 Food and Organic Waste Framework

The Province's Food and Organic Framework is comprised of two components:

- The Action Plan - which outlines Provincial commitments on food and organic waste; and,
- The Policy Statement - which under the Resource Recovery and Circular Economy Act, 2016, provides direction to municipalities, the IC&I sector, owners and operators of resource recovery systems and others to take action to reduce and recover food and organic waste.

The City needs to consider the impact of the Framework on its own operations, policies and programs. The Food and Organic Waste Action Plan outlines strategic commitments to be taken by the Province, including preventing food waste through education and innovative approaches, increasing resource recovery across the IC&I sector, supporting the recovery of food and organic waste in the multi-residential sector and promoting the reintegration of end-products into the economy, through efforts such as regulatory approaches related to soil amendments and supporting the development of RNG. The Action Plan also states that the Province will develop, consult on and implement a food and organic waste disposal ban regulation under the Environmental Protection Act, which could prohibit the disposal of food waste and organic waste at landfills. A recent announcement from the Province states that their priority is to move to phase out food and organic waste sent to landfill by 2030.

The Food and Organic Waste Policy Statement establishes targets for food and organic waste reduction and resource recovery by sector, including municipalities and multi-residential buildings. On September 30, 2020 proposed changes to the Statement were released that expanded the categories of food and organic waste that municipalities should make efforts to reduce and recover, to include compostable coffee pods, soiled paper food packaging and certified compostable bags. Amendments also state that municipalities should support the use of pilot projects and research on the processing of compostable products and packaging, and encourages municipalities to consider adopting technology to collect and process compostable products and packaging in their systems when they are planning for new processing technology.

Under the Resource Recovery and Circular Economy Act, the Policy Statement requires municipalities to ramp up diversion of organics to meet the 70 per cent target for curbside households by 2023 and 50 per cent target for multi-residential properties by 2025. Additional

quantities of source separated organic material may need processing as more curbside residents participate in the program and multi-residential buildings increase organics diversion, particularly given that the City services nearly all of these buildings in Ottawa. While this has the potential to drive increased waste diversion rates and help extend the life of the Trail Waste Facility landfill, it will have increased cost implications associated with processing more organic waste.

As more sectors introduce source separated organics programs to meet these Provincial targets, and/or if organics are banned from landfill disposal by 2030, there will be increased competition for organics processing capacity locally and across Ontario. Should the City develop its own organics processing facility, there is potential to create a revenue stream from providing processing capacity to other municipalities or to the IC&I sector, and potentially creation of renewable natural gas (RNG) if the City chooses to convert biogas from anaerobic digestion, as envisioned in the Energy Evolution Strategy.

Should the City develop its own organics processing facility, it would also assume the risk of designing, building, operating and maintaining the facility. The City would also take on responsibility for finding suitable markets for end-products such as finished compost or digestate and energy. When the processing of organic material is contracted out, as is the current case, the City does not incur these risks or costs.

5.6 Changes in Lifestyles/Consumer Trends

The COVID-19 pandemic has caused a shift in tonnes of waste typically managed by the IC&I sector to the residential sector, with more people working and learning from home. To-date, the City has experienced an increase of approximately 10 per cent in residential tonnage collected by the City[39].

The pandemic has also caused an upswing in online shopping and delivery of groceries/meals to homes, which has shifted the composition of waste managed by the City. It is unknown whether the trend of working from home and an increased reliance on online shopping and delivery will continue and if so, for how long, and whether the City will be permanently dealing with additional quantities and types of waste in the future, making this an area the City will have to continually monitor and adapt to.

[39] Based on the net difference between tonnage collected over the same timeframe in 2019-2020 compared to 2020-2021.

5.7 Packaging

Trends in packaging will continue to evolve in the future. It is anticipated that the use of bioplastics and compostable packaging will continue to increase as producers try to make their packaging more sustainable. It is unclear at this time how these materials will be considered as part of the Blue Box Program transition or future requirements for organics processing.

Compostable packaging is not currently accepted in the City's Green Bin program. These materials behave very differently in organics processing facilities, depending on the processing technology, for example, in a wet anaerobic facility, compostable materials are screened out and sent for disposal. As per the Province's amendments to the Food and Organic Waste Policy Statement, they are encouraging municipalities to find solutions to manage the anticipated increase in compostable packaging.

It is also anticipated that there will be a continued shift to plastic packaging and light-weighting of materials. The shift to different packaging, while not always able to be recycled with current processes and technologies, has contributed to reductions in food waste, reductions in GHGs from transportation, reductions in the need for virgin materials required to manufacture packaging and an increased shelf life of perishable products. It remains to be seen if the contributions to sustainability outweigh the lack of recyclability.

It is unknown what the impact of the proposed Federal ban on single-use plastic items will have on the City's future waste stream composition and whether these items will be replaced with materials that may not be recyclable/compostable or compatible with the City's waste management programs.

5.8 Urban Sprawl and Densification

The City's population is anticipated to increase 40 per cent by 2046. Potential implications of this growth may include:

- More waste being produced, including more garbage requiring disposal at the Trail Waste Facility landfill.
- Continued demand for single-family housing through intensification of existing neighbourhoods and undeveloped lands and more multi-residential housing. This may result in:
    - more waste collection vehicles required to service more residences which can contribute to increased GHGs and longer travel times from collection routes to waste facilities in the absence of fleet technologies that support GHG emission reductions.

    - limits on the land available to site future waste management facilities.
- The need to adapt waste collection approaches and infrastructure to the City's changing needs, policies and initiatives. For example, 613 Flats, which aims to increase the density on re-developed residential lots.
- Narrower streets in some developments, requiring alternative waste collection methods and/or smaller collection vehicles to service these denser neighbourhoods.
- Changes to the Building Code for multi-residential buildings to improve waste diversion.

5.9 Transfer Capacity

The City may require a transfer station/s in the future to realize collection efficiencies, depending on decisions regarding the location of future processing facilities for recycling (pending outcome of IPR), source separated organics and LYW, and whether the City will be collecting recyclables and the volume and type of waste requiring management in the future. The City could site, build and operate a new transfer station/s or contract out this capacity, as there private waste management companies in Ottawa that own and operate these types of facilities.

The implementation of a City-owned transfer station/s or use of a private sector transfer station/s would allow the City to consolidate and direct waste in transport trailers to alternative landfill sites, reducing travel times for those vehicles collecting waste. The use of transfer station/s in the City's waste collection network may also allow operational efficiencies to be realized.

5.10 Other City Plans and Strategies

The City has, or is in the process, of developing other plans and strategies that need to be considered during development of the Solid Waste Master Plan and any future solid waste planning activities.

- Draft Official Plan – In May 2020, a moderate growth strategy was approved that will require 51 per cent of new dwellings to be built in already developed areas (increasing to 60 per cent by 2046) and will add between 1,350 to 1,650 hectares of residential and employment land to Ottawa's urban area.
- Climate Change Master Plan – This plan provides direction for addressing the impacts of climate change on the community and City operations. It includes initiatives to reduce greenhouse gas emissions and build climate resilience in Ottawa.

- Energy Evolution Strategy – This Strategy, part of the Climate Change Master Plan, lays out pathways for getting to 100 per cent reduction of greenhouse gas emissions in Ottawa.
- Greenspace Master Plan, Draft Official Plan and Urban Forest Management Plan – These plans provide direction on maintaining and increasing green space in the City, as well as tree canopy protection policies, which can have an impact on quantities of LYW that the City will need to manage in the future.

5.11 Provision of Waste Collection Services

The City contracts with private sector waste management companies to collect from three of the five curbside collection zones and for collection of all containerized waste from multi-buildings and City facilities that are serviced under this contract. Waste collection costs may increase in the future, for several reasons, including if the City decides to increase levels of service or contract fully with the private sector for waste collection. These higher costs may be a reflection of a limited number of waste collection companies bidding on these contracts or overall increases in costs of providing this services, for example, maintenance, fuel and labour, or the additional of a new service or an enhanced level of service.

In addition, many waste collection providers, including the City's in-house collection group, are experiencing on-going issues with attracting and retaining staff, which can impact service delivery. Should the City continue to provide waste collection services in the future using this approach, it would similarly be competing for staff.

5.12 Acceptance of New/Emerging Technologies (risk, cost, reliability)

There is a tension between the desire to be innovative and to be a world leader in waste management with the desire to use tried and true methods for the management of waste. New and emerging technologies are typically more expensive and generally riskier than more accepted technologies such as landfill and incineration/waste to energy. Historically, thermal treatment technologies have been met with resistance in North America for a variety of reasons (e.g., perceived health and environmental impacts, cost, being at odds with zero waste goals, etc.). These types of treatment technologies have been used for many years in Europe and Asia, for several different reasons, including legislation regulating landfill disposal, limited space available for landfills and increasing urbanization. Similarly, innovative collection fleet technologies that are successful in certain jurisdictions may not be feasible in the Ottawa context, for reasons including but not limited to Ottawa's winter climate.

5.13 Climate Change

On April 24, 2019, the City declared a Climate Emergency. This declaration provided direction for the expanded work on the Climate Change Master Plan and the Energy Evolution Strategy. From a waste perspective, to achieve these aggressive greenhouse gas reduction targets, the Strategy proposes the capture of virtually all organic material for production of biogas and conversion to renewable natural gas through anaerobic digestion, in a landfill or organics processing facility, or gasification. The use of gasification of organic waste for manufacturing of renewable natural gas is not currently being a proven technology for this type of waste stream. It also proposes the use of agricultural residue and manure, IC&I food waste streams, and residential organic waste for anaerobic digestion and future development of gasification facilities where biosolid output from anerobic digestion is used as a source for gasification and RNG production. The drivers and options proposed for achieving the GHG reductions under the Energy Evolution Strategy may be drastically different to what is considered feasible/possible through the development of the Solid waste Master Plan.

Climate change will also impact the probability of severe weather events such as floods and tornadoes, which can impact waste collection, transportation, processing and disposal of materials generated and impacted by these weather events. It may also impact waste collection staff, with summers predicted to get hotter, and waste generation rates and patterns, for example, a longer growing season may result in more LYW being generated.

5.14 Funding Sources

The City provides a number of other programs and services in addition to waste management services and there are ongoing pressures to minimize tax increases and user fees. Competing municipal priorities for operating and capital budgets will influence the recommendations that are brought forward as part of the final Solid Waste Master Plan.

