EXHIBIT A

Local Solid Waste Management Plan Update

City of Dallas

June 1, 2022

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
AAGD	Apartment Association of Greater Dallas
AC	Alley Cat
AD	Anaerobic digestion
ADT	Articulating Dump Truck
ASL	Automated Side Loader vehicles
AUF	Airspace Utilization Factor
BEV	Battery Electric Vehicle
BIC	New York City Business Integrity Commission
BOMA	Building Office Managers Association
BOPA	Battery, Oil, Paint, and Antifreeze
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
BTU	British Thermal Unit
C&D	Construction and Demolition Debris
CAA	Clean Air Act of 1976
CCC	Customer Convenience Center
CCRC	Customer Convenience and Recycling Center
CECAP	Comprehensive Environmental and Climate Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHP	Combined Heat and Power
CIP	Capital Improvement Plan
City	The City of Dallas
CNG	Compressed Natural Gas
COG	Council of Governments
CPI	Consumer Price Index
CPT	Certified power train
CSR	Customer Service Representative
CY	Cubic Yard

Abbreviation	Term/Phrase/Name
DCEMB	Dallas Clean Energy McCommas Bluff, LLC
DFR	Dallas Fire-Rescue
DFW Metroplex	Dallas-Fort Worth Metroplex Area
DSNY	New York City Department of Sanitation
DISD	Dallas Independent School District
ECC	Environmental Collection Center
EFM	Equipment and Fleet Maintenance
ELR	Enhanced Leachate Recirculation
EPP	Environmentally preferred purchasing
EPR	Extended Producer Responsibility
EPS	Expanded polystyrene, "Styrofoam"
EREF	Environmental Research and Education Foundation
FCC	Fomento de Construcciones y Contratas, S.A. dba FCC, S.A
FL	Front Loader vehicles
FOG	Fats, oils, and greases
FTEs	Full time employees
FY	Fiscal year (October through September)
GCCS	Gas Collection and Control System
GHG	Greenhouse gas
GVW	Gross Vehicle Weight
HANTx	Hotel Association of North Texas
HCCC	Home Chemical Collection Center
HDPE	High density polyethylene
HEO	Heavy Equipment Operator
HHW	Household hazardous waste
HOAs	Homeowner Associations
ILA	Interlocal Agreement
LNG	Liquified Natural Gas

Abbreviation	Term/Phrase/Name
2011 LSWMP	Local Solid Waste Management Plan
LSWMP Update	Local Solid Waste Management Plan Update
MFRO	Multi-family Recycling Ordinance
MPC	Master Planned Community
MGD	Million Gallon per Day
MRF	Materials recovery facility
MSW	municipal solid waste
NCTCOG	North Central Texas Council of Governments
NGO	Non-Governmental Organization
NGV	Natural Gas Vehicle
NOx	Nitrogen Oxide
NRDC	The Natural Resources Defense Council
NTMWD	North Texas Municipal Water District
OEQS	Office of Environmental Quality and Sustainability
OCC	Old Corrugated Cardboard
ONP	Old Newspapers
OS	San Antonio Office of Sustainability
OSHA	Occupational Safety and Health Administration
PAYT	Pay-as-you-throw
PET	Polyethylene terephthalate
PM	Particulate Matter
PP	Polypropylene
PPP	Public-private partnerships
PSA	Processing Service Agreement
PVC	Polyvinyl Chloride
RAP	Rubberized Asphalt Paving
RCRA	Resource Conservation and Recovery Act
RDF	Refuse-derived fuel

Abbreviation	Term/Phrase/Name
RFCSP	Request for Competitive Sealed Proposal
RFP	Requests for Proposals
RIN	Renewable Identification Number
RMDP	Recycling Market Development Plan
RMDZs	Recycling Market Development Zone
RNG	Renewable Natural Gas
SA	Semi-automated Vehicle
SARA	Superfund Amendments and Reauthorization Act of 1986
SDG	Sustainable Development Goal
SMM	Sustainable Materials Management
SOP	Standard Operating Procedure
SOx	Sulpher Oxide
SS WWTP	Southside Wastewater Treatment Plant
STA	US Composting Council's Seal of Testing Assurance
STAR	The State of Texas Alliance for Recycling
SWANA	Solid Waste Association of North America
SWDA	Solid Waste Disposal Act
SWMD	San Antonio Solid Waste Management Department
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TCEQ	Texas Commission on Environmental Quality
TAC	Texas Administrative Code
TCE	Texas Campaign for the Environment
TPH	tons per hour
TPY	tons per year
TxDOT	Texas Department of Transportation
URO	Universal Recycling Ordinance
USCAE	U.S. Corp of Army Engineers
U.S.	United States

Abbreviation	Term/Phrase/Name
U.S. EPA	U.S. Environmental Protection Agency
USDA	United States Department of Agriculture
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Purpose

The City of Dallas' (City) Local Solid Waste Management Plan Update (LSWMP Update) evaluates progress toward the goals and recommendations in the 2011 LSWMP adopted by City Council in February 2013. The purpose of the LSWMP Update is to identify current and future material management needs, evaluate programs, policies, and infrastructure options for meeting these needs, and to define a course of action for managing future waste generated in the City. The City and its consultant, Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell), developed the LSWMP Update by evaluating existing programs, policies and infrastructure and analyzing progress the City has made over the last decade toward the previously adopted goals and recommendations. The intent is to establish goals, objectives and recommendations that offer strategic direction for the City to establish a resilient material management system that provides the ability to continue advancing progress towards Zero Waste in alignment with the City's Comprehensive Environmental & Climate Action Plan (CECAP).

Stakeholder Engagement

The LSWMP Update development process engaged stakeholders from the community and multiple City departments. Community stakeholders included representatives from multiple generator sectors (sectors include single-family, multi-family and commercial and are further described in the Updated Goals and Objectives section) for the purpose of gathering insight and opinions regarding the current material management systems and needs for the future of the system. The City engaged multiple stakeholder groups throughout the LSWMP Update development process. Table ES-1 describes the City's engagement approach and stakeholders.

Table ES-1: Description of Stakeholder Engagement Approaches

Engagement Approach	Description	Stakeholders Engaged
Surveys	Developed and released two surveys to the public to gather initial feedback later to gather feedback on options and recommendations.	More than 5,500 survey respondents that included single-family, multi-family and commercial generators.
Interviews	Conducted informational interviews of key stakeholders to gather feedback on their perspectives around current and future material management.	Neighborhood associations, City departments, non-governmental organizations (NGOs), local chambers of commerce.
Educational Video	Worked with City's Communication Department to develop an educational video about the LSWMP Update.	Single-family, multi-family and commercial generators; City leadership (e.g., City Council members and staff).
Public Meeting	Held an in-person public meeting at the Latino Community Center with option to attend virtually.	Single-family, multi-family and commercial generators.
Public Comment Period	The City published the draft LSWMP Update for public comment in anticipation of presenting to City Council for adoption.	Single-family, multi-family and commercial generators.
Presentations to City Leadership	Presented to the Environmental and Sustainability Commission (formerly Environmental and Sustainability task force) and the City Council's Environmental and Sustainability sub-committee.	City leadership and staff.

The key takeaways from the comprehensive stakeholder engagement effort are incorporated throughout the LSWMP Update to inform the options and recommendations that have been developed. Further detailed information about the surveys, interviews, public meetings and presentations to City leadership is provided in Appendix A.

Updated Goals and Objectives

A key consideration of the updated goals and objectives is to balance the demand for resources to meet near-term goals that strategically position the City to make significant progress toward its long-term Zero Waste goal by 2060 as originally established as part of the 2011 LSWMP. The LSWMP Update has been developed to build on the 2011 LSWMP objectives and update them to:

1. Align with goals and objectives related to materials management adopted by the Comprehensive Environmental and Climate Action Plan (CECAP).
2. Acknowledge changes in the materials management landscape (e.g., recycling commodity markets, regulatory and policies adopted, technology innovations).
3. Incorporate the extensive system analysis and stakeholder engagement conducted as part of the LSWMP Update.

The following updated objectives are meant to guide policies, programs and infrastructure to support progress toward the City's near- and long-term goals.

1. Empower residents and businesses to reduce the amount of discarded material generated through proactive education, outreach and compliance efforts.
2. Establish and implement innovative operational best practices to provide efficient, cost effective, and environmentally responsible service.
3. Provide excellent customer service and support residents and businesses to maximize diversion from landfill.
4. Operate a clean, green and efficient waste system that seeks to generate energy from organics.

The level of direct control of a material stream determines the City's ability to increase the City's recycling rate and set realistic, achievable goals. The level of control varies by generator sectors including single-family (e.g., material generated by single-family detached households), multi-family (e.g., material generated by apartment complexes), and commercial (e.g., material generated by properties, facilities and business operations). The City has direct control over material generated by the single-family sector, because it collects, hauls, processes and/or disposes of this material on a daily basis. The City only has influence over material generated by the multi-family and commercial sectors supported by regular reporting requirements from private-sector haulers active in the City.

Figure ES-1 illustrates the level of control that the City has over the various material types and indicates the volume of material generated by that sector (circles are not to scale and are presented for informational purposes only).

Figure ES-1: Control of Material by Sector

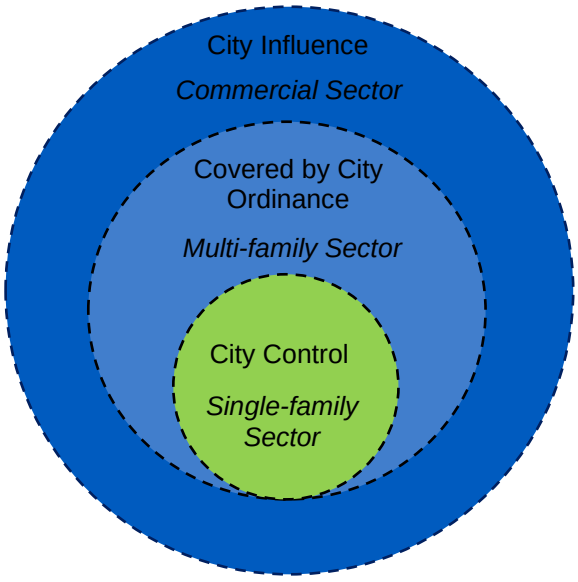

Table ES-2 shows the material management goals adopted by CECAP and how the LSWMP Update addresses them.

Table ES-2: Description of How LSWMP Update Addresses CECAP Goals

No.	Goal	Description of How LSWMP Update Addresses CEACP Goals
1	Actively promote source reduction, recycling and composting to the Dallas community.	Evaluates the City's education, outreach and compliance programs and provides recommendations on how to enhance its capabilities.
2	Develop a comprehensive green procurement plan.	Supports on-going cross-departmental efforts to develop a comprehensive green procurement plan by providing discussion about the impact of purchasing policy on source reduction efforts.
3	Improve solid waste, recycling and brush/bulky item collection frequency.	Evaluates the City's current brush and bulky item collection program and provides recommendations on approaches to scale separate collection on a City-wide basis.
4	Improve potential for electric waste collection vehicles.	Incorporates case studies on collection systems that have incorporated Battery Electric Vehicles (BEVs) provides considerations for implementing a BEVs on a pilot basis.
5	Update and implement the Zero Waste management plan.	Establishes realistic goals and metrics by sector (reference Table ES-3) and strategic approaches to achieve these goals.
6	Expand efforts to reduce illegal dumping by implementing recommendations identified in the Litter and Illegal Dumping Assessment Study.	Evaluates the City's Household Hazardous Waste (HHW) and electronics management programs, including a high-level evaluation of the progress made toward the recommendations of the Litter and Illegal Dumping Assessment Study.
7	Encourage the development of material markets focusing on creating new economic opportunities.	Interviewed the City's Economic Development Department and Chambers of Commerce as part of the stakeholder engagement effort and leveraged the statewide Recycling Market Development Plan (RMDP) to provide information on economic opportunities related to material markets.
8	Continue to capture gas and expand capacity from landfill for reuse and evaluate for City operations.	Evaluates the Landfill's gas collection system and provides recommendations to continue to expand capacity to beneficially reuse Landfill gas.
9	Adopt an ordinance to implement a City-wide organics management program.	In addition to the recommendations related to separately collecting brush and bulky items, the LSWMP Update evaluates the City's non-exclusive franchise ordinances and provides near- and long-term recommendations on increasing organics recycling from the commercial sector.

Table ES-3 summarizes of the updated goals for each generator sector including the goal type and metrics (e.g., recycling rate, program participation, etc.) and organized by 2030 goals and long-term Zero Waste goals (e.g., 2060).

Table ES-3: Updated Goals by Sector

Generator Sector	Single-Family	Multi-family	Commercial
Goal Type and Metrics	Recycling rate, capture rate, disposal per capita.	Program participation; reporting compliance.	Program participation; reporting compliance.
2030 Goals	35% recycling of organic waste by 2030. 60% recycling of paper waste by 2030. 35% reduction in waste landfilled by 2030.	90% reporting compliance and verification of entities covered under the Multi-family Recycling Ordinance (MFRO).	Expand Green Business Certification to increase participants year-over-year. 90% reporting compliance and verification from non-exclusive franchise haulers.
Zero Waste Goals	80% recycling of organic waste by 2050. 90% recycling of paper waste by 2050. 45% reduction in waste landfilled by 2040.	Analyze data to establish goals consistent with future program in place.	Analyze data to establish goals consistent with future program in place.

Guidance for Reading the LSWMP Update

The LSWMP Update is organized into three overall sections: (1) introductory sections, (2) program, policies and infrastructure sections, and (3) appendices. The introductory sections provide key context about the LSWMP Update, materials management trends, regulations, projected material management needs, and regional facilities and infrastructure. Program, policies and infrastructure sections are dedicated to discussion of a specific aspect of the City's material management system where each has unique characteristics requiring a customized approach based on varying generators, material types and customers. The appendices provide detailed information compiled and analyzed throughout the LSWMP Update development process.

Each section of the LSWMP Update is intended to be structured consistently, but customized based on unique characteristics. The introductory sections are structured to provide more general information about materials management, material projections and composition profiles, and regional infrastructure. The program, policy and infrastructure sections each begin with a current system review, evaluation of the recommendations from the 2011 LSWMP, relevant case studies, an evaluation of options and key findings and recommendations. Relevant feedback from the stakeholder engagement efforts precedes the evaluation of options but may be incorporated in other locations throughout the LSWMP Update as appropriate. Table ES-4 indicates how the LSWMP Update is organized, listing each section with a brief description of the content included.

Table ES-4: LSWMP Update Section Organization and Description

No.	Title	Description
Introductory Sections		
1.0	Overview, Goals and Objectives	Describes the purpose, key terms, updated goals and objectives, and guidance for reading the LSWMP Update document.
2.0	Planning Studies, Regulatory and Trends Review	Includes applicable planning studies and regulations, roles of government entities in solid waste management, and current solid waste management industry trends.
3.0	Planning Area Characteristics	Reviews the planning area characteristics such as population, economic projections, and projected material management needs.
4.0	Facilities and Infrastructure	Review of material management facilities and infrastructure in the North Central Texas region and presents information on public-private partnership approaches.
Programs, Policies and Infrastructure Sections		
5.0	Transfer Station System	Review of the operational capacity of the program, policy and infrastructure and evaluation of options to support continued strategic usage to meet near- and long-term goals and objectives established by the LSWMP Update.
6.0	Refuse and Recycling Collection	
7.0	Brush and Bulky Item Collection	
8.0	Landfill Operation	
9.0	Recycling Processing	
10.0	Organics Management	
11.0	Multi-Family and Commercial Sector	
12.0	HHW and Electronics Management	
13.0	Public Education, Outreach and Compliance	
Appendices		
A	Stakeholder Engagement Summary	Provides data and results of the stakeholder engagement efforts.
B	Regional Facilities Map	Map of the materials management, processing and disposal facilities in the region.
C	Transfer Station System Evaluation	Detailed technical evaluation of the City's transfer station system, refuse and recycling collection, and Landfill programs and operations.
D	Refuse and Recycling Collection Evaluation	
E	Landfill Operation Evaluation	
F	Implementation and Funding Plan	Presents a detailed implementation and funding plan matrix that indicates the priority, funding mechanism, difficulty of implementation, and responsible party for each key recommendation of the LSWMP Update.

Key Findings and Priority Next Steps

The following summarizes the most salient key findings and recommendations related to reaching the City's 2030 goals and long-term Zero Waste goals.

- **Continued population growth strains landfill capacity and emphasizes the importance of zero waste infrastructure.** The continued population growth of the Dallas-Fort Worth Metroplex area will continue to strain the materials management infrastructure and facilities in the region including landfills, Material Recovery Facilities (MRFs) and organics processing facilities (e.g., composting, anaerobic digestion). As landfills continue to fill at an accelerated rate and the regional disposal capacity declines, tonnages to the McCommas Bluff Landfill (Landfill) will likely increase and make the Landfill's airspace an increasingly valuable commodity for the City. These same regional market dynamics will correspondingly increase the importance to divert material from disposal through single-stream recycling and organics processing, as well as reuse and source reduction. Currently, the existing recycling capacity can handle the amount of material processed for recycling, but as recycling quantities increase from the single-family, multi-family and commercial sectors, there will be a need for additional infrastructure development throughout the region. Similarly, as diversion of organic material increases, there will be a need for the City to increase processing capacity via public-private partnerships.
- **Upgrade critical processing and disposal infrastructure.** To achieve the near-term 2030 goals and long-term Zero Waste goals, the City must upgrade its transfer station system to manage multiple material streams, engage in a long-term planning effort to maximize Landfill capacity, expand its organics processing capacity, and increase accessibility to HHW and electronics recycling locations.
- **Adjust collection vehicle fleet routing, fuel mix, and fueling infrastructure.** The City is in the process of developing a comprehensive re-route of collection vehicles to provide refuse and recycling collection service more efficiently and is considering expanding the use of natural gas vehicles (e.g., Compressed Natural Gas (CNG), Renewable Natural Gas (RNG)). To support these efforts, the City must expand the available fueling infrastructure for the collection vehicle fleet to support more natural gas vehicles. Additionally, the City should evaluate on consider piloting Battery Electric Vehicles (BEVs) as part of its collection fleet and evaluate the needs to provide the charging and maintenance requirements associated with these vehicle types.
- **Near-term focus on the single-family sector to achieve 2030 CECAP goals.** Since the City directly manages single-family sector materials, the LSWMP Update is able to establish specific actions for the City to achieve the 2030 CECAP goals. To meet the 2030 goals and progress

toward Zero Waste, the City must include organics in its recycling rate and make significant efforts to increase the amount of material recycled under its direct control (e.g., single-stream recycling, yard trimmings, brush). The City must implement separate collection of brush and bulky items to increase its recycling rate and leverage cross-departmental collaboration to expand education, outreach and compliance efforts to increase the capture rate of single-stream material (e.g., scaling the "Take-a-Peek" program City-wide).

- **Implement mandatory programs in the long term to continue progress toward Zero Waste.** When voluntary programs have been shown to drive up the capture rate from the single-stream recycling program, the City should implement mandatory programs such as material bans and residential recycling requirements to increase the capture rate of single-stream recyclables from 60 to 80 percent. Mandatory programs should be considered after the City successfully implements voluntary approaches.
- **Renew interlocal agreement (ILA) with Dallas County to support HHW and electronics management**. The City should extend the current agreement in a similar structure to the existing ILA on a one-year basis with multiple available extensions to ensure that the short-term needs of the City will be met but provides the flexibility to explore other options to minimize future costs as the City continues to grow. As the City considers options for the future of the Household Chemical Collection Center (HCCC) and Battery Oil Paint and Antifreeze (BOPA) programs, working with Dallas County to provide an outlet for HHW and electronics serves to minimize the amount of litter, illegal dumping, and prohibited set outs (e.g., tires) critical to sustaining public health and community cleanliness.
- **Maintain the Multi-family Recycling Ordinance (MFRO) and continue to increase the percentage of covered entities in compliance year-over-year.** The City should continue to implement and increase the compliance from generators and haulers as part of the MFRO, monitoring new developments that come online and continuing to support affected entities with education and outreach. the City must leverage its cross-departmental permit review process to ensure new developments provide access to recycling.
- **Adjust existing requirements on non-exclusive franchise haulers.** Material generated by multi-family and commercial sectors represents the next major opportunity for the City to make progress toward Zero Waste. In the near-term the City should adjust franchise and permitted recycling hauler reporting requirements to include more comprehensive tonnage data reports including refuse, recycling and other divertible tonnages currently collected and the location with they are processed and disposed. After the requirements of franchise hauler reporting has been implemented and analyzed, the City will determine the requirements for haulers to offer diversion

services to customers and establish the enforcement mechanisms to ensure that this maintains a level playing field among franchise haulers. The City should consider incentivizing haulers to recycle by providing credits on franchise fees for haulers that recycle single-stream and/or organic materials.

- **Long-term implementation of commercial recycling requirements to position the City for the development of an exclusive or zoned franchise system.** As a long-term consideration after adjusting the franchise and permitted recycling hauler requirements and ensuring that the available recycling processing capacity supports increased tonnage, the City should implement requirements to contract with franchise haulers to recycle based on the levels of material generation quantity, facility size (square footage) or business size (number of employees). Targeted commercial recycling requirements should be rolled out in a phased approach and would position the City establish an exclusive or zoned franchise system in the future.

The implementation and funding plan (reference Appendix F) prioritizes recommendations and next steps developed as part of the LSWMP Update. Table ES-5 presents the highest priority next steps for the City to continue working toward Zero Waste on a sector-by-sector basis for near-, mid- and long-term considerations. For the purposes of the implementation and funding plan, near-term is zero to three years, mid-term is four to eight years (e.g., through 2030), and long-term is eight years and beyond.

Table ES-5: Priority Next Steps by Sector

Timing	Infrastructure	Single-Family	Multi-family	Commercial
Near-term	• Upgrade transfer stations to separately manage organics and maintain high level of service for residential customers. • Develop composting facility as part of public-private partnership. • Develop long-term Landfill master plan to maximize site life.	• Increase capture rate from blue roll-cart program by enhancing education, outreach, and compliance efforts. • Implement separate collect and process yard trimmings and brush. • Renew interlocal agreement with Dallas County on short-term basis.	• Increase MFRO compliance from covered entities year-over-year. • Continue to support covered entities with education and outreach.	• Expand Green Business Certification Program • Leveraging cross-departmental efforts to provide technical assistance. • Require submission of more comprehensive and verifiable data including refuse, recycling and other tonnages including the location with they are processed and disposed.
Mid-term	• Explore purchase of additional CNG/RNG vehicles. • Install additional natural gas fueling stations. • Explore electric solid waste collection vehicle pilot project.	• Establish more convenient HHW and electronics collection • Work with County to develop permanent or satellite facility in southern areas of City.	• Monitor new multi-tenant developments that come online. • Leverage permit review process to ensure new developments provide accessibility to recycling.	• Adjust non-exclusive franchise ordinance to require haulers offer key services. • Implement targeted commercial recycling requirements in a phased approach.
Long-term	• Increase CNG/RNG electric vehicle fueling capacity.	• Implement mandatory recycling program (e.g., material bans, recycling requirements) to further increase capture rate. • Evaluate feasibility to expand capabilities of BOPA collection program.	• Continue implementation efforts and support haulers and apartment managers to increase compliance year-over-year.	• Implement zoned or exclusive franchise system with compliance mechanisms to ensure that this maintains a level playing field among franchise haulers.

1.0 OVERVIEW, GOALS, AND OBJECTIVES

1.1 LSWMP Update Overview

1.1.1 Purpose

Planning for and implementing an integrated solid waste system is a complex and challenging endeavor requiring a collaborative multi-departmental approach considering technological, institutional, legal, social, economic, and environmental factors. Developing a Local Solid Waste Management Plan Update (LSWMP Update) for the City of Dallas (City) is a critical step in determining how effectively the City has worked toward its goals described in the existing LSWMP and how the City will approach material management going forward as growth continues and market factors continue to evolve. Title 30 of the Texas Administrative Code (TAC) provides guidance for local and regional solid waste management plans. The City's LSWMP developed in 2011 and adopted by the City Council in February 2013 is in conformance with 30 TAC §330.

The LSWMP Update has been organized in a manner consistent with the City's material management services and programs and substantively addresses the requirements of 30 TAC §330 Subchapter O and meets the requirements of 30 TAC §330.641(f). This provision allows updates to an approved plan to provide for changes to data and information contained in the plan which do not substantially change the scope or content of the goals and recommendations of the plan[1]. Further description of the LSWMP Update section layout is provided in Section 1.4.1.

The purpose of the LSWMP Update is to identify current and future solid waste management needs, evaluate programs, policies, and infrastructure options for meeting these needs, and to define a course of action for future waste generated in the City. It is the City's goal to update programs, policies and infrastructure based on what has been accomplished over the last decade, and to establish an implementation plan that aligns with the goals established by the Comprehensive Environmental and Climate Action Plan (CECAP) and maintains progress toward its long-term Zero Waste goal, with as much stakeholder and community feedback as possible.

As the City pursues solutions to its material management challenges, it is increasingly apparent that there is no single strategy, technology, or program offers a complete solution; rather, a combination of methods is needed to provide for appropriate and cost-effective management of the varying types of solid waste in accordance with the unique properties of these various solid waste stream components. The City and its

[1] 30 TAC §330 Subchapter O is provided at the following hyperlink: https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=330&sch=O&rl=Y

consultant, Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell), developed this LSWMP Update to meet its planning requirements and with a focus on the next five years of implementation, understanding that the LSWMP Update will be continually updated going forward as the City works toward its long-term Zero Waste goal.

1.1.2 Stakeholder Engagement

The LSWMP Update development process engaged stakeholders from multiple City department and the community. Community stakeholders included representatives from multiple generator sectors (reference Section 1.2.2) for the purpose of gathering insight and opinions regarding the current material management systems and needs for the future of the system. The City engaged multiple stakeholder groups throughout the LSWMP Update development process. Table 1-1 describes the City's engagement approach and the stakeholders that were engaged.

Table 1-1: Description of Stakeholder Engagement Approaches

Engagement Approach	Description	Stakeholders Engaged
Surveys	The City developed and released two surveys to the public to gather initial feedback later to gather feedback on options and recommendations.	More than 5,500 survey respondents that included single-family, multi-family and commercial generators.
Interviews	Conducted informational interviews of key stakeholders to gather feedback on their perspectives around current and future material management.	Neighborhood association, City departments, non-governmental organizations (NGOs), local chambers of commerce.
Educational Video	Worked with City's Communication Department to develop an educational video about the LSWMP Update.	Single-family, multi-family and commercial generators; City leadership (e.g., City Council members and staff).
Public Meeting	Held an in-person public meeting at the Latino Community Center with option to attend virtually.	Single-family, multi-family and commercial generators.
Public Comment Period	The City published the draft LSWMP Update for public comment in anticipation of presenting to City Council for adoption.	Single-family, multi-family and commercial generators.
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The key takeaways from the comprehensive stakeholder engagement effort are incorporated throughout the LSWMP Update to inform the options and recommendations that have been developed. Further detailed information about the surveys, interviews, public meetings and presentations to City leadership is provided in Appendix A.

1.1.3 City Department Collaboration

This section describes the City departments that work together to manage the programs and policies related to materials management.

- **Department of Sanitation Services.** The Sanitation Department is responsible for provision of solid waste services including collection of refuse, recycling, brush and bulky items from residential customers and operation of key infrastructure including the transfer station system and Landfill. The Sanitation Department also provides education, outreach and compliance services in coordination with the Office of Environmental Quality and Sustainability and Code Compliance (OEQS).
- **Office of Environmental Quality and Sustainability (OEQS).** OEQS provides education, outreach and compliance efforts related to environmental and sustainability messaging. OEQS manages several programs including the City's Multi-family Recycling Ordinance (MFRO), the Materials Recovery Facility (MRF) agreement with its contract recycling processor the Interlocal Agreement (ILA) with Dallas County (County) and Batteries, Oil, Paint, and Antifreeze (BOPA) collection program as part of the Household Hazardous Waste (HHW) and electronics management program. Additionally, OEQS manages the City's environmentally preferred purchasing (EPP) strategies, such as procuring recycled-content products and waste minimization efforts.
- **Department of Code Compliance.** The Code Compliance Department is responsible for inspections and data collection related to compliance of the City's Code of Ordinances. This group is ancillary to the materials management programs but has the potential to serve a critical role supporting the City to achieve its long-term Zero Waste goal.

1.2 Key Terms

1.2.1 Material Types

This section presents definitions of a selection of key terms used throughout the LSWMP Update that are necessary for a comprehensive understanding of the current material management programs, policies and infrastructure that the City will consider implementing.

- **Municipal solid waste (MSW).** MSW is used to refer to the entirety of waste stream that is generated by everyday activities in homes, institutions such as schools and hospitals, and commercial sources such as restaurants, offices, and small businesses. MSW can be further categorized by material types, as described below. Different categories of MSW require different methods of handling for best management practices. MSW does not include hazardous, industrial, agricultural, or mining, wastes.
- **Refuse.** The portion of MSW that cannot practically be recycled, reused, or otherwise diverted is refuse. Refuse is considered true waste because there are no viable recycling methods other than disposal. While alternative methods to managing this residual waste stream are commercially available (e.g., waste-to-energy, chemical recycling), for the purposes of this LSWMP Update the City is not considering energy recovery from refuse as a viable means of recycling. Further discussion of the refuse and recycling collection, transfer station system and Landfill operations are provided in Section 5.0, 6.0 and 8.0, respectively.
- **Single-stream recycling.** Single-stream recycling refers to materials that are typically accepted through municipal curbside recycling programs, processed through materials recovery facilities (MRFs), and sold as commodities to markets where the material is then repurposed. Recyclables include items such as plastic and glass containers, aluminum and steel cans, cardboard, and other various paper products accepted in roll carts collected by the City. Further discussion of the refuse and recycling collection program and recycling processing operation is provided in Section 6.0 and Section 9.0, respectively.
- **Bulky items.** Bulky items consist of items generated from households or commercial customers that are too large to be placed inside a customer's regular roll cart and are collected by the City's brush and bulky item collection program. Further discussion of the brush and bulky item collection program is provided in Section 7.0.
- **Organics.** Organics are plant or animal-based materials. Organics have the potential to be recycled through composting, mulching, or anaerobic digestion processes. Within the category or organics, there are three sub-categories: yard trimmings, brush and food scraps, used throughout the LSWMP Update to describe the material stream and associated processing options. Depending on processing technology, yard trimmings, brush and food waste may be processed together or separately. Further discussion of organics management is provided in Section 10.0.
    - **Brush and yard trimmings.** Dry leaves, grass clippings, brush, tree branches, stumps, and other plant trimmings generated by residential customers or commercial landscaping

contractors are collected from residences comingled with bulky items and disposed. This material is also delivered directly to the Landfill for grinding and on-site use.

- **Food waste.** Putrescible fruits, vegetables, meats, dairy, coffee grounds, and food-soiled paper products generated by residential, multi-family and commercial sector generators. Pre-consumer food waste is considered kitchen waste from food preparation and post-consumer food waste is plate waste discarded after food has been served. Some food waste is collected by private sectors haulers that provide this service and composted at private sector processing facilities, but most food waste is discarded with refuse.

- **Household Hazardous Waste (HHW) and electronics.** HHW and electronics refer to common household chemicals or other materials that should not be disposed of in MSW landfills due to their potential for environmental contamination, health and safety impacts. For the purposes of the LSWMP Update, HHW and electronics refer to the materials generated and delivered to the Household Chemical Collection (HCCC) facility, which is the building operated by the County. Further description of HHW and electronics management and specific material types are provided in Section 12.0.

1.2.2 Generator Sectors

This section presents definitions of generator sectors described throughout the LSWMP Update that are necessary for a comprehensive understanding of the updated goals and objectives described in Section 1.3.

- **Single-family sector.** The residential sector includes material generated by single-family households. Material generated by the single-family sector is under direct control of the City as part of its services provided to residents.

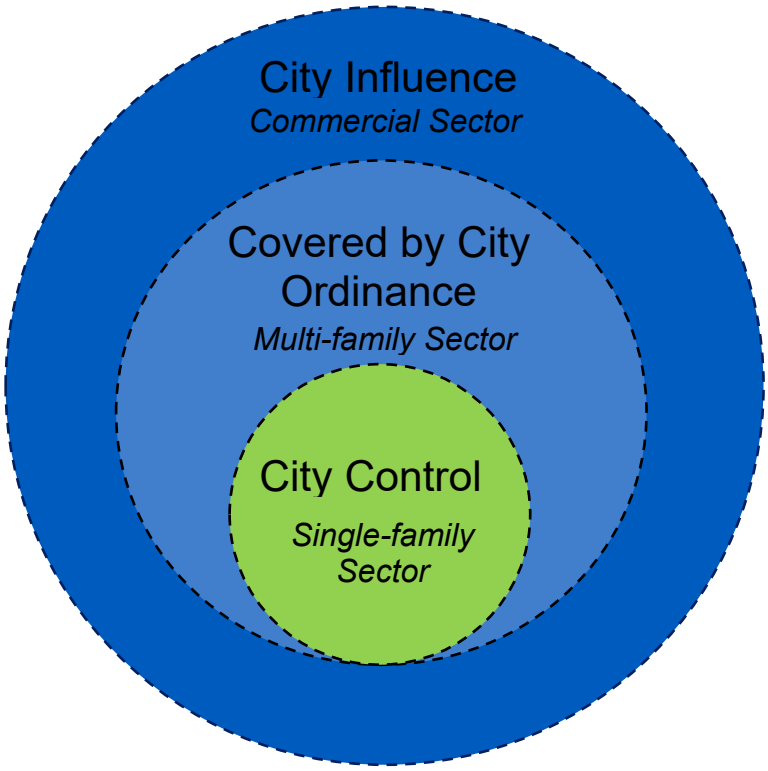
- **Multi-family sector.** The multi-family sector consists of apartment complexes with three or more units and covered under the MFRO. The City does not have direct control over this material but does require that recycling service is provided to multi-tenant complexes. Permitted multi-tenant recycling haulers are required to provide reporting to the City of recycling activity on an annual basis.

- **Commercial sector.** The commercial sector consists of a wide variety of properties, facilities and business operations including material offices, retail, wholesale establishments, restaurants and institutional entities such as schools, libraries, and hospitals. The City does not have control of this material, but non-exclusive franchise haulers are required to provide reporting of refuse collected from entities in the City.

The amount of direct control of a material stream determines the City's ability to increase the City's recycling rate and set realistic, achievable goals. The City has direct control over material generated by the single-family sector, because it collects, hauls, processes and/or disposes of this material on a daily basis. The City only has influence over material generated by the multi-family and commercial sectors supported by regular reporting requirements from private-sector haulers active in the City.

Figure 1-1 describes the level of control that the City has over the various material types and indicates the volume of material generated by that sector (circles are not to scale and are presented for informational purposes only).

Figure 1-1: Control of Material by Sector



1.2.3 Generation, Recycling and Disposal

This section provides definitions used regarding the total amount of solid waste managed by the City and the material disposal or processing streams that comprise total generation quantities.

- **Generation.** Solid waste generation is the total quantity of material collected and disposed in the City among all generator sectors. Total generation is the quantity of material that the City must manage through various disposal and recycling programs and services. Although materials generated in the City and exported to processing or disposal facilities outside the City are

considered part of the total material generated, these quantities are not included for the purposes of the material projections and forward-looking analysis due to data limitation as part of the LSWMP Update.

- **Recycling.** For the purposes of the LSWMP Update, recycling is defined consistently with Texas Health and Safety Code §361.421(8) to include typical recyclables, composting, land application of biosolids/sludge, and pyrolysis of post-use polymers; and to exclude source reduction, energy recovery and reuse. Recycling materials are processed at a MRFs for sale on the secondary material commodity market or composted/mulched. Recycling and recycling rates include MSW material that is generated among all generator sectors, collected and processed through single-stream MRFs and yard waste and organics material that is mulched, composted, or otherwise diverted from landfill disposal.
- **Disposal.** Disposal refers to all remaining material placed in landfills that has not been processed for sale on the secondary material commodity market, composted, or otherwise diverted. Disposed materials include some quantities of materials that were not recovered prior to disposal but could potentially be recovered through improvement of recycling programs, policy, infrastructure, or education, outreach and compliance efforts.

1.3 Updated Goals and Objectives

This section presents the updated goals and objectives as part of the LSWMP Update. The goals and objectives have been updated to align with those adopted as part of CECAP, most recent data collected during the current system review and recent stakeholder engagement conducted as part of the LSWMP Update.

The updated goals and objectives recall the core ideas from the 2011 LSWMP objectives and indicate the needs to continue progress toward the City's long-term Zero Waste goal while focusing the near-term goals in alignment with those adopted by CECAP. The intention of the updated goals and objectives is to provide strategic targets for the City to utilize as part of current and future program and infrastructure planning efforts.

1.3.1 Goals

The following quantitative goals established by the LSWMP Update are consistent with the goals adopted by CECAP:

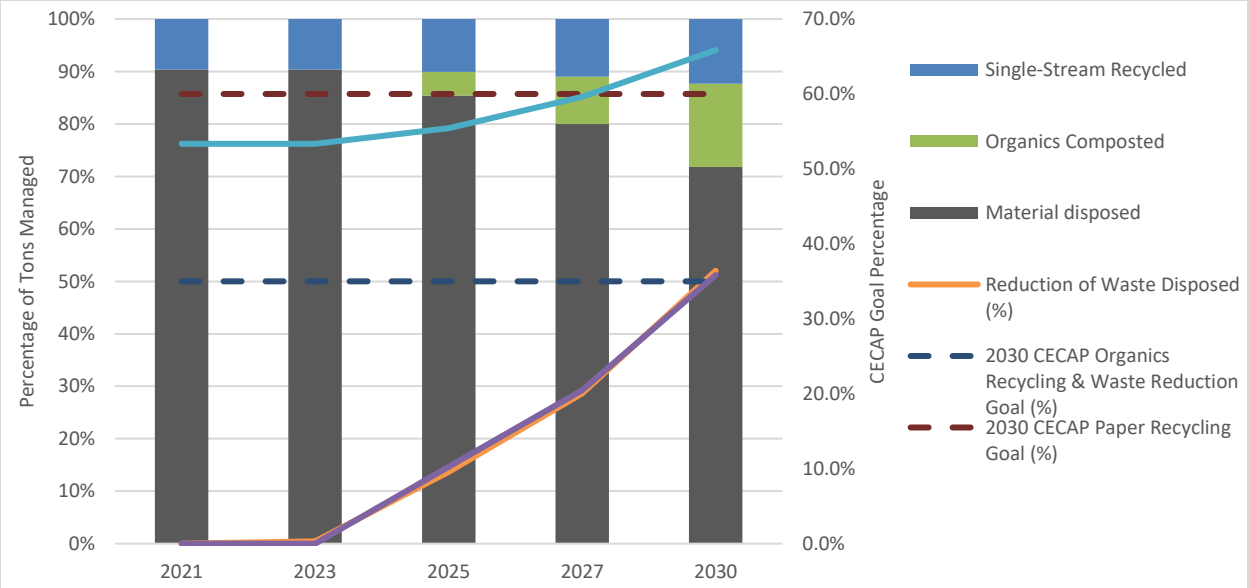
1. Achieve 35% and 80% diversion of organic waste by 2030 and 2050, respectively, from the single-family sector.

2. Achieve 60% and 90% of paper waste by 2030 and 2050, respectively, from the single-family sector.
3. 35% and 45% reduction in waste landfilled in 2030 and 2040 from 2021 tons disposed, respectively, from the single-family sector.

The 2011 LSWMP established long-term Zero Waste goals to establish a vision and empower the City to take effective action to increase its recycling rate. The options, recommendations, and implementation and funding plan as part of the LSWMP Update are focused on meeting the near term 2030 goals established by CECAP; however, the long-term goal for the City is still to strive to achieve Zero Waste by 2060 as originally established as part of the 2011 LSWMP.

The updated goals are intended to focus on the single-family sector, as this is where the City has direct control over the material management. Figure 1-2 shows the pathway to achieve its 2030 LSWMP Update goals assuming that the City would increase the capture rate of recyclables in roll carts to 60 percent by 2030 through increased education, outreach and compliance measures and implement separated collection and processing of yard trimmings and brush.

Figure 1-2: Pathway to 2030 LSWMP Update Goals in Single-Family Sector



The City has elected not to establish tonnage-based goals for the multi-family and commercial sectors since the City only has influence over the material rather than direct control. The 2030 goals for the multi-family and commercial sectors are based on program participation and reporting compliance/verification of current and updated requirements of entities covered under the Multi-family Recycling Ordinance, participation in the Green Business Certification program and non-exclusive franchise haulers, as follows:

- 90 percent reporting compliance and verification of entities covered under the Multi-family Recycling Ordinance by 2030.
- Increasing the number of participants in the Green Business Certification program year-over-year between 2021 and 2030.
- 90 percent reporting compliance and verification from non-exclusive franchise haulers by 2030.

Although tonnage-based goals for the multi-family and commercial sectors will be critical for the City to achieve its long-term Zero Waste goal additional data collection, verification and policy implementation are required before data-driven tonnage goals can be adopted for these sectors. Further discussion of multi-family and commercial data collection and policy considerations are provided in Section 11.0.

1.3.2 Objectives

The objectives are consistent with CECAP and incorporate the updated system evaluation and stakeholder feedback received during the LSWMP Update development process. Table 1-2presents the materials management-related CECAP goals.

Table 1-2: Materials Management-Related CECAP Goal

No.	CECAP Goal
1	Actively promote source reduction, recycling and composting to the Dallas community.
2	Develop a comprehensive green procurement plan.
3	Improve solid waste, recycling and brush and bulky item collection frequency.
4	Improve potential for electric waste collection vehicles.
5	Update and implement the 2011 LSWMP.
6	Expand efforts to reduce illegal dumping by implementing recommendations identified in the litter and illegal dumping assessment study.
7	Encourage the development of material markets focusing on creating new economic opportunities.
8	Continue to capture gas and expand capacity from landfill for reuse and evaluate for city operations.
9	Adopt an ordinance to implement a city-wide organics management program.

Based on the goals adopted by CECAP, the City has updated the objectives for the LSWMP Update to guide policies, programs and infrastructure to support progress toward its 2030 goals and the long-term Zero Waste goal.

1. Empower residents and businesses to reduce the amount of discarded material generated through proactive education, outreach and compliance efforts.
2. Establish and implement innovative operational best practices to provide efficient, cost effective, and environmentally responsible service.
3. Provide excellent customer service and support residents and businesses to maximize diversion from landfill.
4. Operate a clean, green and efficient waste system that seeks to generate energy from organics.

