

**ZERO**  
**WASTE**  
**CAMBRIDGE**

Draft Zero Waste Master  
Plan

Draft Report

*City of Cambridge, MA*  
January 25, 2019



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- Appendix B: Phase 1 Organics Report
- Appendix C: Enhancements to the Current Waste Management System and Additional Options for Consideration for the ZWMP
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- Appendix E: Results of the Curbside Collection Survey (Standardized Trash Barrels, Recycling and Organics set-outs)
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# 1 Introduction

The City of Cambridge (the City) has embarked on a path to Zero Waste to build upon its current waste management system and programs. The development of a Zero Waste Master Plan (ZWMP) and strategy is intended to assist with achieving the City's goals of reducing waste and greenhouse gas emissions. The recommendations developed for the ZWMP are intended to support the Department of Public Works' (DPW) guiding principles of providing high-quality public services, protecting and supporting the health of employees and the public, managing costs and reducing trash.

Definitions of 'Zero Waste' vary. The concept adopted by the City of Cambridge is that Zero Waste is a long term goal that envisions that after waste reduction and reuse, all remaining discarded materials would be destined/designed to become resources for others to use. This is generally consistent with the definition applied by organizations like the Zero Waste International Alliance.<sup>1</sup> Achieving Zero Waste will take time, and engagement of all level of society including government and private sector entities as well as people in their everyday activities.

The purpose of the ZWMP is to:

- Meet the City's waste reduction goals (discussed further below).
- Continue to maintain high quality public services.
- Maximize operational efficiency by making careful choices which offer both environmental benefits and cost control.
- Protect employee health & safety through the selection of approaches that can reduce risks to staff.
- Reduce GHG emissions through waste diversion and program design.
- Reduce costs by diverting materials from trash and effective diversion program design.

The development of the ZWMP was undertaken in three phases.

- Phase 1 of the project involved documenting the City's current waste management system, including services provided, quantity and type of materials managed by the City, service providers and associated contract provisions, and waste composition. This is documented in Appendix A. An assessment of implementing an expanded organics program in the City was conducted. Furthermore, recommendations were made for the

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<sup>1</sup> Zero Waste International Alliance, <http://zwia.org/standards/zw-definition/>

expansion of the organics program. This is documented in the Technical Memoranda provided in Appendix B.

- Phase 2 outlines possibilities and recommendations for the City to reach their waste reduction and GHG emission reduction goals. A review and analysis of other aspects of the City's waste management system, with consideration of relevant policies, programs and infrastructure was undertaken to develop the long list of enhancements to the current waste management system and to identify additional options for consideration for the ZWMP. The results of Phase 2 are documented in the Technical Memoranda in Appendix C and a comparative analysis of these options is provided in Appendix D.
- Phase 3 involved undertaking more in-depth analysis of current trash, recycling and green-bin curbside set-outs in the City, to assist in determining the approach that could be used for standardized trash containers in the City. Phase 3 also included undertaking public consultation regarding the draft ZWMP recommendations through a Public Open House held on December 18, 2018 and a meeting with the Cambridge Recycling Advisory Committee (RAC) held on December 19, 2018. The results of the standardized trash survey are documented in the Technical Memoranda in Appendix E. The public consultation feedback is discussed further in the body of this report.

The purpose of this report is to summarize and document the findings of the Study and to recommend ZWMP options for implementation.

This ZWMP provides an overview of the challenges and opportunities associated with a long term waste management strategy, a discussion on the recommended options, and the impact of the recommended options on the DPW workforce, GHG emissions, overall performance and finances. Recommendations on implementing the options, monitoring and reviewing the system are also provided.

This document represents a 'road map' for the City and is intended to be a living document that will be monitored regularly and updated on a regular basis (as discussed in Section 14).

## 2 Overview of the Current Waste Management System

The City of Cambridge currently provides an extensive range of waste management services to all residents, regardless of housing type. The City is also unique in that they have a public/private split in provision of waste collection services. The City collects trash from residential sources using City forces, and contracts for collection of recyclables and other materials with the private sector. Waste processing and/or disposal is also contracted to the private sector. The majority of commercial collection services are provided by the private sector. One exception is that the City began a Small Business Recycling Pilot in November 2018 to collect recycling from 125 small businesses at no cost to them.

Citizen satisfaction surveys consistently indicate the majority of residents rate City collection services for trash and recycling as “excellent or good”. The 2016 survey had one of the highest ratings with 93% of residents ranking trash collection as “excellent or good” and 90% of residents ranking recycling collection as “excellent or good”<sup>2</sup>.

Cambridge is an attractive place to live as evidenced by its growing population. The City’s population in 2015 was estimated to be 110,402<sup>3</sup> and by 2030 it is expected to be 118,625<sup>4</sup>, living in approximately 50,000 households. The City currently provides trash and source separated organics collection service to approximately 10,800 buildings and 32,000 households and recycling collection service to approximately 11,000 buildings and 45,000 households.

The City provides the following services as summarized in Table 2-1.

**Table 2-1: Waste Management Services Provided by the City**

Material Stream	Collection Frequency	Service Provider	Collection Details
Trash	Weekly	City Staff	Residents provide their own container. Manual collection.
Recycling	Weekly	Private Service Provider	Single Stream, Cart-based, Semi-automated Collection. City provides carts.
Yard Waste	Weekly--Seasonal, April to Mid-December	Private Service Provider	Manual collection - paper bags or labelled rigid containers.

<sup>2</sup> Biannual Citizen Satisfaction Telephone Survey

<sup>3</sup> U. S. Census Bureau, QuickFacts, Cambridge City, Massachusetts

<sup>4</sup> Metro Boston 2030 Population and Housing Demand Projections, Municipal Report, Stronger Region Scenario: Population for Cambridge.



Material Stream	Collection Frequency	Service Provider	Collection Details
Curbside Organics	Weekly	City Staff	Manual collection. City provides containers.
Household Hazardous Waste (HHW)	4 Events	Private Service Provider	Events held in different areas of City. Residents bring material to events.
Waste Electronics	At curb, or by appointment	City staff	Collected at the curb by the City or brought to the Recycling Center.
Large Item Collection	At curb, or by appointment	City Staff	Collected at the curb on a scheduled basis, permits required for some items.
Recycling Center	Open three days per week	City Staff	Customers must drop-off material themselves.

### 3 Challenges & Opportunities

The City provides a comprehensive suite of waste management services to its residents which is beyond the level typically offered by municipalities, with service provided to both multi-family and single family residences. The City maintains some control and flexibility over its waste management program through provision of some services by City forces.

The City has implemented a number of progressive measures intended to increase diversion and/or reduce waste such as City ordinances banning polystyrene takeout containers, single use plastic bags and mandatory recycling. The City conducted a well-planned food scraps collection pilot from 2014-2018 and implemented a full-scale food scrap collection (otherwise known as source separated organics collection or SSO collection) program to buildings with 1-12 residential units in April 2018. The City has an opportunity to build on these initiatives with the implementation of the recommendations in the ZWMP and a continuation of their efforts to reduce waste and GHG emissions.

The City has a number of waste and GHG emission reduction goals that mirror State goals, as discussed in further detail in the following section. The Massachusetts Department of Environmental Protection (MassDEP) has a moratorium on new incineration or landfills for municipal solid waste (MSW). Increasingly, MSW is hauled to facilities outside the state where more capacity exists, as landfill capacity in Massachusetts dwindles with the impending closure of some of the largest landfills in the state. This is anticipated to contribute to increased costs to manage trash, and increases in GHG emissions through transportation. The diversion of materials through recycling or composting programs and other reduce/reuse initiatives could have increasingly better reductions in cost and greenhouse gas emissions. Dependence on export of

trash to other states also poses a potential risk should they not want to accept this exported waste.

The City conducted a pilot curbside food scraps collection program from 2014 through March 2018. The recent expansion of the program Citywide in April 2018 (buildings of 1-12 units) will contribute significantly to the City's waste and GHG emissions reduction goals. The City has a forward thinking and environmentally conscious population that have expressed interest in options that contribute to an aspirational goal of zero waste and development of a circular economy.

Other options considered as part of this study will further contribute to the City's waste reduction and GHG emissions reduction goals. Some options, such as a standard trash container, have the additional benefit of improving worker safety, reducing vermin and encouraging participation in diversion programs.

The City has carefully considered, and provided input into the selection of options for the Zero Waste Master Plan that are technically feasible, fiscally responsible and that contribute to the City's goals. Achieving these goals will contribute to the City's sustainability goals and will build awareness of waste as a resource.