5.15 Data Collection and Management

The City has many databases and tools used by various service areas and departments to monitor the operation of different aspects of the integrated waste management system. With respect to the overall management of waste related data collected across the Corporation, there is no one individual or group responsible for this function. As such, data collection is fragmented and inconsistent. The City requires a streamlined process to collect, maintain and interpret data to feed into various decision-making processes as part of the implementation of the options recommended for the Solid Waste Master Plan.

The City should continue to undertake participation and waste audit studies of different sectors (single family, multi-residential, City facilities, participants in the Yellow Bag program) on an annual basis, and consider collecting data on specific sectors (e.g., weights of trucks collecting specific materials from specific sectors). It should also consider including more sorting categories for waste audits undertaken in the future (e.g. avoidable and non-avoidable food waste, diapers, C&D, etc.) and ensure the sorting categories are consistent for all sectors. In addition, the City should consider more robust data collection and monitoring systems, which could include truck weigh scales to provide more detailed data sets specific to each sector, Radio-frequency Identification (RFID) chips in containers, etc.

5.16 Performance Measures

The City has historically relied on waste diversion as the primary metric to monitor performance and future direction of waste management systems. Municipalities have been expanding performance measures beyond waste diversion rates to include service level and efficiency measures. This allows municipalities to evaluate program data and costs to assess how well service models are working and make improvements to ensure services continue to be provided cost effectively and meet defined service expectations. The City should consider performance measures that are both qualitative (e.g., customer satisfaction) and quantitative (e.g., waste generation and disposal rates, remaining capacity of the Trail Waste Facility landfill). The City will need to develop and implement new metrics to measure waste management system performance to ensure services are meeting the established goals and of the SWMP.

6 Next Steps

The next steps in the development of the SWMP will be to develop a long-list of options that are aligned with the SWMP's draft vision, draft goals and guiding principles identified through community and stakeholder consultation. These options will then be evaluated using an approach and tool specifically developed for the SWMP project. This includes doing a triple bottom line evaluation on options.

The options developed have been identified through a number of sources; by the consultant based on the extensive research conducted in Phase 1 and professional judgement and expertise, City staff based on their knowledge of the City and its needs, City Councillors based on their knowledge and feedback from constituents, and through consultations with various stakeholders and the public during Engagement Series 1. For each option, a description will be developed noting the alignment with the SWMP Guiding Principles and Goals, as well as future

needs. Whether or not the option will be impacted by future IPR regulations will be identified, as well as high level capital and operating costs. Determine if the option proceeds to the evaluation stage, or whether it will be held until more information is available and revisited at a future time during the Master Plan's development.

Following the evaluation process, options that best meet the City's needs will be identified and these short-listed options will undergo further consultation with the public and stakeholders.

Appendix A

Memo

MEMO

Date: Tuesday, June 09, 2020

Project: City of Ottawa Solid Waste Master Plan

To: City of Ottawa

From: HDR

Subject: Tonnage Allocations for Projections

PURPOSE OF THIS MEMORANDUM

The purpose of this Memorandum is to review the City of Ottawa's Solid Waste Management's annual tonnages of waste collected and determine an appropriate allocation to each category of waste generator within the City so that it can be used for the City's tonnage projections.

The City provided the tonnes of material collected in 2019, categorized as Curbside Residential and Multi-residential/Containerized according to if material is collected curbside (i.e. in bags, containers, or bins/bins at the curb) or containerized (i.e. front-end load or carts). The following is a breakdown of the different types of locations serviced under the two waste collection contracts:

CURBSIDE RESIDENTIAL CONTRACT

This includes materials collected from:

- Single family residences - garbage, recyclables, Green Bin (GB) organics, leaf and yard waste (LYW), and bulky items
- Schools – Green Bin organics
- Small businesses (i.e. Yellow Bag program) – garbage, recycling, Green Bin organics
- City facilities – garbage, recyclables and Green Bin organics placed out in bags/bins

- Multi-residential buildings – garbage and recyclables placed out in bins/bags, Green Bin organics placed out in carts and bulky items from all multi-residential buildings (regardless of how other materials are collected)

Multi-residential/Containerized Contract - This includes materials collected from:

- Multi-residential buildings - garbage and recyclables placed in front end load containers and carts
- City Facilities – garbage, recyclables and LYW placed in front end load containers

A methodology for allocating the tonnes collected under the Curbside Residential and Containerized (multi-residential/City Facilities) collection contracts to the appropriate generators materials is required. HDR allocated materials to the various generators serviced by the City using waste audit data for the single family and multi-residential sectors, and container information for City Facilities.

DATA PROVIDED BY THE CITY

The City of Ottawa provided various data sets to aid in the estimations for the tonnage allocations; a number of assumptions were made in order to determine the appropriate estimates.

Total Tonnage Collected (2019)

The City of Ottawa provided the total tonnages collected by the City from 2010 to 2019 for each waste stream and by Curbside Residential or Multi-residential/Containerized. Table 1 presents the information provided by the City on the tonnes of materials collected in 2019 from Multi-residential and Curbside Residential. The first row reflects the terminology used by the City (for cross-referencing to the data provided) and the second row provides a more general terminology meant to better indicate what the terms represent.

Table 1: 2019 Tonnes Collected by the City

Letter	City of Ottawa Terminology [1]	Revised Terminology	Tonnes Collected
A	Apartment Commercial Garbage	Apartment Commercial Garbage	5,663
B	MR Garbage	Multi-Residential Garbage	45,061
C	CS Garbage	Curbside Residential Garbage	137,004

Letter	City of Ottawa Terminology [1]	Revised Terminology	Tonnes Collected
D	MR Containers	Multi-Residential Blue Bin Materials	3,230
E	MR Fibre	Multi-Residential Black Bin Materials	6,195
F	CS Containers	Curbside Blue Bin Materials	21,152
G	CS Fibre	Curbside Black Bin Materials	30,305
H	Leaf and Yard Waste	Leaf and Yard Waste (separate collection)	9,022
I	Residential Organics	Household Organics (Green Bin materials) + LYW set out at curb	80,321
Total	**All Sections**	**All Revised Sections**	**337,952**

Source: 2010_2019 Tonnage Data – updated December 2019

[1] Corresponds to information provided in the Source file

The following list provides the assumptions for each category of waste provided in Table 1 and describes the materials for which tonnage is provided.

A - “Apartment Commercial Garbage”: Includes garbage from multi-residential (containerized) that was collected in excess of the normal container amount weekly.

B - “MR or Multi-residential Garbage”: Includes Garbage from both multi-residential and City Facilities under the containerized collection contract (includes front-end loading containers and carts).

C - “CS Garbage or Curbside Residential Garbage”. Includes all single family residential curbside garbage, Yellow Bag materials, bulky materials collected from single family and multi-residential buildings, and all multi-residential and City Facility garbage set out in bags.

D - “MR Containers or Multi-Residential Blue Bin Materials”: Includes blue bin materials (e.g. glass, metal, and plastic containers) collected from multi-residential and City Facilities and includes containerized or cart materials.

E - “MR Fibre or Multi-Residential Black Bin Materials”: Includes black bin materials (e.g. newspapers and cardboard) collected from multi-residential and City Facilities and includes containerized or cart materials.

F - “CS Containers or Curbside Blue Bin Materials”: Includes blue bin materials (e.g. glass, metal, plastic containers) from all curbside single family residences (set out in blue bins), and any multi-residential and City Facilities’ materials set out in blue bins or carts.

G - “CS Fibre or Curbside Black Bin Materials”: Includes black bin materials (e.g. newspapers, cardboard) from all curbside single family (set out in black bins), and any multi-residential and City Facilities’ materials set out in black bins or carts.

H - “Leaf and Yard Waste”: includes Leaf and Yard waste that is collected separately from Residential Organics from single family residences and some City Facilities. It was assumed that LYW would only be collected from these generators.

I - “Residential Organics” : includes Household organics (Green Bin materials – which includes a small amount of Leaf and Yard Waste) from multi-residential buildings participating in the program, City Facilities, and single family residences set out in carts pluse Leaf and Yard Waste set out at the curb and collected with the Green Bin.

Residential Waste Audit Results (2019)

The City conducted waste audits of single-family residences and multi-residential buildings in 2018 and 2019. Table 2 presents the generation rates from the waste audits that were used to estimate quantities of waste generated in kilograms per household (or unit) per week.

Table 2: 2018/2019 Curbside Seasonal Waste Audit Results: Single Family

Single family Audit Results 2018/2019	Garbage	Bulky	Blue Bin Materials	Black Bin Materials	Household Organics	LYW
Average Generated (kg/hh/week)	6.04	1.43	1.26	1.88	2.45	3.54

Source: 2019 4-Season SF Residential Curbside Waste Composition Study - Summary Report (pdf file provided by the City of Ottawa)

Table 3: 2018/2019 Curbside Seasonal Waste Audit Results: Multi-Residential

Multi-Residential Audit Results 2019	Garbage	Bulky	Blue Bin Materials	Black Bin Materials	Household Organics
Average Generated (kg/unit/week)	7.07	1.13	0.55	1.29	2.43

Source: City of Ottawa Multi-Residential Waste Audit Final (pdf file supplied by L. Webley May 20, 2020)

City Facility Data (2019)

The City provided information about City Facilities receiving collection of garbage, recycling, Green Bin materials and LYW. These files provided data on the number, type and size of containers by material stream and frequency of collection. Estimates of the tonnages collected by type of container were developed using density factors and an assumed fullness of container at collection.

The following density factors[40] were used for the calculations:

- Garbage: 80 kg/ m^3
- Recyclable Fibres: 145 kg/ m^3
- Recyclable Containers: 55 kg/ m^3
- Separately collected LYW: 178 kg/ m^3
- Scrap Metal: 193 kg/m^3

For Green Bin organics, HDR assumed materials would consist of predominantly food waste and used a higher density factor[41] of 650 kg/m^3 [42]. It was assumed that Green Bin organics may consist of pre-consumer food waste at a City Facility such as a long term care facility.

The City of Ottawa provided data which was used to estimate the total tonnages generated at City Facilities, current as of end of March 2020, for each waste stream and container type. Table 3 presents the estimated tonnages from each waste stream based on number of containers, container type, and frequency of collection and illustrates the application of the density factors as well as an assumed container capacity at time of collection for each waste stream. Table 4: Summary of Estimated Materials Generated at City Facilities presents the estimated tonnages by the method (or type) of collection (i.e. bin/cart or containerized). Note

[40] Density factors were taken from the Integrated Curbside Waste Collection model in 2019 (CIF project 1043) developed by the City in partnership with the Continuous Improvement Fund.
[41] As opposed to the density factor of 216.51 kg/m^3 for organics mixed with LYW used for the Integrated Curbside Waste Collection Model
[42] Environment Canada. (2013). Technical Document on Municipal Solid Waste Organics Processing. P.9-7. Retrieved on April 20, 2020 from https://www.ec.gc.ca/gdd-mw/3E8CF6C7-F214-4BA2-A1A3-163978EE9D6E/13-047-ID-458-PDF_accessible_ANG_R2-reduced%20size.pdf.

that the base reports used to determine the potential volume generated in Table 3 was run in 2020, thus represents the customers as of 2020 and presumably the amount of waste that would be collected in 2020.