1.4 Guidance for Reading the LSWMP Update

This section provides guidance reading the LSWMP Update, including the content provided in each section, information about each section is structured, how case studies and benchmarking are utilized, the approach to evaluating options and a description of the implementation and funding plan. The LSWMP Update is organized into three overall sections: (1) introductory sections, programs, (2) policies and infrastructure sections, and (3) appendices. The introductory sections provide key context about the LSWMP Update, materials management trends, regulations, projected material management needs, and regional facilities and infrastructure. Program, policies and infrastructure sections are dedicated to discussion of a specific aspect of the City's material management system where each has unique characteristics requiring a customized approach based on varying generators, material types and customers. The appendices provide detailed information compiled and analyzed throughout the LSWMP Update development process. Table 1-3 indicates how the LSWMP Update is organized, listing each section with a brief description of the content included.

Table 1-3: LSWMP Update Section Organization and Description

No.	Title	Description
Introductory Sections		
1.0	Overview, Goals and Objectives	Describes the purpose, key terms, updated goals and objectives, and guidance for reading the LSWMP Update document.
2.0	Planning Studies, Regulatory and Trends Review	Includes applicable planning studies and regulations, roles of government entities in solid waste management, and current solid waste management industry trends.
3.0	Planning Area Characteristics	Reviews the planning area characteristics such as population, economic projections, and projected material management needs.
4.0	Facilities and Infrastructure	Review of material management facilities and infrastructure in the North Central Texas region and presents information on public-private partnership approaches.
Programs, Policies and Infrastructure Sections		
5.0	Transfer Station System	Review of the operational capacity of the program, policy and infrastructure and evaluation of options to support continued strategic usage to meet near- and long-term goals and objectives established by the LSWMP Update.
6.0	Refuse and Recycling Collection	
7.0	Brush and Bulky Item Collection	
8.0	Landfill Operation	
9.0	Recycling Processing	
10.0	Organics Management	
11.0	Multi-Family and Commercial Sector	
12.0	HHW and Electronics Management	
13.0	Public Education, Outreach and Compliance	
Appendices		
A	Stakeholder Engagement Summary	Provides data and results of the stakeholder engagement efforts.
B	Regional Facilities Maps	Maps of the materials management, processing and disposal facilities in the region.
C	Transfer Station System Evaluation	Detailed technical evaluation of the City's transfer station system, refuse and recycling collection, and Landfill programs and operations.
D	Refuse and Recycling Collection Evaluation	
E	Landfill Operation Evaluation	
F	Implementation and Funding Plan	Presents a detailed implementation and funding plan matrix that indicates the priority, funding mechanism, difficulty of implementation, and responsible party for each key recommendation of the LSWMP Update.

1.4.1 Section Layout

Each section of the LSWMP Update is intended to be structured consistently, but customized based on unique characteristics. The introductory sections are structured to provide more general information about materials management, material projections and composition profiles, and regional infrastructure. The program, policy and infrastructure sections each begin with a current system review, evaluation of the recommendations from the 2011 LSWMP, relevant case studies, an evaluation of options and key findings and recommendations. Relevant feedback from the stakeholder engagement efforts precedes the evaluation of options but may be incorporated in other locations throughout the LSWMP Update as appropriate.

1.4.2 Case Studies and Benchmarking

Each section provides case studies and benchmarking data from refuse and recycling collection programs in peer cities to inform the development of the options that are further evaluated. The case studies and benchmarking cities were selected based on challenges that the City is encountering related to the program, policy or infrastructure addressed in each section.

1.4.3 Options Evaluation

Each of the options and specific tactics identified in the LSWMP Update is evaluated based on the following criteria:

1. **Recycling potential.** Indicates if implementation of the tactic would increase the City's capability to separately mange material for recycling. Depending on the option and/or tactic recycling potential may include recycling, organics, bulky items or HHW.
2. **Operational impact.** Indicates if implementation of the tactic would have an operational impact on staffing, equipment, infrastructure currently used to run one or more programs.
3. **Financial impact.** Indicates if implementation of the tactic would financial impacts including increases or decreases to operational and capital costs or if the tactic would realize cost savings.
4. **Environmental impact.** Indicates if implementation of the tactic would have a positive (e.g., emissions reduction) or negative (e.g., increased emissions) environmental impact including greenhouse gases (GHG) or other emissions such as particulate matter (PM), nitrous oxide (NOx) or sulfur oxide (SOx).
5. **Policy impacts.** Indicates if implementation of the tactic would have policy implications related to the existing City Code of Ordinances or require developing and adopting new policy.

6. **Stakeholder "buy-in".** Indicates if implementation of the tactic has stakeholder "buy-in" among City departments, residential customers, commercial entities, environmental groups, or any other group that would be impacted by the tactic.
7. **Compatibility with existing programs.** Indicates if implementation of the tactic would cause an interruption to the continuity of ongoing programs and services or require changes to current operations.

Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. T The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Table 1-4 provides an example summary of the options evaluation.

Table 1-4: Example Summary of Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Option Title							
Description of tactic.	●	▲	●	●	■	■	▲

1.4.4 Implementation and Funding Plan

The key findings and recommendations are incorporated into the implementation and funding plan summarized in Appendix F. Each recommendation from the LSWMP Update is provided with the following indicators:

1. **CECAP Goal.** Indicates the material management-related CECAP goal(s) that the recommendation/tactic supports.
2. **Priority.** Indicates the urgency with which the City plans to implement the recommendations on a high, medium or low basis.
3. **Recycling potential.** Indicates if implementation of the tactic would increase the City's capability to separately manage material for recycling on a high, medium or low basis.
4. **Difficulty of implementation**. Indicates if implementation of the recommendation would be difficult to implement based on operational impact, policy impacts, stakeholder "buy-in" and compatibility with existing programs on a high, medium or low basis.
5. **Financial impacts.** Indicates the costs of each recommendation on a high, medium or low basis, where high financial impacts are reflective of significant increased cost or capital expenditure.

6. **Funding source.** Indicates if the funding source for the recommendation would be part of a bond offering or other fundraising approach.
7. **Implementation timing.** Provides a general indication of when the proposed recommendation will be implemented on a near-term (one to three years), mid-term (three to five years), or long-term (five to 10 year) basis.
8. **Responsible party.** Indicates which City department or external organization is responsible for the implementation of each recommendation.

2.0 PLANNING STUDIES, REGULATORY, AND TRENDS REVIEW

This section provides a broad perspective of the historic and current state of the MSW management environment in which the City is developing this LSWMP Update. It provides a review of relevant existing planning studies, a summary of relevant laws and regulations, and information on key trends in MSW management.

2.1 Review of Relevant Planning Studies

Understanding prior MSW and community planning projects completed at the local, regional, and state levels is a critical step in effectively and efficiently developing the LSWMP Update for the City. To inform development of this LSWMP Update, Burns & McDonnell reviewed the following studies and plans presented chronologically.

- **Landfill Management and Operations Assessment.** In 2000, R. W. Beck completed performed a management and operations assessment of the McCommas Bluff Landfill (Landfill).
- **Transfer Station Evaluation.** In 2006, R. W. Beck performed an operational review of the City's three transfer stations and transfer fleet to evaluate the efficiencies of the City's transfer operation to determine the City's cost to operate its system.
- **Local Solid Waste Management Plan 2011 - 2060[2].** In 2011, the City contracted with HDR to develop a Local Solid Waste Management Plan (2011 LSWMP) consistent with the requirements of 30 TAC §330. The contract included a formal planning process to identify the policies, programs and infrastructure needed to effectively manage municipal solid waste and recycling materials. Considering economic growth, environmental stewardship, and the City's policies around fiscal responsibility, the plan included goals to systematically reduce the volume and toxicity of wastes, and ways of maximizing diversion and opportunities to recover raw materials and clean energy from the waste stream. The plan included a series of programmatic, policy and infrastructure development recommendations along with a timeline for implementation.
- **Resource Recovery Planning and Implementation Study[3].** In 2014, the City began the planning process to determine where recyclable materials would be processed when its existing contract with

[2] City of Dallas. 2013. "Local Solid Waste management Plan 2011-2060" Available online: https://dallascityhall.com/departments/sanitation/DCH%20Documents/pdf/DallasLocalSWMP_Vol-I-II.pdf

[3] City of Dallas. 2014. "Consulting Services in Support of Resource Recovery Planning and Implementation." Available online: https://dallascityhall.com/departments/sanitation/DCH%20Documents/pdf/ResourceRecoverPlanningAndImplementation.pdf

Waste Management Recycle America expired in 2016. This evaluation included the including the option to take a more active role in a future processing facility by developing a City-owned and managed facility or entering into a public-private partnership. The City evaluated technologies including single-stream recycling, mixed waste processing, gasification and anaerobic digestion and as a result of the analysis and recommendations, released a Request for Competitive Sealed Proposals (RFCSP) as described below.

- **Recycling Processing Request for Competitive Sealed Proposals.** In 2014, Burns & McDonnell developed an RFCSP, as well as the contract for recycling processing services between the City and the selected vendor. Fomento de Construcciones y Contratas, S.A. dba FCC, S.A (FCC) was selected and worked with the City to develop the Materials Recovery Facility (MRF) located on the Landfill site. FCC has and has been operating the MRF since 2016. Further discussion and evaluation of the FCC MRF and contract including key contract terms, accepted materials and annual tonnage processed is provided in Section 9.0
- **North Central Texas Council of Governments (NCTCOG) Regional Solid Waste. Management Plan 2015 - 2040[4].** This plan was developed by NCTCOG in 2015 and covers a 25-year planning period for the NCTCOG, the 16-county regional planning area in the North Central Texas region. The primary purpose of this plan is to inventory closed landfills, quantify regional landfill capacity in relation to projected future growth in waste generation, identify the region's most prominent needs and problems, and outline activities and priorities to be initiated throughout the planning period. NCTCOG is currently working with Burns & McDonnell in the process of updating this regional planning effort.
- **Draft Facility Condition Assessments.** In 2016 the City contracted with AECOM Technical Services to complete a draft Facility Condition Assessment to evaluate the conditions of the transfer station system and other operational buildings including the Sanitation Department heavy shop, administrative building at the Landfill and Eco Park.
- **Evaluation of Collection Methods and Alternatives.** In 2017 the City contracted with Burns & McDonnell to complete a review of collection operations to evaluate the current methods of collection and provide recommendations to increase collection efficiency related to residential refuse, recycling, brush and bulky material collections as well as fleet maintenance. The recommendations were used to support the three-month separated brush and bulky item collection

[4] North Central Texas Council of Governments (NCTCOG). 2015. "Planning for Sustainable Materials Management in North Central Texas 2015-2040." Available online: https://www.nctcog.org/envir/materials-management/materials-management-plan

pilot that was held from October – December 2021. Further discussion of brush and bulky item collection is provided in Section 7.0.

- **TCEQ Study on the Economic Impacts of Recycling[5].** This 2017 study, completed by the TCEQ as outlined in House Bill 2763 of the regular session of the 84th Texas Legislature, documented the quantities of MSW recycled and landfilled in Texas. The report provides a state-level understanding of 2015 recycling and landfill disposal quantities and composition and provides key economic and market trend data. . The study also includes comprehensive information and recommendations on funding methods to increase recycling and identified infrastructure needs and opportunities for rural and underserved areas,
- **Solid Waste Landfill Market Study.** In 2018, the City contracted with Burns & McDonnell to complete completed a Solid Waste Landfill Market Study, which updated prior landfill market studies completed by Burns & McDonnell on behalf of the City to identify the market rate for disposal in the region to determine the impact of the City's current landfill tipping fees.
- **Litter and Illegal Dumping Assessment Study.** In 2018 the City contracted with Burns & McDonnell to complete a study to evaluate the City's ongoing efforts and costs to address litter and illegal dumping. This cross-departmental effort included Dallas Water Utility (DWU), the Marshall's office, the Office of Environmental Quality and Sustainability (OEQS), the Sanitation Department, and Code Compliance. The study and provides recommendations for how the City can implement a more strategic and preventative approach to combatting litter and illegal dumping including:
    - Develop a geographically-focused approach
    - Improve local/regional collaboration
    - Implement proactive and preventative methods
    - Increase community engagement and public education
    - Reduce illegal dumping from construction activities and commercial sources
    - Enhance enforcement of litter and illegal dumping policies.
- **Initial Operational Assessment.** In 2020, Burns & McDonnell completed a study to provide the City with a planning-level understanding of key managerial and operational issues facing the Sanitation Department and present key findings and recommendations that are included in the LSWMP Update.

[5] Texas Commission on Environmental Quality (TCEQ). July 2017. "Study on the Economic Impacts of Recycling." Available online: https://www.tceq.texas.gov/p2/recycle/study-on-the-economic-impacts-of-recycling.

- **TCEQ Recycling Market Development Plan[6].** In September 2021, the TCEQ published a Recycling Market Development Plan (RMDP) to promote the use of recyclable materials as feedstock in processing and manufacturing. Similar to the Study on the Economic Impacts of Recycling, the RMDP provides state-level estimates of recycling and landfill disposal quantities statewide and estimates the resulting economic benefits of recycling. The RMDP also provides a plan recommendations to increase recycling, developed based on the key barriers and opportunities identified across the State.
- **City of Dallas Comprehensive Environmental and Climate Action Plan (CECAP)**[7]. The CECAP was published in 2020 and provides a framework for achieving significant and measurable reductions in carbon emissions, enhancing environmental quality equitably, and creating a more sustainable infrastructure resilient to the negative effects of climate change. The AECOM-developed CECAP communicates goals among eight key environmental sectors including buildings, energy, transportation, solid waste, water resources, ecosystems and green space, food and urban agriculture, and air quality. Solid waste is a key focus of the CECAP and the plan defines nine goals to mitigate waste-based carbon emissions, several of which will be addressed as part of the development of the LSWMP Update. Table 2-1 lists the nine solid waste goals and identifies how they are addressed in the LSWMP Update.

Table 2-1: Description of How LSWMP Update Addresses CECAP Goals

No.	CECAP Goal	How LSWMP Update Addresses Goal
1	Actively promote source reduction, recycling and composting to the Dallas community.	Evaluates the City's education, outreach and compliance programs and provides recommendations on how to enhance its capabilities.
2	Develop a comprehensive green procurement plan.	Supports on-going cross-departmental efforts to develop a comprehensive green procurement plan by providing discussion about the impact of purchasing policy on source reduction efforts.
3	Improve solid waste, recycling and brush and bulky item collection frequency.	Evaluates the City's current brush and bulky item collection program and provides recommendations on approaches to scale separate collection on a City-wide basis.

[6] Texas Commission on Environmental Quality (TCEQ). August 2021. "Recycling Market Development Plan." Available online: https://www.tceq.texas.gov/assets/public/assistance/P2Recycle/Recyclable-Materials/2021%20Recycling%20Market%20Development%20Plan.pdf

[7] City of Dallas. 2020. "Comprehensive Environmental and Climate Action Plan." Available online: https://www.dallasclimateaction.com/cecap

No.	CECAP Goal	How LSWMP Update Addresses Goal
4	Improve potential for electric waste collection vehicles.	Incorporates case studies on collection systems that have incorporated Battery Electric Vehicles (BEVs) provides considerations for implementing a BEVs on a pilot basis.
5	Update and implement the 2011 LSWMP.	Establishes realistic goals and metrics by sector and strategic approaches to achieve these goals.
6	Expand efforts to reduce illegal dumping by implementing recommendations identified in the litter and illegal dumping assessment study.	Evaluates the City's Household Hazardous Waste (HHW) and electronics management programs, including a high-level evaluation of the progress made toward the recommendations of the Litter and Illegal Dumping Assessment Study.
7	Encourage the development of material markets focusing on creating new economic opportunities.	Interviewed the City's Economic Development Department and Chambers of Commerce as part of the stakeholder engagement effort and leveraged the statewide Recycling Market Development Plan (RMDP) to provide information on economic opportunities related to material markets.
8	Continue to capture gas and expand capacity from landfill for reuse and evaluate for city operations.	Evaluates the Landfill's gas collection system and provides recommendations to continue to expand capacity to beneficially reuse Landfill gas.
9	Adopt an ordinance to implement a city-wide organics management program.	In addition to the recommendations related to separately collecting brush and bulky items, the LSWMP Update evaluates the City's non-exclusive franchise ordinances and provides near- and long-term recommendations on increasing organics recycling from the commercial sector.

2.2 Regulatory and Policy Review

Prior regulations and policies related to material management, as well as trends and the current regulatory climate, have largely shaped the state of material management and defined the environment in which this LSWMP Update is being developed. This section provides a summary of federal and state regulations, policies, and trends.

2.2.1 Role of the Federal Government in Regulating Solid Waste

The federal government sets basic requirements for regulations which help provide regulatory consistency across the United States and protects public health and the environment, which helps to provide consistency across the U.S. The United States Environmental Protection Agency (U.S. EPA) is responsible for

hazardous and non-hazardous solid waste management through the Office for Solid Waste and Emergency Response. There are three four major pieces of federal legislation pertaining to solid waste management:[8]

- Prior to 1965, solid waste management was entirely dependent on the judgement and decisions of individuals or local departments of health and sanitation. In 1965, Congress made its first attempt to define the scope of the nation's waste disposal problems by enacting the Federal Solid Waste Disposal Act (SWDA), which financed statewide surveys of landfills and illegal dumps.
- The first significant federal legislation governing the disposal of non-hazardous and hazardous waste was passed in 1976 under the Resource Conservation and Recovery Act (RCRA). RCRA established landfill construction, management, and closure guidelines. It also regulates hazardous waste management facilities that treat, store, or dispose of hazardous waste. In 2006 the U.S. EPA delegated the primary responsibility of implementing RCRA hazardous waste programs to the TCEQ[9]. RCRA has been amended three times since its inception:[10]
    - 1984 Hazardous and Solid Waste Amendments, requiring the phasing out of landfill disposal of hazardous wastes and granting the U. S. EPA with regulatory authority over landfills (Subtitle C Hazardous Waste and Subtitle D Non-hazardous waste).
    - 1992 Federal Facility Compliance Act, strengthening enforcement of RCRA at federal facilities.
    - 1996 Land Disposal Program Flexibility Act, providing regulatory flexibility for land disposal of certain wastes.
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, known as Superfund, was enacted by Congress to address abandoned hazardous waste sites in the United States. CERCLA was subsequently amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) to stress the importance of permanent remedies, provide for increased state involvement, and increase federal funding. [11] The Office of Air and Radiation regulates solid waste-related air emissions, enforcing the Clean Air Act of 1976 (CAA) and its subsequent amendments.[12]

[8] Texas Center for Policy Studies. 1995. "Texas Environmental Almanac." Available online: http://www.texascenter.org/almanac/
[9] Texas Commission on Environmental Quality. "Chapter 335- Industrial Solid Waste and Municipal Hazardous Waste" Available online: https://www.tceq.texas.gov/assets/public/legal/rules/hist_rules/Complete.06s/06032335/06032335_pro_clean.pdf
[10] U.S. Environmental Protection Agency. 2017. "History of the Resource Conservation and Recovery Act (RCRA)." Available online: https://www.epa.gov/rcra/history-resource-conservation-and-recovery-act-rcra
[11] U.S. Environmental Protection Agency (U.S. EPA). 2017. "Superfund: CERCLA Overview." Available online: https://www.epa.gov/superfund/superfund-cercla-overview
[12] U.S. EPA. 2020. "Summary of the Clean Air Act 42 U.S.C. §7401 et seq. (1970)." Available online: https://www.epa.gov/laws-regulations/summary-clean-air-act

- Following the ecological impacts from the Exxon-Valdez Oil Spill, in 1980, Congress passed the Natural Resource Damages Assessment (NRDA) Act, to provide for habitat restoration, replacement and/or preservation following remediation under CERCLA. The U.S. Department of Interior governs actions under the NRDA Program[13].

In addition to federal legislation, there are various ongoing policy development and implementation efforts relates to SMM. To address food loss and waste nationwide, the U.S. EPA established a national goal on September 16, 2015 to reduce food loss and waste by 50 percent by 2030. The Food Loss and Waste Reduction Goal was a joint effort with the U.S. Department of Agriculture to address food insecurity and reduce landfill methane emissions. Achieving the target 50 percent reduction is equivalent to reaching a total disposal rate of 109.4 pounds of food waste per person per year.

Recently, the U.S. EPA developed a National Recycling Strategy identifies objectives and actions needed to create a more resilient and cost-effective recycling system nationwide including integrating recycled materials into product and packaging designs[14]. The National Recycling Strategy supports implementation of the National Recycling Goals developed to there are national policies that in place and under development to guide lawmakers to develop and implement future legislation.

On November 17, 2020 the U.S. EPA established the National Recycling Goal of 50 percent by 2030 to provide the benchmarks needed to evaluate the success of the collective efforts to significantly improve the nation's recycling system. The metrics identified in the National Goal are based on the broad objectives of the draft National Recycling Strategy and are divided into four categories: assessing recycling performance, reducing contamination, increasing processing efficiency and strengthening recycled material markets. The National Recycling Goal aims to create standardized definitions for the recycling industry to keep pace with today's diverse and changing waste system. The following lists the measures that will be used to track the progress toward the National Recycling Goal.

- **Measure 1:** Reduce contamination in recycling. This will be calculated by examining the percentage of contaminants in the recycling stream.
- **Measure 2**: Make the national recycling processing system more efficient. This will be measured by tracking the percentage of materials successfully recycled through recycling facilities compared to the inbound material.

[13] Further information on the National Resource Damage Assessment and Restoration Program is available online: https://www.doi.gov/restoration

[14] U.S. EPA. "National Recycling Strategy Part One of a Series on Building a Circular Economy for All". Available online: https://www.epa.gov/system/files/documents/2021-11/final-national-recycling-strategy.pdf

- **Measure 3:** Strengthen the economic markets for recycled materials. This will be measured by tracking the average price per ton of recycled material on the secondary materials commodity market.

The related National Recycling Strategy identifies objectives and actions needed to create a more resilient and cost-effective recycling system nationwide. The draft National Recycling Strategy was open for public comment until December 4, 2020 and is expected to be finalized in late 2021. The National Recycling Strategy will be aligned with and support implementation of the National Recycling Goals.

National organizations other than the federal government also play a role in national solid waste policies and trends. The Recycling Partnership has been working to develop an initiative called the Circular Economy Accelerator Policy[15] to support the collective U.S. residential recycling collection system to develop a collaborative public-private policy solution that includes:

- A packaging and printed paper fee paid by private-sector brands to support residential recycling infrastructure and education.
- A disposal surcharge on waste generators to help defray recycling operational costs for communities.

Packaging and printed paper fees would be based on a needs assessment and data-driven plan. Fees would be calculated to address the level of investments that are needed to provide recycling access to residents on par with disposal, provide education and outreach to residents to reduce rates of inbound contamination, and enhance MRF capabilities to efficiently sort and process collected materials. A third-party Non-Governmental Organization (NGO) would set and collect fees based on the established needs and disburse funds in order to meet statutory goals.

Combined, this dual-policy solution is intended to bring key stakeholders together to create funding mechanisms that could address the infrastructure, education and operational challenges facing the recycling collection system.

2.2.2 Role of the State Government in Regulating Solid Waste

Texas has a long-standing solid waste material management regulatory program, initiated with the Texas Solid Waste Disposal Act and passed by the state legislature in 1969. This Act required the Texas Health Department to adopt regulations pertaining to the design, construction, and operation of landfills and other processing facilities. Today, the TCEQ holds jurisdiction over solid waste material management. Several

[15] For more information on the Accelerator Policy see the report "Accelerating Recycling: Policy to Unlock Supply for the Circular Economy" here: https://recyclingpartnership.org/accelerator-policy/

other major pieces of state legislation from the state Senate and House of Representatives have been enacted:

- The 1983 Comprehensive Municipal Solid Waste Management, Resource Recovery, and Conservation Act, which established the Municipal Solid Waste Management and Resource Recovery Advisory Council, prescribed criteria and procedures for regional planning agencies and local governments that wanted to develop solid waste management plans.
- The 1987 House Bill 2051 established a preferred hierarchy via state policy for the management of hazardous waste, municipal waste, and municipal sludge. Figure 2-1 illustrates a current version of the municipal waste management hierarchy.
- The 1989 Senate Bill 1519 established a solid waste disposal fee program to fund the state's MSW regulatory programs. It required the state's regional planning agencies (Councils of Governments, COG) to develop regional solid waste management plans and to provide grand funding to support development of local plans.
- The 1991 Omnibus Recycling Act (Senate Bill 1340), set a statewide recycling goal of 40 percent of its MSW by January 1, 1994 and directed several state agencies to develop a joint market study and strategies to stimulate markets for recycled goods.
- The 1993 Senate Bill 1051 expanded state recycling programs and amended the state's 40 percent recycling goal. The goal became a 40 percent waste reduction goal, aimed at reducing the total amount of material disposed of in the state through recycling as well as source reduction.
- The 1993 House Bill 2537 addressed the risks associated with methane gas release from closed landfills by establishing a process for the TCEQ to review proposals and issue permits to build atop closed MSW landfills.[16]
- The 2007 Texas Computer Equipment Recycling Law required manufacturers to establish and implement a recovery plan for collection, recycling, and reuse of computer products.[17]
- The 2013 House Bill 7 reduced the disposal fees that landfills are required to pay to TCEQ from $1.25 per ton to $0.94 per ton and reduced the percentage allocated to Councils of Governments (COGs) to 33.3 percent.
- The 2015 House Bill 2736 required the TCEQ to conduct a study to quantify the amount of materials being recycled in the state, assess the economic impacts of recycling, and identify ways

[16] Texas Center for Policy Studies. 1995. "Texas Environmental Almanac." Available online: http://www.texascenter.org/almanac/

[17] Texas Commission on Environmental Quality. "Guidance for the Texas Recycles Computers Program" Available online: https://www.tceq.texas.gov/p2/recycle/electronics/computer-recycling.html

to develop new markets to increase recycling. The TCEQ completed *Study on the Economic Impacts of Recycling* in 2017.

- The 2019 House Bill 61 is the "Slow Down to Get Around" legislation that establishes a misdemeanor violation for vehicles that do not adhere to the Transportation Code's requirements of slowing and moving 2 lanes away from a solid waste collection vehicle.
- The 2019 Senate Bill 649 required the TCEQ to produce a plan to stimulate the use of recyclable material as feedstock in manufacturing. The bill also requires the TCEQ to develop an education program outlining all the ways that recycling provides economic benefits to the state.
- The 2019 House Bill 1435 authorized the TCEQ to inspect the facility or site before a permit for a proposed MSW management facility is issued, amended, extended, or renewed.
- The 2019 House Bill 1953 prohibited TCEQ from treating post-use polymers or recoverable feedstocks as solid waste if the substances are converted (by pyrolysis or gasification) into other valuable products.
- The state procurement office requires that state agencies give preference to specific types of products known as "first choice purchasing options." These preferred products have a 10 percent price preferential (meaning they should be preferred even if they cost up to 10 percent more than products that do not contain recycled content) and must suit the needs of the purchasing agency. Preferred products include:
- Re-refined oils and lubricants (to be 25 percent recycled content, if quality similar).
- Certain paper products, including paper towels, toilet paper, toilet seat covers, printing, computer and copier paper, and business envelopes (a state agency is to procure the highest recycled content that meets their needs and is offered by the Comptroller).
- Certain plastic products including trash bags, binders, and recycling containers.
- Steel products.
- Additionally, the state comptroller may give priority to Rubberized Asphalt Paving (RAP) material made from scrap tires by a facility in this state if the cost, as determined by life-cycle cost-benefit analysis, does not exceed the bid cost of alternative paving materials by more than 15 percent. (Texas Government Code §2155.443).
- In addition to state legislation, a rule adopted by the TCEQ, the Governmental Entity Recycling Program, became effective July 2, 2020 and requires local government entities in Texas to create and maintain a recycling program for their operations, as well as create a preference in purchasing for products made of recycled materials when the cost difference is less than 10 percent.

As part of the Governmental Entity Recycling Program, entities must give preference to products made with recycled materials, so long as the products meet applicable specifications as to quantity and quality and the average price of the product is not more than 10 percent greater than the price of comparable non-recycled products. The TCEQ rules require municipalities to:

1. Separate and collect all recyclable materials.
2. Provide procedures for collecting and storing recyclable material and making contractual or other arrangements with buyers of recyclable materials.
3. Evaluate the amount of recyclable material recycled and modify the recycling program as necessary to ensure that all recyclable materials are effectively and practicably recycled.
4. Establish educational and incentive programs to encourage maximum employee participation.

To establish a governmental entity recycling program, municipalities should review purchasing procedures, prioritize purchasing products that are recyclable or contain recycled content, encourage the community to buy recycled, and leverage the Texas Smart Buy Membership program (State of Texas Cooperative Purchasing program). The requirements of the governmental entity recycling program are covered as part of the sustainable procurement policy adopted by the City in May 2021. The sustainable procurement policy guides the City in making procurement decisions that positively impact social, economic and environmental health by establishing a working group to maintain an environmentally preferred products list, identify sustainability labels and standards to use in writing specifications, analyze citywide purchases for efficiency and waste reduction opportunities, and make other recommendations to achieve these ends.

2.2.3 Recent State Legislative Trends

The Texas Legislature meets on a biennium, or every other year. When the Texas Legislature is in session, a variety of Senate and House bill proposals relating to solid waste material management are introduced. During the recent 2021 legislative sessions, the Texas Legislature passed the following bills that could have an impact on the solid waste industry:

1. House Bill 1322 requires agencies such as TCEQ to provide plain-language summaries of any proposed rules.
2. House Bull 1869 amends the definition of debt in the Tax Code to include debt for “designated infrastructure” including landfills.
3. House Bill 1118 increases cybersecurity requirements for state and local entities, including compliance with cybersecurity training.

4. House Bill 2708 provides some municipalities access to certain hazardous waste remediation fees for reimbursement related to environmental cleanup at used battery recycling facilities.
5. House Bill 3516 requires TCEQ to adopt rules for the treatment and beneficial use of oil and gas waste, including permitting standards for commercial recycling.
6. House Bill 4110 increases recordkeeping requirements and documentation needed when a person attempts to sell a catalytic converter to a metal recycling facility.
7. Senate Bill 211 creates a 30-day deadline to file a petition on a TCEQ ruling, such as a permit issuance or other decision under the Solid Waste Disposal Act.
8. Senate Bill 1818 defines liability and reasonable care criteria for scrap metal recycling transactions with an end user/manufacturing facility.

Throughout the recent 2021 session and subsequent special sessions, additional topics of interest to state legislators were discussed based on proposed bills, but were not enacted. These topics include[18]:

1. Regulations related to the ability of the State to restrict local government ability to enact prohibitions on the sale or use of a container or package.
2. Regulations that for any product listed as recycled, remanufactured, environmentally sensitive be certified as accurate.
3. Regulations relating to municipal solid waste management services that cap the fee of gross receipts of a collection service provider to two percent.[19]
4. Regulations relating to the authority of certain municipal employees to request the removal and storage of certain abandoned or illegal parked or operated vehicles.
5. Creation of an eight-member council that advises state agencies and local governments on environmental justice issues (15-member review board advises the council) and the creation of an Office of Environmental Justice within the TCEQ.
6. Development of the Texas Clean and Healthy program, a rebate system for recyclable materials with verified end markets and direct economic relief.[20]

[18] North Central Texas Council of Governments. 2021. "87th Session Legislative Matrix." Available online: https://nctcog.org/nctcg/media/Environment-and-Development/Documents/Materials%20Management/87th-Legislative-Matrix_Solid-Waste.pdf
[19] North Central Texas Council of Governments. 2021. "House Bill 753 One-Pager." Available online: https://www.nctcog.org/nctcg/media/Environment-and-Development/Committee%20Documents/RCC/FY2021/HB-753-One-Pager.pdf
[20] North Central Texas Council of Governments. 2021. "Texas Clean and Healthy Initiative." Available online: https://www.nctcog.org/nctcg/media/Environment-and-Development/Committee%20Documents/RCC/FY2021/Texas-Clean-and-Healthy-Initiative_Summary.pdf?ext=.pdf

7. Amendment of the water code to restrict direct discharge or waste or pollutants into a classified stream segments that has had low phosphorus level at or below 0.06 mg/L in 90% or more of water quality samples for 10 years.
8. Regulation to allow a county to regulate solid waste services and ability to establish a mandatory program to collect a fee for solid waste services through the county tax assessor-collector's office.
9. Stricter regulations for locations of new landfills or the horizontal expansion of existing landfills in environmentally sensitive areas, such as over sole source aquifers or within special flood hazard areas.
10. Regulation related to the discharge of preproduction plastic, including prompt and environmentally responsible containment and cleanup, additional stormwater permit requirements, monitoring and implementation of best management practices.

2.2.4 Role of the City of Dallas in Regulating Solid Waste

Chapter 18 of the Dallas City Code regulates the collection and disposal of MSW and defines Sanitation Services as the department of the City that is responsible for the operation of the City's solid waste collection and disposal utility. This provides the regulations for the following aspects of solid waste management:

1. Proper material set -outs
2. Collecting from residences, duplexes, apartments, institutions, commercial establishments and mobile home parks
3. Collection and removal of recyclable materials from multifamily sites
4. Collection and removal of material from the Downtown Area
5. Solid waste not handled by the Sanitation Services Department
6. Charges for disposal of solid waste
7. Collection and removal of illegally dumped materials on private premises
8. Penalties for violation
9. Weeds, grass and vegetation
10. Junked vehicles
11. Private solid waste collection service
12. Tires

2.3 Solid Waste Material Management Industry Trends

Solid Waste management philosophy, trends and practices have evolved significantly since the 2011 LSWMP. Key MSW management trends that may influence development of the LSWMP Update include,

but are not limited to, Sustainable Material Management (SMM), the waste management hierarchy, Zero Waste philosophy, circular economic practices, and several other local and national material management industry trends. This section provides perspective on key MSW management trends that may influence the development of the LSWMP Update and the industry moving forward.

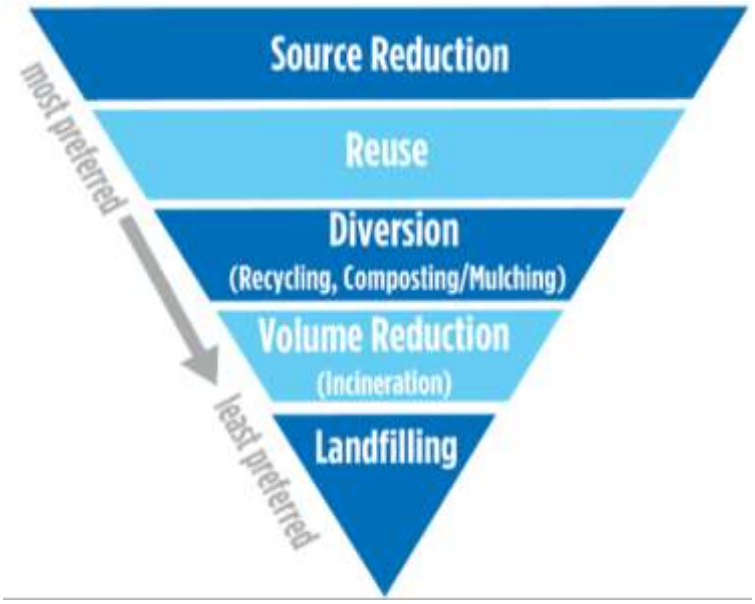
Sustainable Materials Management. SMM is a systematic approach to using and reusing materials more productively over their entire life cycles.[21] SMM encourages changes in how communities think about the use of natural resources and environmental protection, and goes beyond traditional thinking about waste reduction, reuse, recycling, and disposal. SMM emphasizes the consideration of a product's life from manufacturing to disposal and the need to make sustainable choices throughout that life cycle. An SMM approach seeks to:

- Use materials in the most productive way with an emphasis on using less.
- Reduce toxic chemicals and environmental impacts throughout a material's life cycle.
- Provide sufficient resources to meet the material needs of today and the future.

It has been a trend for the material management industry to apply the broad view of SMM to better plan for their community's economic and environmental future. For example, as discussed in Table 2-2, several cities in Texas (including Dallas) have adopted plans with high diversion goals, which typically include addressing SMM concepts.

[21] U.S. Environmental Protection Agency (U.S. EPA). 2017. "Sustainable Materials Management Basics." Available online: https://www.epa.gov/smm/sustainable-materials-management-basics

Figure 2-1: U.S. EPA's Waste Management Hierarchy



Waste management hierarchy. The waste management hierarchy, developed by the U.S. EPA, has been adopted by many communities as a guide to managing MSW. This hierarchy is used as a tool in implementing an SMM approach to waste management. It was developed in recognition that no single waste management approach is suitable for managing all materials and all waste streams in all circumstances. The hierarchy ranks various management strategies from most to least environmentally preferred. It places emphasis on reducing, reusing, and recycling as key to SMM.[22]

Figure 2-2: Circular Economy

Circular economy. Like an SMM approach to planning for a community's future, the concept of a circular economy considers environmentally and economically sustainable decision-making throughout a material's life cycle. It offers a shift from the traditional linear manufacture-use-dispose concept of materials to a circular economy model that keeps resources in use for as long as possible, maximizes life and extracted value, and emphasizes that used materials are recovered and regenerated for other uses. This economic approach allows the cycle to begin again while minimizing material disposal. Circular economy approach is a central theme in recycling market and economic development initiatives and is a

[22] U.S. Environmental Protection Agency. 2017. "Sustainable Materials Management: Non-Hazardous Materials and Waste Management Hierarchy." Available online: https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy

goal of the City's CECAP to encourage the development of material markets and focusing on creating new economic opportunities within the City.

Zero Waste. Zero Waste is a philosophy that encourages the redesign of resource life cycles so that all products are reused. Zero waste is not a static, defined benchmark of eliminating landfill disposal of waste, but is rather a vision or philosophy around which communities and society should develop and adapt their materials management systems and culture. A number of industry organizations, states, and cities have begun setting zero waste goals. While diversion recycling rate is a common metric used to evaluate zero waste progress, 100 percent diversion recycling is not the ultimate goal of zero waste; rather, the focus is on continuous improvement and progressively working toward maximizing use of resources, and minimizing adverse environmental impacts and material disposal.

A comparison of the accepted municipal and industry definitions of zero waste shows that there are a number of prominent or key concepts across zero waste philosophies:

- Zero Waste as a guiding vision, philosophy, or set of principles (rather than a numeric goal); Zero Waste as striving for continuous improvement, not an absolute term or goal.
- System and material life cycle approach.
- Minimize waste generation and promote waste prevention.
- Circular economy.
- Supporting economic value, stimulation, and job creation.
- Minimization of environmental and health impacts (e.g., greenhouse gas emissions, landfill burial, water pollution).
- View used materials as resources, not waste and maximize recovery of materials.
- Extended producer responsibility (EPR).
- Adherence to the materials management hierarchy.

High Recycling or Zero Waste Goals by Other Texas Cities. Over the last 10 years, several cities (including Dallas) in Texas have developed MSW management plans that include goals to recycle or divert a high percentage of material from being landfilled. Some of these cities have specifically developed "Zero Waste" plans, while others have preferred to use terminology such as "high diversion." Zero Waste is a philosophy that encourages the redesign of resource life cycles so that all products are reused. The goal for Zero Waste is that no MSW be sent to landfills or waste-to-energy facilities. Zero Waste is more a goal or

ideal rather than a hard target, as multiple cities with zero waste plans set maximum goals that still include some MSW going to landfills (e.g. 80% landfill diversion)[23].

It has become common for cities to set short-, mid-, and long-term goals for recycling and diversion and to develop progressive programs and strategy implementation plans to meet those benchmarks. Texas cities that have established high diversion or zero waste goals include but are not limited to those presented in Table 2-2.

Table 2-2: Texas Cities with High Diversion or Recycling Goals

City	Goal	Recently Published Recycling/Diversion Rate	
		Percent	Year
Dallas[1]	40% recycling rate by 2020 60% recycling rate by 2040 Zero Waste by 2060	20%	2020
Austin[2]	20% reduction in per capita solid waste disposal by 2012 75% diversion by 2020 90% diversion by 2040	42%	2015
Fort Worth[3]	30% residential recycling rate by 2021 40% total City recycling rate by 2023 50% total City recycling rate by 2030 60% landfill diversion by 2037 80% landfill diversion by 2045	30%	2018
San Antonio[4]	60% single-family residential recycling rate by 2025	36%	2019

1. City of Dallas, 2011-2060 Local Solid Waste Management Plan. These long-term Zero Waste goals were adopted as part of the 2011 LSWMP and are consistent with the LSWMP Update; however, the 20 percent reflected here is only considering residentially collected refuse and recycling and omits any organics that may be collected from the single-family sector.
2. City of Austin, Zero Waste Strategic Plan adopted in 2009. The City of Austin is currently in the process of updating their plan. While these figures may not change, the metrics to evaluate progress toward them may be adjusted as part of the plan update.
3. City of Fort Worth, 2017-2037 Comprehensive Solid Waste Management Plan.
4. City of San Antonio, Recycling and Resource Recovery Plan, 2013 Update.

U.N. Sustainable Development Goals (SDGs). The U.N. SDGs are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs were

[23] While waste-to-energy plays a critical role in an effective integrated solid waste management system, material that is processed for thermal or chemical recycling would not count toward Zero Waste. Further discussion is provided in the waste-to-energy and emerging technologies section below.

set up in 2015 by the United Nations General Assembly and are intended to be achieved by 2030. While the LSWMP Update does not include goals or objectives related to the U.N. SDGs, commercial entities in the City may use this system to support its materials management practices and policies.

Recycling Measurement. Traditionally, a recycling rate has been calculated as a means to measure recycling efforts. A recycling rate indicates the percentage of MSW generated that is recycled. In support of the use of transparent and consistent methods to measure materials recycled, the Solid Waste Association of North America (SWANA) technical policy for Measuring Recycling (T-6.4), published in 2018, defines recycling rate as the proportion of generated MSW that is recycled and is typically calculated utilizing the following formula, where totals are measured by weight in tons[24].

$$\frac{total\ recycled}{total\ recycled + total\ disposed} \times 100\% = recycling\ rate\ percentage$$

The recycling rate may vary depending on the material types and generators that are included in the calculation. For example, including commercially generated material is challenging because there is no mandatory reporting requirement that the City could use to collect, verify and analyze tonnage data and is unaware of any recycling that is currently being conducted in the commercial sector.