## 4 Projected Long Term Needs and Goals

The City and the State of Massachusetts have set two waste reduction goals.

1. Reduce solid waste disposal by 30% by 2020 (from 2008 levels)
2. Reduce solid waste disposal by 80% by 2050 or before (from 2008 levels)

These waste reduction goals may be achieved through a combination of reducing, reusing, composting and recycling. The City's 2008 waste disposal rate was 22.8 pounds per household per week (lbs/hhld/week). The 2020 goal is 16 lbs/hhld/week and the 2050 target is 4.6 lbs/hhld/week.

Table 4-1 presents the tons of waste managed as of 2016 through the status quo program (i.e. diversion of recyclables and pilot food scrap program only).

Based on a waste audit conducted by the City, the tons of food scraps, compostable fibers and recycling<sup>5</sup> available in trash for diversion are indicated as these are the bulk of the materials that would be diverted through additional waste management programs. In theory, approximately 60% of the trash generated in 2016 could have been diverted through organics and recycling collection. In reality residents generally only place a portion of this material out for diversion.

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<sup>5</sup> Assuming trash is comprised of 33% food scraps, 8% compostable fibers, 18% recyclables.

**Table 4-1: Waste Generated in Cambridge (2016)**

Year	Tons of Material Generated			Total Tons of Waste Managed
	Trash	Recycling	Other divertibles	Total
2016	14,419	9,204	532	24,155

**Table 4-2: Estimate of divertible material in the Trash (2016)**

Estimated Tons of Divertible Material Available / Remaining in the Trash		
Food Scraps	Compostable Fibers	Recycling
4,768	1,190	2,608

The City and the State have set a goal of reducing GHG emissions by 80% by 2050<sup>6</sup>. Implementing the recommendations in the ZWMP will assist in decreasing the City's GHG emissions.

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<sup>6</sup> Relative to 1990 levels.

## 5 Recommended Options for the ZWMP

The following sections provide an overview of the recommended options for the ZWMP. Further details on the ZWMP options can be found in Appendices B and C and are compared in Appendix D.

### 5.1 Organics Diversion Program

The first phase of this study involved the development of recommendations for an expanded organics diversion program. The results are documented in Appendix B, Phase 1 Organics Report. The City used a lot of the recommendations to support the roll-out of the curbside food scraps collection program to all residences (1-12 units) in April 2018. The remaining residences (13+ unit buildings) will be added into the program beginning the Fall of 2019. The expansion of the program to 13+ unit buildings will take more time and effort than the initial roll-out, as it is necessary to work with building managers/supervisors to determine the containers and support needed for each building and as generally it can be more difficult to engage residents in larger buildings in organics programs.

The City provided kitchen containers and curbside collection containers to all residences for weekly collection of food scraps and compostable items (e.g. paper towels, napkins, flowers, etc.). The City collects this material with City forces using separate vehicles and transports this material to a facility owned by Waste Management where it is processed into a slurry. The slurry is hauled to the Greater Lawrence Sanitary District wastewater plant where it is co-digested anaerobically with sewage sludge.

The organics program has the potential to significantly reduce trash disposal by 4 to 5 lbs/hhld/week depending on the level of participation and capture rates that are achieved. Anaerobic digestion of the captured organics has the potential to reduce GHG emissions by approximately 1,800 MTCO<sub>2</sub>E annually compared to disposing of this material stream<sup>7</sup>.

Based on experience with other organics programs, and reflecting the feedback received through consultation on the draft ZWMP recommendations, it is recommended that the City continue to provide a robust promotion and education program to support the organics diversion program. This could include providing materials and hands-on support to trouble shoot issues that discourage people from using the program (e.g. fruit flies), educational awareness through the City's school outreach activities, and providing residents with more compostable bags

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<sup>7</sup> Represents the incremental change between the status quo (landfilling and incineration of organics) and anaerobic digestion (AD) of organics, based on the EPA's WARM (v14) model. It should be noted that the WARM model has some limitations with respect to accounting for AD end products (e.g. upgrading biogas and soil carbon sequestration when the digestate/biosolids from the WTP are land applied).

through public events etc. The curbside audit undertaken in the fall of 2018 (see Appendix E for more detail) found that generally participation in the curbside organics program was less than 60%. Promotion and education, coupled with trash disincentives (see below) will be essential to boost participation and increase capture of organics for diversion.

It is recommended that once the organics diversion program has been rolled out to all residences in the City and residents have had an opportunity to adjust to the new program, the City should consider a change to the current ordinance regarding recycling to include diversion of food scraps and compostable fibers. Achieving high participation and capture rates for organics collection will depend on a number of factors including ongoing public education and disincentives for placing organic materials in the trash. From a policy perspective, mandatory organics diversion under ordinance is an element of encouraging participation in the program and is consistent with the approach used by the City to encourage recycling. It is recommended that the City monitor participation in the organics program and review the requirement for a change to the ordinance requiring mandatory organics diversion as part of the five year ZWMP review.

Processing of the current organics stream is undertaken in two stages. The curbside organics are currently received by the CORE facility in Charlestown which pre-processes the material into a slurry that is sent to the Greater Lawrence Sanitary District in North Andover. This organic material has higher energy value and increases biogas production. The current processing contract expires on April 1, 2021. MassDEP has tracked the increase in organics processing capacity statewide. The City should explore all options for organics processing in late-2020 in anticipation of contract expiration.

## 5.2 Trash Disincentives

Trash disincentives are program elements with significant potential to reduce waste disposal and encourage participation in diversion programs. The options considered for the City included a standard size trash container, pay-as-you-throw (PAYT), clear bag programs and reduced frequency of trash collection (i.e. every other week). An assessment of these approaches was carried out to determine the approach which in the near term would best fit the City's needs. This is documented in Appendix C.

Based on this assessment, it is recommended that the City consider providing a standard trash container to residents as the preferred trash disincentive as this approach:

- Reduces potential for vermin;
- Increases worker safety as containers can be emptied with semi-automated collection compared to manual collection;

- Has potential for decreased workers compensation claims with better ergonomics and reduced lifting of containers/bags;
- Increases collection efficiency with a reduced number of containers;
- Improves aesthetics of sidewalks with fewer containers at the curb and with a smaller footprint,
- Reduces trash spillage; and,
- Will encourage participation in diversion programs.

As documented in Appendix E, an audit was undertaken in October 2018 to understand how much capacity (gallons) is currently used by residents when setting out trash. Other information that was collected included the quantity (lbs) of trash set out by each household, set-out rates and the capacity used for recycling, and the set-out rates and capacity used for organics.

The overall average quantity (in gallons) of trash set out in the survey was 26 gallons.



Figure 5-1 as follows, indicates the number of set-outs on each collection day that used different increments of trash container space. Generally it was found that in the Monday, Tuesday, Wednesday and Friday collection area, the average amount of trash per household that was set out for collection was 20 gallons or less (the Thursday average was around 30 gallons per household). In the order of 75% of all households audited set out less than 32 gallons of trash.



Figure 5-2 indicates the lbs of trash collected from each household during the audit. The results indicate some differences between the collection areas, and in particular differences between the Monday area which has had curbside organics collection the longest and other areas of the community. Residents in the Monday audit area set out on average just over 9 lbs of trash, compared to between 11 and 18.3 lbs of trash for the other collection areas. Overall, the average quantity of trash set out was just over 12 lbs per household. This indicates that the organics program in combination with the City's other diversion initiatives, has allowed residents to make some substantive progress towards achieving the goal of 16 lbs/household/week being sent to disposal by 2020.