Table 4: Estimates of Materials Generated at City Facilities (2020): Containers

Type of Container Listed for Facility	Containers	2 Yard T	3 Yard	4 Yard	6 Yard	Carts_360(GMP)	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	Not applicable	80	0	0	0	7,450	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	Containerized Fullness: 50% Cart Fullness: 95%	40	60	80	119	7,078	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 55 kg/m3	0	0	0	0	389,273	Not applicable
Tonnes Collected based on assumed fullness and densities	Not applicable	2	3	4	7	389	40

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 5: Estimates of Materials Generated at City Facilities (2020): Fibre

Type of Container Listed for Facility	Fibre	2 Yard T	3 Yard	4 Yard	6 Yard	Carts_360(GMP)	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	0	0	0	0	0	12,739	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	Containerized Fullness: 10% Cart Fullness: 95%	8	111	406	1,734	12,102	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 145 kg/m3	0	0	0	0	1,754,823	Not applicable
Tonnes Collected based on assumed fullness and densities	0	1	16	59	251	1,755	2,082

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 6: Estimates of Materials Generated at City Facilities (2020): Garbage

Type of Container Listed for Facility	Garbage	2 Yard	4 Yard	4 YardT	6 Yard	8 Yard	In Ground System	Roll-off 20 yard	Roll off 30 yard2	4Yard (C)	6Yard (C)	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	0	7,107	7,438	5,278	40,102	16,771	1,183	12,630	229	795	716	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	40%	2,843	2,975	2,111	16,041	6,709	473	5,052	92	318	286	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 80 kg/m^3	227,434	238,003	168,912	1,283,278	536,681	37,848	404,174	7,340	25,444	22,900	Not applicable
Tonnes Collected based on assumed fullness and densities	0	227	238	169	1,283	537	38	404	7	25	23	2,952

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 7: Estimates of Materials Generated at City Facilities (2020): Brush Leaf and Yard

Type of Container Listed for Facility	Brush Leaf and Yard	Roll-off 20 yard	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	0	1,254	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	90%	1,128	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 178 kg/m^3	200,870	Not applicable
Tonnes Collected based on assumed fullness and densities	0	201	201

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 8: Estimates of Materials Generated at City Facilities (2020): Scrap Metal

Type of Container Listed for Facility	Scrap Metal	Roll-off 30 yard	Roll-off 20 yard	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	0	0	3,517	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	80%	183	2,814	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 193 kg/m^3	0	541,892	Not applicable
Tonnes Collected based on assumed fullness and densities	0	35	542	577

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 9: Estimates of Materials Generated at City Facilities (2020): Organics

Type of Container Listed for Facility	Organics	80L Organic Standard	Carts_240 (SSO)	Organics-47L	Used 240 L Green Bin	Used 47 L Green Bin	ANNUAL ESTIMATED TOTAL Tonnage per Stream (tonnes)
Potential Total Volume Generated Annually (in m3) when 100% full	0	1,793	3,157	266	25	5	Not applicable
Potential Volume Collected based on Assumed Fullness when Collected (m3)	80%	1,434	2,526	213	20	4	Not applicable
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	Density: 650 kg/m^3	932,339	1,641,869	138,526	12,979	2,542	Not applicable
Tonnes Collected based on assumed fullness and densities	0	932	1,642	139	13	3	2,728

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 10: Estimates of Materials Generated at City Facilities (2020): Totals

Type	Total
Potential Total Volume Generated Annually (in m3) when 100% full	**145,871**
Potential Volume Collected based on Assumed Fullness when Collected (m3)	**66,960**
Kilograms collected based on Assumed Densities (kg/m3) (provided by City)	**8,946,394**
Tonnes Collected based on assumed fullness and densities	**8,946**

Source: MRCF Active Building and Collection Route Report City Facilities and RI_03_2020_City_Facilities_MRCF_Report_LyndellC
Note: the type of container listed for facility is verbatim from the excel spreadsheets provided by the City.

Table 11: Summary of Estimated Materials Generated at City Facilities by Type of Collection (2020)

Containerized	Containerized Total Tonnage Per Stream	Carts Total Tonnage Per Stream
Garbage	2,952	0
Fibres	328	1,755
Containers	16	389
Organics	0	2,728
Scrap Metal	577	0
L&Y	201	0

Household Estimates (2020)

The City provided information on the number of single family and multi-residential households, the breakdown between multi-residential containerized and cart-based units and the number of multi-residential units with Green Bin service. This information was used to extrapolate audit results in order to determine an appropriate estimate of the current amount of waste generated by each type of generator.

Table 12: Number of Single family and Multi-Residential Households (2020)

Sector	Number of Residential Units
Single family Households	294,754
Multi-residential Households	119,789
Curbside Multi-residential (carts)	2,016
Containerized Multi-residential	117,773
Number of Multi-residential with Green Binservice	30,522

Information provided by City of Ottawa (L. Webley, May 25, 2020). Curbside household count obtained from February 1, 2020 Solid Waste Tax Report, Multi-residential information obtained from the City's Solid Waste Database March 2020.

ALLOCATION OF TONNAGES BY GENERATOR AND MATERIAL

The City's original data reported tonnes collected as either Multi-Residential or Curbside Residential. As highlighted earlier, Multi-Residential tonnes include materials predominantly from large multi-residential buildings and City Facilities using front end load containers and Curbside Residential includes materials from single family residences, smaller multi-residential buildings using bags or bins and smaller City Facilities using bags or bins. Curbside Residential also includes Green Bin organics and

bulky waste from all single family residences and multi-residential buildings, as well as a small amount of garbage, recycling and Green Bin organics from the Yellow Bag program and a small amount of green bin organics from schools. Tonnes collected through the Yellow Bag program and the School Green Bin program have not been broken out separately and are included under the single family tonnage (as per City direction). As noted earlier, bulky waste from multi-residential and single family is included in the curbside residential garbage tonnage. Audit results were used to estimate these tonnes generated by these two sectors.

Table 6 presents the allocations from the audits, container totals and calculations used to determine appropriate estimates, organized into Multi-Residential and Curbside Residential. **Table 6** provides the breakdown of the estimated tonnes collected by generator and material type using City audit results for single family and multi-residential, and using 2020 collection reports provided for City Facilities. All cells in **yellow are based on audit results**, cells in **green are calculated for City Facilities based on 2020 collection reports**, **purple represents actuals reported by the City** and those in **blue are calculations**, generally representing the remainder of a tonnage reported by the City needing to be allocated.

The following provides an explanation of the calculations in the numbered rows in **Table 6:**

1. Multi-Residential Containerized Tonnes – all tonnages based on audit results (generation rate from Table 2 multiplied by the number of multi-residential households receiving containerized collection from **Table 5**). It was assumed that no LYW was generated, and that any tonnes of household organics that might be generated by this sector would be captured under multi-residential Curbside Cart.

2. Apartment Commercial Garbage (Extra Containerized) – this tonnage reported by the City was allocated solely to multi-residential containerized.

3. City Facilities Containerized – all tonnages calculated were estimated from the City Facilities 2020 Collection Reports provided from the City. Tonnage estimates were derived from the total number of bins organized by size/type of container, stream, and frequency of collection (this data was provided from these Reports). The sum of these bins were then multiplied by the volume of each type of bin and then multiplied by the annual frequency of collection. Estimates on the fullness and density was then applied to each bin type and stream. Estimates on the fullness of containers when collected were developed and are documented on **Table 3**.

4. Estimated Total – this represents the total of all estimated tonnages for multi-residential containerized (multi-residential and City Facilities).

5. Reported Total – this represents 2019 Tonnes Collected by the City as reported and discussed in Table 1: 2019 Tonnes Collected by the City in regard to containerized collection. Note that some of these tonnages in Table 1 have been combined. For example: columns A and B in **Table 1** have been combined to sum to the total of 50,724 tonnes found in Table 6 (row 5).

6. Tonnes over/under – this represents the difference in tonnes between what was estimated and what was reported as tonnage collected by the City under the multi-residential contract.

7. Single Family + Schools + Yellow Bag – since the tonnages of garbage collected from the Yellow Bag are anticipated to be very low, the City has indicated these tonnes would be assumed to be part of the single-family garbage tonnage. Similarly, the tonnes of Green Bin materials from schools was assumed to be very low and would be rolled into the single-family tonnage for household organics. Audit results were used to calculate tonnes of garbage, blue and black bin materials, household organics and bulky (generation rate from Table 2) multiplied by the number of single family households from Table 5. The bulk of LYW collected along with the Green Bin was attributed to this sector, minus the quantity allocated to City Facilities Containerized collection. Quantities of LYW set out at the curb and collected with Green Bin materials were calculated by subtracting the amounts of household organics attributed to multi-residential/single family (using audit data) and City Facilities (by calculation). It was assumed that multi-residential and City Facility Green Bin material would not contain any LYW.

8. Multi-Residential Curbside - all values based on audit results (generation rate from Table 2 multiplied by the number of multi-residential households receiving bin/bag/cart collection from **Table 5**).

9. City Facilities Curbside - all tonnages calculated for recycling and household organics (i.e. food waste) were estimated from the City Facilities 2020 Collection Reports provided from the City. Tonnage estimates were derived from the total number of carts organized by size/type of container, stream, and frequency of collection (this data was provided from these reports). The sum of the cart types was then multiplied by the volume of each type of cart and then multiplied by the annual

frequency of collection. Estimates on the fullness and density was applied to each cart type and stream. Estimates on the fullness of containers when collected were developed and are documented in **Table 3**. The tonnes of garbage attributed to this sector represents the difference between tonnes of Curbside Residential garbage reported and the tonnes attributed to single family (garbage and bulky), multi-residential curbside garbage and multi-residential bulky.

10. Estimated Total – this represents the total of all estimated tonnages for Curbside Residential (single family, multi-residential and City Facility curbside bags/bins/carts).