Over the past decade, the weights and composition of materials in MSW streams have changed. For example, there is now typically less newspaper but more cardboard, and individual plastic bottles and aluminum cans weigh less. Some consumer packaging contains multiple materials, making recycling more challenging. Due to these factors, some communities are considering alternative methods to recycling measurement, other than recycling rates as described above:

- **Single-stream recycling collected.** The amount of residential recyclables collected annually on a pounds per household basis.
- **Capture rate.** Percentage of recyclable material that is recycled versus disposed.
- **Disposal rate.** Based on per capita/employee disposal quantities.
- **Contamination rate.** The amount of contamination (i.e., material that is not accepted by the City's contract recycling processing facility) present in the residential recycling program on a percentage basis. Contamination rate includes both non-recyclable contaminants and MRF process residue.
- **Participation rate.** Based on how frequently a resident or business recycles over a defined time period (e.g., monthly).

[24] Solid Waste Association of North America Technical Policy T-6.4, Measuring Recycling, available at https://swana.org/TechnicalandManagementPolicies.aspx

- **Life cycle analysis.** Analysis of the total environmental impacts associated with a product or process and evaluation of opportunities to reduce impacts throughout its life cycle, using methods such as replacing virgin material inputs with recycled material.
- **Carbon footprint.** Quantification of greenhouse gas reductions through increased use of recycled materials as product inputs (life cycle analysis) and reduction of material landfilled, which reduces the generation of greenhouse gases due to decomposition.

Environmental justice and equity. Environmental justice and equity considerations related to material management are critical trends that municipalities are considering related to economic development, future infrastructure and transportation needs. Equity is a key consideration that informed the recommendations and goals adopted by set by the City's CECAP (e.g. considering equity to determine siting of any future transfer stations or solid waste management facilities). An example of this is the City's Multi-Family Recycling Ordinance (MFRO). A critical intended impact of the policy is to increase the environmental justice and equity for its residents related to solid waste material management by providing increased access to recycling among residents who live in multi-family tenant dwelling units. Further description related to the MFRO is provided in Section 11.0.

Waste-to-energy and emerging technologies. While recycling and disposal have been considered traditional solid waste material management methods in Texas, some components of the solid waste stream can be converted into energy or further processed. In the 2011 LSWMP, several waste-to-energy technologies were evaluated. Following that effort as part of the 2014 Resource Recovery Planning and Implementation Study, the City further evaluated several emerging technology options including the following, with brief descriptions:

- **Mixed waste processing.** A mechanical process to segregate recyclable materials from the solid waste stream to increase the recovery or recyclables from residential or commercial garbage (e.g. mixed waste) and preparation of materials to be sold at market.
- **Gasification**. A technologically-advanced process that converts the carbon-containing materials in mixed waste (such as paper, plastic, wood, rubber and other organics) into a synthesis gas or "syngas" composed primarily of carbon monoxide and hydrogen used as fuel to generate electricity or as a chemical building block in the synthesis of gasoline or diesel fuel
- **Anaerobic digestion.** A biological process by which organic matter found in the solid waste stream decomposes in the absence of oxygen, producing and using biogas to generate energy and producing a compost product marketed as fertilizer or soil amendment.

As part of the results and recommendations of the 2014 Resource Recovery Planning and Implementation Study, the high cost of development and implementation of mixed waste processing, gasification and

combustion technologies drove the City to pursue the development of a single-stream recycling facility. While waste-to-energy does have a role in a balanced integrated solid waste management system, the philosophy of Zero Waste excludes transformation of material through thermal or chemical processing as a viable pathway to achieving Zero Waste.

Over the past several years, many local governments in the United States (U.S.) have considered one or more of these technologies to manage aspects of their solid waste material streams.

The Texas cities included in Table 2-3 have considered and evaluated various technologies for their communities, but none have implemented any waste-to-energy or other conversion technologies. Key reasons for deciding against implementation of these technologies included preferring to focus on more traditional recycling (e.g. single-stream) and organics diversion programs and the relatively low cost of landfill disposal.

Table 2-3: Summary of Texas Cities' Efforts to Evaluate Conversion Technologies

City	Year	Summary
San Antonio	2011	Evaluated the feasibility of waste-to-energy and concluded that those technologies are not economically feasible "at this time or in the foreseeable future." City decided to focus zero waste implementation efforts including increasing traditional recycling strategies and implementing food waste diversion programs.
Waco	2013	Issued request for proposals for waste-to-energy and received five responses. City declined to further pursue proposals as none of the companies were in commercial operation in the U.S. at the time.
Killeen	2013	While the City entered into negotiations for a gasification facility, the private company did not secure financing and the project was terminated.
Dallas	2014	The City evaluated the feasibility of technologies such as single-stream processing, mixed-waste processing, anaerobic digestion and gasification and elected to focus on the more proven single-stream recycling by developing a MRF under a Public-Private Partnership (PPP) structure to increase diversion from landfill.
Fort Worth	2016	City's request for proposals for recycling processing included consideration of alternative technologies. However, City decided to continue contracting for recycling via single-stream processing.
Houston	2017	Evaluated "One Bin for All" approach, where all MSW would be collected together (i.e. mixed waste), but City declined to enter into contract for "One Bin for All" concept.

Although none of the Texas cities have moved forward to include waste-to-energy as part of their materials management system, other U.S. cities have implemented various technologies because high population density, limited landfill capacity, and land-locked geographies make the technologies more economically viable. Some examples of recent waste-to-energy or alternative conversion technologies that have been

implemented include Fiberight (https://fiberight.com/facilities/) in Bangor, ME and Enerkem (https://enerkem.com/company/facilities-projects/) in Edmonton, CAN. The most recent combustion waste-to-energy facility developed in the U.S. was implemented by the Solid Waste Authority of Palm Beach County, Florida in 2015[25]. Although waste-to-energy project is not being actively pursued in the near-term, the City would consider these as long-term options to support the continued development of a robust integrated solid waste management system.

Landfill Trends. As regulations become more restrictive and it becomes increasingly more challenging to obtain permits for new landfills, the MSW industry is seeing an increase in the vertical and horizontal expansion of established landfills. Owners are more commonly seeking to extend the useful life of their landfill by expanding the landfill footprint, improving operations, or implementing additional technologies such as enhanced leachate recirculation (a process in which liquids or air are added into a landfill to accelerate degradation of the waste and prolonging its useful life).

Landfill capacity is a finite resource in the region and permitting new landfills is becoming increasingly difficult. Closing facilities such as the DFW Landfill operated by Waste Management may cause tonnage flows to shift among facilities in the region, where displaced tonnage from closing landfills are required to be disposed at other facilities. Further discussion of the disposal marketplace is provided in Section 4.1.1.2.0.

Landfill Tipping Fees. The Environmental Research and Education Foundation (EREF) has conducted annual studies comparing landfill tipping fees across the country since 2016. In 2019, average per-ton landfill tipping fees in Texas are lower than both the national average and the South Central Region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) average. In 2020, the average landfill tipping fees in Texas remained below the national average but rose slightly higher than the regional average. The average tipping fees in Texas increased while both the regional and national averages decreased slightly in the year from 2019-2020.[26] This increase could be attributed to differences in economic growth across regions and landfill capacity, as well as that EREF received responses from a slightly different set of landfills from one year to the next. The multi-year trends developed by EREF show increasing tip fees nationally and in all regions over the period from 2016 - 2020.

[25] Solid Waste Authority of Palm Beach County. "Renewable Energy Facility 2" Available online: https://www.swa.org/Facilities/Facility/Details/Renewable-Energy-Facility-2-11

[26] Environmental Research & Education Foundation (EREF). March 2020 and January 2021. "Analysis of MSW Landfill Tipping Fees." Available online: https://erefdn.org/bibliography/datapolicy-projects/

The tipping fees shown in Table 2-4 reflect the average of posted tipping fees at surveyed landfills. Negotiated tipping fees between a landfill and individual haulers may be lower.

Table 2-4: Average Per-ton Landfill Tipping Fees

	2019	2020	Difference	Percent Increase
Texas	$40.18	$42.22	$2.04	5.1%
South Central Region	$40.92	$39.66	($1.26)	(3.1%)
United States	$55.36	$53.72	($1.64)	(3.0%)

Source: Environmental Research & Education Foundation (EREF)

Figure 2-3 shows the average landfill tip fees in different regions around the U.S. to highlight the difference in landfill tip fees.

Figure 2-3: National Average Landfill Tip Fees by Region, 2018

Source: Environmental Research & Education Foundation (EREF)

More specific to the Dallas-Fort Worth Metroplex Area (DFW Metroplex), Table 2-5 describes policies to increase landfill disposal rates implemented at the cities of Dallas, Fort Worth, and Garland and Dallas have implemented policies to increase landfill disposal rates.

Table 2-5: Landfill Rate Policies

City	Policies Implemented
Dallas	Raised its gate rate tipping fee from $25.00 per ton in 2017[27] to $34.88 per ton in 2021[28]. Customers with long-term disposal contracts may pay a lower tipping fee than the gate rate.
Fort Worth	Raised its tipping fee from $41.77 per ton in 2020 to $46.77 per ton in 2021. Additionally, Fort Worth has established an additional $5.00 per ton surcharge for certain commercial customers at the Southeast Landfill.
Garland	Raised its tipping fee from $40.00 per ton in 2019 to $42.00 per ton[29] in 2021 for non-contract automated vehicle customers[30].

Fort Worth raised its tipping fee from $41.77 per ton in 2020 to $46.77 per ton in 2021. Additionally, Fort Worth has established an additional $5.00 per ton surcharge for certain commercial customers at the Southeast Landfill. The City of Garland has raised its tipping fee from $40.00 per ton in 2019 to $42.00 per ton[31] in 2021 for non-contract automated vehicle customers[32]. The City has raised its gate rate tipping fee from $25.00 per ton in 2017[33] to $34.88 per ton in 2021[34]. Customers with long-term disposal contracts may pay a lower tipping fee than the gate rate. As disposal facilities close in the region and the tonnage flows shift, this local and regional trend of rising tipping fees may continue going forward. Further discussion of disposal facilities in the NCTCOG region is provided in Section 4.0.

Organics Diversion. A recent trend in solid waste material management is the focus on separating and diverting organic waste material from disposal. Organic waste represents a significant fraction of the solid waste stream and represents opportunities for municipalities to increase diversion from landfill disposal through composting or other organic waste processing technology. Municipalities are increasingly implementing organics diversion programs focusing on collection of yard waste and/or food waste. For

[27] Burns & McDonnell. 2018. "Solid Waste Landfill Market Study – Draft Report."
[28] City of Dallas. "Rate Changes Effective October 1, 2021." Accessed April 7, 2022. Available online: https://dallascityhall.com/departments/sanitation/Pages/Commercial-Landfill.aspx
[29] City of Garland. "Hinton Landfill Fees." Accessed 8/4/21. Available online: https://www.garlandtx.gov/3696/Locations
[30] Based on landfill market research conducted by Burns & McDonnell, the gate rate at the C.M. Hinton Landfill was $40.00 as of 2019 contracted rates for commercial haulers range from $21.00 to $23.50 per ton.
[31] City of Garland. "Hinton Landfill Fees." Accessed 8/4/21. Available online: https://www.garlandtx.gov/3696/Locations
[32] Based on landfill market research conducted by Burns & McDonnell, the gate rate at the C.M. Hinton Landfill was $40.00 as of 2019 contracted rates for commercial haulers range from $21.00 to $23.50 per ton.
[33] Burns & McDonnell. 2018. "Solid Waste Landfill Market Study – Draft Report."
[34] City of Dallas. "Rate Changes Effective October 1, 2021." Accessed April 7, 20221. Available online: https://dallascityhall.com/departments/sanitation/Pages/Commercial-Landfill.aspx

example, the Texas RMDP showed that the quantity of yard trimmings, brush and green waste recycled in Texas increased statewide from 2.3 million tons in 2015 to 5.8 million tons in 2019.

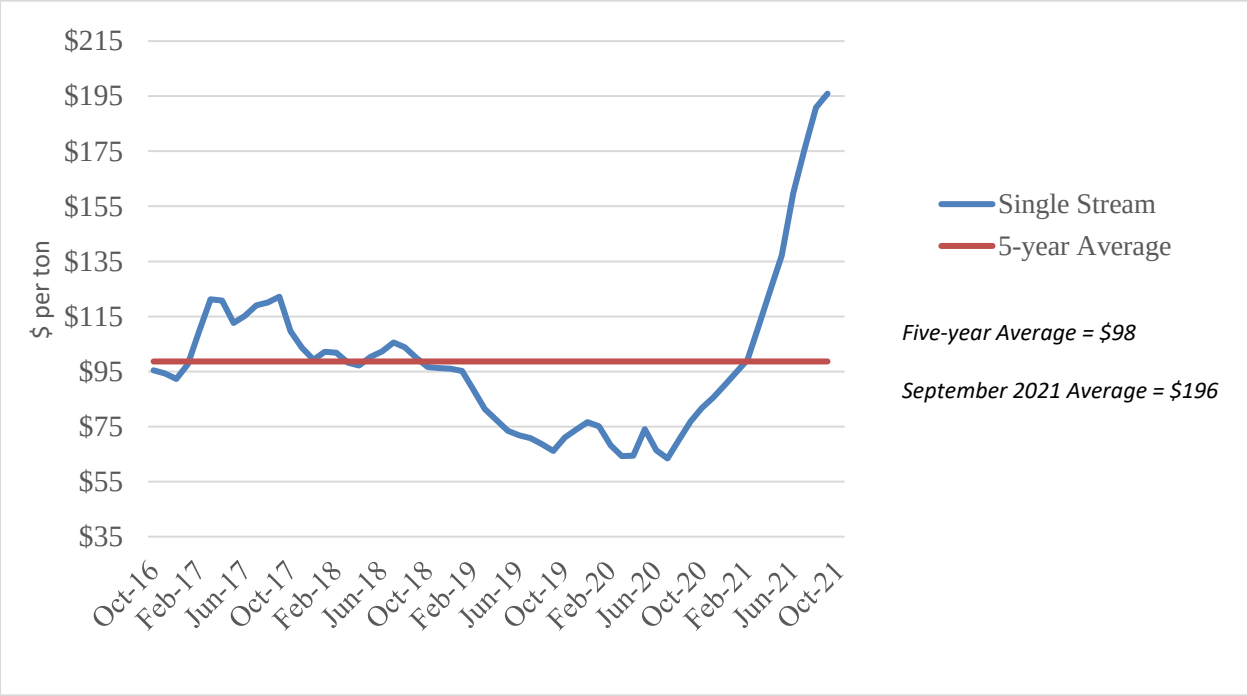
Recycling Processing Fees. The per-ton fees that a municipality pays for the processing of recyclable and organic materials collected from its customers are impacted by the market value of recovered materials and the level of contamination present. MRFs typically charge per ton for processing a municipality's recyclable materials and offer a share of the revenue generated through sale of the material back to the municipality. In 2008, at the beginning of the recession, many MRFs changed their cost recovery structure by charging higher processing fees that would fully recover all processing costs rather than relying on material revenues. As a result, MRFs were then typically willing to offer municipalities a greater share of material revenues. Table 2-6 compares the average single stream materials processing fees and recyclable materials revenue shares in Texas before and after the 2008 recession.

Table 2-6: Average Single-Stream Recyclables Processing Fees and Municipal Revenue Shares

Fee/Revenue	Prior to 2008	After 2008
Processing fee per ton	$30-40	$60-90
Recyclables revenue share to municipality	40-70%	50-90%

This is consistent with the $73.46 per ton rate that FCC charges the City. The average value of single stream materials varies based on the composition of the materials (i.e. quantity of paper, plastics, metal, and glass) and the quality of the materials. The market for this material fluctuates based on many factors, including the state of international end-markets. In 2018, China began decreasing the amount of recycled material it imported based on rising levels of contamination, causing the price for this material to drop as the market adjusted to changes in the end-markets for this material. The average blended market value of processed recyclable materials in the Southwest region of collected single stream (paper, plastics, metal, and glass) from municipal collection programs has ranged from about $52.00 per ton to $110.00 per ton over the five-year period from 2016 to 2021 with a five-year average of $72.00 per ton. Figure 2-4 illustrates the changes in the average value of single stream materials in Texas over this period.

Figure 2-4: Single Stream Material Revenue (per Ton)[1]



1. Source: recyclingmarkets.net

Starting in September 2020, the price for single-stream materials on the secondary commodity market has rebounded from about $60.00 per ton to $175.00 per ton in October 2021. This may be a result of the response from recycling processors to develop additional domestic end-market capacity at paper mills, plastic reclamation facilities, and scrap metal processing facilities due to the restrictions on international end-markets. While the increased revenues from single-stream materials will support MRFs to continue processing materials, the market remains volatile and other macro-economic or policy shifts may impact the revenues from these materials going forward.

The volatility in market prices for recyclables and the shifting practices of private MRF operators were determining factor in the City's decision to enter into a PPP for the processing of its recyclables to minimize the City's long-term risk while still ensuring that recyclables are processed and diverted.

Municipalized Collection Systems. In Texas, many cities provide solid waste material management services either with City resources or through a single private hauler contracted to provide those services. A small number of cities have an open market system in which several private haulers are permitted to operate within the city; however, open market systems are much more common for commercial, rather than residential, services. Generally, cities of smaller size in Texas may choose to contract for solid waste management services, likely due to limited resources available for operation of a municipalized system. Among some smaller cities and many cities with higher populations, there is a split between those that have

municipally and privately provided services. This approach is consistent with cities of comparable size in Texas. Table 2-7 shows the top 10 largest cities in Texas and how residential collection, recycling processing, disposal and transfer operations are managed.

Table 2-7: Comparison Solid Waste Service of 10 Largest Texas Cities[1]

City	Population	Residential Collections	Recycling Processing		Landfill		Transfer Station	
			Ownership	Operations	Ownership	Operations	Ownership	Operations
Houston	2,310,000	M	P	P	P	P	***M***	***P***
San Antonio	1,508,000	M	P	P	P	P	***M***	***P***
Dallas	1,331,000	M	***M***	***P***	M	M	M	M
Austin	950,807	M	P	P	P	P	N/A	N/A
Fort Worth	874,401	P	P	P	***M***	***P***	N/A	N/A
El Paso	679,813	M	P	P	M	M	N/A	N/A
Arlington	395,477	P	P	P	***M***	***P***	N/A	N/A
Corpus Christi	325,780	M	P	P	***M***	***P***	M	M
Plano	287,064	M	P	P	M	M	M	M

- M = Municipalized, P = Private, ***Bold*** = Public-Private Partnership N/A = Not Applicable

Alternative Fleet Fueling. Over the last five years there has been an increase in the manufacture and deployment of alternative fleet fueling options including Compressed Natural Gas (CNG) and battery-powered solid waste collection vehicles and other equipment typical of municipal fleets (e.g. passenger vehicles, pickup trucks, etc.). Cities with ambitious greenhouse gas reduction goals are considering the purchase and implementation of these types of vehicles to support that effort. In the City's CECAP, one of the goals is to explore the potential for electric waste collection trucks to replace short range vehicles over time as part of a fleet replacement program. The requirements, challenges and potential financial impact of implementing battery-powered electric vehicles in the City's fleet is provided in Section 6.0. Additionally, the NCTCOG is currently developing a feasibility study for the manufacture of Renewable Natural Gas (RNG) for use in vehicle fleets in the DFW Metroplex.

3.0 PLANNING AREA CHARACTERISTICS

To properly plan for the City's future solid waste and recycling management needs, an understanding of the factors that will impact those needs is important. This section describes the City's current demographic and economic characteristics as well as anticipated future growth. To the extent that data is available, the material generation in the City is presented. As the population and economic activity of the City and region continue to grow, the volume of materials generated will increase accordingly. Anticipated growth of residents, businesses and development in the City is one of the primary factors the City and North Central Texas region must consider in planning for future materials management. Following description of the demographic and economic characteristics of the City, this section presents material generation forecasts and waste characterization information on a statewide and regional basis that provide the baseline for various analyses included throughout the LSWMP Update such as evaluating facility capacities (e.g., transfer station system, Landfill, FCC MRF, etc.), future operational requirements for the City's programs (e.g., curbside collection, brush and bulky item collection), estimating diversion potential from the residential and commercial sectors, and identifying key material types to target for diversion.

3.1 Demographic and Economic Characteristics

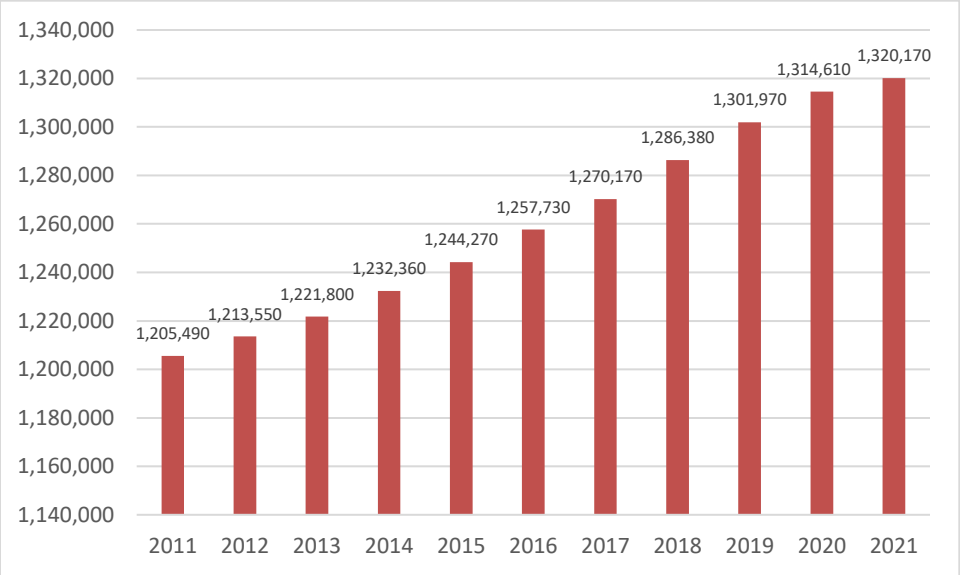
The population and economic growth the City experiences in the coming years will directly determine the quantities of material generated in the City. Anticipated material generation quantities will impact future materials management planning aspects addressed throughout this LSWMP Update including infrastructure development, public-private partnership development, and appropriate timing of continued system and program development. This section presents a selection of existing population data and projections and economic development information to provide an understanding of the planning area considerations under which this LSWMP Update has been developed.

3.1.1 Historical and Current Population

The City's population has grown since the 2011 LSWMP was published, from a population of approximately 1,205,490 in 2011 to 1,320,170 in 2021[35] representing a 0.91% compound annual growth rate. Figure 3-1 presents the City's population growth from 2011 to 2021 based on regional population data published by NCTCOG. The NCTCOG population dataset and projections are used in the LSWMP Update rather than data generated by the U.S. Census Bureau because it is based on the local region.

[35] North Central Texas Council of Governments Regional Data Center. "2021 NCTCOG Population Estimates (City)" Available online: https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::2021-nctcog-population-estimates-city/about

Figure 3-1: Historical Population Growth (2011-2021)



3.1.2 Single-Family and Multi-Family Household Distribution

Many municipal planning efforts, including solid waste and recycling management, categorize residential populations into two general categories – single-family and multi-family. The City's total residential population is distributed between these two categories. In the City, the single-family population is defined as residents living in single-family (one-unit) homes. The multi-family population is defined in Chapter 18 of the Code of Ordinances as residents living in structures with eight or more housing units (e.g., apartment complexes, condominiums, etc.). All single-family households and duplexes are serviced by the City collection vehicles, which has approximately 249,000 customers.

This distinction is important because material generated by multi-family households requires planning and management different than that of single-family households. Multi-family material is generally collected and managed in combination with commercially-generated material, and services and information are provided directly to multi-family property owners and managers, rather than directly to residents, as for single-family customers. Multi-family complexes are required to provide recycling services to tenants per the MFRO. Further discussion of the MFRO is provided in Section 11.0.

As part of the development process of the MFRO, the City compiled the number of multi-family properties by size, shown in Table 3-1.

Table 3-1: Number of Multi-family Properties by Size[1]

Number of Properties	Property Size (number of units)	Total Units	Percent of Total Units
498	8-19	5,753	3%
561	20-99	25,483	12%
344	100-199	50,132	24%
421	200+	124,229	60%
1,824		**205,597**	**100%**

1. Source: Code Compliance multi-tenant property inspection data October 2014 – October 2017

For the purposes of the projections presented further in this section, consistent with the assumptions of the 2011 LSWMP, Burns & McDonnell assumed that 47.1 percent of the City's population lives in single-family homes and 52.9 percent of the City's population lives in multi-family properties[36].

3.1.3 Changing Collection Environments

This section discusses changing collection environments related to development trends and the City's approach to determining if proposed developments can be serviced by the Sanitation Department. A shift toward more condensed development is an ongoing trend among many cities in the North Central Texas region to reduce development sprawl and create more environmentally and socially conscious housing.

Currently planned residential growth throughout the City includes both in-fill development as well as large master planned communities (MPCs) that are developed based on Form-Based Code (e.g., SmartCode[37]). Form-Based Code specifications incorporate elements of New Urbanism (i.e., development that creates walkable, mixed-use neighborhoods) to accommodate environmental techniques such as reduced usage of impervious cover (e.g., pavement, asphalt, cement), increased usage of green spaces (e.g., parks, fields, gardens), and more walkable or multi-modal transit (e.g., bicycle lanes, trolley tracks).

Form-Based Code specifications result in compact mixed-use and high-density developments that can create challenges for solid waste collection to be performed safely and efficiently. If zoning requirements and design codes do provide accessibility for solid waste collection vehicles or equipment, challenging collection environments are built such as:

- **Inaccessible alleys.** Service location in narrow or obstructed alleys.

[36] North Central Texas Council of Governments. "Metroplex Area Sub-Regional Solid Waste Study." 2003
[37] SmartCode is a model transect-based planning and zoning document based on the tenants of Form-Based Code intended to keep settlements compact and rural lands open by reforming the patters of separated-use zoning. More information on SmartCode is available at the following link: https://smartcodecentral.com/

- **Private drives with limited maneuverability.** Service locations only accessible by private drives.
- **Cul-de-sacs with inaccessible set outs.** Service locations on Cul-de-sacs that are too small or contain obstructions.
- **Hammerhead or dead ends.** Service locations on hammerhead (i.e., dead-end streets that end in a "Y" shape) or dead-end streets with undersized turn radii.
- **Boulevards.** Service locations on arterial roads that contain obstacles for collection due to multi-modal transportation lanes.

The City's Development Services conducts a pre-development process to review submittals to support the permit review process. City staff provide a cursory review to identify any major violations (e.g., not meeting minimum right-of-way, located in a thoroughfare, etc.) so the developer can adjust before the submission is fully evaluated. Development Services works collaboratively with other departments such as Dallas Fire-Rescue (DFR) and DWU in the pre-development process to identify any challenges that would cause the submission to ultimately be denied. Based on discussions with City staff, there are currently limited considerations in the pre-development process to ensure that the submission accounts for solid waste collection vehicle accessibility and meets the minimum standards to ensure that Sanitation Department equipment will be able to service these properties safely and efficiently.

Multiple cities across Texas are experiencing collection challenges associated with the implementation of SmartCode development, including Austin, Fort Worth, and San Antonio. Each of these cities have indicated that applications for new developments are provided to its solid waste and recycling collection group for initial review. It is clear, however, that even though this initial review process may be sufficient for the needs of fire truck equipment, the needs of solid waste and recycling collection vehicles require additional attention in regard to interim applications or amendments.

Although the City Code requires the Sanitation Department to provide services for all residences and duplexes, single-family attached properties with eight or less units cause a challenge for providing collection service. These types of properties may take the form of condominiums or in-fill properties added as additional units on existing lots or dividing existing home into multiple units. These types of properties are considered single-family properties and are often constructed based on form-based zoning specifications.

The challenge with single-family attached properties is that when they include challenging collection environments (e.g., private drives) the Sanitation Department has to consider removing the customer from service because they may not be able to safely or efficiently collect set outs, ultimately requiring the customer to hire a private sector service provider. Over time, if increasing numbers of City customers are

serviced by private-sector haulers they may be subject to higher rates for refuse and/or recycling service and require more collection vehicles to travel the City's roads causing increased repair needs.

Higher density developments and single-family attached units result in challenging collection environments that will inhibit the Sanitation Department's or other hauler's abilities to provide services to single-family and higher-density residences.

The proliferation of higher-density developments presents operational challenges for collection services. Collaborate with Development Services to ensure that the Sanitation Department is included in the pre-development process and that form-based code specifications meet the needs of collection equipment to minimize the development of challenging collection environments. Additionally, amend the City Code to define single-family attached properties more clearly as either the responsibility of the Sanitation Department to provide service, or have them covered under the MFRO to ensure that residents have access to cost-effective services and are not forced to hire private sector collection service providers

3.1.4 Population Projections

The NCTCOG previously developed the 2040 forecast to provide the estimated number and distribution of population, households and employment by member city for the North Central Texas region.[38] Burns & McDonnell extrapolated the projection for the City to estimate the total population through 2040. Burns & McDonnell selected this 19-year planning period based on the expectation that the Landfill would be nearing capacity at that point. In 2040 the Landfill would have approximately 15 years of useful life, and the City will must need to determine if the disposal operation could be expanded or if there is a need to prepare to change disposal practices. Additionally, the regional population is also growing, which may impact the volume of material generated outside of the City and imported for disposal at the Landfill. Further discussion about regional landfill capacity is provided is Section 4.0 and detailed information and analysis related to the Landfill is provided in Section 8.0 and Appendix E.

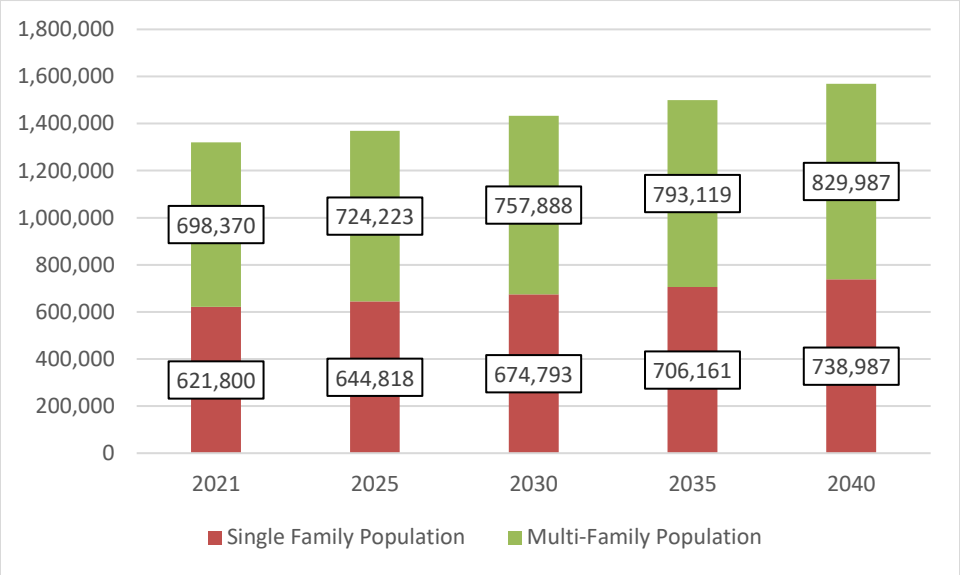
The LSWMP Update projects the population growth based on the historical compound annual growth rate of the City as published by the North Central Texas Council of Governments where the population has grown from 1,205,490 in 2011 to 1,320,170 in 2021, representing an annual growth of 0.91 percent[39]. Using the growth rate of 0.91 percent, the City's population is projected to reach 1,568,974 in 2040.

[38] North Central Texas Council of Governments. Regional Data Center. 2040 Demographic Forecast by District. Available online at: https://data-nctcoggis.opendata.arcgis.com/datasets/2040-nctcog-demographic-forecast-district/explore

[39] North Central Texas Council of Governments. "2021 NCTCOG Population Estimates (City)." 2021. Available online at: https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::2021-nctcog-population-estimates-city/about

The total population is further divided into single-family and multi-family populations based on the respective population distributions presented in the previous section (refer to Section 3.1.2) and is held constant through 2040[40]. Figure 3-2 shows the projected single-family and multi-family population growth of the City over the next 19 years, from 2021 through 2040.

Figure 3-2: Population Projection (2021-2040)



3.2 Economic Characteristics

The City is part of the larger Dallas-Fort Worth (DFW) Metroplex, the largest metropolitan area in Texas and the fourth largest in the U.S.[41] A primary driver of the population growth the City has experienced (refer to Section 3.1.3) is the economic development that has taken place. This section provides information on employment and economic development in the City.

3.2.1 Current Regional Employment

Current employment figures for the DFW Metroplex region are provided for informational purposes. Table 3-2 presents the employees in the DFW Metroplex as of March 2022 as reported by the U.S. Bureau of Labor Statistics.

[40] The distribution of population is held constant for the purposes of these projections, since no historical data on the number of permitted construction was conducted as part of the LSMWP Update; however, there is an anecdotal trend in the City that number of multi-family dwellings being developed outpaces the number of single-family dwellings. Further discussion of multi-family generation sector is provided in Section 11.0.

[41] New Census Bureau Estimates Show Counties in South and West Lead Nation in Population Growth, U.S. Census Bureau Press Release April 18, 2019. Retrieved September 2019 from https://www.census.gov/newsroom/press-releases/2019/estimates-county-metro.html

Table 3-2: Employees in the DFW Metroplex[1]

Major Non-Farming Industry Sector	Employees (Number in Thousands)
Trade, Transportation and Utilities	876.6
Professional and Business Services	722.1
Education and Health Services	483.5
Government	453.2
Leisure and Hospitality	392.4
Financial Activities	360.7
Mining, Logging and Construction	225.7
Manufacturing	293.2
Other Services	126.8
Information	85.6
Total	**4019.8**

1. Source: https://www.bls.gov/regions/southwest/summary/blssummary_dallasfortworth.pdf

3.2.2 Economic Development

Continued growth within the City is inevitable and the City's proactive planning strategies will allow it to manage growth and maximize benefits for the community. With this continued growth, material generated by businesses and institutions will continue to increase and will need to be managed. This increase will include material generation associated with construction and development as well as ongoing business operations and increased employment. There are many underway, planned, and prospective development activities that may be realized within the City over the next several years. Burns & McDonnell conducted interviews as part the stakeholder engagement efforts with several departments within the City that support and manage its growth and development including the following, with brief descriptions:

- **Economic Development.** The City's Economic Development Department strategically engages the business community to overcome obstacles to growth and cultivate markets by leveraging the City's strengths in professional services, technology and logistics. Economic Development provides strategic investments to support the development of the City's economy.
- **Convention and Event Services.** The City's Convention and Event Services Department oversees the operation and development of the Kay Bailey Hutchinson Convention Center Dallas (Convention Center) and other key buildings in the City's Convention Center District. Convention and Event Services is currently in the process of developing a master plan for the Convention Center

District to support the redevelopment of the Convention Center and study multimodal transportation and urban development of the Cedars neighborhood.

- **Development Services.** The City's Development Services supports the private development process of residential and commercial properties including permit and plan reviews, approval and inspection services, and internal multi-departmental reviews.

3.3 Material Generation, Recycling and Disposal

Understanding current and projected solid waste generation, disposal, and recycling rates allows the City to appropriately plan for the types and quantities of material it will need to manage moving forward. Future solid waste management system requirements, including services, programs, and infrastructure are highly dependent on quantities of material and material type distribution. This section provides a baseline understanding of the material generation rates and presents material generation forecasts by sector.

3.3.1 Material Generation Rate

Based on the 2019 tonnages delivered to the Landfill and MRF, Burns & McDonnell categorized material delivered in five material types and estimated the per-capita material generation rates for each to develop the basis for the material projection forecasts. The per-capita figures are generated by dividing the annual tonnage of each material by the 2019 City population and 365 days per year, multiplied by 2,000 pounds per ton to calculate the pounds per capita per day.

Table 3-3: Generation Rate of Material

Material Type	2020 Annual Tons	Pounds/Capita /Day[1]
Municipal Solid Waste	1,389,898	5.79
C&D	176,279	0.73
Contaminated Soil	46,705	0.19
Recycling	60,541	0.25
Other	4,238	0.2
Total	**1,677,662**	**6.99**

1. The per-capita figures are generated by dividing the annual tonnage of each material by the 2020 City population of 1,320,170 and 365 days per year, multiplied by 2,000 pounds per ton to calculate the pounds per capita per day. Pounds per capita per day is assumed to be representative of growth from residential and commercial generators since population growth would have a corresponding impact on commercial material generation (e.g., increased development activity).
2. Other material includes dead animals, slaughterhouse waste, grit trap grease, and septage waste disposed at the landfill.

The following provides further detail of each material type including how each material is managed and the constituent materials that compose each material stream, and how each is further analyzed in the plan. capita generation and how each material category and how each material is managed.

- **Municipal Solid Waste.** MSW tons include refuse, yard waste, brush and bulky items generated by the residential and commercial sectors and collected by the City or private haulers. The majority of this material is generated within the City limits, but some materials may be collected from surrounding municipalities and delivered to the Landfill.
- **Construction & Demolition.** C&D tons include material generated by the commercial sector as part of development within the City including new construction, renovation, deconstruction and demolition projects. The materials in the C&D stream may include concrete, lumber, rebar, gypsum, plastic, and cardboard.
- **Contaminated Soil.** Contaminated soil includes inert materials generated by the commercial sector that have become contaminated with gas, oil, or other chemicals that require it be disposed at the Landfill.
- **Recycling.** Recycling tons include curbside collected single-stream material, separated bulk metal, recycled electronic equipment, and tires generated by residential and commercial sector. Curbside single-stream materials are collected curbside from single-family residences and bulk metal, electronics and tires are delivered to the Landfill and diverted from disposal.
- **Other.** Other material includes dead animals, slaughterhouse waste, grit trap grease, and septage waste generated by the commercial sector and disposed at the Landfill.

In the 2011 LSWMP, the reported annual disposal for 2010 was 5.67 pounds per person per day. Based on the tonnage and per capita generation figures shown in Table 3-3, the generation rate is now 6.99 pounds per person per day, about 1.32 pounds per person per day higher than it had been in the 2011 LSWMP, likely due to the increase in population and associated commercial development and construction.

3.4 Material Generation Forecast

This section presents the baseline material generation forecast and breakdown of material generation forecasts for key materials and generator types. The per capita generation rates (see Section 3.3.1) serves as the basis for the material generation forecasts. Table 3-4 presents the forecast of material to be delivered to the Landfill and managed annually between 2021 and 2040.

Table 3-4: Material Generation Forecast

Material Type	2021	2025	2030	2035	2040
Municipal Solid Waste	1,395,777	1,447,446	1,514,731	1,585,144	1,658,830
C&D	177,025	183,578	192,112	201,042	210,388
Contaminated Soil	46,903	48,639	50,900	53,266	55,742
Recycling	61,557	63,836	66,803	69,909	73,158
Other	4,256	4,414	4,619	4,834	5,059
Total[1]	**1,685,518**	**1,747,913**	**1,829,165**	**1,914,194**	**2,003,176**

1. Totals may not sum exactly due to rounding.

3.4.2 Material Generation Forecast by Sector

This section provides a baseline understanding of the material generation for from residential and non-residential sectors, and presents material generation forecasts by sector. In FY 2021 the City collected a total of 256,750 tons of refuse and 181,844 tons of brush and bulky items from residential customers. These tonnages include all City-collected material processed in the transfer station system and delivered directly to the Landfill.

To account for any errors in data entry (e.g., City staff coding material incorrectly), the material generation forecasts initial year of FY 2021 is based on the average material collected by the Sanitation Department from FY 2016 – FY 2020 and projected out one year to FY 2021 based on the estimated population[42]. The material generation forecast shows City-collected residential and non-City collected material that would be delivered generation to the Landfill through 2040 to provide perspective on the expected tonnage total expected generation that that would need to be managed by the City's collection fleet compared to the amount of material that is delivered to the Landfill by other generators including commercial entities, multi-family properties, and single-family residents located outside the City. For the purposes of this analysis, multi-family material is included in the tonnage of commercial material. Further discussion of multi-family tonnage generation is provided in Section 11.0.

Table 3-5 shows the projected tonnages generated for both single-family residential and commercial tons, broken down by sector and material type from 2021 through 2040. Figure 3-3 shows the material forecast projection broken down by sector from 2021 through 2040.

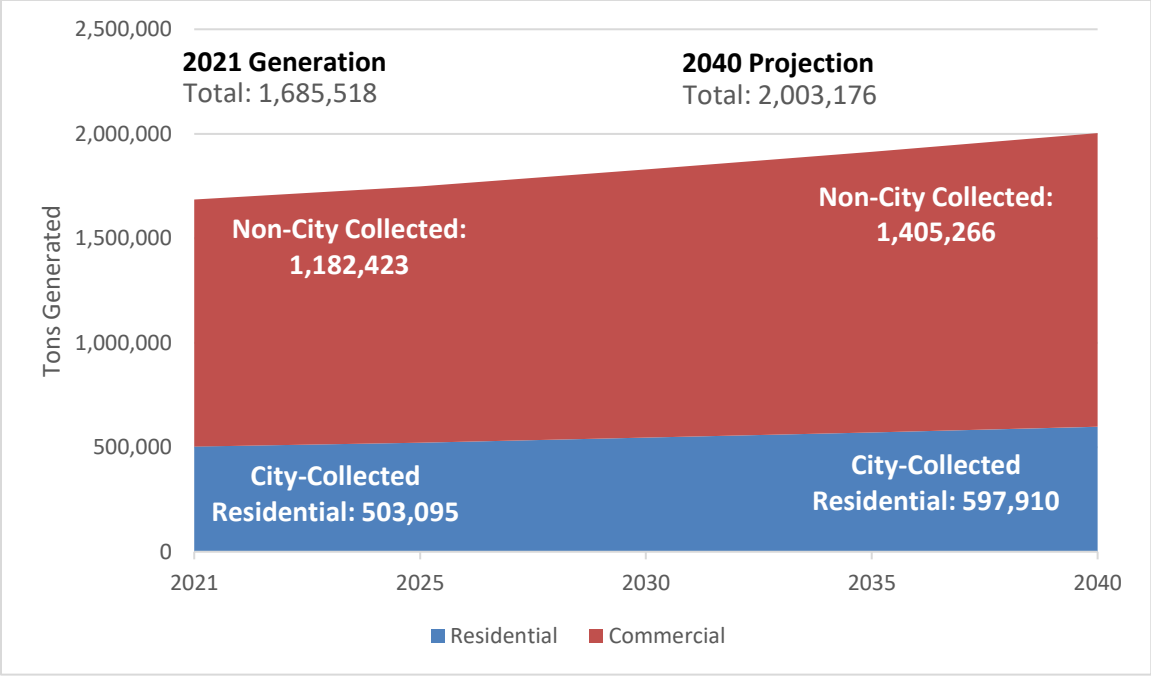
[42] The average FY 2016 – FY 2020 refuse collected by the Sanitation Department is calculated by adding the average tonnage delivered to all the transfer stations (203,884 tons) and the average direct hauling to the Landfill (84,154 tons) including recycling vehicles that were identified as hauling refuse to support operations. The average FY 2016 – FY 2020 brush and bulky items collected is calculated by adding the average tonnage delivered to all the transfer stations (68,606 tons) and the average direct hauling to the Landfill (83,791 tons).