Figure 5-1: Curbside Audit – Volume of Trash Container Space Used per Household

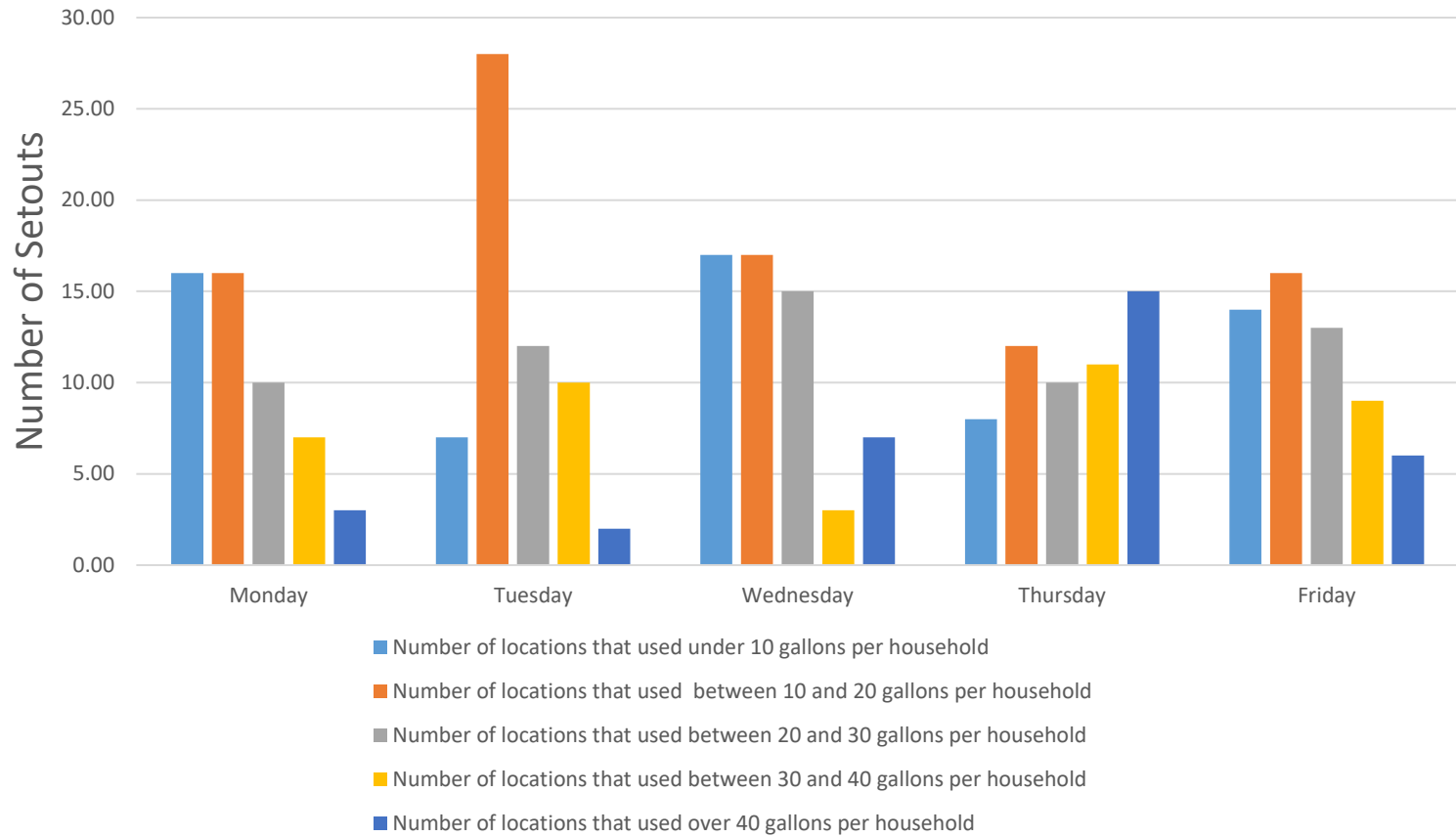
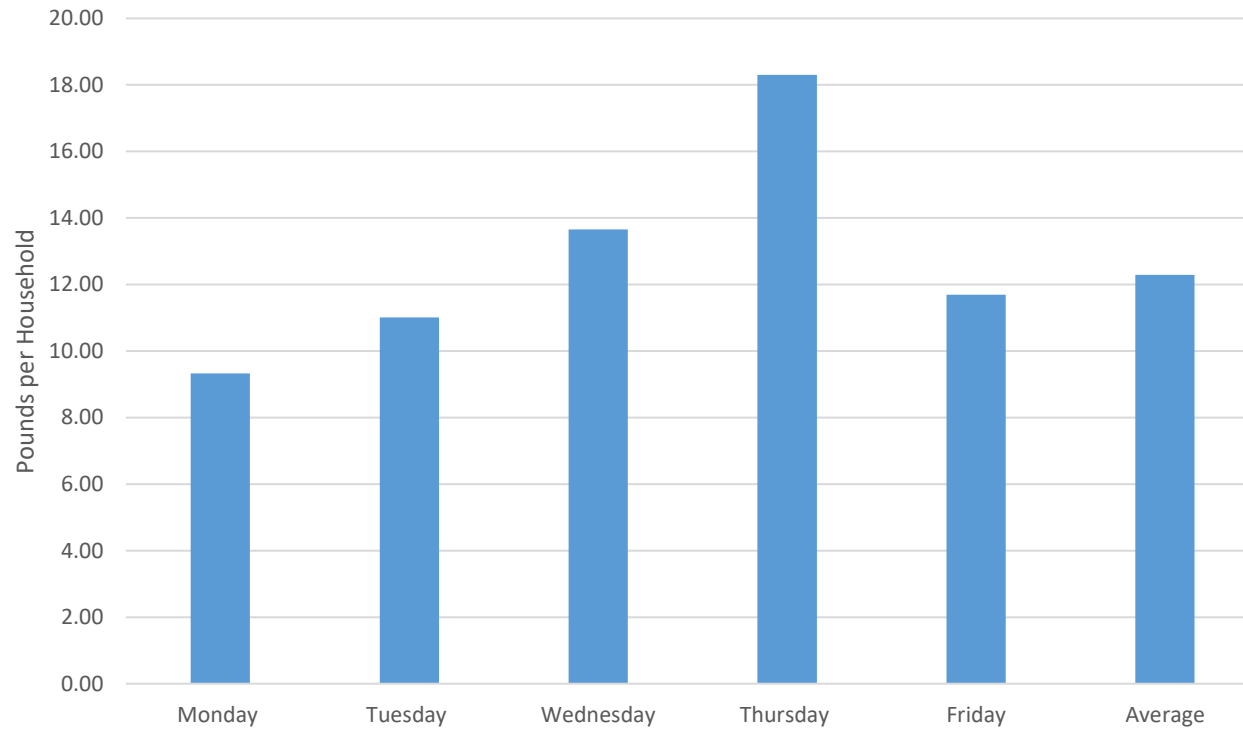


Figure 5-2: Curbside Audit - Average lbs of Trash per Household



It is recommended that, as an initial step, the City provide a trash container in the order of 32 gallons per unit/household. The trash container would be sized based on the number of households in each building (i.e. carts in increments of 32 gallons, and multiple carts as necessary) and reflecting household trash generation rates (compared to the current allowable setouts), tipper-compatible and made of reinforced plastic to deter vermin. The proposed capacity for the standard trash container should be sufficient to manage residential waste, without the need to provide regular excess or overflow capacity, to encourage waste reduction and use of the City's recycling and organics collection services. Feedback through public engagement in December 2018 indicated general support for providing a standard trash bin, although feedback indicated some concerns that there would be some higher volume households (e.g. homes with small children in diapers) that could require some additional trash capacity.

While Pay As You Throw (PAYT) was carried through the analysis in Appendix C and D, neither PAYT (for all trash) or PAYT for excess trash has been carried through as a recommended option as does not have the same potential for improved system performance as the standard container. It is not recommended that the City allow for provision of ways to manage excess waste through purchase of bag tags or specially marked bags as this will not encourage the same level of participation in diversion programs and could impact the City's efforts to reduce trash and GHG emissions as most residents would likely be willing to pay a small amount to dispose of waste that could otherwise be diverted. Instead, the City could consider a "double-up" day where residents would be allowed to put out one additional bag (i.e. one regular sized garbage bag) at no charge after holidays (e.g. Thanksgiving, Christmas) where some additional waste may be generated as an alternative. The City could also provide an opportunity for households with specific circumstances (e.g. homes with small children in diapers, homes with a higher than average number of residents) to sign up for an option to be provided with extra capacity for curbside trash. Households would have to contact the City for this option, and provide justification for this request. Eligibility would be based on a set of criteria, which would include their use of available diversion options.

It is anticipated that the City would implement a standard trash container program within the next three years, likely in FY21 following implementation of the expanded organics program to 13+ unit buildings.

As part of the 5 year review of the ZWMP, the City should review how residents are participating in the City's diversion programs by conducting another fullness/setout survey of curbside trash, recycling and organics containers to determine how resident's behavior has changed. The City could then consider if a further disincentive such as a shift to every other week trash collection to a) encourage participation in diversion programs if people are still disposing of divertible materials in the trash and/or b) reduce collection costs if residents are fully participating and have minimal trash requiring collection. Every other week

trash collection has the potential to offer savings in collection costs and would also reduce GHG emissions associated with transportation/collection of trash.

## 5.3 Recycling and Other Diversion Programs

Other options proposed to reduce waste and GHG emissions are related to reduction and reuse, modifications to existing recycling programs and/or new recycling programs and are discussed in greater detail below. Further details on these options are provided in Appendix C and a comparative analysis of these options is provided in Appendix D.