11. Reported Total – this represents 2019 Tonnes Collected by the City as reported and discussed in Table 1: 2019 Tonnes Collected by the City in regards to curbside collection. Note that actuals for Blue and Black bins have been reported, but for some materials (e.g. bulky, and garbage) some of these tonnages in Table 1 have been combined. For example: column C in Table 1 includes both garbage and bulky from all sectors. The value in Row 11 column “LYW” has been adjusted from 9,022 tonnes (as reported in Table 1) to 8,821. The difference of 201 tonnes is the City Facilities Containerized estimated tonnes. Thus the value is an insert to balance.

12. Tonnes over/under – this represents the difference in tonnes between what was estimated and what was reported as tonnage collected by the City under the Curbside Residential contract.

Table 13: Allocation of Materials by Sector based on Audit Results and Data on City Facilities (2019 tonnes): Multi-residential

Number	Multi-residential Contract	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [43]
1	Multi-residential Containerized	43,298	7,039	3,368	7,900	None	None	None
2	Apartment Commercial Garbage (Extra Containerized)	5,663	None	None	None	None	None	None
3	City Facilities Containerized	2,952	None	16	328	201	None	None
4	**Estimated Total**	**51,913**	**7,039**	**3,385**	**8,228**	**201**	None	None
5	**Reported Total**	**50,724**	Included in Curbside Residential Garbage	**3,230**	**6,195**	**201**	None	None
6	**Tonnes (over)/under**	**(1,189)**	None	**(155)**	**(2,033)**	None	None	None

Table 14: Allocation of Materials by Sector based on Audit Results and Data on City Facilities (2019 tonnes): Curbside Residential

Number	Curbside Residential Contract	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [44]
7	Single Family + Schools + Yellow Bag	92,512	21,936	19,380	28,844	8,821	36,217	37,519
8	Multi-Residential Curbside	741	None	58	135	None	None	3,857
9	City Facilities Curbside	14,775	None	389	1,755	None	None	2,728
10	**Estimated Total**	**108,029**	**21,936**	**19,827**	**30,734**	**8,821**	**36,217**	**44,104**
11	**Reported Total**	**137,004**	Included in Curbside Residential Garbage	**21,152**	**30,305**	**8,821**	**80,321**	Included in Green Bin Organics LYW
12	**Tonnes (over)/under**	**(0.47)**	Included in Curbside Residential Garbage	**1,325**	**(428)**	**None**	**None**	**None**

Colour Coding

Yellow	Based on Audit Results	Green	Estimated using City Facility 2020 Collection Reports	Blue	Calculated Value	Purple	Actual Value Reported

[43] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.
[44] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.

As illustrated in the orange highlighted cells, there is some portion of the tonnage reported by the City that is either under or over allocated using the audit results or containerized or bag/bin calculations. For example, it was estimated that 51,913 tonnes of garbage from multi-residential buildings and City Facilities were generated using multi-residential audit results and calculations on container/cart from City Facilities; but only 50,724 tonnes were reportedly collected. Similarly, it was estimated that 8,228 tonnes of Black Bin (fibres) material were generated from multi-residential and City Facilities (containerized) but only 6,195 tonnes were reportedly collected. These over/under tonnes have been reallocated as presented in **Table 7**.

Table 7 organizes the same data and uses the same colour codes as found in Table 6, however the tonnes over/under are reallocated and added to the preexisting calculations. Variances in tonnage based on audit results for the residential sector is to be expected as audits represent a snapshot in time from select residences and generation rates can be different in actuality. Similarly, estimating quantities of materials from City Facilities is difficult given the unknowns of material density and container fullness. This is particularly true for garbage generation. In general the tonnes for single family and multi-residential tonnes were adjusted as there may be more variability for these sectors.

Adjustments to the allocations were made in **Table 7** as follows:

- Row 1 - Garbage: The overage for tonnes of garbage from multi-residential was allocated to multi-residential containerized. Reducing the tonnage to City Facilities any further would essentially reduce the fullness at collection to less than 40% (the assumed fullness).
- Row 1 – Blue Bin (Containers): Using audit results for multi-residential Containerized blue bin materials resulted in greater tonnage (3,385 tonnes) than was reported as collected by the City (3,230 tonnes). The extra 155 tonnes was subtracted from the estimated 3,368 tonnes of multi-residential Containerized blue bin material.
- Row 1 – Black Bin (Fibres): The overage in black bin material (2,033 tonnes) was subtracted from the estimates allocated to multi-residential containerized.
- Row 7 – Garbage: A very small amount of garbage was subtracted from the single family tonnes of garbage (likely resulting from rounding).
- Row 7 – Blue Bin (Containers): The remaining 1,325 tonnes of Blue Bin (container) materials were added to the Single-family tonnage.

- Row 7 – Black Bin (Fibres): The overage of 428 tonnes of Black Bin (fibres) materials were subtracted from the Single-family tonnage.
- No adjustments were made to any columns that had no value in Row 6 and 12 of **Table 6**.

The resulting allocated tonnages are presented in **Table 7**.

Table 15: Allocation of Materials by Sector with Reallocation (2019 tonnes): Multi-Residential

#	Multi-Residential Contract	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [45]
1	Multi-Residential Containerized	42,109	7,039	3,213	5,867	0	0	0
2	Apartment Commercial Garbage (Extra Containerized)	5,663	0	0	0	0	0	0
3	City Facilities Containerized	2,952	0	16	328	201	0	0
4	**Estimated Total**	**50,724**	**7,039**	**3,230**	**6,195**	**201**	**0**	**0**
5	**Reported Total**	**50,724**	**Included in curbside residential tonnes**	**3,230**	**6,195**	**201**	**0**	**0**
6	**Remaining to be Allocated**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 16: Allocation of Materials by Sector with Reallocation (2019 tonnes): Curbside Residential

#	Curbside Residential Contract	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [46]
7	Single Family + schools (GB) + Yellow Bag (garbage, recycling and green bin)	92,512	21,936	20,705	28,416	8,821	36,217	37,519
8	Multi-Residential Curbside	741	0	58	135	0	0	3,857
9	City Facilities Curbside	14,775	0	389	1,755	0	0	2,728
10	**Estimated Total**	**108,029**	**21,936**	**21,152**	**30,305**	**8,821**	**36,217**	**44,104**
11	**Reported Total**	**137,004**	**Included In Garbage**	**21,152**	**30,305**	**9,022**	**80,321**	**Included In LYW**

[45] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.
[46] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.

#	Curbside Residential Contract	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [46]
12	**Remaining to be Allocated**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Colour Coding

Yellow	Based on Audit Results	Green	Estimated using City Facility 2020 Collection Reports	Blue	Calculated Value	Purple	Actual Value Reported

The following table presents the allocated tonnes by sector.

Table 17: Allocations by Sector (2019 tonnes): Multi-Residential

Multi-Residential	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [47]
Containerized	42,109	7,039	3,213	5,867	0	0	0
Apartment Commercial Garbage (Extra Containerized)	5,663	0	0	0	0	0	0
Curbside	741	0	58	135	0	459	3,398
Total	**48,513**	**7,039**	**3,271**	**6,003**	**0**	**459**	**3,398**

Table 18: Allocations by Sector (2019 tonnes): City Facilities

City Facilities	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [48]
City Facilities Containerized	2,952	0	16	328	201	0	0
City Facilities Curbside	14,900	0	389	1,755	0	325	2,404
Total	**17,852**	**0**	**405**	**2,083**	**201**	**325**	**2,404**

[47] **Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.**
[48] **Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.**

Table 19: Allocations by Sector (2019 tonnes): Single Family

Single Family	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [49]
Single-family + schools (GB) + Yellow Bag (garbage recycling and green bin)	92,512	21,936	20,705	28,415	8,821	36,217	37,519
Total	**92,512**	**21,936**	**20,705**	**28,415**	**9,022**	**36,217**	**44,104**

Table 20: Allocations by Sector (2019 tonnes): Totals

Type	Garbage	Bulky	Blue Bin (Containers)	Black Bin (Fibres)	LYW (Separate Collection)	Green Bin Organics - LYW collected with Green Bin setout and sent to Convertus	Green Bin Organics - Household Organics and LYW in the Green Bin sent to Convertus [50]
Grand Total	**158,876**	**28,851**	**24,382**	**36,500**	**9,022**	**36,217**	**44,104**

[49] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.
[50] Household organics may contain approximately 12% LYW material that is allowed to be placed in the Green Bin.

Next Steps

These tonnage allocations will be used to develop the projections required for the development of the draft Master Plan. Sections of this memo will be incorporated into the technical memorandum for the Waste Projections.

Appendix B

Data Tables for Modelling

Table 1: Historical Curbside Residential and Multi-residential / Containerized Household Units (2006-2020)

Year	No. of Curbside Residential Units Serviced	No. of Multi-residential / Containerized Units Serviced	Total No. of Units Serviced
2006	253,255	88,141	341,396
2007	262,124	89,421	351,545
2008	263,897	89,090	352,987
2009	268,402	90,965	359,367
2010	269,428	92,059	361,487
2011	269,151	91,767	360,918
2012	275,680	93,487	369,167
2013	276,506	97,639	374,145
2014	279,471	99,625	379,096
2015	**282,125**	**103,894**	**386,020**
2016	**284,840**	**106,068**	**390,908**
2017	**287,555**	**108,242**	**395,797**
2018	**290,269**	**110,416**	**400,685**
2019	**292,984**	**112,590**	**405,574**
2020	294,754	119,789	414,543

Source: Housing Type Data Split, taxation data for respective year (provided by City of Ottawa)

*** Bolded values are interpolated values using Excel trend line methods.**

Table 2: Forecasted Curbside Residential and Multi-residential/Containerized Household Units (2021-2052)

Year	No. of Curbside Residential Units Serviced	No. of Multi-residential/Containerized Units Serviced	Total No. of Units Serviced
2021	300,228	121,933	422,161
2022	305,803	124,115	429,918
2023	311,482	126,336	437,818
2024	317,267	128,597	445,864
2025	323,159	130,899	454,057
2026	328,649	132,629	461,278
2027	334,232	134,383	468,615
2028	339,910	136,159	476,069
2029	345,685	137,959	483,644
2030	351,558	139,783	491,341
2031	356,586	141,173	497,759
2032	361,685	142,577	504,262
2033	366,858	143,995	510,853
2034	372,104	145,427	517,531
2035	377,426	146,874	524,299
2036	381,941	148,047	529,987
2037	386,509	149,230	535,739
2038	391,133	150,422	541,555
2039	395,812	151,624	547,435
2040	400,546	152,835	553,381
2041	404,505	153,936	558,441
2042	408,503	155,045	563,548
2043	412,540	156,162	568,702

Year	No. of Curbside Residential Units Serviced	No. of Multi-residential/Containerized Units Serviced	Total No. of Units Serviced
2044	416,617	157,287	573,904
2045	420,734	158,420	579,155
2046	424,892	159,562	584,454
2047	429,091	160,711	589,803
2048	433,332	161,869	595,201
2049	437,615	163,035	600,650
2050	441,940	164,210	606,150
2051	446,307	165,393	611,700
2052	450,718	166,585	617,303

Growth Projections from the New Official Plan: Methods and Assumptions for Population, Housing and Employment 2018 to 2046, Research and Forecasting Unit; Planning, Infrastructure and Economic Development Department, city of Ottawa. Forecasts from 2047 to 2052 are based on linear trend extrapolation.