Table 3-5: Material Generation Delivered to the Landfill Forecast by Sector and Material Type

Material Type	FY 2021	FY 2025	FY 2030	FY 2035	FY 2040
City-Collected Material					
Refuse	289,257	299,965	313,909	328,501	343,772
Brush and Bulky Items	153,041	158,707	166,084	173,805	181,884
Recycling[1]	60,797	63,047	65,978	69,045	72,255
Subtotal	**503,095**	**521,719**	**545,971**	**571,351**	**597,910**
Non-City Collected Material					
Refuse	953,478	988,775	1,034,738	1,082,838	1,133,174
C&D	177,025	183,578	192,112	201,042	210,388
Contaminated Soil	46,903	48,639	50,900	53,266	55,742
Other	4,256	4,414	4,619	4,834	5,059
Recycling[2]	761	789	825	864	904
Subtotal	1,182,423	1,226,194	1,283,194	1,342,844	1,405,266
Total[1]Total[3]	**1,685,518**	**1,747,913**	**1,829,165**	**1,914,194**	**2,003,176**

1. Represents residential recycling material collected by the City.
2. Represents recyclables generated by the commercial sector and separated for diversion at the Landfill.
3. Totals may not sum exactly due to rounding.

Figure 3-3: Material Generation Delivered to the Landfill Forecast by Sector



The material generation forecast, in conjunction with the waste characterization information presented in the next section, will serve as the baseline for various analyses included throughout the LSWMP Update such as evaluating facility capacities (e.g., transfer station system, Landfill, FCC MRF, etc.), future

operational requirements for the City's programs (e.g., curbside collection, brush and bulky item collection), estimating diversion potential from the residential and commercial sectors, and identifying key material types to target for diversion.

3.5 Waste Characterization

Waste characterization is the analysis of the composition of a waste stream. This section presents statewide waste characterization data from the 2020 TCEQ Recycling Markets Development Plan[43] as well as regional waste characterization data developed through studies conducted by the NCTCOG.[44]

3.5.1 Statewide MSW Characterization

Of the estimated 36.5 million tons of material disposed of in landfills in Texas in 2019, approximately two thirds were MSW[45] and the remaining third was comprised of C&D material and other materials (e.g., sludge, septage, tires, and medical waste). All three categories include both recyclable and non-recyclable materials that end up in landfills across the state. Table 3-6 presents the high-level distribution of material disposed of in Texas landfills in 2019.

Table 3-6: Tonnage Disposed in Landfills by Waste Type (2019)

Material Type	Percentage[1]	Tonnage Disposed
MSW	64.0%	23,379,895
C&D	21.3%	7,772,988
Other[2]	7.4%	2,700,795
Industrial[3]	7.3%	2,683,279
TOTAL	**100.0%**	**36,536,957**

1. Percentages rounded for ease of presentation.
2. Other includes solid waste other than MSW and C&D materials such as brush, sludge, septage, contaminated soil, regulated and non-regulated asbestos-containing material, tires, and medical waste. Does not include Class 1, Class 2, or Class 3 non-hazardous industrial waste (NHIW).
3. Includes Class 1, Class 2, and Class 3 materials disposed in landfills. NHIW waste is also disposed in industrial landfills in the State.

[43] Texas Commission on Environmental Quality (TCEQ). September 2021. "Recycling Markets Development Plan." Available online here: https://www.tceq.texas.gov/assets/public/assistance/P2Recycle/Recyclable-Materials/2021%20Recycling%20Market%20Development%20Plan.pdf

[44] North Central Texas Council of Governments (NCTCOG). Regional Recycling Survey and Campaign. https://www.nctcog.org/envir/materials-management/regional-recycling-survey-and-campaign

[45] The TCEQ defines municipal solid waste (MSW) as "solid waste resulting from, or incidental to, municipal, community, commercial, institutional, and recreational activities; it includes garbage, rubbish, ashes, street cleanings, dead animals, medical waste, and all other nonindustrial waste (30 TAC 330.3)."

MSW composition varies from region to region based on various factors, such as percentages of residential versus commercial sectors, access to recycling programs, and vegetative growth. Multiple large cities in Texas and regional planning agencies, including, but not limited to San Antonio and El Paso and the NCTCOG, have completed solid waste characterization studies over the past five years. Burns & McDonnell reviewed these studies to develop an estimate of MSW composition as part of the RMDP[46]. For commercial MSW, Burns & McDonnell estimated the composition based on the El Paso and Dallas waste characterization studies, since those were the only identified recent studies to separately evaluate the composition of commercial MSW.[47]

Table 3-7 presents the estimated composition and tonnage of MSW disposed in Texas by material category.

Table 3-7: Composition of MSW Disposed by Material Category (2019)

Material Group	Material Category	Percentage[1]	Tonnage Disposed[2]
Paper	Cardboard	9.2%	2,151,346
	Office Paper	1.3%	306,471
	Mixed (Other recyclable)	6.7%	1,564,396
	Other (Non-recyclable)	11.1%	2,605,198
	Subtotal	**28.3%**	**6,627,411**
Plastics	PET#1	1.7%	387,469
	HDPE #2	1.4%	319,683
	Plastics #3-7	0.9%	201,516
	Plastic Bags & Film Wrap (Recyclable)[3]	0.6%	142,345
	Plastic Bags & Film Wrap (Non-recyclable)[4]	2.6%	607,687
	Other Plastic	7.6%	1,765,513
	Subtotal	**14.8%**	**3,424,213**
Metals	Ferrous	1.9%	433,491
	Non-Ferrous	1.2%	283,481
	Subtotal	**3.1%**	**716,972**
Glass	Glass	3.9%	908,487
	Subtotal	**3.9%**	**908,487**
Organics	Yard Trimmings, Brush, and Green Waste	3.2%	753,345
	Food and Beverage Materials	18.5%	4,320,480
	Textiles	2.7%	635,265
	Diapers	0.6%	149,192
	Other Organics	5.9%	1,376,755
	Subtotal	**30.9%**	**7,235,037**
	Clean/Unpainted C&D Aggregates	0.1%	13,882
	Clean/Unpainted C&D Wood	4.9%	1,156,627

[46] Composition based on waste characterization studies for other cities and regional planning agencies in Texas, including, but not limited to, San Antonio, El Paso, and NCTCOG.

[47] Data from the City of Dallas waste characterization study was included in the 2015 Study on the Economic Impacts of Recycling. This data was also used for the Recycling Market Development Plan since additional commercial composition data (other than from the City of El Paso) was unavailable.

Material Group	Material Category	Percentage[1]	Tonnage Disposed[2]
C&D Materials	Other C&D Materials	5.9%	1,384,577
	Subtotal	**10.9%**	**2,555,086**
Other	Batteries	<0.1%	5,214
	Electronics	1.1%	265,697
	Paint	<0.1%	194
	Tires	1.1%	263,798
	Other	5.9%	1,377,786
	Subtotal	**8.2%**	**1,912,689**
Subtotal Recyclable[4]		**53.2%**	**12,438,104**
Subtotal Non-recyclable[4]		**46.8%**	**10,941,791**
TOTAL		**100.0%**	**23,379,895**

1. Percentages based on material category tonnage divided by total tonnage. Percentages rounded for ease of presentation.
2. Composition based on waste characterization studies for other cities and regional planning agencies in Texas, including, but not limited to, San Antonio, El Paso, and NCTCOG.
3. Film plastics are recyclable and are included within the RMDP. However, only a portion was assumed to be recyclable in the estimated tonnage of materials that could potentially be recycled, reflective of commercial generators generating high-quality, clean and dry film in sufficient quantities to bale on-site. Burns & McDonnell estimated this to be 20 percent of commercial film, or 142,345 tons out of 750,032 tons landfilled. The remaining 607,687 tons of film plastics were assumed to be non-recyclable.
4. Quantity includes MSW metals that would likely be processed through scrap metal processors. Recyclable materials include the following material categories that could be diverted from disposal: cardboard, office paper, mixed (other recyclable) paper, PET #1, HDPE #2, ferrous metal, non-ferrous metal, glass, yard trimmings, brush and green waste, food and beverage materials, and textiles.

The estimated MSW composition for Texas are compared to the national composition of MSW disposed as reported by U.S. EPA[48]. Paper accounted for a higher percentage of MSW disposed in Texas; 28.3 percent in Texas versus 13.1 percent nationally. This may be due to higher rates of disposal of cardboard and other potentially recyclable paper products. Metals and plastics accounted for a lesser percentage of MSW disposed in Texas; 3.1 percent in Texas versus 9.9 percent nationally for metals, and 14.6 percent in Texas versus 19.2 percent nationally for plastics. In addition, food and beverage materials, yard trimmings, brush, and green waste and glass accounted for a lesser percentage of the MSW disposed in Texas in comparison to average composition of MSW disposed nationally. Table 3-8 compares the composition of MSW disposed post diversion in Texas to the national composition.

Table 3-8: Composition of MSW Disposed by Material Group/Category in Texas versus United States (2019)

Material Group/Category[1]	Texas	National	Difference
Paper	28.3%	13.1%	15.2%
Plastics	14.6%	19.2%	(4.6%)
Metals	3.1%	9.9%	(6.8%)

[48] U.S. Environmental Protection Agency. Advancing Sustainable Materials Management: 2017 Fact Sheet. 2019. Available online at https://www.epa.gov/sites/production/files/2019-11/documents/2017_facts_and_figures_fact_sheet_final.pdf

Material Group/Category[1]	Texas	National	Difference
Glass	3.9%	4.9%	(1.0%)
Food and Beverage Materials	18.5%	22.0%	(3.5%)
Yard Trimmings, Brush, and Green Waste	3.2%	6.2%	(3.0%)
Other	28.4%	24.7%	3.7%
TOTAL	**100.0%**	**100.0%**	

1. Material groups and categories revised to allow comparison of Texas and national composition of MSW disposed. Material groups and categories not listed above are included in Other. Texas composition based on previously cited studies. National data based on previously cited data from the U.S. EPA.

3.5.2 Statewide C&D Composition

Like MSW, the composition of C&D materials varies from region to region. Burns & McDonnell developed a Texas-specific estimate of C&D materials composition based on the C&D waste characterization completed for the North Central Texas Council of Governments as part of a C&D MRF Feasibility Study[49]. The C&D MRF Feasibility Study included waste characterization data from more than 600 loads of C&D material. This study is the only publicly available comprehensive C&D waste characterization study in Texas of which Burns & McDonnell is aware.

Table 3-9 present the estimated composition and tonnage of C&D material disposed in Texas by material category.

Table 3-9: Composition of C&D Materials Disposed by Material Category (2019)

Material Group	Material Category	Percentage[1]	Tonnage Disposed
C&D Materials	Concrete/Cement	28.5%	2,215,302
	Bricks/Cinder Blocks	6.5%	505,244
	Asphalt	5.4%	419,741
	Drywall/ Gypsum	3.9%	303,147
	Subtotal	**44.3%**	**3,443,434**
Paper	Cardboard	5.9%	458,606
	Other	1.3%	101,049
	Subtotal	**7.2%**	**559,655**
Metals	Ferrous	5.0%	388,649
	Subtotal	**5.0%**	**388,649**
Organics	Yard Trimmings, Brush, and Green Waste	3.3%	256,509
	Wood Packaging	2.7%	209,871
	Scrap Lumber	7.4%	575,201
	Soil	21.1%	1,640,101
	Subtotal	**34.5%**	**2,681,682**
Other	Refuse	1.6%	124,368

[49] North Central Texas Council of Governments. Construction and Demolition Material Recovery Facility Feasibility Study. August 2007.

Material Group	Material Category	Percentage[1]	Tonnage Disposed
	Other	7.4%	575,201
	Subtotal	**9.0%**	**699,569**
Subtotal Recyclable[2]		**68.6%**	5,332,270
Subtotal Non-recyclable		**31.4%**	2,440,719
TOTAL		**100.0%**	**7,772,989**

1. Percentages rounded for ease of presentation.
2. Recyclable materials include the following material categories that could be diverted from disposal: concrete/cement, bricks/cinder blocks, asphalt, drywall/gypsum, cardboard, ferrous metal, yard trimmings, brush and green waste, wood packaging, and scrap lumber.

3.5.3 Regional Waste Characterization

Burns & McDonnell assessed the regional waste composition profile of residential refuse material disposed in the Dallas area in a series of regional waste characterizations conducted in 2018, 2019 and 2020. The 2019 and 2020 evaluations included sorting waste and recycling samples to generate the composition profile of both disposal and recycled material streams.

Even though samples of material from the City were sorted, the composition profile represents the wider North Central Texas region and cannot be used to estimate of tonnages of individual refuse materials generated by the City with a high degree of confidence due to limited sample size. Rather, the regional waste composition provides an understanding of the composition of refuse disposed among all the cities in the region and is used to generate a capture rate figure on a material-by-material basis as shown in Figure 3-4 and Figure 3-5.

Figure 3-4: 2020 Regional Waste Composition of Residential Refuse, North Central Texas

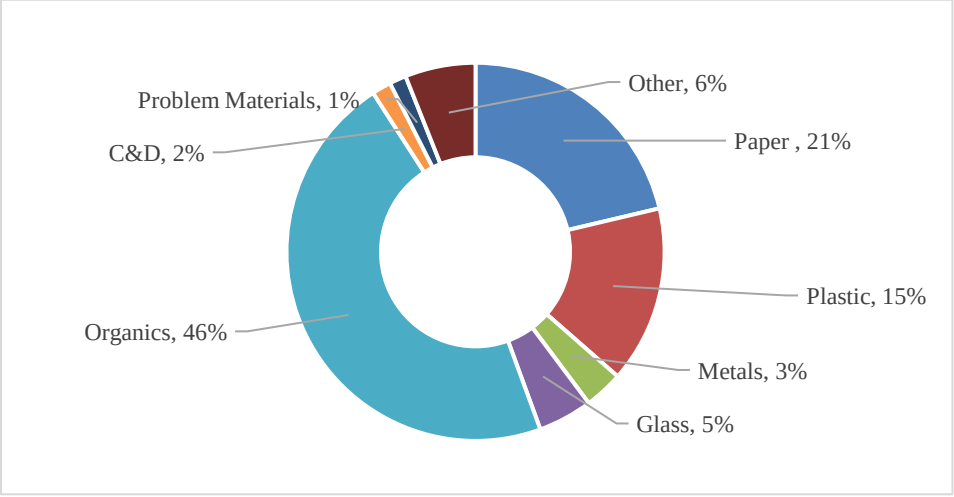
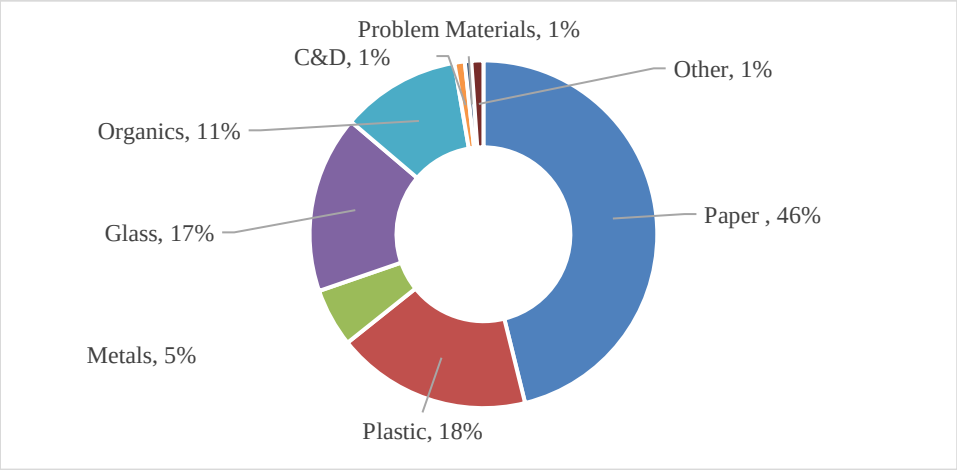


Figure 3-5: 2020 Regional Recycling Composition of Residential Recycling, North Central Texas



During the 2020 sorting event the City provided 12 samples each of refuse and recycling. Based on these samples, 16.7 percent of the refuse stream contained potentially recyclable materials. Conversely, 30.3 percent of the recycling stream contained contamination. Note that the level of contamination in the recycling samples may be higher than what is estimated as part of a typical MRF audit due to differences in material handling, processing, and small samples size. Further information related to the City's recycling audit is presented in Section 9.0.

Material sorted as part of the waste characterization was not compacted in a waste hauling vehicle nor delivered to the MRF. This resulted in moisture as part of the organic fraction of the recycling being counted where this high moisture material would likely lose volume in handling and processing at a MRF. Additionally, given the small sample size, any outlying material category (e.g., if one sample contained a large amount of cat litter) provided by the City would skew the rate of estimated contamination.

3.5.4 Regional Capture Rate

As part of the NCTCOG Regional Recycling Survey and Campaign, the capture rate was a key metric of the data collection and analysis, rather than the traditional recycling rate, to generate a more impactful education and outreach campaign. A capture rate provides insight on individual types of recyclable materials to target for increased recovery and supports the development of focused education/outreach campaign materials.

The capture rates from the NCTCOG waste characterization study were derived by using the composition profile of hand sorted refuse and recycling to calculate the capture rate of between four and 12 samples delivered by each city, where each recycling sample represented about 100 pounds of material and each refuse sample represented about 250 pounds of material.

Low capture rate indicates where opportunities exist to increase material recovery through single-stream recycling and provides an understanding of how effectively a curbside recycling program operates. Table 3-10 compares the capture rate on a material-by-material basis for recyclables among the North Central Texas region for 2019 and 2020 on a region-wide basis.

Table 3-10: Regional Capture Rate by Individual Recyclable Materials

Material Category	2019 Regional Capture Rate	2020 Regional Capture Rate	Year-over-Year Change
Recyclable OCC	58.8%	62.4%	3.6%
Mixed Paper	34.1%	27.7%	(6.3%)
Paper Subtotal	**41.1%**	**38.0%**	**(3.2%)**
PET Containers	24.9%	26.5%	1.6%
HDPE Containers - Natural	28.0%	34.2%	6.1%
HDPE Containers - Colored	25.8%	26.1%	0.4%
#3-#7 Containers	11.3%	12.7%	1.4%
Plastic Subtotal	**22.2%**	**23.7%**	**1.5%**
Aluminum Used Beverage Containers	26.1%	31.0%	4.8%
Ferrous Metal Food Containers	14.2%	18.4%	4.2%
Metals Subtotal	**19.5%**	**24.4%**	**4.8%**
Recyclable Glass	34.4%	33.9%	(0.5%)
Glass Subtotal	**34.4%**	**33.9%**	**(0.5%)**
Regional Capture Rate	**29.8%**	**28.7%**	**(1.3%)**

Approximately 435,000 tons of recyclables are sold to market annually in the North Central Texas region and among all of these material categories the recycling system is operating at a capture rate of less than 30 percent.

Burns & McDonnell also developed the capture rate for the samples provided by each participating city on an aggregated and individual basis. Table 3-11 shows the capture rate for the aggregated participating cities compared to the City, based only on the materials that were delivered to the site during the 2020 sorting event (e.g., composition profiles were not extrapolated across the tonnage in the region as shown above).

Table 3-11: 2020 Participating City and Dallas Capture Rate

Recyclable Material	2020 Dallas Capture Rate	2020 Participating Cities Capture Rate
Recyclable OCC	87%	84%

Recyclable Material	2020 Dallas Capture Rate	2020 Participating Cities Capture Rate
Mixed Paper	49%	52%
PET Containers	52%	51%
HDPE Containers - Natural	56%	58%
HDPE Containers - Colored	61%	52%
#3-#7 Containers	26%	31%
Aluminum Used Beverage Containers	63%	57%
Ferrous Metal Food Containers	24%	41%
Recyclable Glass	60%	59%
Total	**61%**	**59%**

The capture rate of material delivered to the sorting site by the City at 61 percent is slightly higher than the capture rate of the aggregated samples at 59 percent. Based on these results, there is opportunity for the City to improve in the capture of key and highly valuable recyclable materials including mixed paper, PET, HDPE and ferrous metal.

4.0 FACILITIES AND INFRASTRUCTURE

4.1 Current System Review

This section provides a regional perspective of the currently installed material management facilities and infrastructure in the North Central Texas region and in the City, compares the current infrastructure to what was in place at the time of the 2011 LSWMP, and presents data and analysis that supports the current system findings. The information presented is intended to support further discussion included throughout the LSWMP Update that indicates the ability of the current facilities and infrastructure system capacity to meet future material management requirements. Appendix B provides maps of the regional material disposal and processing facilities and infrastructure map of the 16-County region of the NCTCOG.

4.1.1 Landfills

This section provides an overview of existing landfills in the City and region, analysis of historic and projected regional landfill capacities, and a brief summary of the Landfill facility.

4.1.1.1 Regional Type I Landfill Facilities Overview

There are presently 18 active Type I landfills (landfills that accept all types of MSW, including C&D materials and special waste) in the NCTCOG region among Collin, Dallas, Denton, Ellis, Johnson, Navarro, Parker, and Tarrant Counties. Table 4-1 identifies the Type I landfills currently in operation in the region and provides disposal and remaining capacity data, as reported by the TCEQ for FY 2020.[50] Information about active Type IV landfills in the NCTCOG region is provided in Section 4.1.5.1.

Table 4-1: NCTCOG Type I Landfill Disposal and Remaining Capacities, 2020

Permit	Permit Holder/Site Name	Owner	County	Tons Disposed[1]	Remaining Capacity (Tons)	Remaining Site Life (Years)[2]
2294	121 Regional Disposal Landfill	North Texas Municipal Water District	Collin	946,399	72,081,975	76
62	McCommas Bluff Landfill	City of Dallas	Dallas	1,617,121	59,891,574	35

[50] Texas Commission on Environmental Quality (TCEQ). September 2020. "Municipal Solid Waste in Texas: A Year in Review; FY 2020 Data Summary and Analysis." https://www.tceq.texas.gov/downloads/permitting/waste-permits/waste-planning/docs/187-21.pdf

Permit	Permit Holder/Site Name	Owner	County	Tons Disposed[1]	Remaining Capacity (Tons)	Remaining Site Life (Years)[2]
996C	City of Grand Prairie Landfill	City of Grand Prairie	Dallas	244,567	4,940,267	32
1394B	Hunter Ferrell Landfill	City of Irving	Dallas	192,161	3,114,830	33
1895A	Charles M Hinton Jr Regional Landfill	City of Garland	Dallas	586,097	17,707,706	30
1025B	DFW Recycling and Disposal Facility	Waste Management	Denton	915,892	2,139,153	2
1312B	Camelot Landfill	Republic/Farmer's Branch	Denton	716,332	32,006,486	45
1590B	City of Denton Landfill[3]	City of Denton	Denton	388,067	27,677,394	72
42D	Skyline Landfill & Recycling Facility	Waste Management	Ellis	1,772,283	21,205,467	15
1209B	CSC Disposal and Landfill	Republic	Ellis	20	17,184,946	100
1745B	ECD Landfill	Republic	Ellis	154,599	29,260,015	160
1195B	Republic Maloy Landfill[4]	Republic	Hunt	139,346	19,559,746	100
534	City of Cleburne Landfill	City of Cleburne	Johnson	525	7,143	14
1417C	Turkey Creek Landfill[5]	Waste Connections	Johnson	663,541	8,247,586	5
2190	City of Corsicana Landfill	City of Corsicana	Navarro	101,539	11,121,239	110

Permit	Permit Holder/Site Name	Owner	County	Tons Disposed[1]	Remaining Capacity (Tons)	Remaining Site Life (Years)[2]
47A	Weatherford Landfill	City of Weatherford	Parker	125,686	112,811	2
218C	South East Landfill	City of Fort Worth	Tarrant	732,522	16,244,574	22
358B	City of Arlington Landfill	City of Arlington	Tarrant	933,193	34,493,232	37
Total[6]				**10,229,890**	**376,996,143**	**37**

1. Tons disposed in the region does not reflect total MSW generation, as a certain amount of MSW is recycled and diverted as well as imported and exported from the region each year.
2. Remaining years are calculated based on the annual airspace utilization factors reported to TCEQ for each landfill in pounds per cubic yard. The remaining years reported by TCEQ shown in this table do not take population growth into account. Discussion about the remaining landfill capacity taking population growth into account is provided in Section 4.1.1.2.
3. In 2021 the City of Denton Landfill received approval for a vertical and lateral expansion of the existing facility that increases permitted disposal acreage to 107.6 acres and capacity by about 40,000,000 cubic yards (CY). The permit expansion is included in the remaining capacity and site life figures presented.
4. In 2021 the Republic Maloy Landfill received approval for expansion of the existing facility that increases permitted disposal acreage to 206.2 acres and capacity by about 30,080,000 CY. The permit expansion is included in the remaining capacity and site life figures presented.
5. In 2020 the Turkey Creek Landfill received approval for a vertical expansion of the existing facility that increases permitted final cover elevation from 814 ft-msl to 946 ft-msl permitted and capacity by 4,850,000 CY. The permit expansion is included in the remaining capacity and site life figures presented.
6. Total may not sum exactly due to rounding.

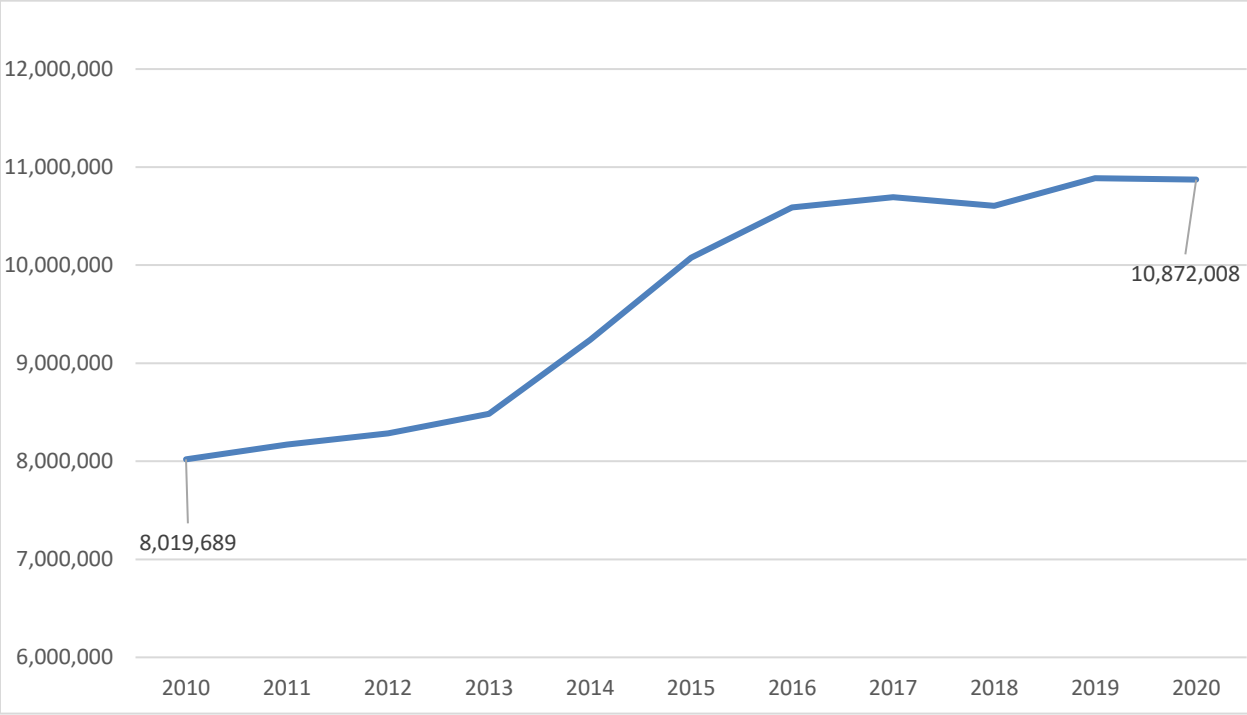
There are a limited number of landfills outside the NCTCOG region where material generated within the City or region flows. One example is the Itasca Landfill in Hill County to the south of the City (Heart of Texas Council of Governments region) owned and operated by Republic Services and provides disposal capacity for material generated in Dallas, Denton, and Tarrant counties and others located in the NCTCOG region. The Itasca Landfill accepted 354,206 tons in 2020 and has an estimated 33,335,362 tons, or 94 years, of remaining capacity.

4.1.1.2 Historic and Projected Regional Landfill Capacities

Figure 4-1 illustrates how remaining regional landfill capacity disposal has changed from 2010–2020. During this time, total annual regional disposal has trended upward, from 8.0 million tons in 2010 to 10.8 million tons in 2020. Data is based on past annual TCEQ summary reports.[51]

[51] Texas Commission on Environmental Quality (TCEQ). Annual Summary of Municipal Solid Waste Management in Texas archive. https://www.tceq.texas.gov/permitting/waste_permits/waste_planning/wp_swasteplan.html

Figure 4-1: Annual Regional Disposal, Type I and IV Landfills (Tons)



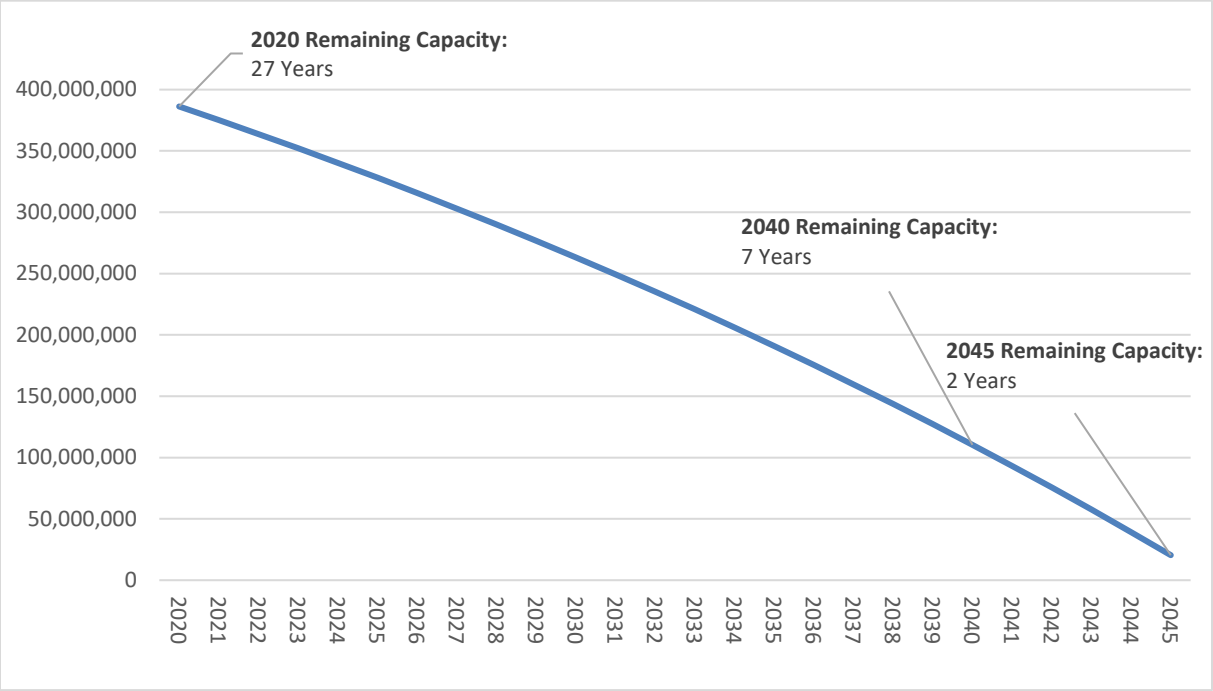
Based on data from the TCEQ's 2020 annual review of MSW generation and facilities in Texas, the region has approximately 37 years of total Type I Landfill capacity remaining at current reported annual disposal rates. When the 2011 LSWMP was developed, the TCEQ 2011 annual review of MSW generation and facilities in Texas projected that the region had 46 years of available disposal capacity. In the 10 years that has elapsed the regional disposal capacity has decreased by about 10 years.

However, these estimates do not account for future population and economic growth and actual total remaining landfill life.[52] Based on population projections from the NCTCOG,[53] the population of the region is projected to grow at an annual rate of 2.2 percent from 2020–2045. Figure 4-2 shows the projected remaining NCTCOG region landfill capacity through 2045, taking into account future population and economic growth and assuming no landfill capacity is added through existing landfill expansion or new permitted landfills.

[52] Data from the TCEQ's 2020 MSW annual report, presented in Table 4-1 and discussed in this section, is reflective of the way data has traditionally been presented by TCEQ in its MSW annual reports. TCEQ data provides an understanding of facilities and capacities at a given point in time and does not incorporate population and economic growth projections.

[53] 2040 NCTCOG Demographic Forecast. NCTCOG Regional Data Center. Accessed February 2021. https://data-nctcoggis.opendata.arcgis.com/datasets/6e99f37880d845758788c18f5a2c36f2_10

Figure 4-2: Projected NCTCOG Remaining Regional Types I and IV Landfill Capacity, 2020-2045



As of 2020 the estimated remaining landfill capacity of the region is approximately 386.3 million tons. If annual disposal quantities, totaling approximately 10.8 million tons in 2020, were to increase at the same rate as regional population projections, the remaining NCTCOG regional landfill capacity would be fully depleted in the year 2047. This equates to total remaining landfill life of 27 years for the region, from the year 2020. Taking into account accelerated growth of both population and economic growth continues to accelerate, the projected 27 years of remaining landfill life would be depleted at a proportionally accelerated rate.

As landfills in the region close and the total disposal capacity decreases, tonnage flows will shift to the available disposal capacity and market pressure will cause the value of airspace to increase over time. This may cause tonnages to flow outside of the region (e.g. to the Itasca Landfill located in Hall County) where there is available capacity at a lower tipping fee. Further discussion and evaluation on the impacts of decreasing regional disposal capacity related to the Landfill is provided in Section 8.0.

4.1.1.3 McCommas Bluff Landfill Facility

The City owns and operates the Landfill, located at 5100 Youngblood Road just north of the intersection of Interstates 45 and 20. The Landfill public operating hours are 5:00 a.m. to 8:00 p.m. Monday – Friday and 6 a.m. to 4 p.m. on Saturdays. Figure 4-3 shows the Landfill permitted boundary including the entrance roads and all ancillary facilities.

Figure 4-3: McCommas Bluff Landfill Facility[1]

1. Current cell may shift as part of ongoing operations. Further detail of ongoing operations provided in Section 8.0 and Appendix E.

The Landfill is a Type I facility and is permitted to accept all non-hazardous waste from both the City's collection program and third-party customers (Permit No. 62). The Landfill consists of a total permit boundary of 965 acres with a waste disposal footprint of 877 acres. About 1,600,000 tons of material are disposed at the Landfill annually and the City reported an expected life of 35 years in the 2020 annual report submitted to TCEQ based on the current operational performance and permitted capacity.

Further detailed description and evaluation of the Landfill is provided in Section 8.0 and Appendix E.

4.1.2 Transfer Stations

This section provides an overview of transfer stations in the region and a description of the City's transfer station system.

4.1.2.1 Regional Transfer Station Facilities Overview

Transfer stations are facilities that are used to consolidate MSW from multiple collection vehicles into larger, high-volume transfer vehicles for economical shipment to distant disposal or processing facilities.

Transfer stations can be used for material destined for landfilling, recycling, and/or composting. With a nationwide trend toward larger disposal and processing facilities, there has been an enhanced need for transfer stations. When transport distances are longer, transfer stations allow collection vehicles to be more productive by maximizing the amount of time spent collecting material rather than driving to a distant facility.

There are presently 17 active transfer stations in the NCTCOG region, located among Collin, Dallas, Denton, Ellis, Johnson, Navarro, Parker, Somervell and Tarrant Counties. Table 4-2 identifies the transfer stations currently in operation in the region as reported by the TCEQ in 2020.[54]

Table 4-2: Transfer Stations in NCTCOG Region

Permit	Permit Holder/Site Name	Owner/Operator	County	2020 Tons[1]
2045A	Custer Solid Waste Transfer Station	North Texas Municipal Water District	Collin	315,048
53A	Lookout Drive Transfer Station	North Texas Municipal Water District	Collin	178,639
1494	Parkway Transfer Station	North Texas Municipal Water District	Collin	109,414
40284	Town and Country Recycling Facility	Champion Waste & Recycling Services	Collin	48,110
2275	North Texas Recycling Complex Transfer Station	Republic Services	Tarrant	4,728
2306A	WC Minnis Drive Transfer Station	Waste Connections	Tarrant	193,327
40052	Southwest Paper Stock Transfer Station	Southwest Paper Stock	Tarrant	24,954
40181	Somervell County Transfer Station	Somervell County	Somervell	12,169

[54] Texas Commission on Environmental Quality (TCEQ). September 2021. "Municipal Solid Waste in Texas: A Year in Review; FY 2019 Data Summary and Analysis." https://www.tceq.texas.gov/downloads/permitting/waste-permits/waste-planning/docs/187-21.pdf

Permit	Permit Holder/Site Name	Owner/Operator	County	2020 Tons[1]
40186	Westside Transfer Station	Waste Management of Texas	Tarrant	215,181
1145	Bachman Transfer Station	City of Dallas	Dallas	160,177
60	Fair Oaks Transfer Station	City of Dallas	Dallas	84,100
1453	Southwest Westmoreland Transfer Station	City of Dallas	Dallas	75,804
12	Garland Transfer Station Facility	City of Garland	Dallas	117,078
1263	Mesquite Transfer Station Facility	City of Mesquite	Dallas	64,159
227	University Park Transfer Station	City of University Park	Dallas	13,059
40196	Community Waste Disposal Transfer Station	Community Waste Disposal	Dallas	119,120
40168	City of Cleburne Transfer Station Facility	City of Cleburne	Johnson	77,395

1. Tons represent all material processed at the facility on an annual basis and may include refuse, recycling, and organic waste. Tons presented are based on TCEQ annual reporting data.

4.1.2.2 City Transfer Station System

The City has three transfer stations that support the collection and disposal of refuse, recycling and bulk/brush material described below.

- **Bachman Transfer Station.** The City of Dallas Bachman Transfer Station (Bachman, or BTS) is located at 9500 Harry Hines Boulevard, Dallas, TX. Bachman is also known as the Northwest Transfer Station. Bachman began operation in 1981 under TCEQ permit number 1145. According to the transfer station permit and the Site Operating Plan (SOP) provided by City staff, dated February 1994, Bachman has a design capacity of 2,000 tons per day (TPD) and serves as the City's main transfer station accepting refuse, recycling and brush/bulk loads (as needed).
- **Fair Oaks Transfer Station.** The City of Dallas Fair Oaks Transfer Station (Fair Oaks, or FOTS) is located at 7677 Fair Oaks Avenue, Dallas, TX. Fair Oaks is also known as the Northeast Transfer

Station. Fair Oaks began operation in 1969, but has undergone several major renovations. The facility currently operates under TCEQ permit number 0060. According to the transfer station permit and the Site Operating Plan (SOP) provided by City staff, dated February 1994, Fair Oaks has a design capacity of 400 TPD and serves one of the City's smaller transfer stations accepting refuse and recycling material.

- **Westmoreland Transfer Station.** The Westmoreland Transfer Station (Westmoreland) is located at 4610 S. Westmoreland Avenue, Dallas, TX. Westmoreland is also known as the Southwest Transfer Station. Westmoreland began operation in 1985 under TCEQ permit number 1453. According to the transfer station permit and the Site Operating Plan (SOP) provided by City staff, dated February 1994, Westmoreland has a design capacity of 400 TPD and serves as one of the City's smaller transfer stations accepting refuse and recycling materials.

When the 2011 LSWMP was developed, the City's transfer station system's physical infrastructure was identical to the current system; however, since that point the City has begun to manage single-stream recyclables at the transfer stations. While Bachman and the satellite transfer stations support the City's current transfer needs for both refuse, recycling, brush and bulky waste during typical operations, the transfer station system struggles to handle and transfer material without extended operating hours when it becomes inundated with material during unanticipated surges in volume.

Further detail and evaluation related the transfer station system and each of the City's transfer stations is provided in Section 5.0.

4.1.3 Material Recovery Facilities

This section provides an overview of MRFs in the region and a description of the FCC MRF located at the Landfill.

4.1.3.1 Material Recovery Facilities Overview

This section provides an overview of Materials Recovery Facilities (MRFs) in the region and provides a high-level overview of the MRF located at the Landfill.

MRFs are designed to receive, process, segregate and bale various recoverable commodities and prepare them for sale on the secondary material commodity market. There are presently eight active MRFs in the NCTCOG region, located among Collin, Dallas, Denton, and Tarrant Counties. Table 4-3 identifies the MRFs currently in operation in the region and provides the owner and/or operator, location, and materials accepted.

Table 4-3: NCTCOG Materials Recovery Facilities and Accepted Materials[1]

Permit Holder/Site Name	Owner/Operator	County	Residential Materials Accepted[2]
Pratt MRF – Denton	Pratt Industries	Denton	Gen 1
Waste Connections MRF – McKinney	Waste Connections	Collin	Gen 1
Republic MRF - Plano	Republic Services	Collin	Gen 2
Republic MRF – Fort Worth	Republic Services	Tarrant	Gen 2
Waste Management MRF – Arlington	Waste Management	Tarrant	Gen 2
CWD MRF - Dallas	CWD	Dallas	Gen 2
FCC MRF – Dallas	FCC Environmental Services	Dallas	Gen 2
Balcones MRF – Dallas[3]	Balcones	Dallas	-
Waste Management MRF – Dallas[3]	Waste Management	Dallas	-

1. This list includes facilities known to process single-stream recycling materials. Reference Table 11-3 for other facilities in the region that process commercial recycling based on data submitted as part of the MFRO.
2. Based on 2018 interviews with the respective residential MRF operators. First generation MRFs (Gen 1) report accepted materials as: cardboard, mixed paper, kraft bags, paperboard, office paper, glass bottles and jars, aluminum cans, steel cans, PET bottles and HDPE bottles and jugs. Upgraded or second generation MRFs (Gen 2) report accepting all Gen 1 materials plus cartons, clean pizza boxes, aerosol cans, aluminum foil, PP #5 containers, and bulky plastics.
3. Commercial MRF processing little to no residential recycling.