### 5.3.1 Reduction and Reuse Options

Waste reduction and reuse options have the potential to significantly reduce GHG emissions through avoidance of the need to extract resources, manufacture products, transport products to/from markets, and dispose of them. Some of these options already exist informally in the City; however, more formal support from the City could help make these options a regular or permanent option for residents. These options were discussed in depth and analyzed in Appendix C.

Considerable support for reduction and reuse options was provided during the consultation sessions in December 2018, over 1/3 of all comments provided were focused on options and concepts for reduction and reuse. The range of input provided included:

- Emphasis on promotion and education, particularly communication on current re-use opportunities, promotion of reusables to replace single-use materials, food waste reduction and events/forums to allow for sharing of ideas.
- Support for more Fix-It clinics.
- Support for additional ordinances to ban materials (e.g. plastic straws), policies and/or permit requirements to increase waste reduction at events, waste reduction during construction/demolition.

It is recommended that the City implement one or more of the following options;

- Continuing to support food waste reduction to raise awareness about food waste and encourage participation in actions to reduce food waste.
- Help enhance online exchange of goods via NextDoor, Facebook, and other online platforms that support reduce and reuse.
- Continuing to support Fix-It clinics.
- Continuing to support reuse events to keep gently used materials (furniture, toys, clothing) from disposal, including events geared to promote/advertise reuse and reduction activities.

- Exploring opportunities to support waste exchange of reusable items such as arts and crafts, school and office supplies, construction and demolition waste, used bicycles, sports equipment, tools etc., through partnerships with existing organizations or at a location such as the Recycling Center.

These options are important to encourage and reinforce the concept of waste reduction and reuse to residents and to support the circular economy, rather than disposing of items in a linear fashion. While the trash reduction potential for these approaches is not as great compared to some of the other recommended options, the GHG emission potential and societal benefits can be greater than recycling and composting options as these approaches avoid more of the elements of the production/supply chain than recycling. These options generally have minor effects on financing of solid waste programs as they require primarily some staff time for support and associated promotion and education costs. It is likely that an additional staff position may be required to support expansion of reduction and reuse initiatives as well as to support the other programs noted below.

### 5.3.2 Improvements to Curbside Recycling

The City's curbside recycling system collects an extensive list of materials, and has been a centerpiece of the City's overall diversion program. In recent years, there have been two key shifts that have affected both the cost and diversion performance of the system. First, markets for recovered recyclable materials have been affected by market changes that have tightened quality requirements by specifying lower contamination rates. Second, contamination rates in the curbside recycling stream have increased. Contamination rate increases reflect the broader spectrum of materials that households are managing.

City audits indicate that 40% of recycling carts have moderate to major contamination. The result for the City is that it is currently paying \$70 per ton for curbside recycling, versus \$35 per ton, as a result of excessive contamination (Note: the base rate increased to \$35 per ton in 2018 at low contamination rates, due to issues with recycling markets). The higher cost reflects the level of effort to remove and manage contaminants such as plastic bags, paper towels, take-out containers, textiles etc.

There are few/no materials that the City could add to its program that currently have markets. The focus for recycling, should be on capturing the recyclable materials that are still being lost to trash (over 2,400 tons a year) and reducing contamination rates to 7% or less.

It is recommended that the City expand its promotion and education program to encourage effective curbside recycling. Public feedback in December 2018 offered a number of suggestions including:

- Providing focused campaigns (i.e. one month target one contamination culprit and a different one the following month) versus complex ads/materials.
- Using pictures rather than icons to help people recognize what they should and shouldn't put out for recycling.
- Refusing to remove carts with contamination.
- Providing an 'indoor' container (e.g. reusable bag) with pictures of acceptable material to show people what they should take out for recycling.

The curbside audit undertaken in October 2018 indicated that 90% of addresses set out their recycling cart for collection. Nearly 50% of the recycling carts were full or overfull on average. Areas with lower quantities of trash set-out (e.g. Monday) had over 60% of their recycling carts full or overfull. As the City moves to implementing a standard trash container program, the City should continue advertising additional carts for recyclables, which are free from the City.

### 5.3.3 Enhancements to the Recycling Center/Mobile Collection

The City should consider the role / function of the existing Recycling Center based on the evolution of the City's diversion programs.

Although the Recycling Center currently provides an outlet for diversion of materials such as organics, recyclables (including corrugated cardboard), the limited hours and shared space with DPW vehicles/ staff and the public are not ideal. Changes to the City's waste management programs, (citywide food scraps collection, commercial recycling and electronics management) will reduce the amount of the materials that would be managed at the Recycling Center. One option that the City could consider is reconfiguring the Recycling Center, focusing on material streams for which there is no curbside collection option such as reusable materials, scrap metal, waste electronics and certain household hazardous materials (batteries, smoke alarms, fluorescent light bulbs).

Reconfiguring the Recycling Center layout is not expected to be capital intensive but would draw upon City resources for design and execution of a plan.

An alternative would be close the Recycling Center to public access, and to instead develop a mobile recycling center service for materials such as small electronics, HHW, small appliances etc. With a large proportion of the population lacking a convenient way to bring divertible materials to the Recycling Center, mobile collection would provide more accessibility and encourage participation in the programs. The City could use some space at the DPW yard to consolidate various materials to send to market. This would increase safety to the public and City staff as well as use the existing space at the DPW yard more efficiently.

The following images present examples of mobile collection options for various waste streams.

**Figure 5-3: Mobile Recycling Center Options**

		
<p>Mobile E-waste Collection Trailer (Tulsa)</p>	<p>Mobile E-waste Collection Trailer (Canada)</p>	<p>Mobile recycling station (Canada)</p>
		
<p>Container to collect small electronics and appliances (Switzerland)</p>	<p>Mobile HHW Collection Center (Germany)</p>	<p>Mobile HHW Collection Center (Germany)</p>

A mobile collection unit could be scheduled to provide service in various parts of the City on a rotating basis in order to provide more convenient and regular access to diversion options for residents, particularly those without a car. It is recommended that the City consider the role and purpose of the Recycling Center at the DPW yard in 2020 based on use of the center and performance of the City's other diversion programs, and consider implementing a mobile recycling center in the next 3 to 4 years.

### 5.3.4 Textile Recycling Program

Although there are various informal textile collection locations across the City, there is still a significant quantity of textiles that end up in the trash. It is estimated that around 80 pounds of textiles per person are disposed by residents of the U.S. each year. Residents dispose of textiles in the trash because they consider the items not reusable (torn, ripped etc.) or because it's easier than transporting them to a textile recycling location. There is potential for GHG emissions reduction with avoided methane emissions from landfill and through



reduced manufacturing of new products associated with avoided emissions of textiles being disposed.

It is recommended that the City develop and implement a textile recycling strategy in 2020/2021, which would build on the current system to divert additional materials (e.g. worn clothing, shoes, handbags) from disposal. There are a number of organizations that offer textile collection programs, either curbside or at dedicated collection points, with whom the City could partner to reduce the required level of effort to roll-out its own program. For example, the City could enter into a contract for a textile collection service like the service provided by Simply Recycling in the City of Somerville and Town of Brookline. This service uses easily identified pink plastic bags that residents can use to place clothing and other household textiles along with other small household items at the curb for collection on their regular trash collection day. Bags are initially provided at the start of the program, and replacement bags are provided when materials are collected, at City locations, or upon request.

### 5.3.5 Mattress Recycling Program

Recycling more mattresses would keep these difficult to manage, bulky materials out of landfills and incinerators and reduce GHG emissions through the recycling of metal, textiles, and wood.

MassDEP has offered grants to encourage municipalities to collect mattresses and make mattress recycling a viable business. The City has applied and was awarded a partial grant for processing of residentially generated, source separated mattresses, but would have to collect and store mattresses separately.

Currently, mattresses are managed as trash at the curb. It is recommended that the City implement mattress recycling within the next year (2019) while funding is available.

### 5.3.6 Carpet Recycling Program

Carpet is another waste stream that is bulky and difficult to manage and that if diverted, offers the option to further reduce waste sent to disposal. While carpet recycling is an approach that has been implemented in other North American jurisdictions, at this time it does not appear that there is any grant program through MassDEP nor have any vendors been identified that offer service to collect and/or process used carpets for recycling/recovery within or near the City. It is recommended that the City monitor opportunities for recycling this material as processors come online and markets develop. This option should be revisited as part of the next update of the ZWMP.