Table 3: Historical City of Ottawa Curbside Residential and Multi residential/Containerized Total and per Household Waste Tonnage (2010-2019)

Year	Contract Type	Tonnes	Households	Tonnes / Household
2010	Curbside Residential	281,749	269,428	1.05
2011	Curbside Residential	283,690	269,151	1.05
2012	Curbside Residential	279,796	275,680	1.01
2013	Curbside Residential	273,522	276,506	0.99
2014	Curbside Residential	274,987	279,471	0.98
2015	Curbside Residential	274,034	282,125	0.97
2016	Curbside Residential	264,849	284,840	0.93

Year	Contract Type	Tonnes	Households	Tonnes / Household
2017	Curbside Residential	277,583	287,555	0.97
2018	Curbside Residential	272,696	290,269	0.94
2019	Curbside Residential	277,804	292,984	0.95
2010	Multi-Residential/Containerized	48,509	92,059	0.53
2011	Multi-Residential/Containerized	48,143	91,767	0.52
2012	Multi-Residential/Containerized	49,282	93,487	0.53
2013	Multi-Residential/Containerized	52,781	97,639	0.54
2014	Multi-Residential/Containerized	55,654	99,625	0.56
2015	Multi-Residential/Containerized	56,537	103,894	0.54
2016	Multi-Residential/Containerized	57,129	106,068	0.54
2017	Multi-Residential/Containerized	59,861	108,242	0.55
2018	Multi-Residential/Containerized	59,698	110,416	0.54
2019	Multi-Residential/Containerized	60,148	112,590	0.53

Table 4 Historical Labour Force Characteristics by CMA; Ottawa- Gatineau, Ontario Part (2009-2019)

Year	Population 15+[1]	Employed Residents[2]	Employment Rate[3]
2009	748,800	500,400	66.8%
2010	763,100	515,300	67.5%
2011	776,100	517,400	66.7%
2012	789,700	535,400	67.8%
2013	802,800	523,500	65.2%
2014	814,800	533,800	65.5%
2015	825,300	531,100	64.4%

Year	Population 15+[1]	Employed Residents[2]	Employment Rate[3]
2016	836,800	543,400	64.9%
2017	850,700	546,700	64.3%
2018	869,600	557,600	64.1%
2019	890,400	590,100	66.3%

Source: Statistics Canada. Table 14-10-0096-01 Labour force characteristics by census metropolitan area, annual

https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410009601

DOI: https://doi.org/10.25318/1410009601-eng

1 Number of persons of working age, 15 years and over.

2 Number of persons who, during the reference week, worked for pay or profit, or performed unpaid family work or had a job but were not at work due to own illness or disability, personal or family responsibilities, labour dispute, vacation, or other reason. Those persons on layoff and persons without work but who had a job to start at a definite date in the future are not considered employed.

3 The employment rate is the number of persons employed expressed as a percentage of the population 15 years of age and over. The employment rate for a particular group (age, sex, marital status, etc.) is the number employed in that group expressed as a percentage of the population for that group. Estimates are percentages, rounded to the nearest tenth.

Table 5: Forecasted Labour Force Characteristics for the CMA of Ottawa-Gatineau, Ontario Part (2020-2052)

Year	Population 15+	Employed Residents	Employment Rate
2020	893,852	575,688	64.4%
2021	897,304	561,275	62.6%
2022	911,054	567,684	62.3%
2023	924,804	574,093	62.1%
2024	938,553	580,502	61.9%
2025	952,303	586,911	61.6%
2026	966,053	593,320	61.4%
2027	978,651	599,175	61.2%
2028	991,249	605,029	61.0%
2029	1,003,847	610,884	60.9%
2030	1,016,444	616,738	60.7%
2031	1,029,042	622,593	60.5%
2032	1,040,245	628,389	60.4%
2033	1,051,448	634,184	60.3%
2034	1,062,651	639,980	60.2%
2035	1,073,854	645,775	60.1%
2036	1,085,057	651,571	60.0%
2037	1,095,982	657,298	60.0%
2038	1,106,907	663,025	59.9%
2039	1,117,832	668,752	59.8%
2040	1,128,757	674,479	59.8%
2041	1,139,682	680,206	59.7%
2042	1,150,230	685,663	59.6%
2043	1,160,778	691,120	59.5%

Year	Population 15+	Employed Residents	Employment Rate
2044	1,171,326	696,577	59.5%
2045	1,181,874	702,034	59.4%
2046	1,192,422	707,490	59.3%
2047	1,209,994	711,098	58.8%
2048	1,221,637	716,518	58.7%
2049	1,233,281	721,937	58.5%
2050	1,244,924	727,356	58.4%
2051	1,256,568	732,775	58.3%
2052	1,268,211	738,195	58.2%

Growth Projections from the New Official Plan: Methods and Assumptions for Population, Housing and Employment 2018 to 2046, Research and Forecasting Unit; Planning, Infrastructure and Economic Development Department, City of Ottawa. Forecasts from 2047 to 2052 are based on linear trend extrapolation.

Appendix C

Model Coefficients

Table 1: Model Coefficients and Performance Summary

Model Variables	Regression Estimates: B	Regression Estimates: Standard. Error	t	Significance level
(Intercept)	0.293	0.061	4.818	<0.0001
Contract Type Indicator = Containerized	-0.579	0.039	-14.914	<0.0001
ln (Employment Rate (lagged))	0.762	0.137	5.551	<0.0001

Adjusted R Square	Durbin-Watson
0.933	1.822

H.D.R. used the Cochrane-Orcutt linear regression method to model the logarithm of total tonnes per household as a function of the logarithm of lagged employment rate controlling for the type of contract (curbside residential or multi-residential/containerized) for values from 2010 to 2019. All model variables are statistically significant as the significance level (Sig.) is less the 0.05. This means that the relationship between the type of contract and employment rate with total tonnes per household over time is not a random occurrence. The model can be used to predict total tonnes per household with a very good level of accuracy. The model's measure of accuracy is called the adjusted R square and is 93.3 percent. This means the model's regression estimates when multiplied by the year appropriate lagged employment rate and controlling whether the prediction is for curbside residential or multi-residential/containerized waste can capture 93.3 percent of the variation in annual waste per household trends. A perfect model would have an adjusted R square of 100 percent. As no statistical model can explain or predict events or quantities with certainty, adjusted R square values are less than 100 percent. The Durbin-Watson (D.W.) statistic is a measure which indicates whether observations are independent of each other or not. When observations are not independent of each other, it is because the observations are serially correlated. Values close to 2 indicate that serial correlation is not an issue and has been addressed by the model's functional form. As the model's D.W. value of 1.8 is close to 2 and the D.W. statistical test indicates that the hypothesis of no serial correlation can be accepted, the assumption of independent observations over time is valid.

Appendix D

Projected Waste Tonnages Tables

Table 1: Projected City of Ottawa Curbside Residential Waste Generation Projections Tonnage (Tonne per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	287,550	268,687	307,736
2021	287,133	266,420	309,457
2022	286,353	264,825	309,631
2023	291,006	268,879	314,954
2024	295,677	273,069	320,157
2025	300,397	277,342	325,369
2026	304,712	281,252	330,129
2027	309,093	285,224	334,960
2028	313,608	289,322	339,931
2029	318,200	293,490	344,990
2030	322,872	297,729	350,139
2031	326,761	301,243	354,442
2032	330,713	304,811	358,815
2033	335,044	308,762	363,564
2034	339,440	312,770	368,384
2035	343,902	316,838	373,276
2036	347,625	320,226	377,369
2037	351,397	323,658	381,514
2038	355,258	327,174	385,752
2039	359,167	330,736	390,043
2040	363,126	334,342	394,388
2041	366,380	337,299	397,969
2042	369,670	340,288	401,588
2043	372,976	343,289	405,229
2044	376,317	346,323	408,909
2045	379,694	349,389	412,628
2046	383,108	352,488	416,388
2047	386,558	355,620	420,187
2048	387,551	356,165	421,703
2049	390,790	359,061	425,323
2050	394,066	361,990	428,985
2051	397,380	364,952	432,690
2052	400,731	367,947	436,436

***The lower and upper limits for each set of projections are based on the model's 95 percent prediction limits**

Table 2: Projected City of Ottawa Multi-Residential/Containerized Waste Generation Projections (Tonnes/Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	66,205	62,354	70,294
2021	65,772	61,154	70,737
2022	65,379	60,490	70,664
2023	66,298	61,251	71,760
2024	67,258	62,099	72,846
2025	68,251	62,993	73,949
2026	68,955	63,623	74,732
2027	69,675	64,271	75,532
2028	70,423	64,946	76,362
2029	71,185	65,634	77,207
2030	71,960	66,332	78,066
2031	72,513	66,826	78,685
2032	73,074	67,326	79,313
2033	73,713	67,905	80,017
2034	74,359	68,491	80,729
2035	75,012	69,084	81,450
2036	75,527	69,548	82,019
2037	76,046	70,017	82,595
2038	76,580	70,500	83,184
2039	77,119	70,988	83,780
2040	77,663	71,480	84,380
2041	78,151	71,921	84,921
2042	78,643	72,366	85,466
2043	79,136	72,810	86,012
2044	79,633	73,259	86,563
2045	80,135	73,711	87,119
2046	80,641	74,168	87,679
2047	81,151	74,628	88,245
2048	81,144	74,544	88,328
2049	81,605	74,951	88,850
2050	82,071	75,362	89,378
2051	82,542	75,777	89,911
2052	83,017	76,196	90,449