Across the NCTCOG region, there is a reported total of nearly 600,000 tons per year (TPY) of MRF processing capacity currently installed. There is approximately 140,00 TPY of installed processing capacity at the FCC MRF. Compared to other MRFs in the region, this facility accepts a robust set of materials including items such as cartons, pizza boxes, rigid plastic and aluminum foil.

4.1.3.2 City Material Recovery Facility

During the development of the 2011 LSWMP, the City operated a voluntary curbside recycling collection program with a reported 64 percent participation rate and material was delivered to Greenstar Recycling. Understanding that the City's 2011 LSWMP called for substantial recycling increases, the City issued the Request for Competitive Sealed Proposals (RFCSP) focused on identifying viable partnership options to increase recycling. Vendors had the option to develop proposals based on either or both of the following options: (1) vendor constructs and operates MRF at the Landfill (building ownership transfers to City at the end of the contract); or (2) vendor provides processing services at its own location (vendor site option). For the McCommas Bluff option, the City offered a 15-acre site and the City initiated permit modification to include a MRF at the Landfill.

As a result of the RFCSP process, the City entered into a long-term contract with Fomento de Construcciones y Contratas, S.A. dba FCC, S.A (FCC) in November 2015 to design, build and operate a MRF at the Landfill. FCC designed and built the MRF from November 2015 through December 2016, and the 15-year processing agreement between the two parties started on January 1, 2016. The initial term of the agreement has since been extended an additional three years. There is the possibility for one 10-year extension and at the conclusion of the processing agreement, the City will take ownership of the MRF building (excluding processing equipment).

The FCC MRF began operations in 2017 and is approximately 60,000 square feet and is designed to process up to 40 tons per hour. In addition to the processing facility, the site includes a 15,000 square foot administrative and operations facility. The FCC MRF and administrative and operations facility located at the Landfill is shown in Figure 4-4.

Figure 4-4: MRF Building Located at the Landfill

The FCC MRF accepts City-collected single-stream recycling, single-stream recycling from other municipalities in the region, and commercial recycling. Although there are times when the facility has become fully utilized, there has been few instances of sustained unplanned downtime and the facility continues to accept and process the City-delivered material. However, if the City were to implement a policy that increased the amount of commercial recycling flowing to the FCC MRF, the capacity made available for the City's curbside single-stream collection may become constrained and would require that recycling material collected by the City be stored using the transfer station system.

The City pays a rate of $73.46 per ton that is adjusted annually based on a contractually-based rate adjustment (that only applies to the operation component of the rate) and receives 50 percent of the revenue of material sales, based on the higher of actual sales or index pricing. The City and FCC conduct MRF audits on a semi-annual basis to ensure that the processing efficiency of the equipment meets the contractually obligated 95 percent efficiency and to calculate revenue sharing. As of the most recent audit conducted in September 2021, the contamination of the City's material is about 25 percent by weight.

The City provides disposal of residuals and contamination from materials delivered by the City at no cost to FCC and receives about $16.60 per ton host fee for guaranteed tonnages and a $1.11 per household public education fee. FCC also provides $40,000 annually for community outreach and $25,000 annually for managerial education support, although these are not paid directly to the City and are provided as in-kind services.

Further discussion and evaluation of the MRF and processing agreement are provided in Section 109.0.

4.1.4 Organics Processing Facilities

This section provides an overview of organics processing facilities in the region and the City's current organics processing system.

4.1.4.1 Organics Processing Facilities Overview

TCEQ regulation and oversight of organics processing regulations vary depending on the types of materials a facility accepts and therefore TCEQ does not actively regulate all organics processing facilities. Burns & McDonnell has compiled an inventory of known active organics processing facilities, although there may be additional organics processing operations in the region that are small scale or do not generate a compost product that is marketed commercially. Table 4-4 identifies major organics processing facilities within the Denton, Collins, and Tarrant County areas that accept a combination of yard trimmings and food scraps.

Table 4-4: Organics Processing Facilities in NCTCOG Region[1]

Site Name	County	Accepted Materials[2]
Plano Pure Products	Collin	Vegetative materials only
Living Earth	Collin	Vegetative materials only
Sustainable Soil Solutions	Collin	Vegetative materials only
The Organic Recycler of Texas	Collin	Vegetative materials only
City of Denton Yard Waste Facility	Denton	Putrescible and vegetative materials
Living Earth	Denton	Putrescible and vegetative materials
Living Earth	Dallas	Putrescible and vegetative materials
Soil Building Systems	Dallas	Vegetative materials only
The Organic Recycler of Texas	Dallas	Putrescible and vegetative materials
City of Grand Prairie Landfill	Dallas	Vegetative materials only
Hunter Ferrell Landfill	Dallas	Vegetative materials only
Charles M. Hinton Jr Regional Landfill	Dallas	Vegetative materials only
City of Mesquite Municipal Compost	Dallas	Vegetative materials only
Alpine Materials LLC	Tarrant	Vegetative materials only
Living Earth	Tarrant	Putrescible and vegetative materials
Living Earth – Fort Worth SE Landfill	Tarrant	Putrescible and vegetative materials
Living Earth – City of Arlington Landfill	Tarrant	Putrescible and vegetative materials
Silver Creek Materials Recovery Facility	Tarrant	Vegetative materials only
The Organic Recycler of Texas	Tarrant	Putrescible and vegetative materials
Thelin Recycling	Tarrant	Vegetative materials only
Living Earth – City of Arlington Landfill	Tarrant	Putrescible and vegetative materials

1. Landfill facilities with organics processing operations that market processed material are shown. Some landfills in the region process organics for use in operations and are not included.
2. Accepted materials are categorized as putrescible or vegetative. Putrescible materials have high moisture content and include, but are not limited to, pre- and post-consumer food waste, biosolids, sludge, or liquid waste. Vegetative materials are cellulosic with low moisture content and include, but are not limited to, tree branches and limbs, grass, shrubs, yard waste, lumber, dry animal bedding, or floral trimmings.

Among the operators that Burns & McDonnell has had discussions with, there is limited capacity for accepting additional third-party material and operators carefully consider specification of any unprocessed material that is accepted to avoid challenges related to high levels of contamination.

4.1.4.2 Current Organics Processing System

The City currently contracts with a processer to grind clean yard waste and wood waste that are delivered to the Landfill. Figure 4-5 shows the clean yard waste and wood waste processing area at the top of the landfill.

Figure 4-5: Clean Yard Waste and Wood Processing Area

This material is processed for volume reduction and used to support the landfill operations on an as-needed basis by providing clean fill and roadbase because it is not permitted to be used as alternative daily cover or to be sold commercially. When the 2011 LSWMP was developed, the City processed yard waste and brush material either at Bachman or the Landfill on an as-needed basis and co-collected bulky items and brush were not diverted from disposal. Since then, the grinding operation has become more consistent but bulky items and brush are still not diverted from disposal.

The City's Southside Wastewater Treatment Plant (SS WWTP) is able to process an inbound flow of 50-55 Million Gallons per Day (MGD). The SS WWTP was developed to meet regulatory standards prior to discharging material into receiving streams (rivers, lakes, etc.) Previously, there had been two conservation efforts that added to the SS WWTP's capacity to install low flow toilets and enforced lawn irrigation standard. The water conservation efforts reduced the volume of influent flow dramatically and have allowed the facility to operate with excess capacity.

Treatment is multi-stage process that treats both liquid and solid wastes. Initially liquid material flows through liquid process flow including a fine screen, influent pump station, grit removal, clarifiers, diffused aeration, final clarifiers and chlorine disinfection. Solids are then treated by pumping material through a thickener, anaerobic digestion system, dewatering system (to about 15% solids), and then finally directly land applied as a soil amendment. Biogas from the digesters is used to fuel internal combustion engines connected to electricity generators and provides over 40 percent of the plant's electrical needs. The SS WWTP has a total of six mesophilic anaerobic digestion units operated by Ameresco. Figure 4-6 shows an overhead of the SS WWTP.

Figure 4-6: Southside Wastewater Treatment Plant

The City is in the process of considering if the SS WWTP shall accept food waste from commercial generators. Accepting material from high volume generators of food waste may boost biogas generation from anaerobic digestion but must be pre-processed to remove inorganic contaminants and ground into a slurry before it can be pumped into SS WWTP.

Further discussion and evaluation of the organics processing management is provided in Section 11.0.

4.1.5 Construction and Demolition Facilities

This section provides an overview of regional construction and demolition (C&D) processing facilities in the region including Type IV landfills and C&D processing facilities.

4.1.5.1 Type IV Landfill Regional Overview

A Type IV landfill only accepts brush, construction or demolition waste, and other similar non-household or non-putrescible waste (organic waste that decomposes without causing odors or attracting pests). There are three Type IV Landfills in the NCTCOG region as indicated in Table 4-5.

Table 4-5: Regional Type IV Landfills

Permit	Permit Holder/Site Name	County	2020 Tons	Remaining Site Life[1] (years)
1983C	Fort Worth C&D Landfill	Tarrant	403,606	11
1749B	Lewisville Landfill	Denton	10	100
664	City of Stephenville Landfill	Erath	16,290	27
2278	Osttend C&D Waste Landfill/380 McKinney	Collin	222,212	24

1. Remaining years are calculated based on the annual airspace utilization factors reported to TCEQ for each landfill in pounds per cubic yard.

When the 2011 LSWMP was developed, the Osttend C&D Waste Landfill/380 McKinney facility had not been active at that point. Although there is still an estimated 57 years of Type IV landfill capacity in the region, as Type I landfills close, the tonnage directed to Type IV facilities may accelerate the depletion of the region's Type IV landfill capacity.

4.1.5.2 Regional C&D Processing Facilities Overview

The only mixed C&D materials recovery facility in the region is Champion Waste & Recycling's Town & Country Recycling Facility in Celina, which opened in 2015 as a single-stream construction. The facility separates construction material using a combination of processing equipment and sorting labor. Materials recycled throughout the process include cardboard, wood, concrete, metal, plastics, wall board, paper, and aluminum. Figure 4-7 shows the type of equipment and labor required as part of Champion's operation.

Figure 4-7: Champion Construction MRF Materials Processing Line

Source: https://www.championwaste.com/

Champion staff assists contractors with generating waste diversion reports that qualify towards a project's Leadership in Energy and Environmental Design (LEED) certification. However, without a regulatory

obligation to provide recycled C&D tonnage or diversion metrics, Champion does not generate regular reports regarding the diversion of material from projects in the City.

In addition to Champion's mixed C&D processing capability, there are a number of material-specific processors throughout the region processing materials such as concrete/aggregate and scrap metal and disposal facilities in the region may manually sort mixed C&D loads to divert high-value materials such as scrap metal.

Local markets are available for key C&D materials including concrete/aggregate, metals, cardboard, plastic, lumber, and gypsum. Concrete/aggregate, metals, cardboard, and plastic have established end-markets that are strong and consistent. Lumber and gypsum markets are more limited or intermittent. The market prices for materials fluctuate like any, but the materials with strong markets provide incentive for processors to dedicate resources to separate and sell. There is a high demand in the local market for clean, processed concrete/aggregate given the high level of local construction and industrial activity. Cardboard and plastic generated as part of construction projects are typically taken to one of the local MRFs and sold along with other residential and commercial materials in the secondary materials markets. Wood or gypsum is often ground on the processor's site and used as part of disposal operations, composted, or otherwise repurposed on site. C&D material processors seek alternative end-markets for lumber to process it into a commodity product. There are limited local markets for hard to recycle materials such as treated wood and painted gypsum (once painted, gypsum becomes difficult to recycle). Processors struggle to separate and recycle these materials in a cost-effective way.

4.1.6 Household Chemical Collection Center

This section provides a high-level description of the Dallas County Home Chemical Collection Center (HCCC) and the City's Household Hazardous Waste (HHW) program.

To manage HHW, the City participates in a regional program with Dallas County. This serves as an important outlet for residents to drop off hard-to-recycle materials including the processing, diverting, and safe disposal hard-to-recycle materials such as plastic film, batteries, electronics, paint, household cleaners, automotive fluid, fertilizers, and pesticides.

City residents can take material to the HCCC, which is located at 11234 Plano Road in northeast Dallas. The County's facility is open Tuesday (9:00 am – 7:30 pm), Wednesday (8:30 am – 5:00 pm) and Thursday (8:30 am – 5:00 pm) and two Saturdays per month (9:00 am – 3:00 pm). Additionally, Dallas County and the City host distinct mobile collection events to accept either BOPA (batteries, oil, paint and antifreeze)

or HHW materials meant to provide more convenient access for City residents who do not live near the HCCC.

Dallas County began offering a regional HHW program in 1997 and has owned and operated its permanent HCCC since 2002. The program offers facility drop-off of material to residents of its 16 participating cities (including Dallas), as well as hosting large mobile events and "mini" mobile events per year (separate from the City's BOPA mobile collection events). The County bills participating cities on a monthly basis after actual costs are assessed. Costs for each City are divided into operating costs, based on the City's population, and disposal costs, based on the City's actual participation for each billing period. The current agreement with the County expires in 2023, at which point the City will need to determine if it should continue participating in the current HHW program or identify alternative approaches to managing HHW materials.

Further detail and evaluation related to the City's current HHW program and future considerations are provided in Section 12.0

4.2 Public-Private Partnerships

The City has engaged in PPPs to develop materials management infrastructure and may take this approach to develop facilities going forward to meet future disposal and processing needs.

PPPs can be an effective model to provide needed infrastructure without the full financial risk falling on either the City or the private business. Effective PPP exist when both local governments and the private industry collaborate to share resources, capital investment, risk, and revenue. When considering a public-private partnership, a local government should consider the degree to which it wants to be involved in the operations and capital investment of a facility.

There are advantages and disadvantages to the different types of arrangements and which entity takes ownership of the land, capital investment, and operations. While the processing services agreement is the most common option, public-private partnerships are gaining more appeal as a means to share risk among market volatility. Table 4-6 provides an overview of the different public-private partnership options available to local governments and private businesses.

Table 4-6: Examples of Public-private Partnership Options for Recycling Operations

Responsibility	City-Owned and Operated	City-Owned with Private Operations*	Privately Owned and Operated on City Land	Processing Services Agreement
Land Ownership	City	City	City	Private
Capital Investment	City	City	Private	Private
Operations	City	Private	Private	Private

The FCC MRF was successfully developed by PPP and the LSWMP Update indicates where the City could consider future PPPs, such as developing additional organics processing capacity.

4.3 Current System Findings Key Findings and Recommendations

This section provides a brief summary of current system key findings and recommendations for each type of material management facility including landfills, transfer stations, MRFs, organics processing, C&D processing, and HHW processing.

Landfill capacity. While there is currently sufficient capacity for the City's disposal needs, the life of the Landfill may decrease more rapidly than currently projected if population growth and development increase in the future. Similarly, the projected landfill capacity in the region may decrease more rapidly than projected further increasing the value of airspace for disposal. Based on data from the TCEQ's 2020 annual review of MSW generation and facilities in Texas, the region has approximately 37 years of total Type I Landfill capacity remaining at current reported annual disposal rates which has been depleted by ten years since the development of the 2011 LSWMP. However, these estimates do not account for future population and economic growth and actual total remaining landfill life. Taking these factors into account, the total remaining landfill life in the region is about 27 years, about ten years less than projected by TCEQ. As landfills in the region close and the total disposal capacity decreases, tonnage flows will shift to the available disposal capacity and market pressure will cause the value of airspace to increase over time. Further discussion of the capacity of the Landfill to meet future disposal demands is provided in Section 8.0

Transfer station system. The City's transfer station system is currently sufficient to meet its needs but encounters challenges during periods of unanticipated surges of inbound material and working with aging buildings and equipment. When the 2011 LSWMP was developed, the City's transfer station system's physical infrastructure was identical to the current system; however, since that point the City has begun to manage single-stream recyclables at the transfer stations. The City is able to effectively utilize Bachman in conjunction with the two satellite stations to aggregate materials for transfer to the Landfill or MRF;

however during surges of higher than typical inbound volume, the transfer station system struggles to complete daily operations. While Bachman and the satellite transfer stations support the City's current transfer needs for both refuse and recycling (and occasionally brush and bulky loads, as needed) during typical operations, the transfer station system requires extending working hours to manage material when it becomes inundated during unanticipated surges in volume.

Further discussion of the capacity of the transfer station system to meet future material management demands is provided in Section 5.0.

FCC MRF. The current agreement with FCC has been sufficient to meet the City's recycling processing needs. Although there are times when the facility has become fully utilized, there has been few instances of sustained unplanned downtime and the facility continues to accept and process the City-delivered material. However, if the City were to implement a policy that increased the amount of commercial recycling flowing to the FCC MRF, the capacity made available for the City's curbside single-stream collection will become constrained and would require that recycling material collected by the City be stored using the transfer station system. Further discussion of the current agreement and capacity of the FCC MRF to meet future single-stream recycling processing demands is provided in Section 9.0.

Organics processing. The City's current contract to grind clean yard waste and wood waste delivered to the Landfill is sufficient to meet the City's needs. When the 2011 LSWMP was developed, the City processed yard waste and brush material either at Bachman or the Landfill on an as-needed basis and co-collected bulky items and brush were not diverted from disposal. Since then, the grinding operation has become more consistent but bulky items and brush are still not diverted from disposal. Among the organics processing operators in the region, there is limited capacity for accepting additional third-party material and operators carefully consider specification of any unprocessed material that is accepted to avoid challenges related to high levels of contamination. The SS WWTP has available capacity to accept organics material from high volume generators of food waste which could boost biogas generation from anaerobic digestion; however, this material must be pre-processed to remove inorganic contaminants and ground into a slurry before it can be pumped into SS WWTP. but requires Additionally, the SS WWTP would require further infrastructure development to accept this material delivered this way. Further discussion and evaluation of the organics processing is provided in Section 10.0.

C&D disposal and processing. The current capacity for C&D disposal in the region has been sufficient to meet the City's needs. Although there is still an estimated 57 years of Type IV landfill capacity in the region, as Type I landfills close the tonnage directed to Type IV facilities may accelerate the depletion of the region's Type IV landfill capacity. The only mixed C&D materials recovery facility in the region is

Champion Waste & Recycling's Town & Country Recycling Facility. In addition to Champion's mixed C&D processing capability, there are a number of material-specific processors throughout the region processing materials such as concrete/aggregate and scrap metal and disposal facilities in the region may manually sort mixed C&D loads to divert high-value materials such as scrap metal.

HCCC facility and BOPA events. The current agreement with Dallas County to operate the HCCC and City-hosted BOPA events are able to meet the City's HHW management needs. Since the agreement with Dallas County expires in the next two years, the City needs to determine if the current arrangement will support the City's future HHW management needs. Further discussion and evaluation of the City's future HHW management needs and options is provided in Section 12.0.

5.0 TRANSFER STATION SYSTEM

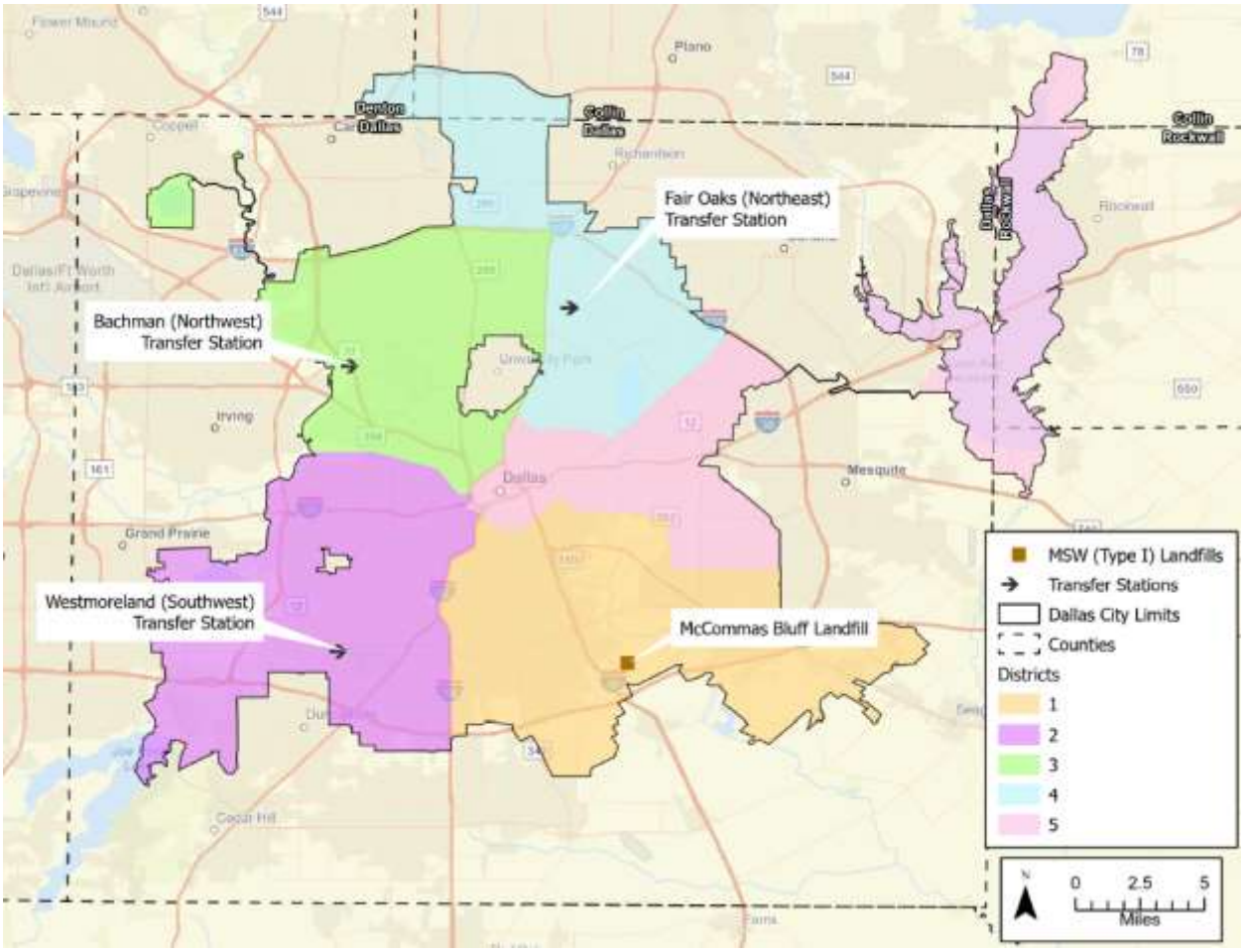
The transfer station system is critical to the long-term material management needs of the City and supports the collection operations to minimize the environmental impact and maximize operational efficiency and supports the capabilities of the services offered by the Sanitation Department and OEQS. The City must support the aging transfer station system to ensure it can be utilized on a sustained, long term basis to meet the operational, financial and environmental needs to reach Zero Waste.

Further detailed technical evaluation of the transfer station system collection operation is provided in Appendix C. City has evaluated several potential options to support the immediate and long-term needs of the transfer station system.:

5.1 Current System Review

The transfer station system consists of the City's three transfer station facilities that collectively shorten haul times for the Sanitation Department's collection system. All materials accepted at the transfer stations are hauled to the Landfill for disposal and to the MRF for recycling. The transfer stations are operated via City-owned equipment and City personnel. The transfer stations are geographically located in the northeast, northwest and southwest areas of the City, allowing for more efficient transfer and disposal of material. The transfer station system consists of three transfer stations including Bachman, the largest facility in the northwest region of the City, and two smaller transfer stations called Fair Oaks and Westmoreland facilities located in the northeast and southwest regions of the City, respectively. Figure 5-1 shows the location of the City's transfer stations.

Figure 5-1: Transfer Station Locations and Sanitation Department Collection Districts



Further description and an in-depth evaluation of each transfer station is provided in Section 4.0 and Appendix C.

The transfer station system is critical in supporting the operations of the City's collection and Landfill and recycling processing operations and serve the following customers:

- **Sanitation Department.** City-operated waste collection vehicles, which have tared weights, including automated side-load or rear-load compactor trucks that deliver larger loads collected from the City's residential customers and from City department locations.
- **Residential customers.** City of Dallas residents drop off materials using light-duty vehicles such as pickup trucks or small trailers that deliver small loads that are self-hauled six days per week at Bachman and on Wednesday and Saturdays at Fair Oaks and Westmoreland.
- **Commercial customers.** Cash and account customers that use residential or light-duty vehicles such as pickup trucks or small trailers that deliver small loads that are self-hauled including roofing, scrap metal or other C&D material. Commercial customers with roll-off or compacting vehicles

are accepted at Bachman. City-operated light-duty or pickup vehicles providing material generated from various City department operations (e.g., parks and recreation) are included with commercial customers.

The transfer station system was originally designed and constructed in the late 1970's and early 1980's to only accept refuse. Since then, recycling program have become introduced as part of standard solid waste systems and the transfer stations now accept both recycling and brush/bulk material. This has created challenges leveraging the transfer station system to maximize current and future diversion from the Landfill.

As part of the LSWMP Update, operations were observed including a review of key daily activities and discussions with transfer station staff and management. The following lists key challenges identified as part the analysis provided in Appendix C and informed by discussions with transfer station system staff and management:

- Managing multiple material streams and customer types reduces the City's ability to utilize full permitted capacity of transfer station system
- Unexpected changes on number and timing of inbound loads create challenges to manage and process material safely and efficiently.
- With more volume than expected is delivered, staff is not able to transfer material out of facility quickly enough and are forced to store material on the tipping floor, which constrains space and increases customer queues.
- With less volume than expected is delivered, heavy equipment operators and transfer trailers sit idle waiting for material to arrive.
- Material is stored in the pit and on the transfer floor on Monday and Tuesday at Bachman then operators manage and transfer the stored material later in the week contributing to space constraints in the transfer building.
- The vehicle scales and scalehouse designs cause increased wait times at facilities and transfer trailer scales are on a separate system than inbound customer scales.
- Truck drivers and crew leaders are working positions and are expected to fill in as heavy equipment operators at times of peak tonnage flows minimizing the capacity for transfer fleet to be responsive during peak tonnage flows.
- Equipment not optimal size for certain materials (e.g., loads from 60 CY brush trucks are larger than some wheel loaders can manage in one push) and others require upgrade to key components in-house to proactively minimize maintenance needs and damage to transfer building floors.
- Transfer fleet trucks and drivers are dispatched to Bachman and a designated small satellite facility, but may be forced to operate reactively and "chase waste" when material flows fluctuate from

anticipated inbound volumes, limiting management's flexibility to adapt when inbound flows change unexpectedly. This is particularly challenging for transfer trucks designated to haul recyclables based on changing tonnage flows.

Further detailed information and analysis related to these challenges are provided in Appendix C.

5.2 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or programs. Additionally, this section identifies any fundamental changes that have been made related to programs, policies or forecasts as it relates to the transfer station system and consistency with CECAP goals.

Table 5-1 lists the recommendations from the 2011 LSWMP related to the transfer station system with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 5-1: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress to date	Potential Next Steps
Assess methods to optimize the available disposal capacity.	Unable to maximize capacity of current system due to delivery of multiple material streams.	Evaluate capital and operational changes to maximize existing capacity.
Maintain transfer station capacity to reduce effects of traffic and air quality impacts.	Utilize transfer station system to minimize environmental impacts of transportation.	Evaluate options to maintain sufficient capacity to meet future needs, especially for new material types (e.g., separately collected brush, food waste)
Develop other infrastructure, as needed, to implement plan.	Current infrastructure aging and not able to efficiently process multiple material types.	Evaluate option to develop new transfer station or rebuild on existing sites.

In the 2011 LSWMP the capacity of the transfer station system was deemed to be sufficient to manage operations and support the City to achieve its Zero Waste goals. Based on the evaluation of the transfer station system, the introduction of multiple material streams has significantly impacted the capacity of the transfer station system to manage material streams separately for recycling. Without the ability to manage multiple materials effectively among the transfer stations, the City has struggled to meet goals identified in the 2011 LSMWP and there are instances when the system is unable to meet the current service demand during surges in tonnage, most notably at Bachman.

CECAP set goals to recycle 35 percent of organic waste, 60 percent of paper waste and achieve a 35 percent reduction of waste landfilled by 2030. The City must address the challenges with the transfer station system to be in a position to achieve these goals in the time frame established by CECAP.

5.3 Case Studies

This section provides descriptions of transfer stations that demonstrate configurations or operational considerations that would support the City's long-term planning needs related to the future of the transfer station system. The following section provide perspective about separating customers by type and multi-material streams.

5.3.1 Separating Customers by Type

Separating customers by type is a key consideration for the City and is a challenge shared by other transfer station facilities. The Bow Lake Recycling & Transfer Station located in King County, Washington is an example of a facility that was designed and constructed to intentionally separate self-haul or manual unload customers from large compacting solid waste vehicles. The facility opened in 2012, with expanded recycling added in 2013, and replaced an older 33,000 square foot station built in 1977. The upgraded transfer building is approximately 68,000 square feet, processes approximately 267,000 tons annually and cost approximately $88 million when constructed[55]. The high capital cost may be due in part to the multiple operational areas of the facility segregated by customer type and sophisticated traffic control system. **Error! Reference source not found.** shows the facility layout of the Bow Lake Recycling & Transfer Station.

[55] More information about the Bow Lake Recycling & Transfer station is available at the following links:
https://kingcounty.gov/~/media/depts/dnrp/solid-waste/facilities/documents/factsheet-Bow-Lake.ashx?la=en
https://interfaceengineering.com/work/bow-lake-transfer-and-recycling-station

Figure 5-2: Bow Lake Recycling & Transfer Station

The facility shown has dedicated queuing lanes with stoplights for self-haul customers, larger solid waste collection vehicles, and transfer trailers as well as both inbound and outbound scales managed by a scalehouse building. The queuing allows for traffic management in the site, and there are separate entrances and exits for all three customer types and a dedicated drop-off area for self-haul customers. The facility layout and traffic design effectively separate customers by type which increases the ability to manage and transfer material in the transfer building and decreases operational safety risks.

5.3.2 Manage Multiple Material Streams

Based on the need to make additional infrastructure investments at the transfer station, the City of Georgetown, Texas is developing a new transfer station at the site of its existing transfer station. Beyond the longer-term capacity of a newer, upgraded transfer station, one of the key advantages is that it would allow the simultaneous acceptance of several material streams including, trash, recycling, and organics, for transportation to the appropriate disposal or processing location. The upgraded transfer building is permitted at approximately 23,000 square feet with three individual transfer bays and a design capacity of 1,080 tons per day. The facility will utilize an existing citizen convenience drop-off center that contains six roll-off containers, and the hours of operation and have not yet been finalized. Figure 5-3 shows an early conceptual rendering of the City of Georgetown transfer station currently in the design phase. While some elements of the site plan have changed since the conceptual design, the primary transfer station building is similar to the conceptual design shown in Figure 5-2. The estimated capital cost for this facility is approximately $11.6 million.

Figure 5-3: Conceptual Rendering of City of Georgetown Transfer Station

The Georgetown transfer station will be able to manage multiple material streams because the tipping floor is adequate size and there are three transfer trailer bays that provide the ability to separately manage refuse, recycling and brush and yard trimming materials. The ability for the upgraded facility to manage multiple material streams is dependent on the capability to swiftly transfer material out of the building by utilizing three transfer truck bays. There is also an area of the site dedicated to storing full transfer trailers during the day that are hauled at night during reduced traffic hours.

5.4 Options Evaluation

This section analyzes a series of options related to the transfer station system that have been identified based on the operational analysis, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and case studies.

Based on the results of the outreach activities conducted as part of the LSWMP Update. The transfer station citizen drop-off program is popular among residents where about 40 percent of respondents indicated they visit a drop-off facility at least once per year. Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Maximize existing capacity of the transfer station system.** Describes adjustments to the transfer fleet equipment and operations, increased diversion of self-haul customers from tipping floors, and increased coordination with collection operation that would maximize the existing capacity of the transfer station system.

- **Upgrade site layout and/or transfer buildings.** Evaluates impact of upgrading existing facilities to overcome existing challenges.
- **Separately receive and process brush and yard trimmings.** Evaluates the impact on operations to manage material streams for processing in the transfer station system including separate handling of brush and yard trimmings using the existing equipment and staffing resources available.
- **Major expansion or rebuild of Bachman.** Describes a major expansion or rebuild of Bachman that would support the long-term needs of the City, including any future programs developed.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 5.5 to support the key findings, recommendations and implementation and funding plan.

5.4.1 Maximize Existing Capacity

Overview. Maximizing the existing capacity among the transfer station system without expanding the existing transfer buildings can be accomplished with the following approaches:

- **Increase number of transfer trucks, trailers and drivers.** The City currently has 26 transfer trucks and trailers and 18 drivers[56]. Based on the evaluation provided in Appendix C, if the City were to increase the number of transfer trucks, trailers and drivers by they would be able to better meet surge demands and more proactively deploy equipment and drivers rather than reacting to real-time needs that cause challenges transferring material out of the facility. The City should consider multiple trailer types to increase the ability to transfer the current and future material streams that may require separate transfer including the following:
    - **Tipper trailer.** Tipper trailers can haul refuse and brush and bulky items for disposal at the Landfill because they have access to trailer tipper equipment.
    - **Ejector trailer.** Ejector trailers are the only ones that can haul recycling because there is no trailer tipper at the FCC MRF.
- **Adjust operations to store material in transfer trailers on site.** With more transfer trucks, trailers and drivers, City staff would increase equipment availability and have a higher degree of flexibility to manage materials into transfer trailers for storage to minimize storing material in the transfer building. To accomplish this, transfer station operators would store material utilizing idle

[56] City staff has received approval to hire five additional truck drivers and purchase three new trucks and six new trailers (three for refuse and three ejector trailers). If successfully hired, the number of FTEs will increase to 22, the number of trucks will increase to 29 and number of trailers will increase by 32.

transfer trailers, maneuvering and staging them on-site with a yard tractor to and hauling the transfer trailers to the Landfill for disposal after the transfer stations are closed to customers for the day. This would allow materials to be moved out of the transfer buildings the same day they are delivered to minimize overnight storage of in the transfer buildings, but may require a modified permit that supports storing material in trailers as part of the operations. The adjusted operations would be most applicable at Bachman.

- **Separate Sanitation Department vehicles from self-haul and manual unloading customers.** Separating Sanitation Department vehicles from self-haul or manual unloading customers is critical to maintaining a safe operating environment in the transfer buildings by reducing excess traffic and maintaining a physical separation between these customers and larger collection vehicles. This is most important at Bachman due to the current practice of storing material in the building throughout the week. When the pit and tipping floor are used to store material, the space constraints increase the risk for vehicle collisions or damage to the transfer building. Separating customer types can be accomplished by increasing the number of staff or upgrading the scalehouse at the entrance of Bachman to manage the flow of self-haul and manual unload customers into the building. This would allow the City to reserve adequate unloading space for Sanitation Department vehicles. Holding self-haul or manual unload customers near the entrance to Bachman would provide an opportunity to request customers take better advantage of the Dry Gulch drop-off facility instead of entering the transfer building, as applicable, and collect data to track the number of times customers have used the facility to streamline billing processes and other information that would support capital upgrades to the Dry Gulch drop-off facility.
- **Increase coordination with collection operation**. Increasing the frequency of communication between transfer station supervisors and collection supervisors to provide accurate estimates of when Sanitation Department vehicles are expected to arrive at a transfer station would increase the capability of City staff to make proactive and real-time operational adjustments to clear material from tipping areas as soon as it is delivered. Increased communications could be accomplished via dedicated radios and leveraging on-board equipment to identify changes in expected route completion time on a real-time basis (e.g., equipment breakdown, unanticipated high levels of traffic, etc.).

Recycling potential. Maximizing the existing capacity of the transfer station system to support processing of yard trimmings, brush or other organic materials on a separated basis provides high diversion recycling potential.

Operational impact. Increasing the equipment and staffing to clear the transfer floor daily and more frequently communicating with the collection operation minimizes safety risks and reduces overtime demand required to clear material stored in transfer buildings throughout the work week. Storing material in extra trailers on site may present challenges due to space constraints at transfer stations and adjustments to the typical hauling operating schedule to work at night. Separating customer types at transfer stations would increase the amount of floor space available so that the City could consider managing material types separately, particularly during surges in material. If the refuse and recycling collection program transitions to five day per week collection (reference Section 6.4.1), residents may be able to be accepted at the transfer stations before Sanitation Department vehicles arrive (e.g., between 7:00 AM and 10:00 AM).Overall, maximizing existing capacity would have a medium operational impact because it would require additional staff and equipment to operate transfer trucks and provide traffic control, but would allow the transfer station system to manage additional material while minimizing overtime demand.

Financial impact. Maximizing the existing capacity would require the purchase of additional equipment (e.g., transfer trailers or yard tractors), staff and pursuing small to medium-sized capital projects (e.g., upgrading scalehouse system at Bachman). The financial impact of this option is less than building upgrades or site re-designs efforts, and therefore this option would have a medium financial impact.

Environmental impact. Maximizing existing capacity would allow separate management of more recycling and brush and yard trimmings. If material is recycled or composted rather than disposed the City would realize environmental benefits and the option would have a low impact.

Policy impact. Better tracking the number of uses by customer at the transfer stations would allow the City to better regulate customers that are frequent users of the disposal allowance provided by the City. There would be a medium policy impact if the City enforces the maximum number of uses throughout the transfer station system by turning away customers that utilize the free residential drop-off program excessively and contribute to the traffic congestion among facilities.

Stakeholder "buy-in". There is medium stakeholder buy-in on this option because while there is a high level of buy-in for increasing the capacity of the transfer stations but , there is lower buy-in from an operational perspective related to space constraints of storing material in idle transfer trailers on site and hauling material at night. Additionally, enforcing a maximum number of uses of the residential drop-off program may result in backlash due to perceived reduction in service.

Compatibility with existing programs. This option has a medium compatibility with existing programs because there would be changes in hauling operations, traffic control, and enforcing a maximum number of uses of the residential drop-off program.

5.4.2 Upgrade Site Layout and/or Transfer Buildings

Overview. Upgrading the transfer building and/or equipment would help to overcome current challenges and transition the transfer station system to meet the City's long-term needs. Bachman, Fair Oak and Westmoreland transfer buildings were constructed in 1978, 1969, and 1983, respectively. The transfer stations in the system have undergone several upgrades since they were initially installed. Table 5-2 presents the challenges and recommended upgrades to address the challenges for each transfer station in the system.

Table 5-2: Transfer Station System Operational Challenges and Recommended Upgrades

Operational Challenge	Recommended Upgrades		
	Bachman	**Fair Oaks**	**Westmoreland**
Limited floor space and reinforced walls to manage separate material streams.	Relocate control tower to direct and coordinate customers and equipment operators in the transfer building to manage separate management of material streams.	Reinforce back wall to support tipping floor operations.	Relocate break room and bathrooms to increase maneuverability in the transfer building.
Dangerous or inefficient entrance/egress in transfer building.	Upgrade scalehouse and scale to provide more effective traffic control that separates self-haul customers from Sanitation Department vehicles.	Reconfigure entrance and exit so back of transfer building can be used as an exit.	Adjust entrance so right hopper is not impacted by inbound vehicle traffic.
Dangerous or inefficient vehicle traffic patterns around site.	Upgrade scalehouse and scale to provide more effective traffic control that separates self-haul customers from Sanitation Department vehicles.	Reconfigure entrance and exit so back of transfer building can be used as an exit.	Install scale outside transfer building with scalehouse to minimize number of overweight collection vehicles that need to use the transfer trailer scales.
Self-haul and/or manual unload customers increase traffic in transfer building.	Upgrade Dry Gulch to accept increased numbers of customers to minimize traffic in the transfer building.	Large numbers of self-haul and manual unload customers crowd facility on Wednesdays and Saturdays. Increase size of queuing areas to more efficiently manage vehicle traffic.	Large numbers of self-haul and manual unload customers crowd facility on Wednesdays and Saturdays. Increase size of queuing areas to more efficiently manage vehicle traffic
Facility damage and aging structures.	Re-build operations tower to better direct customers on tipping floor and upgrade pit so material does not need to be lifted to be placed into the transfer truck bay.	Reinforced walls to support tipping floor operations.	Reinforced walls to support tipping floor operations.
Inadequate utilities (e.g., lighting, three phase power, wireless internet, scale system).	Upgrade Dry Gulch to have three phase power to allow for compactors.	Upgrade lighting system.	Upgrade lighting system.

Recycling potential. Upgrading the site layouts and transfer buildings would help overcome the existing challenges and position the City to better manage increasing volumes of refuse, recycling and commingled brush and bulky items in the future. These upgrades on their own would not necessarily provide the ability to separately collect brush and yard trimmings citywide and represent a medium recycling potential.

Operational impact. Increasing the capacity of Dry Gulch and upgrading the scalehouse and scale to provide more effective traffic control would allow for better management of current material streams and increase the transfer station system efficiency. Once Dry Gulch is upgraded, in combination with the steps defined in Section 5.4.1 to maximize existing capacity, the City would be able to manage some or all separately collected brush and yard trimmings at Bachman. During construction, operations may be impacted requiring alternative measures to be taken to manage customers among the transfer station system. It may be necessary to suspend customer drop off service during this period to ensure that Sanitation Department vehicles are able to deliver collected material. Therefore, this option has a medium operational impact.

Financial impact. A 2016 draft Facility Conditions Report developed by AECOM assessed the condition of the substructure, shell, interior, services, equipment and furnishings of each transfer station building. The budgetary estimate to replace the systems and subsystems that were identified as deficient, presented in Table 5-3, provides an estimate of the order of magnitude estimate of capital costs to replace deficient systems and/or subsystems of the existing transfer buildings.

Table 5-3: Estimated Replacement Cost of Transfer Buildings Systems/ Subsystems

System/Subsystem	Bachman	Fair Oaks	Westmoreland	Total
Substructure	$257,854	$172,756	$160,527	$591,137
Shell	$1,455,497	$1,075,545	$634,857	$3,165,899
Interiors	$151,509	$108,514	$102,121	$362,144
Services	$560,623	$337,519	$300,770	$1,198,912
Equipment & Furnishings	$135,294	$29,750	$26,338	$191,382
Total[1]	**$2,560,777**	**$1,724,084**	**$1,224,613**	**$5,509,474**

1. Cost estimates are based on 2016 dollars, and do not include any upgrades, repairs or replacements that have occurred since the draft Facility Conditions Report was provided to the City.