### 5.3.7 Waste Electronics Recycling Program

There are currently several options for residents to properly dispose of waste electronics, including through take-back/recycling programs offered by vendors,

at the Recycling Center and curbside collection by the City. Depending on how/when some of the ZWMP options are implemented, the City could consider changes to how electronics are managed. Electronics could be managed through mobile recycling collection, or in combination with other events such as HHW collection events or locations (e.g. bottle depots or ecoATMs). It is recommended that the City monitor how electronics can be best managed through other ZWMP options and revisit this topic at the five year ZWMP review.

## 5.4 Summary of Recommended Options

The following table provides an overview of the recommended options and their timing.

**Table 5-1: Summary of Recommended Options**

Option	Recommendation	Timing
Organics	Expand organics program to all residents on City's trash collection routes.  Continued promotion and education.  Monitor participation in the organics program and consider a mandatory diversion ordinance at the 5 year review.	13+ units – late 2019, early 2020  Post-expansion of program and at 5 year review (2023)
Trash	Provide a standard trash container in the order of 32 gallons per household. Provide a mechanism for occasional excess trash.	Early 2021
Reduce/Reuse	Continue to support reduction/reuse activities in the community including Fix-It clinics, reuse events, food waste reduction, and waste exchange/swaps.	2019 and ongoing
Curbside Recycling Program Improvements	Increase promotion and education, and curbside enforcement to improve capture of target materials and reduce contamination.  Continue providing additional recycling carts when implementing the standard trash container program	2019 and ongoing  Early 2021

Option	Recommendation	Timing
Recycling Center	Consider reconfiguration or repurposing the Recycling Center to focus on collection and/or consolidation of specific materials.	2020
Mobile Recycling Center	Provide mobile collection of materials such as small electronics, HHW, small appliances.	2020/2021
Textile Recycling	Develop and implement a textile recycling strategy either run by the City or in partnership with an existing organization.	2020/2021
Mattress Recycling	Collect mattresses and recycle them by a vendor identified by MassDEP through their grant program.	2019
Carpet Recycling	Continue to monitor opportunities to divert carpet.	2027/2028
Waste Electronics Recycling Program	Potentially adjust this program based on performance of other programs (recycling center, mobile collection)	2025/2026

## 6 Commercial Recycling Collection

The City launched a pilot program for 125 small businesses in November 2018. The businesses that the City provides recycling collection service to are smaller retail stores such as coffee shops, restaurants and general retailers. Participants in the program receive twice weekly collection of up to 3 recycling bins.

If the small commercial sector is provided with curbside recycling collection, it is anticipated that the City would see a significant decrease in the number of visits to the Recycling Center and volume/tons of corrugated cardboard generated by small businesses and dropped off at the Recycling Center.

If the Pilot expands, it is recommended that the City hire a dedicated program manager to oversee the commercial recycling program, responsible for coordination, education, outreach and enforcement.

## 7 Promotion and Education

All of the recommended options will require a promotion and education (P&E) campaign to support. In particular, the introduction of curbside organics will require ongoing and consistent outreach to help the community adjust to a new curbside waste diversion program.

The City has plans to overhaul their website and developed a “Get Rid of It Right” app to complement information available on its website.

In the first 9 months of installation, more than 30,000 residents have used the “Get Rid of It Right” search toolbar 130,000 times.

Ongoing P&E campaigns are crucial to ensuring residents are aware of programs and are participating fully in the programs and services offered by the City. This engagement is crucial to the City achieving its waste reduction and GHG emission targets.

As noted previously, a substantive part of the feedback provided by the public in December 2018, focused on promotion and education as a critical element of the City’s waste diversion programs. The range of suggestions overall as noted by participants in the public open house and the Recycling Advisory Committee (RAC) included:

- More engagement in developing zero waste curriculum in schools
- More opportunities for face-to-face engagement including use of volunteers, community discussions/debates, involvement with neighbors, community events
- Educational programs/initiatives targeting small businesses
- Promotion of community swaps, Fix-It events
- More tips on how to avoid problem materials (e.g. how do I use less plastic)

The ability of the City to expand and enhance promotion and education programs is linked to staff resources (see below) as it takes effort to develop and implement these initiatives. Assistance and participation from the public will be essential in supporting these programs, including an evolution in the role of the RAC to be engaged in delivering promotion/education programs.

## 8 Workforce Evaluation

The Department of Public Works (DPW) administers all waste materials management programs in the City. The Solid Waste Division is comprised of the following three divisions: Recycling, Rubbish and Street Cleaning.

The Recycling Division has six full-time employees (a director, two program managers, two inspectors, and an administrative assistant), and three part-time employees who are responsible for the City’s diversion programs and the Recycling Center. Collection of recyclables and yard waste is contracted out to a private service provider.

The Rubbish Division provides weekly curbside collection of trash from residences, public buildings, schools and some non-profit organizations. Collection of trash is undertaken by City of Cambridge staff, using six, three-person rear packers. Two trucks with two people on each truck collect organics curbside from 25,000 households, 14 schools, and 8 other locations. Collection of large, bulky items from residents and four household hazardous waste collection events held annually are also provided by the Rubbish Division. This division also is responsible for oversight and enforcement of the City’s Refuse and Litter Ordinance. The City is currently providing small business recycling collection service using a private service provider.

The Street Cleaning Division is responsible for maintaining streets and sidewalks, as well as cleaning public area trash and recycling receptacles and removing graffiti using City staff.

Table 2-1 presents the breakdown of the current staffing complement and potential new staff positions that could be required over the next five years. Additional driver laborers may be needed for expansion of organics collection to 13+ unit buildings.

Based on review of the current staff capacity and existing programs, and the increased staffing demands associated with the ZWMP recommendations, it is recommended that the City increase the staff support for Diversion programs. In the order of 2 full time positions will likely be necessary to adequately support the proposed program expansions. This will include:

- Hands-on support for the expansion of organics collection to 13+ unit buildings.
- Development and roll-out of the standard trash container program.
- Expanding waste reduction & reuse activities.
- Developing and implementing a mobile recycling center and textile recycling programs.
- Enhanced promotion and education programs.

**Table 8-1: Staffing Complement**

Environmental Services Manager	
Diversion Programs	Trash/Rubbish Programs

- Recycling Director
- 2 Program Managers
- 3 Recycling Program Assistants (recycling/compost outreach, operations)
- 1 Recycling Center Monitor
- \* New – Waste Reduction Coordinator(s) - 2
- Supervisor of Solid Waste Operations
- 4 Supervisors
- Sweeping – 17 driver/laborer
- Collection – 19 driver/laborer
- Graffiti/Power Washing – 2 driver/laborer
- Public Area Bins – 4 driver/laborers
- Organics – 4 driver/laborers (additional driver/laborers may be required for expansion to 13+ unit buildings)

## 9 Greenhouse Gas (GHG) Emissions Inventory

During the development of the ZWMP, GHG emission estimates were developed based on two approaches:

1. An inventory of the GHG emissions associated with the current waste management system in the City was developed based on guidance provided by the Protocol for Community-Scale Greenhouse Gas Emissions Inventories for applicable waste subsectors. GHGs in the inventory were calculated based on an average landfill gas emission factor; Environmental Protection Agency (EPA) Center for Corporate Climate Leadership published emission factors for mobile sources; and EPA Waste Reduction Model (WARM) for landfilled and incinerated tonnages. The results of the GHG emission inventory exercise is discussed below.
2. The potential for changes in life-cycle GHG emissions with the implementation of new diversion initiatives, associated with the reduction, reuse and recycling of materials compared to trash disposal, were developed for each option based on application of the US EPA WARM model (v14). Those results are discussed in Section 10.

The primary difference between the GHG emission inventory and the life-cycle GHG emissions calculations is that the inventory looks at actual emissions on an annual basis from emission sources like trucks collecting and hauling waste, carbon dioxide and other emissions from incineration, and methane emissions from landfill; while the life-cycle GHG emissions also factor in the GHG emission reductions or off-sets that come from reducing, reusing, recycling materials and recovering renewable energy. The GHG emission inventory indicates that there are direct emissions of GHG's to the environment associated with waste transportation and disposal, while the life-cycle GHG analysis indicates that these emissions can be more than off-set by the avoidance and recovery of materials and energy through diversion.

### 9.1 Baseline GHG Emission Inventory

GHG emissions were estimated for the period from 2012 to 2016 for direct transportation of waste materials, indirect transportation of materials and emissions from waste management facilities including anaerobic digestion, composting, landfill and waste to energy (WTE). As noted above, this inventory was developed based on guidance provided by the Protocol for Community-scale

Greenhouse Gas Emissions Inventories for applicable waste subsectors. The outcome of the inventory is presented in the following table.