***The lower and upper limits for each set of projections are based on the model's 95 percent prediction limits**

Table 3: Projected City of Ottawa Single Family Waste Tonnage (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	261,457	244,306	279,812
2021	261,078	242,244	281,376
2022	260,368	240,794	281,534
2023	264,600	244,480	286,374
2024	268,847	248,290	291,105
2025	273,138	252,175	295,844
2026	277,062	255,730	300,172
2027	281,045	259,342	304,565
2028	285,150	263,069	309,085
2029	289,325	266,858	313,684
2030	293,574	270,712	318,366
2031	297,110	273,907	322,279
2032	300,703	277,152	326,255
2033	304,641	280,744	330,573
2034	308,638	284,389	334,956
2035	312,695	288,088	339,404
2036	316,081	291,168	343,125
2037	319,510	294,288	346,895
2038	323,021	297,486	350,748
2039	326,575	300,724	354,649
2040	330,175	304,003	358,600
2041	333,134	306,691	361,856
2042	336,125	309,409	365,147
2043	339,131	312,138	368,457
2044	342,169	314,897	371,803
2045	345,240	317,684	375,185
2046	348,344	320,502	378,603
2047	351,480	323,350	382,058
2048	352,384	323,845	383,437
2049	355,329	326,479	386,728
2050	358,308	329,142	390,058
2051	361,320	331,835	393,426
2052	364,368	334,558	396,833

Table 4: Projected City of Ottawa Multi-Residential Waste Tonnage (Tonner per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	67,853	63,868	72,086
2021	67,434	62,690	72,537
2022	67,049	62,032	72,471
2023	68,001	62,825	73,604
2024	68,994	63,703	74,725
2025	70,020	64,626	75,863
2026	70,763	65,294	76,690
2027	71,523	65,978	77,534
2028	72,312	66,690	78,408
2029	73,116	67,416	79,299
2030	73,934	68,153	80,205
2031	74,527	68,683	80,867
2032	75,128	69,221	81,540
2033	75,810	69,840	82,291
2034	76,501	70,466	83,052
2035	77,199	71,100	83,822
2036	77,753	71,600	84,434
2037	78,312	72,106	85,053
2038	78,887	72,626	85,687
2039	79,466	73,151	86,327
2040	80,052	73,681	86,974
2041	80,572	74,152	87,549
2042	81,098	74,626	88,130
2043	81,623	75,101	88,712
2044	82,154	75,580	89,300
2045	82,689	76,063	89,893
2046	83,229	76,551	90,491
2047	83,774	77,043	91,094
2048	83,785	76,973	91,200
2049	84,279	77,409	91,759
2050	84,779	77,851	92,324
2051	85,284	78,297	92,894
2052	85,794	78,747	93,471

Table 5: Projected City of Ottawa City Facilities Waste Tonnage (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	24,446	22,868	26,133
2021	24,393	22,640	26,281
2022	24,315	22,489	26,290
2023	24,703	22,824	26,736
2024	25,094	23,174	27,173
2025	25,490	23,533	27,611
2026	25,842	23,851	27,999
2027	26,200	24,175	28,394
2028	26,568	24,510	28,800
2029	26,943	24,850	29,213
2030	27,325	25,196	29,634
2031	27,638	25,478	29,980
2032	27,956	25,765	30,333
2033	28,305	26,083	30,716
2034	28,660	26,407	31,105
2035	29,020	26,735	31,500
2036	29,318	27,006	31,829
2037	29,621	27,281	32,161
2038	29,931	27,563	32,501
2039	30,244	27,849	32,846
2040	30,562	28,138	33,194
2041	30,825	28,377	33,484
2042	31,091	28,618	33,777
2043	31,358	28,860	34,071
2044	31,628	29,105	34,369
2045	31,900	29,353	34,669
2046	32,176	29,603	34,973
2047	32,455	29,856	35,280
2048	32,527	29,891	35,395
2049	32,787	30,124	35,686
2050	33,051	30,359	35,981
2051	33,317	30,597	36,280
2052	33,587	30,838	36,581

Table 6: Projected City of Ottawa Single Family Household Waste Tonnage: Garbage (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	97,876	91,456	104,748
2021	97,735	90,684	105,333
2022	97,469	90,141	105,392
2023	99,053	91,521	107,204
2024	100,643	92,947	108,975
2025	102,249	94,402	110,749
2026	103,718	95,733	112,370
2027	105,209	97,085	114,014
2028	106,746	98,480	115,706
2029	108,309	99,898	117,428
2030	109,899	101,341	119,180
2031	111,223	102,537	120,645
2032	112,568	103,752	122,134
2033	114,043	105,097	123,750
2034	115,539	106,461	125,391
2035	117,057	107,846	127,056
2036	118,325	108,999	128,449
2037	119,609	110,167	129,860
2038	120,923	111,364	131,302
2039	122,254	112,576	132,763
2040	123,601	113,804	134,242
2041	124,709	114,810	135,461
2042	125,828	115,827	136,693
2043	126,954	116,849	137,932
2044	128,091	117,882	139,185
2045	129,241	118,925	140,451
2046	130,403	119,980	141,730
2047	131,577	121,046	143,024
2048	131,915	121,232	143,540
2049	133,017	122,217	144,772
2050	134,133	123,214	146,018
2051	135,260	124,223	147,279
2052	136,401	125,242	148,554

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 7: Projected City of Ottawa Single Family Household Waste Tonnage: Bulky Items (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	23,302	21,774	24,938
2021	23,269	21,590	25,078
2022	23,205	21,461	25,092
2023	23,583	21,789	25,523
2024	23,961	22,129	25,945
2025	24,344	22,475	26,367
2026	24,693	22,792	26,753
2027	25,048	23,114	27,144
2028	25,414	23,446	27,547
2029	25,786	23,784	27,957
2030	26,165	24,127	28,375
2031	26,480	24,412	28,723
2032	26,800	24,701	29,078
2033	27,151	25,021	29,462
2034	27,508	25,346	29,853
2035	27,869	25,676	30,250
2036	28,171	25,950	30,581
2037	28,477	26,229	30,917
2038	28,789	26,514	31,261
2039	29,106	26,802	31,608
2040	29,427	27,094	31,960
2041	29,691	27,334	32,251
2042	29,957	27,576	32,544
2043	30,225	27,819	32,839
2044	30,496	28,065	33,137
2045	30,770	28,314	33,439
2046	31,046	28,565	33,743
2047	31,326	28,819	34,051
2048	31,406	28,863	34,174
2049	31,669	29,098	34,467
2050	31,934	29,335	34,764
2051	32,203	29,575	35,064

Year	Projections	Lower Limit	Upper Limit
2052	32,474	29,818	35,368

*The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.

Table 8: Projected City of Ottawa Single Family Household Waste Tonnage: Blue Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	21,995	20,552	23,539
2021	21,963	20,379	23,670
2022	21,903	20,257	23,684
2023	22,259	20,567	24,091
2024	22,616	20,887	24,489
2025	22,977	21,214	24,888
2026	23,308	21,513	25,252
2027	23,643	21,817	25,621
2028	23,988	22,130	26,001
2029	24,339	22,449	26,388
2030	24,697	22,773	26,782
2031	24,994	23,042	27,111
2032	25,296	23,315	27,446
2033	25,628	23,617	27,809
2034	25,964	23,924	28,178
2035	26,305	24,235	28,552
2036	26,590	24,494	28,865
2037	26,878	24,757	29,182
2038	27,174	25,026	29,506
2039	27,473	25,298	29,834
2040	27,776	25,574	30,167
2041	28,025	25,800	30,441
2042	28,276	26,029	30,718
2043	28,529	26,258	30,996
2044	28,785	26,490	31,278
2045	29,043	26,725	31,562
2046	29,304	26,962	31,850
2047	29,568	27,201	32,140
2048	29,644	27,243	32,256
2049	29,892	27,465	32,533

Year	Projections	Lower Limit	Upper Limit
2050	30,142	27,689	32,813
2051	30,396	27,915	33,097
2052	30,652	28,144	33,383

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 9: Projected City of Ottawa Single Family Household Waste Tonnage: Black Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	30,185	28,205	32,304
2021	30,141	27,967	32,485
2022	30,059	27,800	32,503
2023	30,548	28,225	33,062
2024	31,038	28,665	33,608
2025	31,534	29,114	34,155
2026	31,987	29,524	34,655
2027	32,446	29,941	35,162
2028	32,920	30,371	35,684
2029	33,402	30,809	36,215
2030	33,893	31,254	36,755
2031	34,301	31,622	37,207
2032	34,716	31,997	37,666
2033	35,171	32,412	38,165
2034	35,632	32,833	38,670
2035	36,100	33,260	39,184
2036	36,491	33,615	39,614
2037	36,887	33,975	40,049
2038	37,293	34,345	40,494
2039	37,703	34,718	40,944
2040	38,119	35,097	41,400
2041	38,460	35,407	41,776
2042	38,805	35,721	42,156
2043	39,152	36,036	42,538
2044	39,503	36,355	42,925
2045	39,858	36,677	43,315
2046	40,216	37,002	43,710

Year	Projections	Lower Limit	Upper Limit
2047	40,578	37,331	44,108
2048	40,682	37,388	44,268
2049	41,023	37,692	44,648
2050	41,366	37,999	45,032
2051	41,714	38,310	45,421
2052	42,066	38,625	45,814

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 10: Projected City of Ottawa Single Family Household Waste Tonnage: Leaf and Yard Waste (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	9,370	8,756	10,028
2021	9,357	8,682	10,084
2022	9,331	8,630	10,090
2023	9,483	8,762	10,264
2024	9,635	8,899	10,433
2025	9,789	9,038	10,603
2026	9,930	9,165	10,758
2027	10,073	9,295	10,915
2028	10,220	9,428	11,077
2029	10,369	9,564	11,242
2030	10,522	9,702	11,410
2031	10,648	9,817	11,550
2032	10,777	9,933	11,693
2033	10,918	10,062	11,848
2034	11,061	10,192	12,005
2035	11,207	10,325	12,164
2036	11,328	10,435	12,297
2037	11,451	10,547	12,433
2038	11,577	10,662	12,571
2039	11,704	10,778	12,710
2040	11,833	10,895	12,852
2041	11,939	10,992	12,969
2042	12,047	11,089	13,087
2043	12,154	11,187	13,205

Year	Projections	Lower Limit	Upper Limit
2044	12,263	11,286	13,325
2045	12,373	11,386	13,446
2046	12,484	11,487	13,569
2047	12,597	11,589	13,693
2048	12,629	11,606	13,742
2049	12,735	11,701	13,860
2050	12,842	11,796	13,979
2051	12,950	11,893	14,100
2052	13,059	11,990	14,222