The recommended upgrades identified to overcome operational challenges would require significant capital expenditures including expanding Dry Gulch, relocating the control tower in Bachman to better manage multiple material streams, upgrades to scalehouse and scale systems at multiple facilities, and reconfiguring traffic flows among the sites and transfer buildings. While the financial impact of this option is more than the options to maximize existing capacity, it is less than major expansions or rebuilding efforts and would have a medium financial impact. Since the assessment was drafted in 2016, there is also a need to update the estimates provided in Table 5-3. The City's capital improvement schedule indicates that $1.5 million

are budgeted to renovate Bachman to increase waste flow in FY 2023 and FY 2024, $1.8 million is budgeted between FY 2022 and FY 2025 to provide repair and improvements to the transfer station facilities, and $1 million is budgeted between FY 2023 and FY 2024 to renovate Fair Oaks in combination with repairs to the City's Northeast Service Center.

Environmental impact. Upgrades to the transfer sites or buildings will allow continued management of multiple material streams on a separated basis. Although there may be more vehicles or more hauling trips required to transport separately managed material, if material is recycled or composted rather than disposed, the City would realize environmental benefits and the option would have a low impact.

Policy impact. Upgrading the site layout and/or transfer buildings would have a low policy impact.

Stakeholder "buy-in". Upgrading the site layout and/or transfer buildings would have a high level of stakeholder "buy-in" since it would help overcome the existing operational challenges.

Compatibility with existing programs. Upgrades indicated would help overcome existing operational challenges in line with existing programs.

5.4.3 Separately Receive and Process Brush and Yard Trimmings

Overview. As part of this option City crews would separately collect brush and yard trimming material using the existing equipment and staffing and the option would require Bachman to receive, store, handle, and transfer material without commingling the material with refuse, recycling, or mixed brush and bulky items. The Fair Oaks and Westmoreland facilities are not configured to receive large brush loads in addition to the refuse and recycling material that is currently delivered. At Bachman, dedicated transfer trailers would need to be re-allocated from their current roles to haul separated brush material to a processing facility with a trailer tipping equipment, since ejector trailers are required to transfer recycling materials. This additional material stream would need to be processed inside the transfer building, since brush material cannot be stored outside the transfer building.

Recycling potential. If Bachman were able to separately manage and transfer brush material, the total tons of clean brush that could be collected and potentially recycled is estimated as 45 percent of the current brush and bulky items collected, or about 69,000 tons per year, and has high recycling potential[57].

Operational impact. To separately receive, store and transfer about 69,000 tons per year of source separated brush delivered to Bachman, there would need to be a dedicated area of floor space and between one to three transfer trucks, trailers and drivers to haul material to a composting facility, depending on the

[57] Tonnage range based on estimated percentage of clean brush set out as part of the separated brush collection pilot. Further discussion of the results of the separated brush collection pilot is provided in Section 7.2.

volume of brush separately collected. Although the total tons of material processed through Bachman would not increase substantially, there would be an increase in the number of inbound vehicles based on separate collection of brush/yard trimmings and bulky items. This would have a high operational impact due to increased vehicle traffic in the transfer building and because the hauling operation would need to haul the materials separately, requiring more trips from Bachman to the processing and/or disposal facility. The additional effort to manage this material separately would potentially increase the volume of material that is stored in the transfer building throughout the week and increase the risk of vehicle collisions and other safety challenges.

Financial impact. Separately managing brush and yard trimmings at Bachman would require storing additional material in the transfer building throughout the week. It would cause additional overtime demand on staff and hauling operations due to additional handling efforts and require increased overtime in addition to the current overtime demand. Therefore, this option would have a high financial impact.

Environmental impact. Maximizing existing capacity would allow separate management of more recycling and brush and yard trimmings. If material is recycled or composted rather than disposed the City would realize environmental benefits and the option would have a low impact because the option would minimize emissions related to avoided disposal.

Policy impact. There is a medium policy impact related to this option because the City would need to implement separate brush and yard trimmings collection.

Stakeholder "buy-in". This option has medium stakeholder "buy-in" because separately collecting and processing brush and yard trimmings will support the City's long-term recycling goals but would cause operational and safety challenges due to space constraints and increased vehicle traffic in transfer buildings.

Compatibility with existing programs. Separately receiving and managing brush and yard trimmings has low compatibility with existing programs, since it would require separately managing an additional material stream.

5.4.4 Major Expansion or Rebuild of Bachman

Overview. As part of this option the City would complete a major expansion or rebuild of Bachman to expand the tipping floor and number of transfer truck bays to better manage multiple material streams. Although Fair Oaks and Westmoreland would benefit from increasing permitted capacity, dedicating the resources for a major expansion or capital upgrade at Bachman would provide the most long-term beneficial impact to the transfer station system. While the current square footage of Bachman transfer building is sized at 24 square feet per permitted ton, which is consistent with the City of Georgetown's upgraded transfer station at 22 square feet per permitted ton, the City is unable to separately manage multiple material streams

because there are only two transfer truck bays and limited transfer trucks and drivers. Variations in operating hours also contribute to the discrepancy. Without dedicated bays for materials that are intended to be handled separately, future operators will experience similar challenges to ongoing operations. If additional material streams are added and Bachman is unable to transfer the material shortly after it is delivered, it could cause even more material to be stored in the transfer building, increasing the risk of safety challenges. A major expansion or rebuild could reconfigure the facility layout, add an additional transfer bay, and support future programs that the City would seek to implement to advance towards its recycling goals.

Recycling potential. Expanding Bachman to have a dedicated third bay for organics (including brush, yard trimmings and potentially residential food waste) would allow the City to make significant progress toward its recycling goals.

Operational impact. A major expansion or rebuild of Bachman would require a construction effort that could halt operations and cause a high level of disruption to operations. If collection vehicles are directed to the Landfill during this time, there would be significant operational impact on collections due to the increased time for collection vehicles to travel across the City rather than consolidate materials at the transfer station. For example, between FY 2016 and FY 2020 Bachman had an annual average of about 32,000 transactions from Sanitation Department vehicles and if each of these vehicles were required to direct haul material to the Landfill at an estimated round trip time of 60 minutes[58] the collection operation would fall behind on collections due to the 32,000 hours of driving time to direct haul material for disposal or recycling compared to the current ability to deliver to Bachman and head back to the collection route in significantly less time. If a major expansion or rebuild of Bachman were to be developed, it is possible to schedule construction phasing so that the facility would not be non-operational throughout construction but would still have a significant impact on the ability of the collection operation to manage material collected in the north part of the City.

Financial impact. There would be high capital costs associated with a major expansion or rebuild of Bachman. Table 5-4 describes the major cost items related to this type of construction project.

[58] 60 minutes round trip is used for example purposes, and may be longer in practice based on wait times for unloading at the Landfill.

Table 5-4: High Level Cost Items of Major Transfer Station Expansion or Rebuild

Cost Item	Description
Building shell/envelope	Costs of pre-engineered metal or pre-fabricated materials to construct the building exterior.
Structural foundation	Poured concrete to construct the structural foundation, retaining walls, ramps in and out and other components of a major expansion or rebuild.
Paving	Pavement poured at the site based on the expected vehicle traffic loading.
Sitework	Earthwork/grading, utilities interconnections, landscaping, vegetation, gates, fencing and other site development needs.
Site Plan Preparation	Preparation of engineering design and site plans. Typically range from 8-10 percent of construction costs.
Project Management	Preparation of legal documents and other miscellaneous site and project management.

Environmental impact. If collection vehicles are required to direct haul material to the Landfill, there would be a high environmental impact of the additional road miles traveled and potentially increased numbers of collection vehicles required to keep up with service demand. This would occur only during the construction period.

Policy impact. If the City pursues a major expansion, there would be low policy impact; however, if the City seeks to build a new transfer station at a different location there would be a high policy impact related to the decision about where to site a new large transfer station facility.

Stakeholder "buy-in". If construction operations for a major expansion or rebuild required customers to go to the Landfill as well, it may contribute to increased traffic congestion at the Landfill or increased occurrences of illegal dumping. Although the transfer station system would benefit from a major expansion or rebuild, there would be challenges related to service interruption and would therefore have medium buy-in.

Compatibility with existing programs. There would be low compatibility with existing programs if all or part of Bachman were forced to shut down during the construction of a major expansion or rebuild.

5.5 Key Findings and Recommendations

This section presents the key findings and recommendations related to approaches to maximize the usage of the transfer station system based on the current system review, evaluation of case studies and stakeholder engagement. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The

meaning of the rating differs for each option and/or tactic but can generally be described as “green circle is favorable or low impact,” “yellow triangle is neutral or medium impact,” and “red square is less favorable or higher impact.” Further description of the criteria is provided in Section 1.4.3. Table 5-5 provides a summary of the evaluation of the transfer station system options.

Table 5-5: Summary of Transfer Station System Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Maximize Existing Capacity							
Add more transfer trucks, trailers and drivers.	●	●	■	▲	●	●	●
Adjust hauling operations to store material in transfer trailers and haul at night.	●	▲	●	●	●	■	■
Reduce traffic congestion by separating Sanitation Department vehicles from self-haul and manual unload customers	●	●	●	●	■	●	●
Increase communication protocols and leverage on-board vehicle technology.	●	●	●	●	●	●	●
Upgrade Site Layout and or Transfer Building							
Implement recommended upgrades at each transfer station.	●	▲	▲	●	●	●	●
Separately Receive and Process Brush and Yard Trimmings							
Separately receive and manage separately collected brush and yard trimmings at Bachman using the existing equipment and staffing.	●	■	■	●	▲	▲	■
Major Expansion or Rebuild of Bachman							
Expand existing building to better manage multiple material streams.	●	■	■	▲	●	■	■
Rebuild the transfer building at Bachman or an alternative location.	●	■	■	▲	■	■	■

5.5.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **Self-haul and manual unload customers cause challenges in the transfer buildings.** The high volume of self-haul and manual unload customers minimizes the capacity of the transfer stations to manage multiple material streams and presents safety risks to customers.
2. **Managing multiple material streams and customer types minimizes the City's ability to utilize full permitted capacity of transfer station system**. Processing recycling and brush and bulky items limits the capacity of the transfer station system and indicates the current transfer station system would be unable to manage additional separated materials (e.g., brush and yard trimmings separated from bulky items). Unexpected changes on number and timing of inbound loads create challenges to manage and process material safely and efficiently.
3. **Fair Oaks and Westmoreland are not able to store material in the transfer building overnight due to permit restrictions.** The transfer fleet must prioritize these facilities over Bachman when there are surges of material.
4. **Storing material in Bachman's transfer building throughout the week minimizes the City's ability to manage multiple materials.** Material is stored when the transfer fleet is unable to haul all the material out of Bachman's transfer building during daily operations and causes space constraints in the transfer building required to separately manage and transfer out recycling and clean brush.
5. **The vehicle scales, scalehouse designs and traffic flow cause challenges during surges of material**. The traffic flows at the transfer stations result in increased traffic congestion due in part to the location and capabilities of scale and scalehouses. Notably at Westmoreland, vehicles that exceed the weight of the scale must encircle the facility several times to weigh at the transfer trailer scales and then deliver material in the transfer building.
6. **Transfer fleet trucks and drivers are dispatched reactively.** Without clear indications of when surges of material are approaching, the transfer station operators' ability to proactively deploy resources to meet service demand is limited.
7. **The City must address the existing challenges with the transfer station system to achieve the goals set by CECAP.** CECAP set goals to recycle 35 percent of organic waste, 60 percent of paper waste and achieve a 35 percent reduction of waste landfilled by 2030 in the single-family sector. The City will not be able to achieve these goals without being able to consolidate material collected in the north part of the City for transfer to processing facilities in the southern areas of the City.

5.5.2 Recommendations

Each of the following recommendations are components of the planning level implementation & funding plan provided in Appendix F.

1. **Implement key operational adjustments and capital upgrades to maximize existing capacity among the transfer station system.** Implement the number of transfer trucks and drivers required to meet the operational needs of a separated brush and bulky item collection program. Additionally, execute upgrades to the various transfer station buildings and facilities including increasing the capacity of Dry Gulch to effectively divert the majority of self-haul and manual unload customers from the transfer building at Bachman. Move forward to comprehensively upgrade the transfer station system including reconfiguring transfer station sites as necessary, upgrading transfer buildings, and integrating the hardware and software of scales and scalehouses.
2. **Concurrently with implementation of key operational and/or capital upgrades, transfer brush and yard trimming loads through Bachman on a pilot basis.** As transfer station operational and capital upgrades are being planned and executed, begin processing separated brush material through Bachman on a regular basis for transfer to the Landfill's existing brush grinding operation until an available composting facility is identified. During the separated brush and bulky item collection pilot a small amount of material was processed at Bachman, but there was not enough room in the transfer building to maintain this throughout the pilot.
3. **Develop engineering design study and preliminary construction phasing plan for major expansion or rebuild of Bachman.** Prepare for a future major expansion or rebuild of Bachman by developing a series of options that would effectively route traffic through the site and maintain the capability to expand services while maintaining continuity of service through strategic construction phasing. This engineering design study would provide the configurations required to manage separately collected brush and potentially separately collected food waste in the future.

6.0 REFUSE AND RECYCLING COLLECTION

Refuse and recycling collection is provided by the Sanitation Department to single-family customers using multiple equipment types and crew configurations to collect roll carts both in the alley and at the curb. The Sanitation Department is the exclusive provider for single-family and duplexes in the City, although commercial customers can request roll cart service. Further description of collection provided by the Sanitation Department to commercial customers is provided in Appendix D. Providing this service is critical to supporting progress toward the City's recycling goals, as it allows the Sanitation Department direct control over the collection, transportation, processing and disposal of material. The Sanitation Department has been in the process of re-routing its refuse and recycling collection vehicles to increase the operating efficiency in coordination with recently implemented on-board technology over the past year. This section presents considerations to incorporate as part of the ongoing re-routing effort to position the City's operations to increase the efficiency of current program and support implementation of future programs to increase recycling.

As part of the LSWMP Update, select on-route refuse and recycling collection operations were observed as part of the Collection Operation Observations on February 8 and 9, 2021 including both alley and curbside collection services. Additionally, discussions were held with various members of management and staff to discuss ongoing operations and collect data. Further detailed technical evaluation of the refuse and recycling collection operation is provided in Appendix D. The City has evaluated several potential scenarios to adjust services to support providing more efficient services.

6.1 Current System Review

The City's refuse and recycling collection operation services approximately 250,000 households across five collection districts. Chapter 18 of the City's Code of Ordinances establishes that collection services, including collection, removal, disposal and processing of refuse and recycling must be provided by the Sanitation Department for all single-family residences and duplexes. The following refuse and recycling collection services are provided by the Sanitation Department (further discussion of brush and bulky item collection services, including yard trimmings, is provided in Section 7.0):

- **Refuse.** Once per week collection and disposal of refuse contained in 64 and 96-gallon carts from approximately 250,000 households. All residential customers receive refuse collection from City crews and residents can request additional carts for an additional monthly fee. The City also provides "Packout" services at an additional charge for collection on private drives.
- **Recycling.** Once per week collection and processing of recyclables contained in 96-gallon carts from approximately 249,000 households. Recycling collection is voluntary, and residential

customers may elect not to receive this service (e.g., do not have a recycling roll cart) resulting in fewer recycling households serviced.

- **Commercial.** Collection is provided to a limited number of commercial customers via roll carts. Multi-family and commercial properties may receive service for up to 10 refuse and 10 recycling roll carts. The Sanitation Department provides front-load and roll-off service for City facilities on an as-needed basis. A contractor provides this service for about 300 locations, but the City maintains equipment to provide supplemental service as needed. collects a small number of larger solid waste dumpsters.

The City is organized into five collection districts that operate independently but coordinate closely, where each district has a manager of operations. Figure D-1 shows the collection areas of the City by day, the Sanitation Department collection districts, and the location of the transfer stations and Landfill.

Figure 6-1: Sanitation Department Collection Districts and Collection Day Boundaries

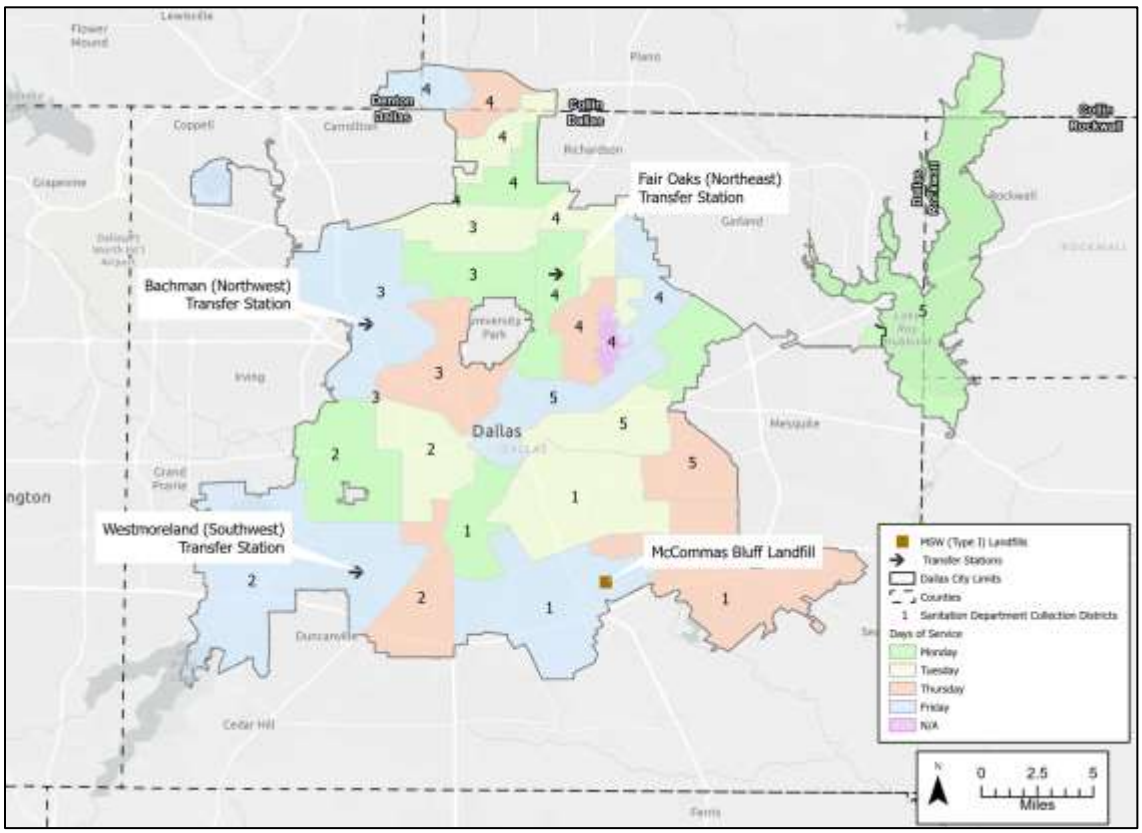
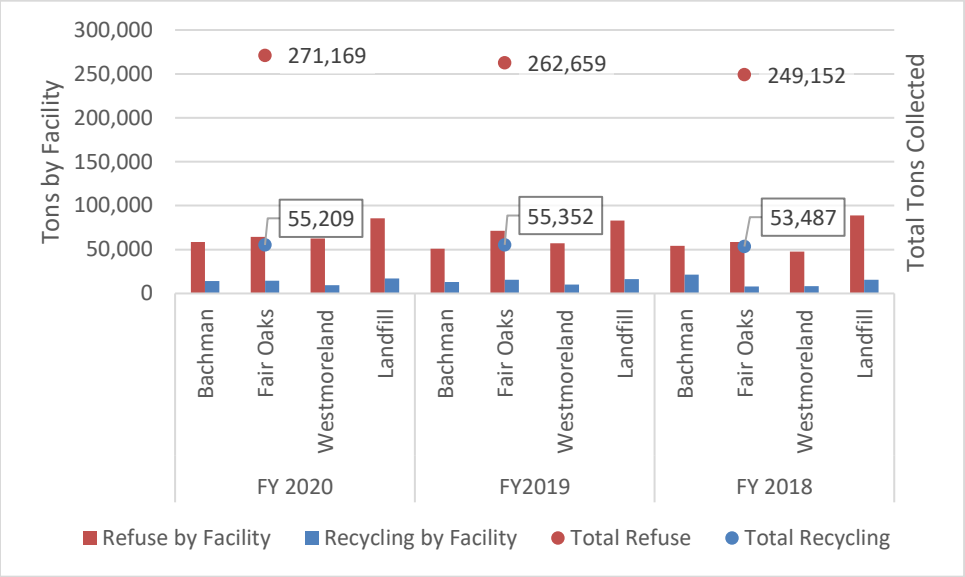


Figure 6-2 shows the annual historical inbound refuse and recycling tonnage processed through the City's transfer station system and delivered directly to the Landfill and MRF from FY 2018 to FY 2020.

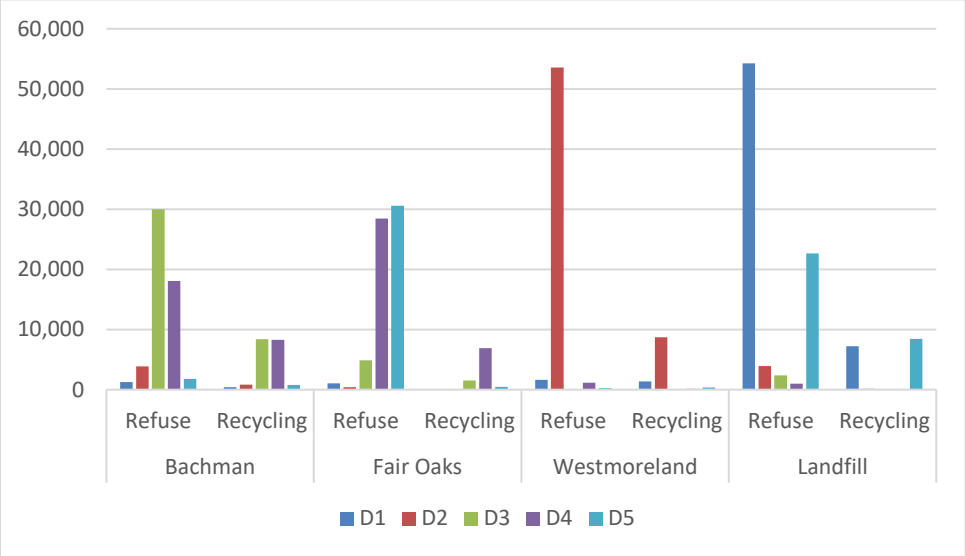
Figure 6-2: Annual Inbound Sanitation Department Collected Refuse and Recycling by Facility[1]



1. Recycling by facility tons reflect the tonnage reported by WasteWORKS of recycling material transferred to the MRF and the tonnage direct-hauled to the MRF reported by FCC. There is a slight discrepancy in the amount of material transferred because of reporting from two different scale systems.

The transfer station system is critical to supporting collection operations by consolidating material for transfer. Figure 6-3 shows the average annual tons of refuse and recycling delivered to each transfer station and directly to the Landfill for disposal from FY 2016 through FY 2020.

Figure 6-3: Average FY 2016 -FY 2020 Annual Sanitation Department Refuse and Recycling by Collection District[1]



1. Recycling direct hauled to the MRF represents the average tons delivered reported by FCC from FY 2017 – FY 2020.

As part of the LSWMP Update, operations were observed including a review of key daily activities and discussions with transfer station staff and management. The following lists key challenges and/or findings identified by refuse and recycling staff and management:

- City struggles to complete routes and meet labor demand during surges of material or labor shortages.
- 116 fewer recycling routes compared to refuse routes due to fewer recycling tons, customers, and lower set out rates.
- Collecting in alleys negatively impacts collection efficiency due to confined space, obstructions (e.g., gas meters, utilities), and collection of empty containers.[59]
- The challenges meeting service demand are compounded when staff is pulled to help on brush and bulky item collection, resulting in staff working high amounts of overtime.

6.2 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or programs. Additionally, this section identifies any fundamental changes that have been made related to programs, policies or forecasts as it relates to the transfer station system.

Table 6-1 lists the recommendations from the 2011 LSWMP related to refuse and recycling collection with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 6-1: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress to date	Potential Next Steps
Mandatory recycling ordinance.	The City has not implemented a mandatory recycling ordinance or other requirements.	The LSWMP Update focuses on measures to encourage participation in the near-term, and considers mandatory measures as future efforts once programs, policies and infrastructure are in place to manage the increased material generation resulting from mandatory policies.

[59] For residents that receive service in the alley, carts are often left in the same location during non-collection days. If a recycling cart is empty, the collection crew either checks the cart (for SA) or collects the cart (for ASL), which reduces collection efficiency.

Since the 2011 LSWMP the collection environments in the City have evolved based on trends shifting toward more condensed development. This shift is an ongoing trend among many cities in the North Central Texas region to reduce development sprawl and create more environmentally and socially conscious housing.

City Code requires the Sanitation Department to provide services for all single-family detached residences and duplexes. Single-family attached properties such as condominiums and townhomes which are not required to seek collection services with the Sanitation Department cause a challenge because roll carts at these locations are not able to collected in a safe and efficient manner. These types of properties may take the form of condominiums or in-fill properties added as additional units on existing lots or dividing existing home into multiple units. These types of properties are not considered single-family properties and are often constructed based on form-based zoning specifications, which does not allow the City the right of first refusal of service in some cases. Further discussion of the City's permit review process is provided in Section 6.3.5.

Although there was limited discussion of natural gas or electric powered solid waste collection vehicles in the 2011 LSWMP, this became a key goal of CECAP and has recently become a focus of the NCTCOG. Further discussion of alternative fuel collection vehicles is provided in Section 6.3.3.

6.3 Case Studies and Benchmarking

This section provides descriptions of programs or operational considerations from peer cities that would support the City's long-term planning needs related to the future of refuse and recycling collection. The following sections provide perspective about the following topics, and is organized as follows:

- Alternative collection schedule and frequency
- Leverage on-board vehicle equipment
- Collection equipment backup ratio
- Permit review process

6.3.1 Alternative Collection Schedule and Frequency

The City collects refuse and recycling from single-family households on a weekly basis. Table 6-2 compares the City's residential refuse and recycling collection operating schedule and frequency to peer cities in the region.[60]

[60] Peer cities were selected to show a range of municipal collection programs of varying sizes, operating schedules and collection frequencies.

Table 6-2: Single-Family Collection Schedule and Frequency Benchmarking

City	Dallas	Denton	Garland	Austin	San Antonio
Operating Schedule[1]	4-10's	4-10's	4-10's	5-8's	5-8's
Households[2]	250,000	33,600	63,000	201,500	370,000
Collection Days	M, T, Th, F	M, T, W, Th	T, W, Th, F	M, T, W, Th, F	M, T, W, Th, F
Collection Frequency					
Refuse	Weekly	Weekly	Weekly	Weekly	Weekly
Recycling[3]	Weekly	Weekly	EOW	EOW	Weekly
Organics[4]	N/A	N/A	N/A	Weekly	Weekly

1. Indicates a four day per week, ten-hour workday (4-10's) or a five day per week, eight-hour workday (5-8's).
2. Rounded for ease of presentation and not reflective of current monthly customer counts.
3. EOW indicates every other week recycling schedule.
4. Reflects cart-based food and yard waste collection. Dallas, Denton and Garland have programs for collection of bundled or bagged yard waste and brush, but not via roll cart service.

Denton and Garland operate on a four day per week, ten-hour per day schedule requiring these operations to increase the number of households collected per route but allowing an extra day to make up for missed collections or catch up if operations fall behind schedule. Austin and San Antonio operate a five day per week, eight hour per day schedule which distributes collection resources over more days and minimizes the required number of households collected per route to meet weekly service demand.

The weekly service for refuse and recycling collection is consistent with Denton and San Antonio, but both Austin and Garland provide every other week recycling collection. While there may be operational benefits to transitioning to an alternative collection schedule and/or service frequency, there are several key challenges to successfully implementing changes to service schedules and frequencies including:

- Re-structuring existing routes and/or service districts
- Adjusting vehicle operator schedules
- Coordinating with transfer, processing and disposal facilities
- Communicating changes in service days to customers

Conducting these activities are critical first steps to transitioning to an alternative collection schedule and/or frequency and must be carefully evaluated to ensure service demand can be met with existing staffing and equipment availability, that customers are proactively educated about proposed changes and compliance is diligently enforced. Additionally, the City should consider any programmatic changes to be added to existing operations and rolled out in phases. For example, when rolling out its roll cart based commingled yard trimming and food waste collection program, Austin had an existing separated yard waste collection program, and the carts were distributed to customers in phases spanning three years.

6.3.2 Leveraging On-board Vehicle Technology

Implementation of on-board vehicle technology and advanced data analytics (e.g., artificial intelligence) is being implemented by both public and private-sector collection operators to increase the efficiency of refuse and recycling collections and support service verification is. The City has recently installed on-board hardware and software to support routing planning efforts, service verification and operator safety[61].

Peer cities in the region are exploring vendors to provide the hardware, software and service to increase the efficiency of managing their collection systems. The City of Denton contracted with Rubicon Global (Rubicon) to install on-board equipment (e.g., tablets, sensors) on collection vehicles to support service verification and as a feedback tool to optimize routing and route planning. Currently the data is not used for compliance reporting, although Denton is considering this application. Vehicle operators use a dashboard mounted tablet to take pictures of contaminated carts or dumpsters that is transmitted to their customer service center for service verification. Additionally, Rubicon's system collects, analyzes and reports individual vehicle operating data such as fuel efficiency, sudden stops or starts, speeding and fault codes for maintenance.

Based on discussion with staff at Denton, there are up-front capital costs to install the system (e.g., tablets, geocoding customers) and an annual subscription cost, but the system was competitive compared to other providers in the market (e.g., FleetMind, Routeware). Since installing the system in 2020, Denton has seen a decrease in the contamination reported by its recycling processor because the technology system streamlines operations for drivers, holds customers to account by providing data to support service verification and helps the operations keep up with customer growth. Additionally, through the route assist program route supervisors are able to see how drivers are doing in real time and can re-deploy resources to support when needed if one or more drivers are behind schedule.

In the future, Denton is seeking to expand its use of Rubicon's hardware and software to run a pilot to collect and analyze contamination data using on-board cameras, streamline its billing system and potentially leverage the equipment and software to capture other data such as images of challenging collection environments, graffiti and potholes.

6.3.3 Alternative Fuel Collection Vehicles

Increasing numbers of alternative fuel collection vehicles are being implemented by public and private sector fleets and there has been an industry trend to explore electric powered heavy-duty vehicles. Fleet managers seek the most effective vehicle and fueling types to achieve increase operational efficiency and

[61] Further information about Third Eye refuse fleet solutions is provided here: https://www.3rdeyecam.com/refuse-fleet-management-systems/

minimize emissions. Battery electric vehicles (BEVs) have emerged recently, but the importance of lifecycle assessments to compare and contrast technology and fuel options is critical to consider as part of the long-term direction of the City's vehicle fleet. The following alternative fuel collection vehicles and manufacturers are currently active in the solid waste collection vehicle market, based on a recently released report by the non-profit Energy Vision called The Refuse Revolution [62]:

- **Natural gas vehicles.** Includes both CNG and Liquified Natural Gas (LNG) extracted through drilling and oil excavation. These fuels are compatible with natural gas engines burn cleaner than gasoline or diesel and reduce emissions of nitrogen oxide (NOx) by 90 percent and particulate matter (PM) by 60 percent compared to diesel. Additionally, fossil natural gas vehicles are 50 percent quieter than diesel engine vehicles. There are about 18,000 natural fossil gas burning trucks on the road and these vehicles can reduce the lifecycle of GHG emissions by five percent compared to diesel. Renewable Natural Gas (RNG) is not a fossil fuel and is made from a renewable resource: food waste, animal manure, and other types of organic wastes. Production of RNG traps and refines methane biogases which would otherwise escape into the atmosphere with significant environmental impacts. The incremental cost increase of purchasing of natural gas collection vehicles is about $38,000 more than comparable diesel models.[63] There are about 10,000 RNG burning collection vehicles on the road and these vehicles reduce can reduce GHG emissions by 50 - 300 percent compared to diesel, depending on the feedstocks used to manufacture RNG. Some natural gas vehicles are retrofitted diesel vehicles, which may be subject to increased maintenance and downtime challenges compared to new natural gas vehicles.
- **BEVs.** These vehicles have zero tailpipe emissions and have significantly quieter operations due to the electric battery, but the environmental benefits are not as competitive to natural gas fueled vehicles from a lifecycle perspective. There are benefits of BEVs including minimal tailpipe emissions, quieter operations, and less maintenance costs over the life of the vehicle compared to diesel or natural gas vehicles. Additionally, certain models of BEVs can provide a charge through regenerative braking, where breaking energy that would normally be lost as heat is returned to the battery as electricity. The challenges with BEVs are that these vehicles have limited range between charges require a large electricity demand to power the batteries, which may result in more lifecycle emissions if the electricity is generated by coal-fired power plants. The extraction and

[62] Further information and analysis on the operational, financial, and environmental components of alternative fuel collection vehicles including renewable diesel, hydrogen fuel, hydraulic hybrids, biodiesel, and dimethyl ether as part of the following report: https://energy-vision.org/wp-content/uploads/2021/12/The_Refuse_Revolution.pdf
[63] U.S. Department of Energy. "Case Study – Compressed Natural Gas Refuse Fleets." February, 2014. https://afdc.energy.gov/files/u/publication/casestudy_cng_refuse_feb2014.pdf

transportation of rare or precious metals (e.g., lithium, cobalt and other rare earth minerals) and the associated labor requirements are a key challenge related to the scalability of BEVs. Additionally, there are limited outlets to recycle or dispose batteries when they reach the end of their useful lives. Based on these challenges related to the scalability of BEVs, there are less than 50 fully electric refuse trucks on the road nationwide, and their cost is nearly 70 percent higher than diesel trucks – as much as $800,000 compared to $300,000.

Waste Management has maintained consistent messaging over the past several years that their intention is to purchase as many natural gas solid waste collection vehicles for operations across the country where the opportunities exist to do so. Additionally, they are seeking to increase the percentage of vehicles in their collection fleets that are fueled by RNG.[64] Waste Management currently maintains a fleet of about 100 RNG solid waste collection vehicles at the Skyline Landfill that are fueled by the processed landfill gas. These vehicles are deployed to service municipal and commercial customers in the DFW Metroplex area.

There are several equipment manufacturers marketing BEVs including Motiv Power Systems, Mack, and Build Your Dreams (BYD, a Chinese manufacturing company). These equipment manufacturers have recently sold BEV solid waste collection vehicles to cities including Chicago, Sacramento, Los Angeles, Seattle and New York City. Although there are cities incorporating battery electric vehicles in their fleets, the results of pilot efforts have had mixed reviews. Los Angeles piloted a BYD vehicle for four months in 2017 and concluded the test was successful, although they have not added more BEVs. Other cities have piloted BEVs and have limited or discontinued their use citing challenges with battery operation in cold weather, reliability of hydraulics (e.g., ASL collection arms), reliability issues and less collection capacity compared to natural gas or diesel vehicles due to the size of the battery pack.

Even with the identified challenges, there is continued interest in BEVs for solid waste collection. For example, in an application to the NCTCOG's Regional Transportation Council's North Texas Clean Diesel Projects, the City of Plano submitted an application to support their fleet to replace one diesel refuse collection vehicle with one BEV.

6.3.4 Equipment Backup Ratio

The equipment backup ratio is a critical consideration for collection service operators to ensure that the amount of available equipment is sufficient to meet service demands. The backup ratio is the amount of

[64] Waster Dive. "Waste Management Looks to Surpass 80% CNG Collection Fleet." June 2, 2021. https://www.wastedive.com/news/waste-management-cng-electric-sustainable-fleets/601037/

front-line collection vehicles available compared to the total of front-line and backup vehicles. Table D-8 shows the frontline and backup collection vehicles in the Sanitation Department's fleet.

Table 6-3: Frontline and Backup Collection Vehicles

Vehicle Type	Collection Vehicles[1]	Front Line[2]	Backup	Backup Ratio[3]
ASL	84	51	33	39.3%
SA	91	67	24	26.4%
AC	14	12	2	14.3%
PUP	2	1	1	50.0%
Total	**191**	**131**	**60**	**31.4%**

1. Total collection vehicles by type represents vehicle inventory data as of November 16, 2021.
2. Frontline vehicles include all vehicle types and sizes used to service the total daily refuse and recycling routes as of December 10, 2021. Number of daily routes frontline vehicles, and total collection vehicles are subject to change based on pending re-routing and equipment availability.
3. Backup ratio is calculated by dividing the number of backup vehicles by the total collection vehicles.

It is industry standard best management practice to maintain between a 20 percent and 25 percent back-up ratio to account for vehicle downtime and maintenance, which assumes that a typical vehicle would be unavailable for service one day of a four- or five-day operating week. This operational indicator allows fleet managers to develop vehicle purchasing and replacement schedules to ensure that unexpected downtime would not cause the collection operations to fall behind. If a vehicle type has a lower backup ratio than 20 percent, there is increased risk that delays in routine maintenance or unplanned downtime will cause collection operations to fall behind. If a vehicle type has a higher than standard backup ratio, it could indicate that the fleet replacement schedule or preventative maintenance practices are causing aging vehicles to be utilized past their useful lives or that long turnaround times at the fleet maintenance garage requires the City to hold more backup inventory to meet service demand.

The optimal backup ratio is dependent on the size of the fleet, number of routes, the efficiency of maintenance services, the type of vehicles that are deployed and their fuel types. For example, based on benchmarking of several municipal solid waste collection fleets[65], the back-up ratio for diesel ASL and SA collection vehicles ranged from 12 percent to 55 percent based on the amount of daily required equipment and vehicles in the fleet. The backup ratio for these cities was significantly different for natural gas vehicles, ranging from five percent to 93 percent. As part of this benchmarking, other cities indicated similar challenges that Dallas faces including increased maintenance needs for vehicles that service alleys,

[65] Benchmarked municipalities include San Antonio, Austin, and El Paso based on data compiled as part of the 2018 Collections and Fleet Review conducted on behalf of the City.

minimizing maintenance requirements and allowing maintenance staff sufficient time to make all necessary repairs before vehicles are required to be re-deployed to meet service demand.

6.3.5 Permit Review Process

Currently planned residential growth throughout the City includes both in-fill development as well as large master planned communities (MPCs) that are developed based on Form-Based Code (e.g., SmartCode[66]). Form-Based Code specifications incorporate elements of New Urbanism (i.e., development that creates walkable, mixed-use neighborhoods) to accommodate environmental techniques such as reduced usage of impervious cover (e.g., pavement, asphalt, cement), increased usage of green spaces (e.g., parks, fields, gardens), and more walkable or multi-modal transit (e.g., bicycle lanes, trolley tracks).

Form-Based Code specifications result in compact mixed-use and high-density developments that can create challenges for solid waste collection to be performed safely and efficiently. If zoning requirements and design codes do provide accessibility for solid waste collection vehicles or equipment, challenging collection environments are built such as:

- **Inaccessible alleys.** Service location in narrow or obstructed alleys.
- **Private drives with limited maneuverability.** Service locations only accessible by private drives.
- **Cul-de-sacs with inaccessible set outs.** Service locations on Cul-de-sacs that are too small or contain obstructions.
- **Hammerhead or dead ends.** Service locations on hammerhead (i.e., dead-end streets that end in a "Y" shape) or dead-end streets with undersized turn radii.
- **Boulevards.** Service locations on arterial roads that contain obstacles for collection due to multi-modal transportation lanes.

City staff provide a cursory review to identify any major violations (e.g., not meeting minimum right-of-way, located in a thoroughfare, etc.) so the developer can adjust before the submission is fully evaluated. Development Services works collaboratively with other departments such as Dallas Fire-Rescue (DFR) and DWU in the pre-development process to identify any challenges that would cause the submission to ultimately be denied. Based on discussions with City staff, there are currently limited considerations in the pre-development process to ensure that the submission accounts for solid waste collection vehicle accessibility and meets the minimum standards to ensure that the Sanitation Department equipment will be able to safely and efficiently service these properties. Developers are able to complete a dumpster waiver

[66] SmartCode is a model transect-based planning and zoning document based on the tenants of Form-Based Code intended to keep settlements compact and rural lands open by reforming the patters of separated-use zoning. More information on SmartCode is available at the following link: https://smartcodecentral.com/

form to develop properties that may not be accessible to solid waste vehicles. The challenge with single-family attached properties is that when they include challenging collection environments (e.g., private drives) the Sanitation Department has to consider removing the customer from service because they may not be able to safely or efficiently collect set outs, ultimately requiring the customer to hire a private sector service provider.

Multiple cities across Texas are experiencing collection challenges associated with the implementation of SmartCode development, including Austin, Fort Worth, and San Antonio. Each of these cities have indicated that applications for new developments are provided to its solid waste and recycling collection group for initial review. It is clear, however, that even though this initial review process may be sufficient for the needs of fire truck equipment, the needs of solid waste and recycling collection vehicles require additional attention in regard to interim applications or amendments. This is due to the fact that solid waste and recycling collection vehicles will visit these locations more frequently than emergency fire vehicles. Additionally:

- Fort Worth noted that even after reviewing initial permits, developments were still being installed that did not meet the needs of solid waste and recycling collection equipment and indicated that it is challenging to devote resources to interim reviews.
- Austin indicated that it has a strategic development team that is dedicated to tracking policy development and reviewing inconsistencies in code that would impact solid waste and recycling collection vehicle accessibility. This team works closely with Austin's Planning and Zoning Department.
- San Antonio has developed a committee that seeks to ensure the safest and most efficient solid waste and recycling collection equipment is able to remain in operation. This committee is tasked to create an informational bulletin that would serve as the policy to determine criteria for SmartCode policy implementation. Recommendations may include variable fee structures, minimums for ASL service and emergency fire equipment, cart set out placement, parking restrictions, and protocols for private haulers.

6.4 Options Evaluation

This section analyzes a series of options related to the refuse and recycling collection program that have been identified based on the operational analysis, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and case studies.

The following summarizes the key takeaways from the community survey and other outreach activities conducted as part of the LSWMP Update.

- 95 percent of respondents to the survey are homeowners and 93 percent indicated that use garbage collection once per week and 84 percent indicated they use recycling collection once per week.
- 74 percent of respondents indicated they were satisfied or very satisfied with refuse collection service and about 70 percent indicated the same for recycling collection service.
- 58 percent of respondents indicated they have collection service provided in an alleyway, compared to 42 percent of respondents receiving collection at the curb.
- 25 percent of respondents indicated they would be supportive of transitioning to curbside collection in areas where alleys are not conducive to automated collection compared to 67 percent of respondents that were opposed or very opposed.
- 58 percent of respondents indicated they would be supportive of ordinances that require participation in services in programs, such as mandatory recycling.

Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Evaluate potential efficiencies of adjusting collection schedule.** Describes the considerations of evaluating adjustments to the collection schedule for refuse and recycling collection schedule from four days per week to five days per week as part of the ongoing re-route.
- **Minimize alley collection and combined routes.** Evaluates the impact of adjusting collection routes to minimize the number that collect in alleys and from routes that contain alley and curbside collection, leveraging on-board technology to track performance metrics and maximize collection efficiency
- **Decrease use of diesel collection vehicles.** Describes the impact of increasing the use of CNG/RNG collection vehicles for refuse and recycling collection and piloting a BEV.
- **Release procurement for cart supplier.** Describes the considerations of releasing a procurement for cart supplier and/or cart management service provider to leverage cooperative purchasing to realize cost savings.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 6.5 to support the key findings, recommendations and implementation and funding plan.

6.4.1 Evaluate Potential Efficiencies of Adjusting Collection Schedule

Overview. As part of this option the City would evaluate adjusting its current collection schedule of four, 10-hour operating days per week to five, eight-hour operating days per week as part of the ongoing re-route. This would require an adjustment to the collection districts that, given reduced number of households per route, may allow resources from multiple collection districts to more effectively share collection demand when necessary (e.g., equipment could be deployed from one sanitation district to another in the case of unplanned vehicle downtime). Adjusting current service days and adjusting the boundaries of the solid waste collection districts to support the ongoing re-route may benefit the operation if there are increased operating efficiencies (e.g., fewer trips to disposal/processing per route, more streamlined maintenance, higher equipment availability, etc.). As long as adjusted routes and sanitation districts allows collection operation to within a 40-hour work week (e.g., not requiring a sixth day of operation to meet service demand), distributing resources over a five-day schedule has the potential to balance the number of customers collected per day and minimize the strain on both drivers and equipment. Although transitioning to a 5-8 collection schedule would not guarantee improved routing efficiencies, if the City is able to capture efficiencies related to the transition, the Sanitation Department would be able to deploy collection resources more effectively and position the City to gain the capacity to implement expanded service offerings in the future (e.g., material types collected, frequency of collection). There would be challenges to ensure that brush and bulky item collection has sufficient resources, since refuse and recycling collection vehicle operators are often pulled onto this service on Wednesdays to support the brush and bulky item collection operation.

Recycling potential. Adjusting the collection schedule would provide the same level of service for recycling collection. This option has recycling potential if the City captures efficiencies upon implementation of a re-route and increases its capability to expand service offerings in the future (e.g., roll cart collected organics, every other week recycling, etc.); however, the recycling potential of this option would not be realized in the short-term time frame.

Operational impact. Adjusting the collection schedule would distribute refuse and recycling customers over five days and potentially minimize strain on existing collection equipment and staff to meet current and future service demand, limit the occurrence of overpacking vehicles, streamline vehicle maintenance workflow and provide increased capability to support unplanned downtime of collection vehicles. Re-configuring the refuse and recycling routes would shorten the length of daily routes, but could increase the time total time per week that crews are not on-route (e.g., lunch breaks, pre- and post- trip inspections). Transitioning to a five day collection may have a positive effect on the transfer station system because there would be fewer daily inbound tons to transfer out for disposal and/or processing. Adjusting the collection

schedule would cause challenges that the City would need to overcome such as ensuring there are sufficient resources to meet brush and bulky item collection service demand (since refuse and recycling staff would not be able to support brush and bulky item collection on Wednesdays), re-configuring the transfer station programs and operations to support the adjusted collection schedule and determining the equipment types that are deployed on each route. Additionally, maintenance requirements of collection vehicles would need to be distributed throughout the week rather than concentrated on Wednesdays like it is currently with the 4-10's collection schedule.

Financial impact. If the City is able to achieve efficiencies by implementing a re-route on a 5-108 collection schedule, regularly completing collections without falling behind and meeting service demand even during surges of material generation, there may be less overtime demand. Although there would be education and outreach efforts required as part of the implementation of an adjusted collection schedule, these efforts could be managed by the Sanitation Department staff.

Environmental impact. The environmental impact of this option depends on the results of the ongoing re-route and if it would require increased collection vehicles and road miles traveled.

Policy impact. Adjusting the collection schedule would be an operational decision and has minimal policy impacts.

Stakeholder "buy-in". If adjusting the collection schedule minimizes the strain on equipment and staff there would have high "buy-in" from an operational perspective. If service demand could be met in a 40 hour work week, there would be a high "buy-in" from collection staff. There may be mixed "buy-in" from other parts of the Sanitation Department operation that would be changed such as brush and bulky item collection and the transfer station system. Additionally, customers that have their collection days changed may become confused about the correct set out days and times.

Compatibility with existing programs. There is low compatibility with current programs due to the changes to collection days and required adjustments to other Sanitation Department operations.

6.4.2 Minimize Alley Collection and Combined Routes

Overview. This option would reduce the number of customers that are serviced in the alley and minimize routes that have both alley and curbside collection as part of the ongoing re-route. Minimizing alley collections and combined routes would decrease safety and property damage risks by leveraging on-board technology to determine the most effective approach to phasing out mixed routes. Collecting a high percentage of households in the alley decreases refuse and recycling collection efficiency and accelerates

wear and tear on both vehicles and alleys. Table 6-4 shows the number of customers that are serviced in the alley and curbside by district.

Table 6-4: Alley and Curbside Refuse Customers by District[1]

District	Alley Customers	Percent Alley	Curbside Customers	Percent Curbside	Total
1	4,269	8.9%	43,747	91.1%	48,016
2	14,802	27.2%	39,671	72.8%	54,473
3	24,890	64.9%	13,460	35.1%	38,350
4	39,018	64.1%	21,808	35.9%	60,826
5	17,440	36.4%	30,534	63.6%	47,974
Total	**100,419**	**40.2%**	**149,220**	**59.8%**	**249,639**

1. Alley and curbside refuse customer counts by district represent most recent data as of November 4, 2021, does not represent average annual figures and is subject to change based on pending re-routing and daily operational needs

When vehicles are deployed to service routes that have mixed alley and curbside collection points the vehicle size and type is typically only suited to one or the other. For example, the smaller body 20-22 CY SA collection vehicles are able to service alleys safely and efficiently, but the smaller truck body has smaller payload and must leave its route to dispose of material more frequently, minimizing its route efficiency. Alternatively, larger 26-30 CY ASL collection vehicles are able to stay on route longer, but are unable to navigate the alleys without risking damage to the vehicle or property in the alley. Although servicing customers in the alleys presents operational challenges, adjusting customers set out locations or outsourcing collection in the alleys to private haulers would require updates to the City's existing Code of Ordinances.

Recycling potential. Deploying vehicles that are uniquely suited to its collection environment of its route would allow the collection operation to service more households per route. Based on the anticipate growth population growth, or in the case that the City implements mandatory recycling from residential customers in the future, minimizing alley collection and combined routes would support the City's ability to meet increased service demand for recycling set outs. Leveraging on-board equipment to provide feedback to increase the efficiency of the collection operation (e.g., collecting and analyzing real-time operational data) would increase the effectiveness of education, outreach and compliance efforts such as directing resources implementing the "Take-a-Peek" program to routes or areas of the City that have higher instances of incorrect or highly contaminated recycling set outs.

Operational impact. Minimizing the combined alley and curbside routes would allow the City to deploy collection vehicles more strategically by type and capacity to maximize routing efficiency. For example, to

service alleys, ASL vehicles need to service one side of the alley then turn around to service the other side because the collection arm is only located on one side of the vehicle. Traveling down an alley twice increases the time to collect material, number of times the collection vehicle travels along alleys, and increases the potential for property damage. On-board technology can be used to support route adjustments to minimize combined alley and curbside routes.

Financial impact. There would be financial benefit to minimizing alley collection and combined routes based on reduced overtime demand, reduce vehicle maintenance costs and increased collection vehicle capacity. Based on financial analysis modeling the hypothetical situation that all customs were collected from curbside utilizing ASL, alley cat and PUP collection vehicles, the full system could be serviced utilizing 115 vehicles compared to the current 129[67].

Environmental impact. There would be a beneficial environmental impact to minimizing alley collection and combined routes because the City would be better positioned to deploy vehicles that are uniquely suited to each route's collection environment. This would eliminate excess road miles and damage to City roads and alleys that are required when collection vehicles are deployed to challenging collection environments (e.g., ASL required to travel down alleys twice, smaller body vehicles required to leave routes to dispose material more frequently).

Policy impact. Minimizing alley collection and combined routes would require consideration for adjusting the location of residential set outs at certain locations, charging customers for the additional effort to service in the alleys, or outsourcing collection of challenging collection environments to the private sector. These considerations would have a high impact on the existing City Code and policy for residential customers.

Stakeholder "buy-in". There is high "buy-in" from refuse and recycling collection operators, but low buy in from residential customers that would potentially be required to adjust their set out location. Some customer locations are not designed to store and transport roll carts to the curb, and other residential streets are not conducive to curbside collection because of residential parking rules. Overall, there is medium stakeholder "buy-in" for this option.

Compatibility with existing programs. The Sanitation Department is in the process of a re-route and is actively seeking to minimize collection from alley set outs; however, further reducing the alley set outs and

[67] Further detailed evaluation of the financial and operational impacts of transitioning to all-curbside collection is provided as part of the draft Financial Impact of Alley Collection memorandum dated March 14, 2022.

combined routes would require City-wide changes. Since this option could be implemented by making iterative adjustments to the routing in strategic phases, it has medium compatibility with existing services.

6.4.3 Decrease Use of Diesel Collection Vehicles

Overview. This option would decrease the use of diesel vehicle fuel through the expansion of natural gas vehicles for refuse and recycling collection and piloting BEV collection vehicles. Expanding the number of natural gas vehicles would require a corresponding expansion of the vehicle fueling capacity (e.g., fueling stations, vehicle storage locations, etc.) and coordination with maintenance to ensure the expanded number of natural gas vehicles could be maintained. Piloting a BEV collection vehicle would also require installation of charging infrastructure and identifying funding sources that could support the purchase cost of one or more pilot BEVs.

Recycling potential. There is no additional recycling potential for single-stream materials, but there would be the potential to increase the recycling of organics to generate RNG through anaerobic digestion at the SS WWTP that could be used to fuel natural gas vehicles. Increasing the natural gas demand from the collection vehicle fleet would support increased generation of RNG.

Operational impact. The Sanitation Department utilizes 45 natural gas collection vehicles. The majority of these vehicles are rear-load vehicles and are fueled at the operation center in District 3 and District 4. There are no natural gas fueling stations at other operation centers, and to expand the use of natural gas vehicles would require fueling capability in other sanitation districts. Additionally, the City would need to have capacity and parts to manage the maintenance needs of a higher percentage of natural gas vehicles in the fleet. To incorporate BEVs in Sanitation Department's collection fleet, the fueling infrastructure would need to be established to support deploying the vehicle for service. Other operational challenges would need to be overcome including the parts and knowledge to provide specialized maintenance and repair for BEVs, limitations on range on a given charge, and redundancy in the event the vehicle experiences unplanned downtime. Given the limited existing fueling infrastructure for both natural gas and BEVs and increased maintenance requirements this option would have a high operational impact.

Financial impact. The purchase cost of both CNG/RNG vehicles and BEVs are higher than their diesel counterparts and the operations are typically less as well, but are subject to fluctuations of the fuel and electricity market. The maintenance costs for natural gas vehicles are higher than its diesel counterparts, particularly if the vehicle has been retrofitted as a CNG/RNG vehicle. The maintenance cost for BEVs are less than the cost of its diesel counterparts, but require that the City has the appropriate equipment, parts and knowledge to service electric refuse collection vehicles.

Environmental impact. There are environmental benefits to replacing diesel burning vehicles with natural gas vehicles or BEVs. There are even further environmental benefits to utilizing RNG because it has the climate benefit of trapping methane biogases that would otherwise escape into the air as GHGs, including from landfills. Natural gas reduces particulate matter compared to diesel burning vehicles and reduces nitrogen oxide emissions by over 90 percent compared to the EPA standard when used in new natural gas engines (model year 2016 or newer)[68].

Policy impact. This option is operationally-focused and would not have an impact on policy.

Stakeholder "buy-in". There is high stakeholder "buy-in" for this option because it supports CECAP goals and incorporates state of the art technology for both natural gas vehicles and BEVs as part of the City's current and future fleet planning.

Compatibility with existing programs. This option is compatible with existing programs, but requires adjustments to the City's existing infrastructure and maintenance practices. This option has medium compatibility with the City's existing programs.

6.4.4 Release Procurement for Cart Supplier

Overview. As part of this option the City would procure vendors to provide roll cart sales and maintenance before the current contract for cart purchase expires to identify the costs and needs to support future goals as part of the LSWMP Update. The City currently has a contract in place to purchase carts and manages and deploys carts using City resources. This procurement would solicit information related to the cost of cart purchases (including 96- and 64-gallon cart sizes) and costs to outsource cart management operations including cart inventory, managing warranty replacement, cart repair and replacement. Understanding the costs of cart purchase and other service, including potential cooperative purchasing arrangements with peer cities, would provide the information required to consider the costs of implementing future service offerings (e.g., roll cart based organics collection) and potentially finding cost savings by outsourcing management and maintenance of carts as the City's cart inventory continues to age.

Recycling potential. This option would not increase the amount of recycling collected and has low recycling potential.

[68] Energy Vision. "The Refuse Revolution Leading the Way to a Sustainable Future." https://energy-vision.org/wp-content/uploads/2021/12/The_Refuse_Revolution.pdf

Operational impact. Replacing aging carts and increasing the ability for City staff to manage inventory supports efficient collection operations and could free resources the City currently dedicates to this activity. These resources could be deployed elsewhere in the operation to meet service demand.

Financial impact. Releasing a procurement for cart supply and maintenance would potentially minimize costs if the City were able to leverage cooperative purchasing with peer cities to reduce the unit price of carts or if a third-party provider can manage carts more cost effectively by reducing the amount of staff time required to repair, replace and distribute carts. The City would have the ability to determine if responses were in its best interest and would only move forward if a response was more competitive than its current cart management operation.

Environmental impact. This option would not have an environmental impact.

Policy impact. This option would not have a policy impact.

Stakeholder "buy-in". The current cart management system supports the City's current needs but exploring the opportunity to leverage collective purchasing power and minimizing staff demand has high "buy-in" from City staff.

Compatibility with existing programs. This option would not interrupt existing services and has a high compatibility with existing programs.

6.5 Key Findings and Recommendations

This section presents the key findings and recommendations related to program and policy approaches increasing the effectiveness of the City's refuse and recycling collection program based on the results of the overview, evaluation of case studies, benchmarking and stakeholder engagement. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Further description of the criteria is provided in Section 1.4.3. Table 6-5 shows the summary of refuse and recycling collection options evaluation.

Table 6-5: Summary of Refuse and Recycling Collection Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Adjust Collection Schedule							
Adjust collection schedule from 4-10's to 5-8's	△	△	●	N/A	●	△	■
Minimize Combined Alley and Curbside Routes							
Reduce number of alley customers and routes that service both alleys and curbside customers.	●	●	●	●	■	△	△
Leverage on-board technology to track performance metrics and maximize collection efficiency	●	●	●	●	●	●	●
Decrease Use of Diesel Collection Vehicles							
Increase number of CNG vehicles in fleet and required fueling infrastructure	△	△	■	●	●	●	△
Pilot electric collection vehicle	N/A	△	■	●	●	●	■
Release Procurement for Cart Supplier							
Develop Request for Proposal (RFP) for cart supplier that includes cart management services.	●	●	●	●	●	●	●

6.5.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **The City has an opportunity to identify opportunities to increase the efficiency of refuse and recycling collections as part of the ongoing re-route.** Evaluating adjusted routes would provide insight to the benefit of potentially adjusting the service schedule to identify opportunities to minimize overtime demand and reducing occurrences of overpacking vehicles and decreasing maintenance turnaround time.
2. **Transitioning collection schedule to a five-day collection week requires proactive route planning, resource allocation, education, outreach and compliance efforts.** Successfully adjusting the collection schedule would require proactive communication with impacted residents (particularly those whose collection day changes) and other stakeholders.
3. **Adjusting existing customer set out locations is challenging but would achieve financial savings.** Changing from alley to curbside set out location is challenging for customers based on conflicting street parking configurations, cart storage and house configuration. Some residential single-family customers do not have a place in front of their house to store carts during the week, or a paved path to roll carts out to the curb. At the curb, some areas of the City allow for street parking that would block the set out of roll carts at the curb and create challenges for ASL vehicles to service roll carts; however, there would be potential financial savings if the City were able to transition to an all-curbside system. While it would not be possible to transition to a completely curbside system, the City could realize financial benefits to transitioning out of the alleys.
4. **Leveraging on-board hardware and software is an increasing trend among municipal collection operations.** As an example, Denton has experienced success implementing Rubicon's hardware and software and would provide the City with greater ability to track key performance metrics.
5. **An increasing number of customer locations are unable to be serviced by the Sanitation Department due to high density housing developments.** If City customers are required to hire private-sector haulers for service, the Sanitation Department would be unable to prevent residents from being assessed to higher rates or reduced levels of service.
6. **BEVs are being implemented as a continued industry trend, but do not yet have the operational track record of success necessary for widespread adoption.** While there is continued interest in BEVs as an industry trend and they are now being piloted by public and private refuse fleets in several locations, but there is not yet an established track record that these vehicles

can operate consistently under the challenging conditions facing the Sanitation Department. Since the City currently has the maintenance and fueling infrastructure in place to support natural gas collection vehicles, there are more practical applications to increase the amount of CNG or RNG as part of the current collection fleet.

7. **RNG presents the greatest environmental benefit from a lifecycle perspective compared to its diesel-burning counterpart.** While natural gas vehicles and BEVs are comparable from an emissions reduction perspective compared to diesel-burning collection vehicles, RNG presents that greatest opportunity to minimize emissions from the City's refuse and recycling collection operation. Additionally, the NCTCOG is pursuing regional projects to support the feasibility and development of RNG projects and pilot programs.

6.5.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Evaluate efficiencies that could be achieved by adjusting collection schedule to five days per week, eight hours per day as part of the ongoing re-route.** The City should evaluate the impact of the reducing the number of households per route required for a five day collection week, identifying efficiencies in the re-routed system that could position the City to implement increased service levels in the future (e.g., every other week recycling, weekly collection of yard trimmings).
2. **Develop an education, outreach, and compliance plan to establish the key steps required to implement an adjustment to the City's collection schedule**. The Sanitation Department, OEQS and Code Compliance should collaborate to develop an implementation plan (separate from the Implementation & Funding Plan provided in Appendix F) to communicate service changes and the beneficial impacts for the City to reach its Zero Waste goals. This plan should include how the City would leverage on-board technology to support compliance efforts, required adjustments to other City programs (e.g., brush and bulky item collection, transfer station operation), and phasing plan regarding the implementation of the re-route.
3. **Utilize on-board vehicle technology to collect key performance metrics and support compliance efforts.** The City should leverage on-board collection technology to track key performance metrics such as daily time on-route and off-route, number of trips to disposal/processing facilities per route, and tonnage collected per route and per household to support the City's "Take-a-Peek" program.

4. **Exit the alleys and minimize combined alley and curbside routes as part of the ongoing re-route.** The City should minimize the number of alley collection and combined routes by strategically adjusting the collection routes and/or sanitation districts that have customers with household configuration that allow them to change collection location.

5. **The City should ensure that the Sanitation Department is involved in its permit pre-approval review process conducted by Development Services.** Including the Sanitation Department to regularly review permit applications for mixed use developments or multi-tenant complexes would require developers to consider solid waste collection and recycling capabilities as part of the development process to minimize challenging collection environments.

6. **Increase number of CNG and/or RNG vehicles in collection fleet and expand fueling infrastructure.** CNG and/or RNG present significant environmental benefits and support CECAP goals of implementing a cleaner, greener solid waste collection system. The key challenge to increase the number of CNG and/or RNG vehicles is the ability to fuel at multiple locations throughout the City. The City should consider implementing additional CNG and/or RNG fueling stations and leveraging NCTCOG grant funding to support this infrastructure expansion to meet the demand of increased natural gas-burning vehicles.

7. **Track ongoing efforts to implement BEVs and explore the feasibility of a BEV pilot project based on the results from peer cities.** This City should continue to track the ongoing efforts of BEV collection vehicles around the country and explore the feasibility of running a BEV pilot upon successful implementation of these vehicles on a long-term basis (e.g., through a full replacement cycle) in peer cities. The City should then gauge the ability of the existing infrastructure and maintenance capabilities to support BEVs for collection vehicles and leverage regional or national grants or other available funding support to subsidize the purchase, infrastructure upgrade, or maintenance needs to successfully implement a pilot project.

8. **Explore opportunities to procure carts leveraging cooperative purchasing arrangement with peer cities.** The City should release an RFP in conjunction with peer cities to explore the ability to leverage collective purchasing power with peer cities to realize cost savings on cart purchase and/or cart management and support services.

7.0 BRUSH AND BULKY ITEM COLLECTION

Brush and bulky item collection is provided by the Sanitation Department to single-family customers using multiple equipment types and crew configurations. Brush and bulky items represent a large portion of the materials collected annually by the City and contains yard trimming and brush that, if separately collected and processed, would significantly increase the recycling rate. This section presents information and analysis regarding brush and bulky item collection including a review of the recent separate collection pilot and other program and policy considerations to scale the separate collection of brush and bulky items.

As part of the LSWMP Update, select on-route brush and bulky item collection operations were observed as part of the Collection Operation Observations on February 8 and 9, 2021 including multiple equipment and staffing configurations of brush and bulky item collection. Additionally, discussions were held with various members of management and staff to discuss ongoing operations and collect data. The City has evaluated several potential scenarios to adjust service frequency to support separately collecting brush and bulky items. This section relies, in part, on the past evaluation of these scenarios. Further description of the previous evaluation and scenarios is provided in Section 7.2.

7.1 Current System Review

The City provides once a month collection of brush and bulky items to all residential refuse customers and is included in each resident's monthly service fee. Non-residential customers are not eligible for monthly brush and bulky item collection services. Brush and bulky item collection is an essential service provided by the City to maintain clean neighborhoods, minimize illegal dumping, and provide residents with a high level of quality collection service.

Separating organic waste as part of this operation presents a significant opportunity to increase the tonnage of material diverted from disposal annually. For the purposes of the LSWMP Update, "brush" and "bulky items" are referred to as separate material types, anticipating that the City will ultimately collect these items separately. In the past, the City has considered several options for implementing separate collection of brush and bulky items; however, collections are still operated on a com-mingled basis and limits the ability for the City to divert organics from diversion.

Residents are instructed to put brush and bulky item materials out for collection no earlier than the Thursday preceding their scheduled collection week or later than 7:00 a.m. on the Monday of the collection week. Table 7-1 describes acceptable material and any specific set out requirements communicated to customers as part of brush and bulky item collection service.

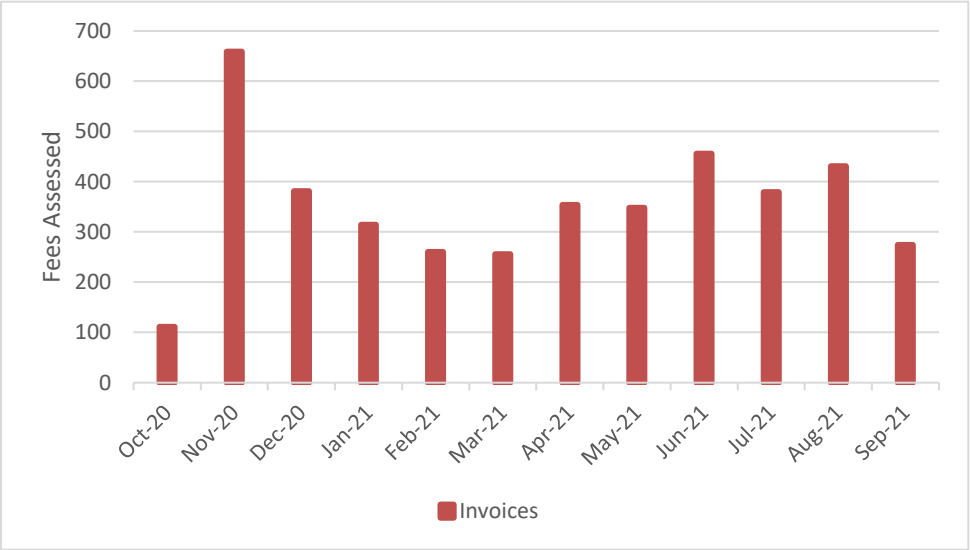
Table 7-1: Accepted Materials and Set Out Requirements

Item	Material Description	Set Out Requirements
Brush	Vegetative cuttings or trimmings from trees, shrubs, or lawns. Individual pieces may not exceed eight inches in diameter or 10 feet in length.	Brush should be placed behind the curb line in front of the property that generates the material in a location that will not interfere with traffic.
Yard trimmings	Yard trimmings such as grass, leaves, and small limbs. and similar items resulting from yard maintenance.	Separated yard trimmings can be placed in paper or compostable lawn bags. Material placed in plastic bags is considered a bulky item.
Bulky Items	Furniture, appliances (refrigerants removed), mattresses, and other household objects too large for routine placement in roll carts.	Bulky items should be placed behind the curb line in front of the property that generates the material in a location that will not interfere with traffic.

To increase collection efficiency, the City Council adopted key changes to the brush and bulky program in 2019 by adding a 10 CY set out limit and fees for oversize set outs. The intent of changing the program was that customers would change behavior over time and ultimately decrease the amount of oversize set outs that collection crews would need to service. This change took effect on July 1, 2020, and fees for oversize set outs began to be assessed in October 2020. When a set out exceeds 10 CY and a request for an oversized collection is not submitted, or the set out contains unacceptable materials, customers are assessed a fee of $60 per five cubic yards[69]. Figure 7-1 shows the charges assessed in FY 2021.

[69] Oversized brush and bulky set outs, excessive and non-compliant brush and bulky set outs are defined in Section 18-4 of the City Code located at the following link: https://codelibrary.amlegal.com/codes/dallas/latest/dallas_tx/0-0-0-8865

Figure 7-1: FY 2021 Oversize Brush and Bulky Item Set Out Violations



In FY 2021 the average oversized set out in FY 2021 was approximately 26 CY and was assessed an average charge of was $191 per invoice. Customers are allowed one oversize set out exceeding 10 CY one time per year. The request must be submitted the week prior to the customer's collection week. The oversized collection occurs on one of the resident's 12 monthly collections and the dimensions may not exceed 20 CY or consist of more than 10 CY of bulky items. Any oversized set outs collected after the one free available collection are assessed a fee.

Major violations related to brush and bulky item set outs are referred to Code Compliance for enforcement action. Table 7-2 describes unacceptable set outs that are prohibited as part of the brush and bulky item collection program, provides example photographs from the Collection Operations Observations and indicates where residents should bring unacceptable set outs for disposal.

Table 7-2: Unacceptable Set Out Description and Disposal Instructions

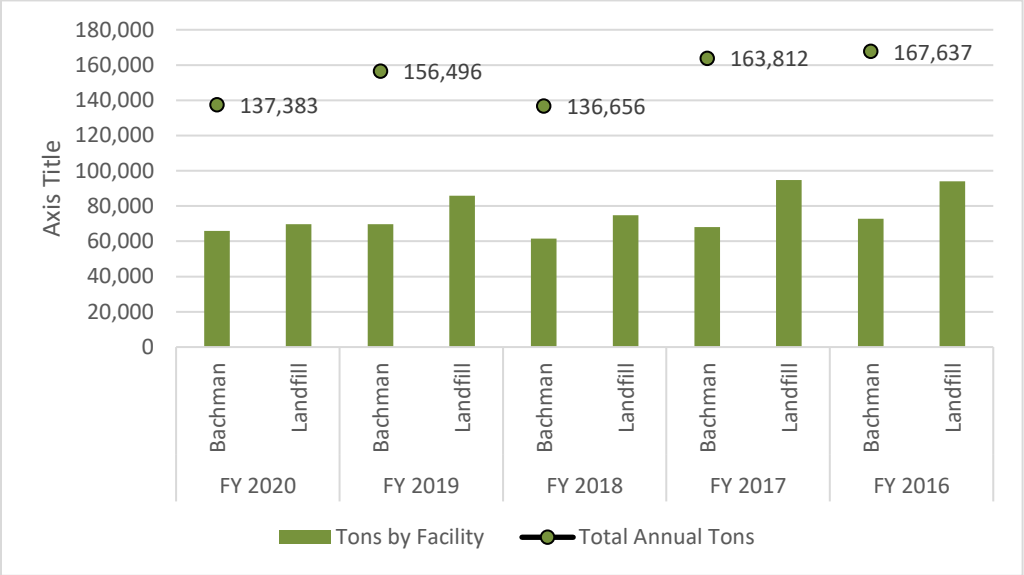
Unacceptable Set Out	Description	Example	Disposal Instructions
Oversized	Set out exceeding 10 CY by volume, including material generated by tree trimming or interior renovation contractors.		Self-haul to the Landfill or transfer station for disposal; request an oversize collection.
Next to refuse/recycling carts	Brush and bulky items placed too close to outside of refuse and recycling carts.		Place brush and bulky items at least five feet away from roll carts and other obstructions.
C&D Materials	Concrete, scrap metal, plaster, dimensional lumber, dirt, rocks, other inert materials		Self-haul to the Landfill or transfer station; request Cost - Plus Service.
Automobile Parts/Tires	Tires, parts or machinery containing gasoline.		Dispose up to six tires at the CCRC at the Landfill; return to retailers; deliver to HCCC or BOPA event.
HHW/Electronics	Paint, chemicals, batteries, televisions, electronics.		Self-haul televisions/electronics to the CCRC at the Landfill or to Bachman or Fair Oaks for disposal; deliver to HCCC or BOPA event.

The City also offers Cost-Plus service that provides on-demand collection for construction or remodeling materials. This service can also be used for on-demand collection of brush and bulky items outside of a customer's normal collection week. A minimum fee of $50.00 (plus tax) per five cubic yards is billed to the associated utility billing account for Cost-Plus services but is subject to increase based upon the load inspection. Cost-Plus had 730 requests for service in FY 2021. Resources for this program are used for Brush Buster requests (e.g., City provided tree trimming) or Code Compliance Department when they issue

a violation. As part of the Clean Curb initiative, collection crews have been servicing any materials in set outs during normal collection and assessing violations for prohibited material. No set outs are left at the curb (except for dirt, rocks, concrete, or other inert material).

Figure 7-2 shows the historical annual tons and loads collected and delivered to Bachman and the Landfill from FY 2016 to FY 2020. Incidental amounts from rear-load collection vehicles (on average about 1,000 tons per year) are accepted at Fair Oaks or Westmoreland (very few loads are processed at Westmoreland),).but t These facilities are not regularly used to manage brush and bulky items since they are smaller transfer stations and are not configured to accept larger amounts or material from brush trucks.

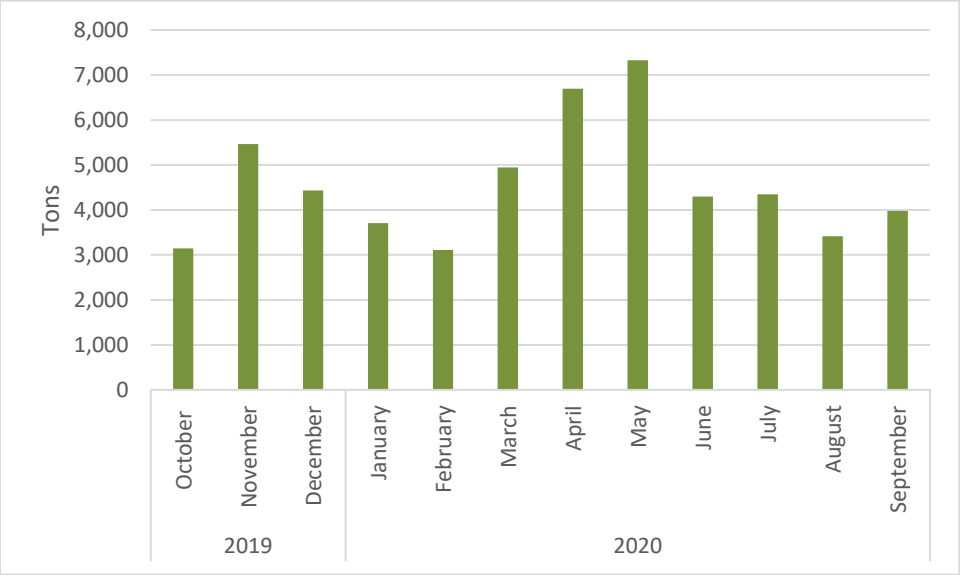
Figure 7-2: Historical Annual Brush and Bulky Item Collection by Facility



Brush and bulky items collected by City collection crews are hauled to either Bachman or to the Landfill. Material transported to Bachman is transferred to the Landfill via transfer trailer for disposal. The tonnage collected between FY 2016 and FY 2020 ranges from 136,600 to 167,600 per year where Bachman received 60,000 to 70,000 tons per year and the Landfill received between 70,000 to 95,000 per year.

Brush and bulky item collection volumes fluctuate seasonally. Figure 7-3 shows the FY 2020 brush and bulky item tonnage collected by the City and processed at Bachman by month.

Figure 7-3: FY 2020 Brush and Bulky Item Processed at Transfer Stations by Month



The tonnage of brush and bulky items processed among the transfer stations in FY 2020 ranged from approximately 3,000 tons in October to over 7,000 tons in May. The seasonal variations in tonnage requires the City's collection and transfer operations to adjust the personnel and equipment to meet service demand. Further data and analysis of the transfer station system is provided in Appendix B.

Besides seasonal variations, the volume of brush and bulky item material collected is impacted by unforeseen natural events such as storms, tornados, and floods. Table 7-3 describes storm events that occurred between FY 2018 and FY 2020 and the impact on tonnage generated.

Table 7-3: Storm Events Impacting Brush and Bulky Item Collection Operations FY 2018 to FY 2021[1]

Year	Storm Event Description	Impact on Tonnage Generated
FY 2021	A polar vortex caused a sustained deep freeze statewide causing the City to match is record low temperature for February 16 at negative two degrees Fahrenheit.	The freezing temperatures led to increases in the number of felled trees, vegetative debris material and interior renovations due to burst pipes and flooding. Additionally, power outages caused increased generation of refuse from residential customers.
FY 2019	On October 20, 2019, a tornado hit the City that left a 15-mile path of damage in the northwest part of the City.	Destruction caused by the tornado led increased volumes of vegetative material and debris.
FY 2019	On June 9, 2019, a series of thunderstorms storms produced winds up to 70 miles per hour toppling large trees and causing power outages.	High winds caused increased numbers of felled trees, vegetative debris and power outages caused increased generation of refuse from residential customers.

FY 2018	On September 21 and 22, 2018 the region recorded 8.11 inches of rain, the third-most in a 24-hour period.	Flooding caused increase generation of vegetative debris.

2. Source: https://www.dallasnews.com/news/weather/2019/12/26/these-are-8-of-the-most-memorable-dallas-fort-worth-weather-events-of-the-2010s/

With the brush and bulky item program already placing substantial demands on the collection operations, having to also collect large quantities of storm debris places additional strains on the operation. When the Sanitation Department is unable to keep up with service demand, the City procures third-party contractors to support operations to meet surges. One of the key challenges of the brush and bulky item collection operations is to anticipate volume surges and ensure that the mix of City staff, contract labor, and contract collection crews are in place to meet the service demand.

The following sections provide a detailed overview of brush and bulky item collection operations and identify challenges based on the Collection Operation Observations, discussions with City staff and data analysis. The brush and bulky item collection operation overview is organized as follows, with brief descriptions:

- **Collection schedule.** Describes the schedule of collection for brush and bulky item collection including the days of the week and week of the month service is provided and number of households serviced.
- **Operating procedure.** Describes the operating procedure including the tagging of oversize or inaccessible set outs, quality control efforts and contracting third-party collection crews.
- **Equipment and personnel.** Presents the types of equipment used and how collection crews are staffed among the various equipment configurations.
- **Processing and disposal.** Presents information on the current processing and disposal of brush and bulky items collected by the City.

7.1.1 Collection Schedule

The City currently services customers four days per week operating on a 10-hour per day schedule. Brush and bulky item collection operations occur year-round, with the exception of City-designated holidays, servicing portions of each of the collection five collection districts daily on a routed basis. Customers are informed of their collection week through information provided by the Sanitation Department's website and mobile application.

Table 7-4 presents the number of households scheduled for brush and bulky item collection by sanitation district and week of the month.

Table 7-4: Customers Serviced by Sanitation District and Week of the Month[1]

District	Week 1	Week 2	Week 3	Week 4
1	14,360	12,033	10,522	9,566
2	18,980	14,956	10,338	10,104
3	10,605	8,047	9,792	10,297
4	14,890	15,981	14,147	14,049
5	11,580	10,727	13,022	13,830
Total	**70,415**	**61,744**	**57,821**	**57,846**
Percentage	**28%**	**25%**	**23%**	**23%**

3. Household counts by district represent most recent data as of August 14, 2020, does not represent average annual figures and is subject to change based on typical customer fluctuations or programmatic changes.

The total customers serviced per week of the month is higher in the first week of the month and decreases through the month. Although the routes are scheduled, there may be significant changes to the customers serviced on a weekly basis when there are surges in material that cause the collection schedule to fall behind. When the collection schedule falls behind, the number of households serviced each week is subject to change. Brush and bulky item collection is split into collection areas that represent a location where crews are deployed to service available set outs. When a crew is deployed to a collection area, they travel through all the streets within that boundary until all set outs are collected. Table 7-5 presents the number of scheduled collection areas for brush and bulky item collection by sanitation district and week of the month.

Table 7-5: Scheduled Monthly Collection Areas by Sanitation District and Week of the Month[1]

District	Week 1	Week 2	Week 3	Week 4
1	7	8	9	5
2	6	5	6	5
3	8	5	6	5
4	5	8	5	6
5	5	10	10	5
Total	**31**	**36**	**36**	**26**
Percentage	**24%**	**28%**	**28%**	**20%**

1. Route counts by district represent most recent data as of August 14, 2020 and is subject to change based on typical customer fluctuations or programmatic changes.

Although the number of households is highest in the first week of the month, the highest number of scheduled collection areas is during the second and third week of the month. Based on the monthly scheduled routes, there is an average of 32.3 collection areas serviced per week or, based on a four day per week collection schedule, 8.1 average daily collection areas serviced.

The collection schedule is based on a four working days per week (Monday, Tuesday, Wednesday and Thursday). but based on discussions with City staff, the brush and bulky item collection operation often

deploys crews on Fridays, Saturdays and Sundays to meet collection demand. Equipment from the refuse and recycling collection program (reference Section 6.0) is utilized on Wednesdays and Saturdays, as-needed, to meet service demand by collecting smaller set outs. Collections operations managers anticipate the need to The City should be deploying about 31 crews per day to meet the scheduled service demand, but due to labor shortages has only been able to deploy about half of that on a daily basis which challenges crews to completely service collection areas. This causes the collection operation to deploy crews on Fridays, Saturdays and Sundays to meet service demand and, as a result, the City to incur rising overtime costs rise. and creates challenges completing daily routes, particularly during labor shortages. Further discussion about the equipment and personnel requirements are provided in Section 7.1.4.

When there are disruptions in the typical collection schedule (e.g., routes are not able to be completed and are completed the following day or weeks), brush and bulky item collection operators struggle to deploy resources to maintain the scheduled service collection and make up for portions of routes that were not collected. The collection districts operate independently as it relates to deploying personnel and equipment, although resources are shared from one district to shift to another on an as-needed basis similar to the refuse and recycling collection operation.

Consequently, when the collection schedule falls behind, determining which sanitation districts and areas within those districts to prioritize becomes a major operational challenge. The determination of which areas to prioritize occur on a case-by-case basis and are impacted by which areas are experiencing surges in material, available staffing and equipment, and requests from residents through 311 or other City departments. As part of the stakeholder engagement effort, residential customers expressed frustrations about requests to make these determinations with all possible equity. Further discussion of the operating on procedures related to brush and bulky item collection is provided in Section 7.1.3.

7.1.2 Operating Procedures

This section describes the operating procedures related to the collection and management of brush and bulky items . The following describes the key components of the Sanitation Department's current operating procedures based on the Collection Operations Observations and discussions with City staff:

- **Collection.** Set outs are not allowed in alleys (paved or unpaved), in front of a vacant lot or business or within five feet from a roll cart, mailbox, fence, wall, fire hydrant, water meter, telephone connection box, parked cars or under low hanging tree limbs or power lines. Collection crews collect brush and bulky item set outs in two operational configurations that are routed throughout the sanitation districts. Equipment and personnel configurations for brush and bulky item collection are further described in Section 7.1.4. City staff indicated that set outs placed at corner-houses (e.g.,

houses that are located on two intersecting streets) present a challenge as customers may place set outs in locations that are missed by collection crews.

- **Inaccessible set outs.** When set outs are inaccessible to collection crews, they are identified with an orange tag and not collected. Set outs may be inaccessible for a number of reasons including parked cars, low hanging utility wires, or other physical impediments that do not allow the crew to get close enough to the set out without damaging City or private property. The City's Code Compliance Department is responsible for writing violations for improper brush and bulk item set outs. The City ordinance presently only allows the Code Compliance Department to fine violators. When a violation is provided by the Code Compliance Department, a Brush Buster request is initiated and the customer is charged when a set out has to be collected out of the regular schedule cycle. Figure 7-4 shows an example of an inaccessible set out identified during the Collection Operation Observations.

Figure 7-4: Example of Parked Car Blocking Brush and Bulky Item Set Out

- **Oversize set outs.** Set outs that are estimated to exceed 10 CY in volume are measured to determine the size of the set out. Figure 7-5 shows an example of a crew measuring an oversize set out with a yardstick and wheel.

Figure 7-5: Brush and Bulky Item Collection Crew Measuring Oversize Set Out

The dimensions of the set out are entered into a tablet-based software and the data is then confirmed by Sanitation Department staff. The collection crew collects the oversize set out and then leaves a blue tag indicating to the customer that their set out was oversized. Based on the Collection Operation Observations this process takes about 8-10 minutes in the field, as measuring and data entry are often slowed by network delays. A service request is then submitted, and the customer's utility account is charged. There is a two-step dispute process the customers may utilize through the City's 311 system. Anecdotally, collection crews report fewer oversize set outs; however, this does not necessarily result in an increase in collection efficiency due to the time required to measure and enter data for oversize set outs in the field. Tree trimmers and interior construction contractors hired by residential customers may leave material as a brush and bulky item set out and contribute to the high numbers of oversize set outs experienced in the field.

- **Quality control.** Supervisors in a pickup truck drive the routes to provide quality control and survey the route using a separate tablet-based software called Field Maps, an ArcGIS platform. The supervisor confirms any inaccessible set outs are still inaccessible and have been properly tagged, submitting a brush violation record using a software called Survey 123[70]. Any set outs that have become accessible are indicated and a crew is directed to service the set out if they are still within a one to two mile radius or as the daily operation allows.