**Table 9-1: GHG Emission Inventory 2012 to 2016 (metric tonnes CO2e)**

	2012	2013	2014	2015	2016
<b>Direct Transportation (City Collection Fleet)</b>	230	238	280	286	266
<b>Indirect Transportation (Contracted Collection and Transfer)</b>	419	546	552	550	549
<b>Waste Management Facilities (Landfill, Organics Processing, WTE)</b>	12,753	10,731	10,614	10,615	10,654
<b>Total</b>	13,402	11,515	11,446	11,451	11,469

## 9.2 Impact of Recommendations

The potential impact from implementing the recommended options on the GHG emission inventory was extrapolated over the period from 2017 to 2030, based on potential changes in tons managed in the waste management system. It was not possible to estimate potential changes in the direct and indirect transportation emissions over time, however it is not anticipated that there would be substantive changes in these emissions, and they only represent in the order of 7% of the current inventory.

Implementation of the recommended ZWMP options, is anticipated to reduce the inventory of emissions from waste management facilities by in the order of 6,000 MTCO2e by 2030, a reduction of 58% compared to 2016, primarily as a result of the decrease in tons of waste disposed. An interim goal of 50% GHG emission reduction compared to 2016 levels would appear to be a reasonable and achievable target for the City.

These estimates do not account for all potential life cycle GHG emissions associated with the reduction, reuse and recycling of materials. The overall potential change in life cycle GHG emissions was calculated and is presented in Section 10 below.



## 10 Projected Diversion and GHG Performance

The trash disposal rate as of 2017 was approximately 17.5 lbs/hhld/wk. The roll-out of the curbside organics program is expected to achieve significant progress towards the 2020 goal of 16 lbs/hhld/wk. It is anticipated that once the curbside organics program is more mature, it should be able to reduce the trash disposal rate by 3 to 4 lbs/hhld/week.

The next major program change, implementation of a standard trash container, is expected to lower this rate even further by approximately 3 lbs/hhld/wk. Implementation of the rest of the reduction/reuse/recycling options as discussed in Section 5.3, are expected to result in more modest reductions in trash disposal. However, these options are estimated to produce the largest incremental GHG emission reductions<sup>8</sup>.

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<sup>8</sup> As modelled using the EPA's Waste Reduction Model (WARM v14)

Figure 10-1 presents the estimated change in trash disposal rates with implementation of the recommended programs. Actual change will depend on participation in the diversion programs, and the capture rates for targeted materials for diversion.

This figure shows the 2020 and 2050 trash disposal goals as well as the impact on the trash disposal rate with implementing the identified options. The trash disposal rate is estimated to decrease from 17.5 lbs/hhld/week in 2016/2017 to approximately 9.4 lbs/hhld/week as of 2030 with implementation of all options.

It is estimated that there would be an overall reduction in GHG emissions of approximately 5,000 metric tonnes of CO<sub>2</sub> (MTCO<sub>2</sub>E) with the implementation of the organics program and standard trash container options and an estimated overall GHG reduction of approximately 20,000 MTCO<sub>2</sub>E by 2030 with implementation of all recommended waste diversion options compared to landfilling/incineration.

Achieving these waste and GHG emission reduction estimates depends on participation and uptake of the recommended options by residents. Continued promotion and education will be crucial to encouraging participation in order to achieve the capture rates assumed for the development of the waste and GHG reduction estimates.

**Figure 10-1: Change in Trash Disposal with New Programs**

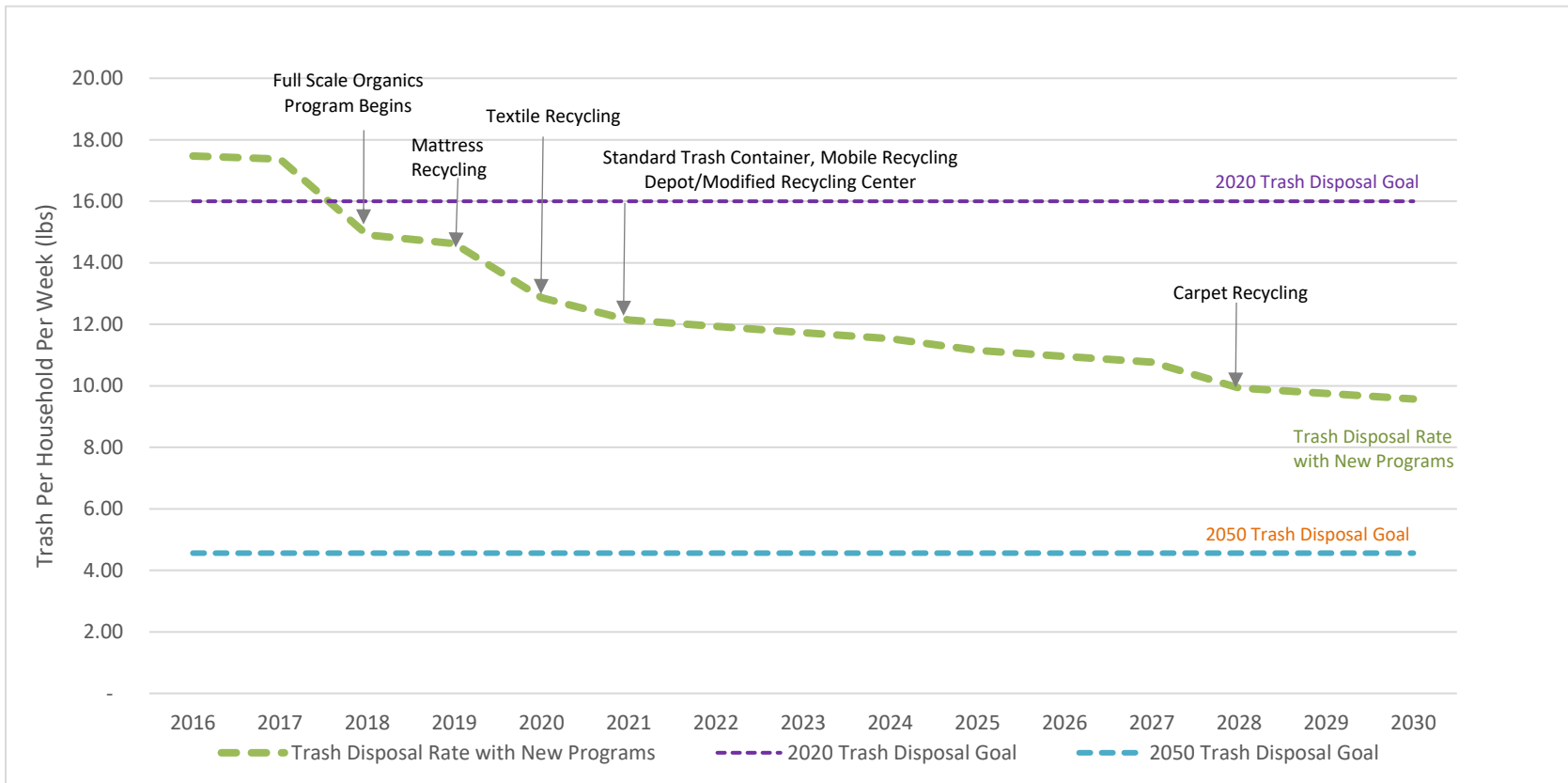
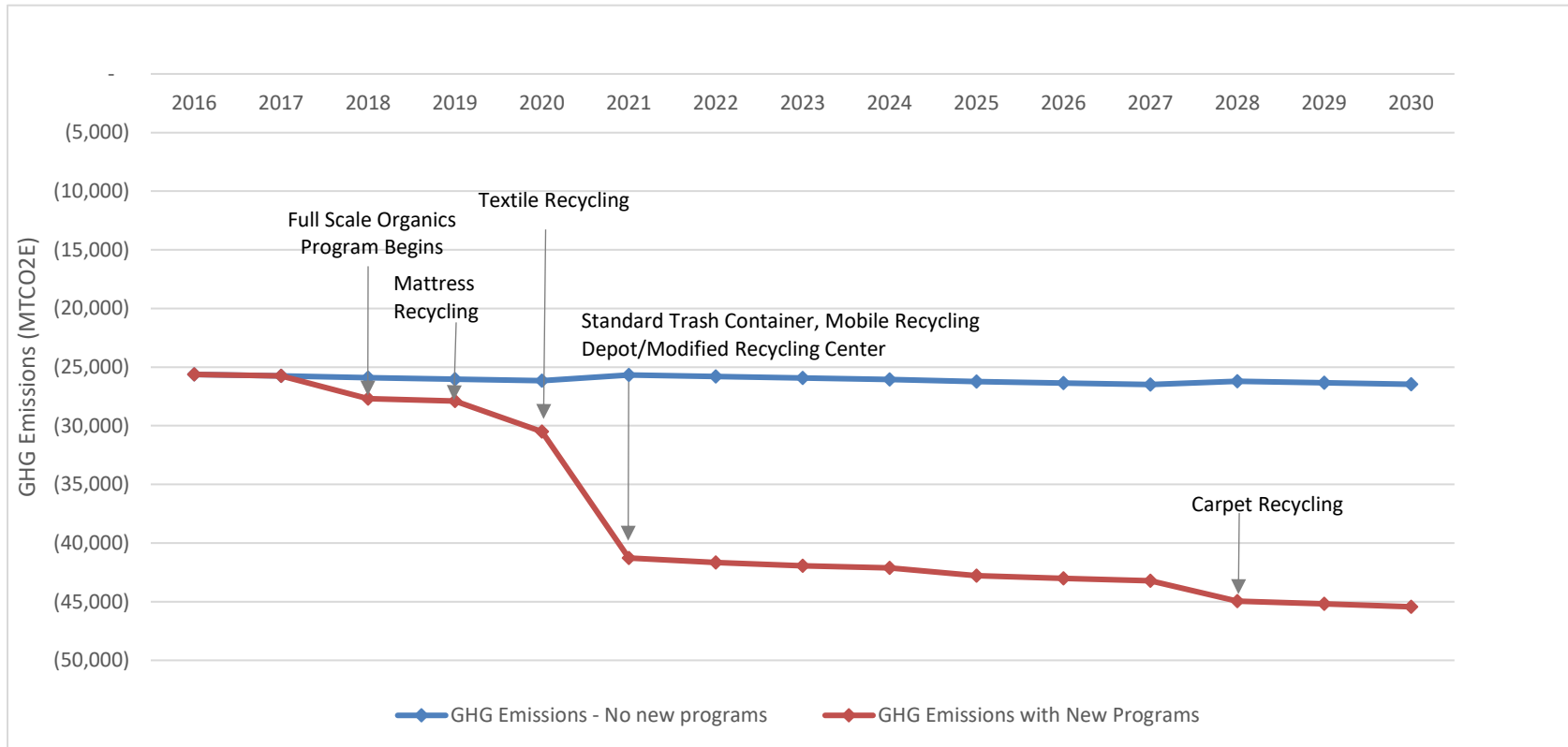