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 11: Projected City of Ottawa Single Family Household Waste Tonnage: Residential Organics – LYW in Green Bin (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	38,473	35,949	41,174
2021	38,417	35,646	41,404
2022	38,313	35,433	41,427
2023	38,936	35,975	42,140
2024	39,560	36,536	42,836
2025	40,192	37,107	43,533
2026	40,769	37,630	44,170
2027	41,355	38,162	44,816
2028	41,959	38,710	45,482
2029	42,574	39,268	46,158
2030	43,199	39,835	46,847
2031	43,719	40,305	47,423
2032	44,248	40,783	48,008
2033	44,828	41,311	48,643
2034	45,416	41,847	49,288
2035	46,013	42,392	49,943
2036	46,511	42,845	50,490
2037	47,016	43,304	51,045
2038	47,532	43,775	51,612
2039	48,055	44,251	52,186
2040	48,585	44,734	52,768

Year	Projections	Lower Limit	Upper Limit
2041	49,020	45,129	53,247
2042	49,460	45,529	53,731
2043	49,903	45,931	54,218
2044	50,350	46,337	54,710
2045	50,802	46,747	55,208
2046	51,258	47,162	55,711
2047	51,720	47,581	56,219
2048	51,853	47,653	56,422
2049	52,286	48,041	56,907
2050	52,725	48,433	57,397
2051	53,168	48,829	57,892
2052	53,616	49,230	58,393

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 12: Projected City of Ottawa Single Family Household Waste Tonnage: Residential Organics – Household Organics (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	40,254	37,614	43,080
2021	40,196	37,296	43,321
2022	40,087	37,073	43,346
2023	40,738	37,641	44,091
2024	41,392	38,227	44,819
2025	42,053	38,826	45,549
2026	42,657	39,373	46,215
2027	43,270	39,929	46,892
2028	43,902	40,503	47,587
2029	44,545	41,086	48,296
2030	45,199	41,679	49,016
2031	45,744	42,171	49,619
2032	46,297	42,671	50,231
2033	46,903	43,224	50,896
2034	47,519	43,785	51,571
2035	48,143	44,355	52,255
2036	48,665	44,829	52,828
2037	49,193	45,309	53,409

Year	Projections	Lower Limit	Upper Limit
2038	49,733	45,802	54,002
2039	50,280	46,300	54,603
2040	50,835	46,805	55,211
2041	51,290	47,219	55,712
2042	51,751	47,637	56,219
2043	52,213	48,058	56,729
2044	52,681	48,482	57,244
2045	53,154	48,911	57,764
2046	53,632	49,345	58,291
2047	54,115	49,784	58,823
2048	54,254	49,860	59,035
2049	54,707	50,265	59,542
2050	55,166	50,675	60,054
2051	55,630	51,090	60,573
2052	56,099	51,509	61,097

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside contract forecasts further segmented by the single family residential sector and its waste streams according to the 2019 allocation scheme.**

Table 13: Projected City of Ottawa Multi-residential Household Waste Tonnage: Garbage (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	47,766	44,982	50,723
2021	47,457	44,124	51,042
2022	47,177	43,648	50,991
2023	47,841	44,199	51,783
2024	48,535	44,812	52,567
2025	49,253	45,458	53,365
2026	49,764	45,916	53,933
2027	50,286	46,387	54,514
2028	50,830	46,877	55,116
2029	51,383	47,376	55,729
2030	51,946	47,883	56,353
2031	52,348	48,243	56,803
2032	52,757	48,607	57,260
2033	53,222	49,029	57,773
2034	53,692	49,455	58,291

Year	Projections	Lower Limit	Upper Limit
2035	54,168	49,887	58,816
2036	54,543	50,225	59,231
2037	54,922	50,568	59,651
2038	55,311	50,920	60,080
2039	55,703	51,275	60,514
2040	56,100	51,634	60,952
2041	56,455	51,955	61,345
2042	56,813	52,278	61,742
2043	57,172	52,602	62,139
2044	57,534	52,929	62,540
2045	57,899	53,258	62,944
2046	58,267	53,590	63,352
2047	58,638	53,925	63,763
2048	58,636	53,867	63,827
2049	58,972	54,163	64,207
2050	59,311	54,463	64,591
2051	59,654	54,765	64,979
2052	60,000	55,071	65,371

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by the multi-residential sector and its waste streams according to the 2019 allocation scheme.**

Table 14: Projected City of Ottawa Multi-residential Household Waste Tonnage: Bulky Items (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	6,805	6,409	7,226
2021	6,761	6,286	7,271
2022	6,720	6,218	7,264
2023	6,815	6,296	7,376
2024	6,913	6,383	7,488
2025	7,016	6,475	7,601
2026	7,088	6,540	7,682
2027	7,162	6,606	7,764
2028	7,239	6,676	7,849
2029	7,317	6,747	7,936
2030	7,397	6,818	8,024
2031	7,454	6,869	8,088

Year	Projections	Lower Limit	Upper Limit
2032	7,511	6,920	8,153
2033	7,577	6,980	8,225
2034	7,643	7,040	8,298
2035	7,711	7,101	8,372
2036	7,763	7,149	8,431
2037	7,817	7,197	8,490
2038	7,872	7,247	8,551
2039	7,927	7,297	8,612
2040	7,983	7,347	8,674
2041	8,033	7,393	8,729
2042	8,084	7,438	8,785
2043	8,134	7,484	8,841
2044	8,186	7,530	8,898
2045	8,237	7,577	8,955
2046	8,289	7,624	9,013
2047	8,342	7,671	9,071
2048	8,341	7,662	9,079
2049	8,388	7,704	9,133
2050	8,436	7,746	9,187
2051	8,485	7,789	9,242
2052	8,533	7,832	9,297

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by the multi-residential sector and its waste streams according to the 2019 allocation scheme.**

Table 15: Projected City of Ottawa Multi-residential Household Waste Tonnage: Blue Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	3,224	3,036	3,424
2021	3,203	2,978	3,445
2022	3,184	2,946	3,442
2023	3,229	2,983	3,495
2024	3,276	3,025	3,548
2025	3,325	3,068	3,602
2026	3,359	3,099	3,641
2027	3,394	3,131	3,680
2028	3,431	3,164	3,720

Year	Projections	Lower Limit	Upper Limit
2029	3,469	3,198	3,762
2030	3,507	3,232	3,804
2031	3,534	3,257	3,835
2032	3,561	3,281	3,865
2033	3,593	3,310	3,900
2034	3,625	3,339	3,935
2035	3,657	3,368	3,971
2036	3,682	3,391	3,999
2037	3,708	3,414	4,027
2038	3,734	3,438	4,056
2039	3,761	3,462	4,086
2040	3,788	3,486	4,115
2041	3,812	3,508	4,142
2042	3,836	3,530	4,169
2043	3,860	3,552	4,195
2044	3,885	3,574	4,223
2045	3,909	3,596	4,250
2046	3,934	3,618	4,277
2047	3,959	3,641	4,305
2048	3,959	3,637	4,310
2049	3,982	3,657	4,335
2050	4,005	3,677	4,361
2051	4,028	3,698	4,388
2052	4,051	3,719	4,414

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by the multi-residential sector and its waste streams according to the 2019 allocation scheme.**

Table 16: Projected City of Ottawa Multi-residential Household Waste Tonnage: Black Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	5,918	5,573	6,285
2021	5,880	5,467	6,324
2022	5,846	5,408	6,318
2023	5,928	5,477	6,416
2024	6,014	5,553	6,514
2025	6,103	5,633	6,612

Year	Projections	Lower Limit	Upper Limit
2026	6,167	5,690	6,683
2027	6,232	5,748	6,755
2028	6,299	5,809	6,830
2029	6,368	5,871	6,906
2030	6,438	5,934	6,984
2031	6,488	5,979	7,040
2032	6,539	6,025	7,097
2033	6,597	6,077	7,161
2034	6,655	6,130	7,225
2035	6,714	6,184	7,291
2036	6,761	6,226	7,342
2037	6,808	6,269	7,395
2038	6,857	6,313	7,448
2039	6,906	6,357	7,502
2040	6,955	6,402	7,557
2041	6,999	6,441	7,606
2042	7,044	6,482	7,655
2043	7,089	6,522	7,704
2044	7,134	6,563	7,754
2045	7,179	6,604	7,805
2046	7,225	6,645	7,855
2047	7,271	6,687	7,907
2048	7,271	6,680	7,915
2049	7,313	6,717	7,962
2050	7,355	6,754	8,010
2051	7,398	6,792	8,058
2052	7,441	6,830	8,107

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by the multi-residential sector and its waste streams according to the 2019 allocation scheme.**

Table 17: Projected City of Ottawa Multi-residential Household Waste Tonnage: Household Organics (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	4,139	3,867	4,429
2021	4,133	3,835	4,454
2022	4,121	3,812	4,457

Year	Projections	Lower Limit	Upper Limit
2023	4,188	3,870	4,533
2024	4,256	3,930	4,608
2025	4,324	3,992	4,683
2026	4,386	4,048	4,752
2027	4,449	4,105	4,821
2028	4,514	4,164	4,893
2029	4,580	4,224	4,965
2030	4,647	4,285	5,040
2031	4,703	4,336	5,101
2032	4,760	4,387	5,164
2033	4,822	4,444	5,233
2034	4,886	4,502	5,302
2035	4,950	4,560	5,373
2036	5,003	4,609	5,431
2037	5,058	4,658	5,491
2038	5,113	4,709	5,552
2039	5,169	4,760	5,614
2040	5,226	4,812	5,676
2041	5,273	4,855	5,728
2042	5,321	4,898	5,780
2043	5,368	4,941	5,832
2044	5,416	4,985	5,885
2045	5,465	5,029	5,939
2046	5,514	5,073	5,993
2047	5,564	5,118	6,048
2048	5,578	5,126	6,070
2049	5,625	5,168	6,122
2050	5,672	5,210	6,174
2051	5,719	5,253	6,228
2052	5,768	5,296	6,282

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by the multi-residential sector and its waste streams according to the 2019 allocation scheme.**

Table 18: Projected City Facilities Waste Tonnage: Garbage (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	18,705	17,500	19,994
2021	18,663	17,322	20,108
2022	18,603	17,206	20,114
2023	18,899	17,462	20,455
2024	19,198	17,729	20,788
2025	19,501	18,003	21,123
2026	19,769	18,246	21,419
2027	20,041	18,492	21,719
2028	20,322	18,747	22,029
2029	20,608	19,006	22,344
2030	20,898	19,270	22,665
2031	21,136	19,485	22,928
2032	21,378	19,703	23,196
2033	21,644	19,945	23,488
2034	21,914	20,191	23,784
2035	22,188	20,441	24,084
2036	22,415	20,647	24,334
2037	22,645	20,856	24,587
2038	22,881	21,071	24,846
2039	23,119	21,288	25,108
2040	23,360	21,508	25,373
2041	23,561	21,689	25,593
2042	23,763	21,873	25,816
2043	23,966	22,058	26,040
2044	24,172	22,244	26,267
2045	24,379	22,432	26,495
2046	24,589	22,623	26,726
2047	24,801	22,815	26,960
2048	24,855	22,841	27,047
2049	25,053	23,018	27,269
2050	25,254	23,197	27,493
2051	25,457	23,378	27,720

Year	Projections	Lower Limit	Upper Limit
2052	25,662	23,561	27,950

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by city facilities and its waste streams according to the 2019 allocation scheme.**

Table 19: Projected City Facilities Waste Tonnage: Blue Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	429	401	459
2021	428	397	462
2022	427	395	462
2023	434	401	470
2024	441	407	477
2025	448	414	485
2026	454	419	492
2027	461	425	499
2028	467	431	507
2029	474	437	514
2030	481	444	522
2031	487	449	528
2032	493	454	535
2033	499	460	542
2034	505	466	549
2035	512	472	556
2036	518	477	562
2037	523	482	568
2038	529	487	574
2039	534	492	580
2040	540	497	587
2041	545	502	592
2042	550	506	597
2043	555	511	603
2044	560	515	608
2045	565	520	614
2046	570	524	619
2047	575	529	625
2048	576	530	627

Year	Projections	Lower Limit	Upper Limit
2049	581	534	632
2050	586	538	638
2051	591	542	643
2052	596	547	649

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by city facilities and its waste streams according to the 2019 allocation scheme.**

Table 20: Projected City Facilities Waste Tonnage: Black Bin Materials (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	2,187	2,046	2,338
2021	2,182	2,026	2,351
2022	2,175	2,012	2,352
2023	2,210	2,042	2,392
2024	2,245	2,073	2,431
2025	2,280	2,105	2,470
2026	2,312	2,134	2,505
2027	2,344	2,163	2,540
2028	2,377	2,193	2,576
2029	2,410	2,223	2,613
2030	2,444	2,254	2,651
2031	2,472	2,279	2,682
2032	2,501	2,305	2,713
2033	2,532	2,333	2,747
2034	2,563	2,362	2,782
2035	2,595	2,391	2,817
2036	2,622	2,415	2,847
2037	2,649	2,440	2,876
2038	2,677	2,465	2,907
2039	2,705	2,490	2,937
2040	2,733	2,516	2,968
2041	2,757	2,538	2,994
2042	2,780	2,559	3,020
2043	2,804	2,581	3,047
2044	2,828	2,603	3,073
2045	2,853	2,625	3,100
2046	2,877	2,647	3,127

Year	Projections	Lower Limit	Upper Limit
2047	2,902	2,670	3,155
2048	2,908	2,673	3,165
2049	2,932	2,693	3,191
2050	2,955	2,714	3,217
2051	2,979	2,736	3,244
2052	3,003	2,757	3,271

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by city facilities and its waste streams according to the 2019 allocation scheme.**

Table 21: Projected City Facilities Waste Tonnage: Leaf and Yard Waste (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	198	186	210
2021	197	183	211
2022	195	181	211
2023	198	183	214
2024	201	186	218
2025	204	188	221
2026	206	190	223
2027	208	192	226
2028	210	194	228
2029	213	196	231
2030	215	198	233
2031	217	200	235
2032	218	201	237
2033	220	203	239
2034	222	205	241
2035	224	206	243
2036	226	208	245
2037	227	209	247
2038	229	211	249
2039	230	212	250
2040	232	214	252
2041	234	215	254
2042	235	216	255
2043	236	218	257

Year	Projections	Lower Limit	Upper Limit
2044	238	219	259
2045	239	220	260
2046	241	222	262
2047	243	223	264
2048	242	223	264
2049	244	224	266
2050	245	225	267
2051	247	226	269
2052	248	228	270

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by city facilities and its waste streams according to the 2019 allocation scheme.**

Table 22: Projected City Facilities Waste Tonnage: Household Organics (Tonnes per Year, 2020-2052)

Year	Projections	Lower Limit	Upper Limit
2020	2,927	2,735	3,132
2021	2,922	2,712	3,150
2022	2,914	2,695	3,151
2023	2,962	2,737	3,206
2024	3,009	2,779	3,258
2025	3,057	2,823	3,312
2026	3,101	2,863	3,360
2027	3,146	2,903	3,409
2028	3,192	2,945	3,460
2029	3,239	2,987	3,511
2030	3,286	3,030	3,564
2031	3,326	3,066	3,607
2032	3,366	3,102	3,652
2033	3,410	3,143	3,700
2034	3,455	3,183	3,749
2035	3,500	3,225	3,799
2036	3,538	3,259	3,841
2037	3,576	3,294	3,883
2038	3,616	3,330	3,926
2039	3,656	3,366	3,970
2040	3,696	3,403	4,014

Year	Projections	Lower Limit	Upper Limit
2041	3,729	3,433	4,050
2042	3,762	3,463	4,087
2043	3,796	3,494	4,124
2044	3,830	3,525	4,162
2045	3,864	3,556	4,200
2046	3,899	3,588	4,238
2047	3,934	3,619	4,277
2048	3,944	3,625	4,292
2049	3,977	3,654	4,329
2050	4,011	3,684	4,366
2051	4,044	3,714	4,404
2052	4,079	3,745	4,442

***The lower and upper limits for each projection are based on the model's 95 percent prediction limits for curbside and MR/C contract forecasts further segmented by city facilities and its waste streams according to the 2019 allocation scheme.**

Table 23: Projected Single Family Household Waste Tonnage per Capita per Year by Stream (2020-2052)

Year	Garbage	Bulky Items	Blue Bin Materials	Black Bin Materials	Leaf and Yard Waste	LYW in Green Bin	Household Organics
2020	0.098	0.023	0.022	0.030	0.009	0.039	0.040
2021	0.096	0.023	0.022	0.030	0.009	0.038	0.039
2022	0.094	0.022	0.021	0.029	0.009	0.037	0.039
2023	0.094	0.022	0.021	0.029	0.009	0.037	0.039
2024	0.094	0.022	0.021	0.029	0.009	0.037	0.038
2025	0.093	0.022	0.021	0.029	0.009	0.037	0.038
2026	0.093	0.022	0.021	0.029	0.009	0.037	0.038
2027	0.093	0.022	0.021	0.029	0.009	0.036	0.038
2028	0.093	0.022	0.021	0.029	0.009	0.036	0.038
2029	0.092	0.022	0.021	0.029	0.009	0.036	0.038
2030	0.092	0.022	0.021	0.028	0.009	0.036	0.038
2031	0.092	0.022	0.021	0.028	0.009	0.036	0.038
2032	0.092	0.022	0.021	0.028	0.009	0.036	0.038
2033	0.092	0.022	0.021	0.028	0.009	0.036	0.038
2034	0.092	0.022	0.021	0.028	0.009	0.036	0.038
2035	0.091	0.022	0.021	0.028	0.009	0.036	0.038
2036	0.091	0.022	0.021	0.028	0.009	0.036	0.038
2037	0.091	0.022	0.021	0.028	0.009	0.036	0.038
2038	0.091	0.022	0.020	0.028	0.009	0.036	0.038
2039	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2040	0.091	0.022	0.020	0.028	0.009	0.036	0.037

Year	Garbage	Bulky Items	Blue Bin Materials	Black Bin Materials	Leaf and Yard Waste	LYW in Green Bin	Household Organics
2041	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2042	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2043	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2044	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2045	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2046	0.091	0.022	0.020	0.028	0.009	0.036	0.037
2047	0.090	0.022	0.020	0.028	0.009	0.036	0.037
2048	0.090	0.021	0.020	0.028	0.009	0.035	0.037
2049	0.090	0.021	0.020	0.028	0.009	0.035	0.037
2050	0.090	0.021	0.020	0.028	0.009	0.035	0.037
2051	0.089	0.021	0.020	0.028	0.009	0.035	0.037
2052	0.089	0.021	0.020	0.028	0.009	0.035	0.037

Table 24: Projected Multi-Residential Household Waste Tonnage per Capita per Year by Stream (2020-2052)

Year	Garbage	Bulky Items	Blue Bin Materials	Black Bin Materials	Household Organics
2020	0.185	0.026	0.013	0.023	0.016
2021	0.181	0.026	0.012	0.022	0.016
2022	0.177	0.025	0.012	0.022	0.015
2023	0.176	0.025	0.012	0.022	0.015
2024	0.176	0.025	0.012	0.022	0.015
2025	0.175	0.025	0.012	0.022	0.015
2026	0.175	0.025	0.012	0.022	0.015
2027	0.174	0.025	0.012	0.022	0.015
2028	0.174	0.025	0.012	0.022	0.015
2029	0.173	0.025	0.012	0.021	0.015
2030	0.173	0.025	0.012	0.021	0.015
2031	0.172	0.025	0.012	0.021	0.015
2032	0.172	0.025	0.012	0.021	0.016
2033	0.172	0.024	0.012	0.021	0.016
2034	0.172	0.024	0.012	0.021	0.016
2035	0.172	0.024	0.012	0.021	0.016
2036	0.171	0.024	0.012	0.021	0.016
2037	0.171	0.024	0.012	0.021	0.016
2038	0.171	0.024	0.012	0.021	0.016
2039	0.171	0.024	0.012	0.021	0.016
2040	0.171	0.024	0.012	0.021	0.016
2041	0.171	0.024	0.012	0.021	0.016
2042	0.170	0.024	0.012	0.021	0.016
2043	0.170	0.024	0.011	0.021	0.016
2044	0.170	0.024	0.011	0.021	0.016
2045	0.170	0.024	0.011	0.021	0.016
2046	0.170	0.024	0.011	0.021	0.016
2047	0.170	0.024	0.011	0.021	0.016
2048	0.168	0.024	0.011	0.021	0.016
2049	0.168	0.024	0.011	0.021	0.016
2050	0.168	0.024	0.011	0.021	0.016
2051	0.168	0.024	0.011	0.021	0.016
2052	0.168	0.024	0.011	0.021	0.016