Figure 10-2: Change in GHG Emissions with New Programs<sup>9</sup>



<sup>9</sup> As modelled using the EPA's Waste Reduction Model (WARM v14)

# 11 Financial Summary

## 11.1 Program Costing for Recommended Options

The following table summarizes the potential costs and savings associated with the recommended options.

**Table 11-1: Summary of Potential Costs**

Recommendation	Potential Cost Increases	Potential Cost Savings
Standard Trash Container	<ul style="list-style-type: none"> <li>Promotion and education campaign.</li> <li>Direct cost to the City to purchase and distribute containers in the order of \$40 to 45 per household, or around \$1.2 - \$1.5 million.</li> </ul>	<ul style="list-style-type: none"> <li>Potential decrease in waste management fees as more people will compost and recycle which costs less per ton</li> </ul>
Reduction/Reuse Activities	<ul style="list-style-type: none"> <li>One new shared staff position with other additional recycling initiatives</li> <li>Additional P&amp;E costs anticipated in the order of \$2 to \$3/hhld shared with other recycling initiatives.</li> </ul>	<ul style="list-style-type: none"> <li>Potential for small decrease in diversion processing and/or trash disposal costs</li> </ul>
Mattress Recycling	<ul style="list-style-type: none"> <li>Shared staff and P&amp;E costs</li> <li>City is eligible for grants to recycle mattresses.</li> <li>Costs associated with collecting mattresses for removal.</li> </ul>	<ul style="list-style-type: none"> <li>Potential decrease in trash disposal costs and \$25/mattress surcharge from trash disposal contractor.</li> </ul>
Carpet Recycling	<ul style="list-style-type: none"> <li>Shared staff and P&amp;E costs</li> <li>It is unknown at this time if grants/funding for recycling would be available.</li> </ul>	<ul style="list-style-type: none"> <li>Potential decrease in trash disposal costs.</li> </ul>
Enhanced Recycling Program and/or Recycling Center	<ul style="list-style-type: none"> <li>P&amp;E campaign</li> <li>Some staff time required to implement changes to Recycling Center.</li> <li>The capital costs to change the Recycling Center (small, could vary based on approach)</li> <li>Mobile recycling depot capital costs vary based on design (\$100,000 to \$250,000 or more).</li> <li>The potential operating costs for a mobile depot will depend on the frequency of operation. This could be operated at an additional cost to the Recycling Center or if operated in-lieu of the Recycling Center there may be little or no net change in costs.</li> </ul>	<ul style="list-style-type: none"> <li>Potential decrease in trash due to more accessible and welcoming Recycling Center.</li> </ul>

## 11.2 Impacts to MSW Tipping Fees

The trend towards decreasing landfill capacity in Massachusetts is anticipated to result in increased MSW tipping fees as demand outstrips supply. Already, tipping fees in the Northeastern U.S. are higher than in other parts of the country and are expected to continue to increase as capacity decreases. Concurrently, hauling fees are also expected to increase as waste needs to be transported longer distances to landfills located farther away. It is expected that tipping fees at Waste-to-Energy facilities will increase as their capacity replaces landfill capacity. The City has estimated the disposal fees could escalate by approximately 20% with future contracts.

At present, tipping fees for diversion programs are significantly less than trash tipping fees. Current Recycling and organics tip fees are approximately \$35/ton (\$70 per ton for loads with excess contamination) and \$60/ton, respectively. The trash tipping fee is approximately \$100/ton. It is anticipated that tipping fees for trash will continue to increase in the near future. Recycling tip fees have the potential to increase with the next recycling contract, as the net cost of recycling is increasing due to material market issues (see below). Compost tipping fees don't appear to be changing much in the immediate future. However it is anticipated in the foreseeable future for the City that the tipping fees for recycling and composting will remain less than trash tipping fees.

## 11.3 Market Revenue Potential

As this plan was developed, the global economy with respect to recycling markets has had significant changes, as the Chinese government implemented new policies under the "National Sword" program which restricts imports of various grades of recycled paper and plastic unless very high quality standards (0.5 % contamination rates) are met. It is difficult to know what the long-term implications of this program will be on the U.S. recycling market and potential revenue. The City is fortunate to have a long-term contract with their processor which should cushion major swings in the marketplace until a more stable market is established. However, it is possible at least in the longer term that shifts in the recycled material market could result in the City paying a higher price for recycling. The City is likely to continue to see significant price differentials for loads that meet or exceed contamination rates, emphasizing the need for promotion and education and recycling collection system performance as discussed previously.

In regards to other programs identified in the ZWMP, minimal other revenue potential has been identified.

## 11.4 Funding Options/Mechanisms

MassDEP provides funding for municipalities through a Recycling Dividends Program (RDP) where funds are allocated depending on the number and type of programs and policies that are proven to maximize waste reduction, reuse and recycling.

Currently, it appears that there is potential for the City to achieve additional funding through the RDP program as they appear to have received approximately \$62,000 for achieving 10 points out of a maximum of 18 points (FY17). Although not reaching the maximum number of points, the City received the second highest payout of all qualifying communities in Massachusetts. There is potential for additional funding if additional qualifying programs were put in place (e.g. the proposed textile recovery initiative). RDP funds are restricted to certain activities and equipment.

Grants are available for transportation and recycling of mattresses for up to two years. Additionally, MassDEP may pay for rental of a mattress storage container to store mattresses so they can be aggregated for collection.

It appears that funding may be available for a standard trash container, recycling carts for small businesses and curbside food waste collection containers.

## 11.5 Other Revenue Potential

There is potential for some revenue sharing from textile recovery, depending on how the program is implemented and with whom. Some organizations offer a rebate to municipalities for curbside collection programs.

# 12 Implementation Plan

The figure below presents an approximate high level timeline for implementing the options in the ZWMP between 2018 and 2028. Some options will take longer to implement than others, depending on the level of effort, whether supplies or equipment need to be procured, and the staff and resources available to the City.

Figure 12-1: Implementation Timeline





# 13 Measuring Performance in the Future

Monitoring the performance of the current waste system, as well as new system options that may be added is vital to ensure its success and effectiveness.

Understanding the performance of the overall waste system, as well as each component of the system, provides for a better understanding of the potential areas for improvement, future trends to watch for, and return on investment as new programs or facilities are implemented.

The metrics identified below should be considered for future reporting and have been specifically identified to:

- Reflect the performance of the current integrated waste management system;
- Measure the impact of the new ZWMP;
- Monitor trends associated with waste reduction and reuse activities; and,
- Provide for transparency on aspects of solid waste management including customer service, enforcement actions, safety performance, etc.

**Table 13-1: Recommended Performance Metrics**

Category	Metric	Measurement
<b>ZWMP Related</b>		
Trash Disposal Rate  Residential	Change in Trash Disposal rate	Waste Audits conducted before and after major program changes, and/or on regular intervals.
	Pounds per household per week	
Recycling Rate  Commercial and/or Residential	Change in Recycling rate	Waste audits or through information provided by the City's recycling processor
	Pounds per customer per week	
Reduction - Food Waste  Residential	Change in organics generated (placed in Green Bin and/or trash bins)	Waste Audits and/or information provided by the City's processor
	Pounds per household per week	
Reuse Textile/Electronics Reuse or Recycling  Residential	Change in quantities of textiles/electronics in trash bins/collected at the curb	Waste Audits and/or information provided by the City's collector or processor
	Pounds per household per week	

Category	Metric	Measurement
Greenhouse Gas Emissions Related to the System	Annual tonnes of CO <sub>2</sub> equivalents reduced	Calculated using the WARM model
<b>Operations Related</b>		
Safety Performance	Annual Measures (e.g. Worker's Compensation Claims)	Operational information
Total Tonnage Managed	Tons	Totals reported by the City's processors.

## 14 Zero Waste Master Plan Updates

This ZWMP is intended to be a 'living document' to be used by the City as guidance for waste management system changes. It is not intended to be static, as opportunities and issues related to waste management can change rapidly, requiring adaptation. The adoption and implementation of the ZWMP recommendations will and should be subject to regular adjustments based on direction by Council, the City Manager and Staff.

It is recommended that the City undertake a review of the ZWMP at regular intervals. Typically plans like these are reviewed every five years to take into account changes in population, demographics, new technologies, changes in laws/regulations, shifts in waste generation and materials markets. Waste management planning is a continuous process, which involves reviewing and revising plans or strategies at regular intervals. Aside from providing a formal mechanism to incorporate lessons learned and new information obtained over the previous implementation period, having a regular review process allows adjustments to be made to ensure progress towards the ZWMP's long-term objectives.

An annual report should be prepared to present an ongoing update of progress of the ZWMP. The annual report should also identify any specific achievements or issues that arose during the year and how they were addressed. Implementation plans for options in the following year should also be identified.

The following sections provide an overview of the processes involved in updating and reviewing the ZWMP and annual system monitoring and reporting.

### 14.1 Updates and Revisions to the ZWMP

It is recommended that the first formal review of the ZWMP be completed in five years or during 2023, with subsequent updates being completed every five years. Formal review points, and as required interim review points, provide an opportunity for any adjustments to the ZWMP as required. It is recommended that the initial review include a comprehensive assessment of the performance of

each ZWMP option implemented to determine if the anticipated objectives over that period have been met, and identify any issues that may have affected their implementation and performance. The review will consider the annual performance metrics data recorded (e.g. waste reduction, worker injuries) to confirm any trends that may need to be investigated further. Reasons for success or under performance should be explored and documented. The ZWMP can be updated to reflect the results of the review, identify any changes required to achieve the targets, or any changes in the implementation timeline for the planning period.

The following are some key factors that should be considered and may necessitate the need for revision of the ZWMP:

- A significant change in customer base;
- Changes in waste composition and generation;
- A change in legislation as it relates to program and/or service delivery;
- Financial impacts/opportunities such as new sources of funding or decreased material markets, customers and commodity prices; and,
- Advancements in new technologies that could benefit the City.

The review process should be formally documented for presentation to Council and/or the City Manager and to the broader community (including the Recycling Advisory Council). This would take the form of an update report on the ZWMP.

## 14.2 Annual System Monitoring and Reporting

Annual reporting, both internally and externally, beyond the data collected and reported formally to other parties, is an excellent means of demonstrating the progress achieved by both the municipality and the non-municipal partners and participants.

An annual report card presents the opportunity to report on the current year, highlight accomplishments, and present minor adjustments. It is recommended that an annual report card documenting the performance of the ZWMP be prepared in the spring of each year.

In addition to the performance of the subject year, a comparison to the baseline should be provided with commentary where appropriate to address items such as:

- Programmatic or facility changes that were implemented that could have impacted quantities managed, tonnes diverted, etc.;
- Waste generation anomalies (e.g. severe weather events);
- Changes to external influences such as changes to State or Federal legislation;

- Any other internal or external factors that impacted the ZWMP implementation;
- Contract changes with City contracted service providers; and,
- Identification of potential trends, such as a year over year decrease in waste disposal that should be monitored to assess the potential for future system impacts.

Keys to Success  
 The ZWMP has been developed to enhance the City's existing waste management programs and with a number of elements which will contribute to its success. However, there are a number of risk factors that need to be considered which could affect the implementation of the ZWMP, some of which are currently beyond the City's control.

### 14.3 Success Factors

The ZWMP is a robust, forward-looking plan that builds on the City's historic waste diversion success and leadership, and lays the foundation for achieving an ambitious waste reduction target going forward. The anticipated successful implementation of the plan is based on a variety of key factors:

- **Customer participation** – Although the ZWMP outlines several new and innovative waste management options (e.g. food waste, textiles and waste electronics reduction and reuse strategies; mobile drop-off depots, etc.), a central focus of this plan is to further improve participation and proper utilization of the City's existing programs and services by, for example, expanding services to the small commercial sector and expanding promotion and education. The success of the ZWMP is very dependent on the participation of the customers of the City of Cambridge.
- **Expanded public engagement** – In a city with a population that is diverse and located predominantly in multi-family residences, there are significant challenges associated with engaging residents in waste management initiatives, but also tremendous opportunities. Meaningful and effective public engagement is a cornerstone to the successful implementation of this ZWMP.

### 14.4 Barriers and Risks

As in any other planning process, there are risk factors that could result in the ZWMP not producing the expected results. These could include both internal factors (e.g. failure to engage City residents) and external factors (e.g. changes in waste composition, consumer patterns, and/or governing legislation). It is important that the ZWMP is flexible so that it is able to respond to risks and barriers that have been identified throughout the implementation and operating periods. The first five year review is intended to allow for a mid-course correction

if some of the assumptions built into the ZWMP are found to not occur as anticipated over time.

Barriers and related risks that may influence the success of the ZWMP include the following:

- Changes in State waste legislation, regulations, policies - Changes in waste legislation have the potential to significantly impact the City's ability to achieve lower rates of waste disposal.
- Waste reduction estimates may not be reached - The diversion estimates presented in the ZWMP may not be reached either because:
  - Waste composition changes over time in ways which are not predictable today; and/or,
  - Residents may not participate, or do not participate properly in the waste reduction and diversion programs, thereby resulting in lower capture rates for targeted materials.
- The impacts of the "evolving" ton - Changes in the composition of waste that will be generated by City households and businesses through the ZWMP timeline present a risk to success, as waste reduction estimates have been based on the current waste composition. Some of the most significant changes in the waste stream that have been anticipated to continue throughout the planning process include:
  - a continued decline in the generation of newsprint;
  - an increase in plastics packaging (especially hard-to-recycle films, stand-up pouches and plastic laminates);
  - an increase in old corrugated cardboard in both households and businesses due to growing internet sales; and,
  - an increase in the quantity and types of waste electronics and electrical equipment (WEEE) in both households and businesses.
- The ZWMP depends on successful partnerships - Elements of the ZWMP require partnerships with non-profits for particular programs. The food waste reduction strategy, could be strengthened by collaborating or working with local municipalities and various food related organizations, as well as universities and colleges interested in the topic. Operating textile and drop-off facilities should ensure that non-profits currently collecting these materials are not negatively impacted by the City program, and partnerships with the existing non-profits may be considered to expand the service. Partnerships require a significant investment of time to establish and maintain, and unless they are executed effectively, they may not be successful.

## 15 Conclusion

The recommendations contained in this report represent actions that are aligned with the DPW's guiding principles and will contribute to reaching the City's waste and GHG emission reduction goals in a fiscally responsible manner, while contributing to the health and well-being of City employees and residents, as well as the environment.