- **Third-party collection contractors**. During surges of material that cause the brush and bulky item collection schedule to fall behind, the City hires third-party collection contractors known as "storm chasers" that service set outs and help City staff to catch up. Storm chasers charge on an hourly

[70] Further information on Survey 123 can be found at the following link: https://www.esri.com/en-us/arcgis/products/arcgis-survey123/overview?rsource=%2Fen-us%2Farcgis%2Fproducts%2Fsurvey123%2Foverview

basis anywhere between $150 - $250 per hour depending on the amount of equipment and personnel required.

7.1.3 Equipment and Personnel

Based on discussions with City staff as part of the Collection Operation Observations, deploying equipment effectively and providing adequate staffing is the most critical challenge to brush and bulky item collection. Although there is significant potential to increase diversion from disposal in this material stream by separately processing organics, achieving this is only possible if the City has the capacity to offer this type of service. Currently, collection crews are operating at capacity and fall behind when unanticipated events cause surges in service demand. Brush and bulky item collection operations utilize the following equipment configurations and personnel, provided with technical descriptions:

- **Rotoboom and brush truck/trailer(s).** One of the configurations of equipment and personnel for servicing brush and bulky item collection routes is a rotoboom and two brush trucks with 40 CY capacity. Based on the Collection Operation Observations, it takes approximately 45 minutes to one hour to fill a brush truck depending on the number of set outs, size of set outs and physical obstacles encountered on the route. Rotobooms and the majority of brush trucks are fueled by diesel and 13 of the City's brush trucks are fueled by CNG. The rotoboom and brush trucks travel alongside each other and the rotoboom uses a grapple to lift material into the brush trailer. When the first brush trailer is full, it leaves the route to dispose of the material at the Landfill or Bachman transfer station and the second brush truck takes its place to continue servicing set outs. Figure 7-6 shows an example of a rotoboom and long trucks servicing a brush and bulky item set out.

Figure 7-6: Rotoboom and Long Truck Collection

- **Rotocombo.** The other configuration of equipment and personnel for servicing brush and bulky item collection routes is a rotocombo. The City has both 28 CY and 60 CY capacity rotocombos. The 28 CY rotocombos are primarily used for Cost-Plus and Brush Buster collections. Rotocombos contain a grapple and bed to store collected material on one vehicle. Figure 7-7 shows a 60 CY rotocombo servicing a brush and bulky item set out.

Figure 7-7: 60 CY Rotocombo Collection

The larger 60 CY capacity rotocombos are able to collect more material before leaving the route to dispose at the transfer station or Landfill compared to the 28 CY capacity. Transfer station staff indicated that managing the material from the 60 CY rotocombos presents a challenge, where smaller front-end loaders are not able to manage material in one push

Table 7-6 presents the City's inventory of brush and bulky item collection vehicles and average age.

Table 7-6: Brush and Bulky Item Collection Vehicles[1]

Vehicle Type	Collection Vehicles[2]	Average Age
Rotoboom	30	3.7
Rotocombo[3]	15	4.8
Brush Truck	51	4.9
Brush Trailer	51	8.1
Total	**147**	

1. SA collection vehicles are utilized for brush and bulky item collection on Wednesdays and Saturdays, which is an off day for refuse and recycling collection but are not included in this evaluation since these are deployed on an as-needed basis. This analysis assumes there are sufficient pickup trucks available for supervisors to perform quality control tasks.
2. Total collection vehicles by type represents vehicle inventory data as of November 16, 2021.
3. Eight of the rotocombo vehicles are recently purchased 60 CY capacity. The remaining seven are older 28 CY capacity vehicles. One vehicle in each sanitation district is dedicated to providing Cost-Plus service.

Both rotoboom and brush truck/trailer and rotocombo equipment and crew configurations have benefits and drawbacks. Table 7-7 describes the staffing for each type of equipment configuration and a brief description of each equipment configuration's impact on collection efficiency.

Table 7-7: Staffing Requirement by Equipment Configuration[1]

Equipment Configuration	Staffing Requirement	Impact on Collection Efficiency
Rotoboom, Brush Truck/Trailer	1 Crew Leader 1 Rotoboom Driver 2 Brush Truck Drivers 1-2 Crew Member	Collection time per set out may be faster than rotocombo equipment configuration because more personnel allow crews to collect material quickly. Limited brush truck/trailer availability or delays in one brush truck/trailer returning to the route increases time to complete routes.
Rotocombo	1 Driver	One person can drive the vehicle and operate the grapple. This configuration suited to clearing large piles. Collection time per set out may be longer than rotoboom and brush truck/trailer configuration because driver exit the truck cab to operate the grapple, and then dismount the vehicle to organize small items together and sweep the set out clean at each set out.
SA Collection Vehicle	1 Driver 1 Crew Member	These vehicles are borrowed from refuse and recycling collection operations when available on Wednesdays and Saturdays. Manually loading brush and bulky item set outs is limited to items that a crew members can safely load into an SA collection vehicle. The configuration is suited to clearing small piles/items and limited when it comes to larger items that require more manpower or grapple equipment to manage.

A key capacity constraint in the brush and bulky item collection operation occurs if two brush trucks are not deployed with each rotoboom, or if one of the brush trucks gets delayed returning to the route. As an example, during the Collection Operations Observations there were two brush trucks initially deployed with a rotoboom vehicle; however, after the first brush truck/trailer was full and departed to disposal, the second brush truck/trailer became full before the first arrived back. There was approximately 30 minutes where the rotoboom could not continue servicing set outs until the first brush truck/trailer returned to the route.

Table 7-8 presents the number of FTE brush and bulky item collection positions filled and vacant.

Table 7-8: Current Brush and Bulky Item Collection Staffing[1]

Title/Job Function	FTE Positions Filled	FTE Positions Vacant	Total	Role
Field Supervisor	5	0	5	Supervisory position that manages collection operations both district-wide and on a route-by-route basis and performs quality control checks by driving routes that have been completed to ensure all set outs are serviced. When Field Supervisor is unavailable, crew leader steps in to perform daily duties.
Crew Leader	30	1	31	Manages crews on a route-by-route basis by riding with and operating rotoboom equipment and overseeing rotocombo routes.
Truck Driver[2]	71	11	82	Drives rotoboom, rotocombo or brush truck/trailer vehicles to service brush and bulky item routes.
Crew Member[3]	15	0	15	Crew members supports collection operations including managing small items as part of set outs..
Total Staff	**121**	**12**	**133**	

1. FTE Supervisors and Truck Drivers are based on organizational charts provided as of August 8, 2020. Managers oversee both refuse and recycling collection as well as brush and bulky item collection. Information about the current staffing of managers is provided in Appendix B.
2. Truck drivers do not include personnel borrowed from the refuse and recycling collection operation.
3. Crew members calculated based on FY 2020 contract labor costs for brush and bulky item collection service, excluding overtime costs.

The collection crews are deployed where Districts 2, 3, 4, and 5 have rotoboom configurations, with some rotocombos deployed on an as-needed basis. Districts 2, 3, and 5 typically utilize five rotobooms and ten brush trucks and District 4 utilizes six rotobooms and 12 brush trucks. District 1 typically requires ten rotocombo vehicles and uses these exclusively.

As described in Section 7.1.2, during times when there are surges in material and the City falls behind, crews struggle the operation experiences challenges deploying additional equipment to catch up on incomplete routes and service the regularly scheduled routes simultaneously. As the volume of materials set out increases, the City is unable to scale up the number of equipment and personnel deployed to meet

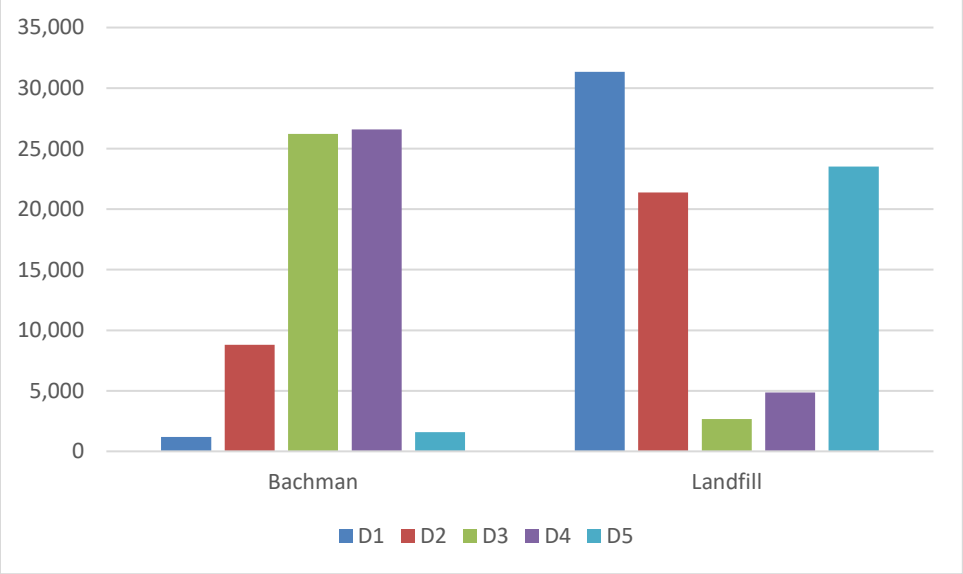
the increased service demand and is forced to pull refuse and recycling collection equipment and personnel on to brush and bulky item routes or hire third party contract collection crews to support brush and bulky item collection operations.

While SA collection vehicles can be used to collect brush and bulky items, material must be manually lifted into the vehicle and limits this equipment configuration to only collecting small set outs. Additionally, when there are challenges securing contract labor for refuse and recycling collection operations, these vehicles are unable to be used to support brush and bulky item collection operations.

7.1.4 Processing and Disposal

When material is collected, it is hauled to the transfer stations or directly to the Landfill. Figure 7-8 shows the average annual tons collected and delivered to Bachman and the Landfill by sanitation district between FY 2016 and FY 2020.

Figure 7-8: Average Annual Inbound Tons by Sanitation District and Facility FY 2016 - FY 2020



Incidental amounts from rear-load collection vehicles (on average about 1,000 tons per year) are accepted at Fair Oaks or Westmoreland, but these facilities are not regularly used to manage brush and bulky items since they are smaller transfer stations and are not configured to accept larger amounts or material from brush trucks. The majority of material is from District 3 and District 4 are delivered to Bachman and material from District 1, District 2 and District 5 are delivered directly to the Landfill.

Table 7-9 presents the annual tons, loads and average tons per load of brush and bulky items from FY 2020.

Table 7-9: FY 2020 Brush and Bulky Item Tons and Loads Disposed

Disposal Location	Tons	Loads	Avg. Tons per Load
Bachman	65,945	14,044	4.7
Fair Oaks	1,508	273	5.5
Westmoreland	271	42	6.5
Landfill	69,659	15,670	4.4
Total	**137,383**	**30,029**	**4.6**

Bachman has challenges managing brush and bulky items because it significantly decreases the ability of the transfer station to manage the refuse and recycling tonnage delivered, particularly during times when there are surges of material volume. Delivering material directly to the Landfill sometimes requires long wait times to scale in and dispose at the working face. When brush trucks are delayed returning from the Landfill and are not able to make it back to the route before the second brush truck is filled, the route must stop and wait before collections can resume.

7.2 Brush and Bulky Item Separation Pilot Program

This section provides information about the previous considerations regarding separate collection of brush and bulky item collection, the ongoing separate collection pilot program that began in October 2021 and preliminary results from the initial weeks of the pilot program.

Previously, Burns & McDonnell assisted the City in evaluating several potential scenarios to adjust service frequency to support separately collect brush and bulky items. Table 7-10 shows the potential scenarios that had been previously evaluated.

Table 7-10: Previously Evaluated Brush and Bulky Item Collection Frequency Scenarios[1]

Material Type	Existing System	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Brush	Monthly	Monthly	Twice per Year	Every Other Month	Monthly
Yard Trimmings			Monthly		
Bulky Items		Appointment-based	Twice per Year	Every Other Month	Quarterly

1. All collection frequency scenarios include the current volume limits, require use of bundles or paper/compostable bags for yard trimmings, prohibit material collected from private landscapers, and no collection of C&D material.

Sanitation Department staff conducted a set out survey in 2018 that indicated that 72 percent of brush and bulky item set outs contained some brush or yard waste, and 55 percent were brush-only set outs that could be diverted without further processing. City Council directed staff to implement a separately collected brush

and bulky pilot in October 2021. The pilot program was modeled after Scenario 4 to explore customer willingness and ability to separate material at the curb and the impact on operations to collect brush separately while reducing the frequency of bulky item collection to once per quarter.

The purpose of pilot was to support CECAP goals related to increasing diversion from disposal and explore an alternative method of providing brush and bulky item collection service to increase service efficiency. Six neighborhoods were selected to participate in a three-month Brush and Bulky Item Separation Pilot Program, from October through December 2021.

Each neighborhood represented approximately 800-1,000 homes, where each had distinct transportation challenges to disposal sites for collection crews to test. A community meeting was held in each neighborhood preceding the pilot to discuss any questions from residents. Residents in the pilot areas received monthly brush collection service during their regular collection week and bulky items were collected quarterly (e.g., only once during the three-month pilot period). Bulky items were collected the same week as brush collection but picked up using separate collection equipment so that would not be co-mingled with clean brush or yard waste. The total volume of set out each month remained limited to 10 cubic yards.

As part of the pilot, strategies for the post-collection handling of green waste during the pilot were evaluated including the capacity to keep separately collected materials segregated during processing from transfer stations to the Landfill. The intent of the pilot was to have clean brush material processed into mulch and be made available for their beneficial reuse at the Landfill and by other City departments, such as Parks and Recreation.

Table 7-11 lists the pilot areas with brief descriptions of the locations and provides images of bounds of each pilot area.

Table 7-11: Brush and Bulky Item Separation Pilot Program

Pilot Area	Description	Area Boundary
Oak Park North / Twin Oaks	Pilot area 1 was located in the southwest region of the City. Brush and yard trimming material was collected the first Monday of each month, and bulky items were collected in October 2021.	

Ledbetter Gardens / Westmoreland Heights	Pilot area 2 was located in the northwest region of the. Brush and yard trimming material was collected the third Monday of each month, and bulky items were collected in October 2021.	
Highland Hills	Pilot area 3 was located in the southeast region of the City. Brush and yard trimming material was collected the first Monday of each month, and bulky items were collected in November 2021.	
Pemberton/ Trinity Forest	Pilot area 2 was located in the southeast region of the City. Brush and yard trimming material was collected the second Monday of each month, and bulky items were collected in November 2021.	
Casa View Oaks	Pilot area 2 was located in the northeast region of the City. Brush and yard trimming material was collected the first Monday of each month, and bulky items were collected in December 2021.	

Schreiber Manor / Forestcrest Estates	Pilot area 2 was located in the northwest region of the City. Brush and yard trimming material was collected the third Monday of each month, and bulky items were collected in December 2021.	

Table 7-12 presents the number of households serviced in each pilot area and tons collected over the three month period. in each pilot area on its scheduled week for each month.

Table 7-12: Separate Brush and Bulky Item Collection Pilot Tons Collected by MonthResults[1]

Pilot Area	Household Count	Brush	Bulky Items	Total	Percentage of Brush
1	949	27.8	15.1	42.9	64.8%
2	917	41.1	18.0	59.1	69.5%
3	956	30.2	17.5	47.7	63.3%
4	913	82.3	23.3	105.6	77.9%
5	785	50.6	35.1	85.7	59.0%
6	806	54.6	9.0	63.6	85.8%
Total		286.6	118.0	404.6	70.8%

1. Results reflect tonnage collected over three-month trial period including.

Based on the tonnage of separately collected brush and bulky items throughout the three months of the pilot, the amount of brush and yard trimming material that makes up the commingled set outs ranged from 59.024 percent to 85.869 percent. The number of loads collected per pilot area each month ranged from one to nine. . Additionally, crews tracked the number of violations (e.g., brush and bulky items commingled when they should have been separated, or brush and bulky set out together when only brush was scheduled for collection). The number of violations fluctuated by week and pilot area, ranging from 2 to as much as 135 in a given week. As part of the pilot, notices were provided to residents and if the set out was corrected by the next day, the material was collected.

Pilot areas one through five were hauled directly to the Landfill, where bulky items were disposed and separately collected yard trimmings and brush were processed for volume reduction. Material collected from pilot area six was delivered to Bachman and transferred to the Landfill. Mid-way through the pilot,

the area where separately collected brush and bulky items were stored at Bachman became unavailable. At that point in the pilot, the material was co-mingled for transportation to Landfill.

From an operational perspective, the separate collection structure increased the number of equipment and personnel required to meet service demand. On the weeks where brush and bulky items were collected, multiple crews are deployed to separately collect material compared to the current service configuration where one crew can provide service for commingled set outs. If scaled City-wide, the service demand would increase due to the need to send additional crews to service brush and bulky item set outs simultaneously for customers that are scheduled to have both materials serviced that month.

7.3 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policy and/or program. Additionally, this section identifies any fundamental changes that have been made since related to programs, policies or forecasts as it relates to brush and bulky item collection.

Table 7-13 lists the recommendations from the 2011 LSWMP related to brush and bulky item collection with a brief description of progress to date and next steps as part of the LSWMP Update.

Table 7-13: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress To Date	Potential Next Steps
Provide separate collection for organics.	This recommendation includes separate collection brush and yard trimmings from residential customers for processing and diversion. City staff has presented several options for implementing separate collection of brush and bulky items to City Council since the 2011 LWMP.	The Brush and Bulky Item Separation Pilot Program concluded in December 2021. Data gathered as part of the pilot will inform the evaluation of the LSWMP Update and next steps for collection operations as it evaluates the feasibility of scaling separate collection of brush and bulky items City-wide.
Provide bulky item reuse and recycling.	One of the options presented to City Council was the consideration of an appointment-based collection program for bulky items. This program was not included in the Brush and Bulky Item Separation Pilot Program. Bulky items are currently commingled with brush and yard trimmings and there has been limited progress to date providing reuse and recycling of bulky items.	As the City considers the feasibility of scaling separate brush and bulky item collection City-wide, a key consideration is to identify opportunities to expand programmatic and infrastructure capabilities to reuse and/or recycling recycle of separately collected bulky items in the future at one or more transfer stations or Landfill.

Separate collection of organics, including brush generated by residential customers, was a critical milestone identified in the 2011 LSWMP required to be implemented to achieve the City's goal of Zero Waste and was also a key solid waste related goal in CECAP. Separate collection and processing of brush presents the most tangible opportunity to move the needle closer to Zero Waste. The timing and goals established in the 2011 LSWMP are not feasible without separately collecting and processing brush and providing an outlet for bulky item reuse and recycling. Further discussion about the impacts on diversion related to the separate collection and processing of brush and other organics is provided in Section 10.0.

7.4 Benchmarking

This section provides compares the City's brush and bulky item collection program to other programs in peer cities in Texas. This group of peer cities has been selected to show a mix of program types and sizes that are smaller and larger to the City's program to provide a range examples.

The following criteria on each peer city's brush and bulky item collection programs are provided below with brief descriptions:

- **Year.** Indicates the year that the benchmarking data represents, including if it is on a fiscal year (FY) or calendar year (CY) basis.
- **Households.** Represents the total households serviced as part of the benchmark collection program.
- **Service provider.** Indicates if collection service is provided by the municipality or a private sector contractor.
- **Service type.** Describes the type of service provided to residents including routed collection or appointment/scheduled service and if the material is collected on a separated or co-mingled basis.
- **Materials accepted.** Provides the materials that are accepted as part of the program.
- **Service frequency.** Describes the number of services provided to customers.
- **Prohibited materials and set out limits.** Identifies the materials prohibited and any limitations on the amount of material that can be set out by customers.
- **Pounds per household per year collected.** Indicates the amount of material collected and disposed on a pounds per household per year basis.
- **Disposal allowance.** The volume (CY) that is serviced on an annual basis. This represents the total volume that is provided as part of the program, not an estimate of the volume of material collected. Disposal allowance is calculated by multiplying the service frequency by the amount of material that is allowed to be set out per service.

Table 7-14: Brush and Bulky Item Collection Benchmarking

Benchmark Criteria	Dallas, TX	Austin, TX	San Antonio, TX	Fort Worth, TX	Houston, TX	Richardson, TX	El Paso, TX	Corpus Christi, TX
Year	FY 2020	FY 2019	FY 2021	CY 2020	CY 2019	FY 2021	CY 2021	FY 2019
Households	250,000	201,500	340,000	240,000	390,786	43,000	268,310	86,090
Service Provider	City of Dallas Sanitation Department	City of Austin Resource Recovery.	City of San Antonio Waste Management Department.	Waste Management.	City of Houston Solid Waste Management Department.	City of Richardson Public Services Department.	City of El Paso Environmental Services.	City of Corpus Christi Solid Waste Services.
Service type	Routed; co-mingled.	Routed; separated.	Routed; separated.	Routed; separated.	Routed; separated.	Appointment/scheduled; separated.	Fee-based appointment; co-mingled[8].	Routed; co-mingled and brush only collection.
Materials Accepted	Bulky items, brush, yard trimmings.	Bulky items, brush, yard trimmings, food waste.	Bulky items, brush, yard trimmings, food waste.	Bulky items, brush, yard trimmings.	Bulky items, brush, yard trimmings.	Bulky items, brush, yard trimmings.	Bulky items, brush, yard trimmings.	Bulky items, brush, yard trimmings.
Service frequency	Monthly brush and bulky item collection.	Semi-annual brush and bulky item collection. Weekly yard trimming collection.	Semi-annual brush and semi-annual bulky item collection.	Monthly brush and bulky item collection. Weekly yard trimming collection.	Brush and bulky items collected on alternating months.	Up to eight calls per year.	Unlimited.	Semi-annual brush and bulky item collection and semi-annual brush only collection.
Set out limits	10 CY	No set out limits but there are guidelines for brush set outs and strict requirements enforced related to separate set out of brush and bulky items and prohibited items.	8 CY	10 CY	8 CY of bulky items and 4 CY of building material.	C&D materials and remodeling debris is prohibited.	None.	No set out limits but enforcement fines assessed for prohibited items and bulky items set out outside of authorized bulky item collection schedule.
Disposal allowance (CY)[1]	30,000,000	18,538,000[2]	19,720,000[3]	35,040,000[4]	37,515,456[5]	17,200,000[7]	N/A[9]	15,496,200[10]
Pounds per household per year	1,099	544	514	732	1,625[6]	Brush and bulky collection and refuse tonnage are not tracked separately.	N/A	617

1. Disposal allowance is calculated by multiplying the total annual number of services provided per customer per year by the set out limits of each benchmark program.
2. Assumes the semi-annual brush and bulky item collection includes four total annual collections for this material and the maximum set out is 10 CY. Weekly yard trimmings and roll cart-based organics collection is assumed to have a maximum set out of 0.5 CY for the weekly service. Weekly yard trimmings collection is assumed to have a maximum of 0.5 CY for the weekly service.
3. Weekly yard trimmings are collected with roll cart based organics collection and is assumed to have a maximum set out of 0.5 CY for the weekly service.
4. Weekly yard trimmings are assumed to have a maximum set out of 0.5 CY for the weekly service.
5. Calculation assumes that maximum set out limit is 8 total CY, even though the set out limits specify residents are able to set out up to 8 CY of bulky items and 4 CY of building materials.
6. Figure includes brush, bulky and yard trimmings collected through residential drop off locations and transfer stations and shows a higher pounds per household per year collected compared to the other benchmark cities.
7. Richardson services customers with a 30 CY rotoboom vehicles and a 20 CY rear loader. Calculation assumes Richardson provides 50 CY of collection service up to 8 times per year per customer.
8. El Paso has a fee-based appointment-based program where residents are able to schedule brush and bulky item pickup for $35.00 for five CY and an additional $7.00 per CY after the first five.
9. El Paso allows for unlimited fee-based collection serviced by pickup trucks with a Grab-All attachment. The City collects approximately 14,000 CY of bulky items on an annual basis.
10. Corpus Christi uses 45 CY brush trucks for brush and bulky item collection, and brush only collection. Calculation assumes twice per year collection for brush and bulky items together, and twice per year brush only collection.

Austin and San Antonio offer cart-based food waste collection and yard trimmings are collected by this method. While Austin does not have quantitative set out limits, they take great effort to enforce their set out restrictions based on material type. If there are any prohibited items, the set out is not serviced. Both Austin and San Antonio have structured their programs to provide less disposal allowance annually and supplement brush and bulky item collection with weekly roll cart based organics collection. With these programs in place, Austin and San Antonio collect 500 – 550 pound per household per year.

The City is consistent with other benchmark cities on its set out limits but is the only city to collect material on a co-mingled basis without any other dedicated separated collection. Richardson and El Paso utilize an appointment-based call-in program, and while they are a smaller municipalities (which makes this type of system more manageable) their system allows them to create separate work order tickets based on material types allows them to generate a clean source-separate stream of brush, bulky items, and tree trimmings.

7.5 Options Evaluation

This section analyzes a series of options related to brush and bulky item collection that have been identified based on the results of the stakeholder engagement, evaluation of the recommendations from the 2011 LSWMP, and benchmarking comparison.

The following summarizes the key takeaways from the community survey and other outreach activities conducted as part of the LSWMP Update:

- 44 percent of the respondents indicated they were very satisfied with the frequency of brush and bulky item collection service. 85 percent were aware of changes being made to the program to implement set out limits at 10 CY and 95 percent of the respondents had not been charged a fee for oversize set outs.
- 53.9 percent of respondents indicated that they dispose of their yard trimmings through the brush and bulky item collection program, and 62 percent of respondents indicated they would be supportive of a brush and bulky item collection program that required residents to set out items separately. Additionally, 72 percent of residents indicated they would support a rate increase of more than $1.00 on their monthly bill to support this type of program.

Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Evaluate 10 CY set out limit.** Presents the options related to the current set out limits in place and evaluates the impacts of (1) staying with the current 10 CY set out limit or (2) reducing the set out limit to 8 CY to be more consistent with benchmark cities.
- **Adjust mix of collection equipment.** Describes the impact on personnel and equipment associated with the planned increase in number of rotocombo vehicles in the City's equipment fleet.
- **Implement separate brush and bulky item collection.** Evaluates the impact on equipment, staffing, equipment and processing capacity to implement separate brush and bulky item collection based on Scenario 1 and Scenario 3 (reference Table 7-10). Information and analysis presented as part of this option is based, in part, on the draft Evaluation of Collection Methods and Alternatives report.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 7.6 to support the key findings, recommendations and implementation and funding plan

7.5.1 Evaluate 10 CY Set Out Limit

Overview. Leveraging the City's 10 CY set out limit is an important step toward advancing the brush and bulky item collection program to decrease material disposed. Oversize set outs cause significant operational challenges and limit the ability to implement a separate brush and bulky items collection program because oversize set outs require longer to collect. In FY 2021, there were a total of 4,223 oversize set outs assessed a fee. For each of these set outs, collection crews measured and entered data about the set out so the fees could be justified and properly assessed. Based on the benchmarking, peer cities all have set out limits of 10 CY, 8 CY or enforce restrictions on materials that are set out. Among the benchmarked cities, the City followed only Houston in the amount of brush and bulky item materials on a per household per year basis and total collection service provided on CY per year basis[71]. Currently, the City provides residents with a high level of service based on the current set out limits and service frequency. If every customer put out the maximum 10 CY that they are allowed each month, the City would become overwhelmed and fall behind on collections.

Recycling potential. Leveraging the 10 CY set out limit and fee mechanism to influence customer behavior could support future programmatic changes to collect brush and bulky items separately, which would allow

[71] The 1,625 pounds per household per year collected by Houston is likely comparable to the City's 1,099 pounds per household per year because, due to data limitations, the pound per household figure presented for Houston is inclusive of both curbside collected material and drop off station material where none of the other benchmark cities include drop off station tonnage.

for clean brush to be regularly diverted. Further discussion on the diversion recycling potential of diverting brush as part of the brush and bulky item collection is provided in Section 10.0.

Operational impact. While the current procedure to measure and input data on oversize set outs takes more time in the field, the intended long-term impacts of the set out limits and fee structure is to change resident behavior to set out less material, require less data entry in the field, and ultimately reduce the number of incomplete brush and bulky item routes. Influencing customer behavior to minimize the number of oversize set outs and pounds per household per year to between 500 – 750 pounds per household per year would reduce the strain collection crews and supervisors and minimize staffing and equipment required to meet service demand. This would also reduce the need to pull resources from the refuse and recycling collection operation. If there is no reduction in the total number of oversize set outs or pound per household per year collected, the City could consider reducing the set out limits to 8 CY which would initially increase the number of oversize set outs, demand on collection crews to measure and log information, and total fees assessed; however, over time decreasing the set out limits could result in more effective behavior change because more residents would be assessed fees and educated about the program.

Financial impact. If the City is able to achieve behavior change over time, there would be less data entry requirements by brush and bulky item collection crews resulting in a reduction in the number of incomplete routes. There would be fewer instances when staff and equipment need to be pulled from refuse and recycling collection or the City has to hire a third-party collection services. With higher capacity to meet service demand and less need to rely on refuse and recycling resources or third-party contractors, the operation would realize positive financial benefit. The magnitude of this positive financial impact would depend on the amount of overtime and third-party contractor hours. Even if customer behavior changes to result in fewer oversize set outs and pound per household per year collected, in the event of a storm event or surge in material generation there will still be a need for additional resources to meet service demand above the typical staff and equipment. Hiring staff and buying equipment to meet the maximum service demand at times when material volumes are surging would cause the City to have excess equipment that would ultimately be unused during typical operations. Developing contingency plans and building a reserve fund over time could allow the City to hire a third-party collection service on an as -needed basis without purchasing equipment and hiring staff that would not be fully utilized during typical operations.

Environmental impact. Influencing behavior change to minimize the number of oversize set outs would reduce the number of vehicles that need to be deployed to complete routes. Incomplete routes require the City deploy more collection crews to service set outs and increase the emissions and road miles traveled by vehicles. Ultimately, the City is required to service all the set outs, but there are marginal environmental benefits to being able to complete routes using fewer vehicles.

Policy impact. There is minimal policy impact since the 10 CY set out limit and fee mechanism have been adopted. Any future adjustments to reduce the set out limits would require updating the City Code.

Stakeholder "buy-in". Decreasing the amount of brush and bulky item collection service may result in resistance from residents if it is perceived as a reduction in service levels.

Compatibility with existing programs. Maintaining the current 10 CY set out limits would be highly compatible with existing brush and bulky item collection program and reducing the set out limit to 8 CY represent a change but is still highly compatible.

7.5.2 Adjust Mix of Collection Equipment

Overview. Based on the current mix of equipment for brush and bulky item collection there are 30 rotoboom and 15 rotocombo vehicles, some of which are utilized for Cost-Plus and Brush Buster service. The City is planning to purchase up to 10 additional rotocombos at an estimated cost range of $210,000 - $230,000 to be deployed as part of brush and bulky item collections. When considering how to deploy these different vehicle types, the rotocombos are more effective at servicing larger set outs where rotobooms are more effective at servicing smaller set outs. Table 7-15 presents the tonnage generated per household per year by district.

Table 7-15: Average Tonnage Collected per Household per Year[1]

District	1	2	3	4	5
Average Tons Collected	32,528	30,292	28,937	32,226	25,157
Customers per District	46,481	54,378	38,741	59,067	49,159
Tons per Household per Year	1,400	1,114	1,494	1,091	1,023

1. Average annual tons collected between FY 2016 and FY 2020.

While the data would need to be refined on a more granular basis (e.g., incorporating a more detailed set out study and incorporating seasonality) before used to strategically deploy equipment types, this high-level evaluation provides an indication of the districts that have historically generated the highest volume on a per household basis.

Recycling potential. While adjusting the mix and deployment of collection equipment, the Sanitation Department could strategically increase the operational efficiency of the current operation and proactively develop the operational procedures and capability to implement separate collection of brush and bulky items in the future.

Operational impact. Table 7-16 presents the change in personnel and equipment requirement if 10 new 60 CY rotocombos would replace 10 existing rotoboom vehicle crews.

Table 7-16: Additional Rotoboom and Rotocombo Comparison

Description	Rotoboom	Rotocombo
Vehicles per Crew		
Rotoboom/Rotocombo	10	10
Brush Truck/Trailer[1]	20	0
Subtotal	**30**	**10**
Personnel		
Crew Leader[2]	10	0
Driver	30	10
Crew Member	20	0
Subtotal	**60**	**10**

1. Assumes each rotoboom crew includes two brush truck/trailers.
2. Assumes that a designated driver serves as crew leader on rotocombo routes.

Replacing the ten rotoboom crews with rotocombos on a one-to-one basis would free 50 FTEs to support other parts of the operation as- needed if they could be replaced on a one-to-one basis. Based on the collection efficiency of rotocombos in District 1, which is serviced entirely by rotocombos, meeting service demand requires approximately twice as many rotocomobos to collect the same amount of material as rotoboom crews. For this reason, transitioning the operation to use exclusively 60 CY rotocombos may not provide time or cost savings, but balancing the mix of vehicles to more strategically deploy equipment would provide the most effective use of resources.

Financial impact. Deploying 60 CY rotocombos to service areas with larger tonnage generation and rotobooms or SA collection vehicles to service areas with fewer tons generated would increase the efficiency of collection operations system. Considering SA collection vehicles to service areas with smaller set outs that can be serviced manually would allow the rotoboom or rotocomobos to focus on the collection of larger set outs may save the rotoboom and rotocombo crews time, increasing route efficiency and minimizing the number of unfinished routes. Over time, this would allow the Sanitation Department to reduce overtime burden and need to hire third-party contractors to realize a cost savings over time.

Environmental impact. The rotocombo crews only require 10 vehicles total, where the rotoboom crews require 30 vehicles that increases traffic on routes and in the long-term increases wear and tear on roads. However, rotoboom crews are able to collect four to five loads per day where rotocombo crews are only able to collect two. The magnitude of any emissions reductions is dependent on how well the City captures efficiency of deploying rotobooms and rotocombos to collection areas where set outs are more consistent with their strengths.

Policy impact. There is no policy impact related to adjusting the mix of equipment utilized for brush and bulky item collection service.

Stakeholder "buy-in". There are no impacts on stakeholder "buy-in" related to this option.

Compatibility with existing programs. Adjusting the mix of vehicles is compatible with the existing program but adjusting the strategy for deploying equipment may conflict with the existing programs if the current boundaries and resources of sanitation districts are changed to have rotocombos service areas with larger set outs and rotobooms or SA collection vehicles service areas with smaller set outs. This approach may require the use of additional on-board technology to adjust routes in-field or utilizing SA collection vehicles to run routes ahead of the rotoboom or rotocombos to identify large set outs and collect small set outs. Additionally, the transition would need to be coordinated with EFS to ensure that they have the capacity to service more 60 CY rotocombos.

7.5.3 Implement Separate Brush and Bulky Item Collection

Overview. Implementing separate brush and bulky item collection is critical to achieving the City's near-term recycling goals and long-term Zero Waste goals. Scenarios 1, 2, and 3 (reference Table 7-10) are evaluated as part of this option. Scenario 2 (weekly yard trimmings collection, monthly commingled brush and bulky item collection) and Scenario 4 (monthly yard trimmings/brush collection and quarterly separate bulky item collection) were evaluated based on the results of the pilot program, indicating the level of the commingled brush and bulky item collection on a monthly basis would not allow the City to maximize collection of organics and the quarterly collection of bulky items in Scenario 4 requires increased staff and equipment resources to service individual households with two separate crews. and may result in bulky item set outs being left at the curb for extended periods of time. Information and analysis presented as part of this option is based, in part, on the draft Evaluation of Collection Methods and Alternatives report. The following descriptions of Scenarios 1, 2 and 31 and Scenario 3 provide a high level overview of each option and relevant assumptions:

- **Scenario 1: Monthly brush collection and appointment-based bulky item collection.** This collection scenario would have City crews collect yard trimmings and brush from residents on a monthly basis, consistent with the current collection service and utilizing the same crew and equipment configurations. Residents would be instructed to set out only yard trimmings and brush on their current collection days and utilize a appointment-based service for bulky item collections, which would be collected using the same crew and equipment configuration of rotobooms with brush trucks and rotocombos depending on the type and size of material being collected.

Appointments would be scheduled, and routes generated, but routed based on the number, and location, and type of material of call-ins. There would be a violation assessed for set outs that were commingled with bulky items and assumes that two to four collections per year would be provided to residents as part of their base residential rate, with additional collections charged an additional fee.

- **Scenario 2: Monthly trimmings collection and alternating quarterly brush and bulky item collection.** This collection scenario would have City crews collect yard trimmings on a monthly or weekly basis, and brush and bulky item collection on an alternating quarterly basis. Separated yard trimmings would be collected by a combination of SA collection vehicles, rotobooms with brush trucks and rotocombos. This scenario provides the flexibility for the City to increase frequency of yard trimming collection from monthly to weekly and residents would be instructed to set out brush or bulky items on an alternating basis once per quarter. Violations would be assessed for set outs that were commingled, or if the wrong material were set out.
- **Scenario 3: Every other month brush collection and every other month bulky item collection.** This collection scenario would have City crews collect yard trimmings and brush from residents on a monthly basis, and bulky items on an alternating monthly basis. Material would be collected utilizing the same crew and equipment configurations, and violations would be assessed for set outs that were commingled, or if the wrong material were set out.

Recycling potential. There is a high recycling potential for all three scenarios based on separate collection of brush and yard trimmings. Between the three, there is a similar amount of yard trimmings and brush that would be separately collected, but Scenarios 1 has higher recycling potential because the appointment-based bulk program would minimize the number of bulky items set out for disposal (assuming that requirements for appointment-based collection would change behavior of residents compared to routed collection). Additionally, Scenario 1and provides greater opportunity to recycle or reuse bulky items. Additionally, Scenarios 1 and 2 positions the City to adjust service frequency to weekly yard waste and brush collection over time in conjunction with potential adjustments to the service frequency of refuse and recycling collection. Further discussion of adjustments to the service frequency of refuse and recycling service is provided in Section 6.0.

Operational impact. The collection operation of Scenarios 1 and 2 would require include a rear loader, rotoboom and two brush trucks to service yard trimming and brush set outs. The appointment-based call in bulky item collection routes of Scenario 1 would require include one rotocombo combo boom and one brush truck/trailer (assuming the rotocombo boom would stay on route throughout the day and the brush

truck would make several trips for processing and disposal). Scenario 3 would require the same crew and equipment configuration as the yard trimming and brush routes of Scenario 1 (rear loader, rotoboom and two brush trucks). While each scenario would meet the service demand from a collection perspective, there is currently no viable outlet to deliver separate yard trimmings and brush on a separated basis, as demonstrated during the recent pilot project. Although there is brush grinding ongoing at the Landfill, if the estimated 68,000 tons of separately collected yard trimmings and brush (reference Section 10.0, Table 10-3) would likely exceed the processing capacity and storage space available as part of the current brush grinding operation. Scenario 3 presents a challenge based on the increased volume of yard trimmings and brush generated in the summer and fall seasons that could be left at the curb would require residents to store high volumes of material between every other month service. Additionally, the City would be responsible for the marketing and sales of processed material, which would present a key bottleneck in the operation if the product were not able to be screened and marketed to City Departments or sold.

Financial impact. Both Each scenarios would allow the City to operate with similar crew and equipment configuration. The draft Evaluation of Collection Methods and Alternatives indicated there are opportunities for cost savings as part of collection service for all scenarios compared to the current system once they are fully implemented and does not include costs associated with the public education campaigns required to educate customers on program changes. Scenario 2 presented the highest level of potential cost savings at 20.3 percent, followed by Scenario 1 at 14.5 percent and Scenario 3 at 11.5 percent.in both Scenario 1 and Scenario 3 ranging from 11.5 to 14.5 percent[72]. The call-in bulky item collection as part of Scenario 1 is assumed to provide more cost savings because restructuring the program would reduce the amount of material that the City would collect as part of the base rates. Overall, separately collecting and processing yard trimmings and brush would result in a cost increase because processing and marketing yard trimmings and brush and identifying outlets for bulky items to be reused or recycled would be higher than the cost of managing the material by simply disposing.

Environmental impact. If the crew and equipment configurations for Scenario 1 and Scenario 3each Scenario are able to meet service demand without increasing the number of vehicles required, separately collecting and processing yard trimmings and brush and reusing or recycling bulky items would result in beneficial environmental impacts due to avoided disposal.

Policy impact. There would be a significant policy impact to both all scenarios, where the City's Code of Ordinances would need to be updated to implement the changes in residential service frequency and

[72] The draft Evaluation of Collection Methods and Alternatives assumed there would be no assistance from residential collection operation and would operate on a four day per week, 10-hour per day collection schedule. The cost savings figures provided are provided to indicate cost saving potential on a percentage basis, and do not reflect an updated evaluation based on the current equipment and staffing.

adjustments to the definition of brush, yard trimmings and bulky items to identify them as separate items and omit containerized trash and cardboard from accepted bulky items. Additionally, replacing the current service with a bulky item appointment-based program may cause increased illegal dumping or instances of uncollected piles left at the curb without significant education, outreach and compliance efforts.

Stakeholder "buy-in". The changes to the program structure would have high stakeholder "buy-in" from environmental advocates because the City must implement separate brush and bulky item collection to achieve its near-term goals and long-term Zero Waste goal. There would be less stakeholder "buy-in" from operational staff since there is already challenges meeting service demand during surges of material, insufficient capacity at the transfer stations to manage these materials separately and no existing processing capacity to recycle separately collected brush and yard trimmings. Additionally, changes to the collection days or set out instructions may increase complaints from residential customers and there would be low "buy-in" if residents perceive adjustments to collection programs as a reduction in service.

Compatibility with existing programs. There is low compatibility with the existing programs because of the significant changes to the collection frequency and set out instructions. Additionally, the City would need to adjust the Cost-Plus program to support the bulky item appointment-based collection service as part of Scenario 1.

7.6 Key Findings and Recommendations

This section presents the key findings and recommendations related to program and policy approaches increasing the effectiveness of the City's brush and bulky item collection program based on the results of the overview, evaluation of case studies, benchmarking and stakeholder engagement. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Further description of the criteria is provided in Section 1.4.3. Table 7-17 shows the summary of refuse and recycling collection options evaluation.

Table 7-17: Summary of Brush and Bulky Item Collection Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Evaluate 10 CY Set Out Limit							
Maintain existing 10 CY set out limit and continue in-field data collection and fee assessment as currently established.	●	●	●	●	●	●	●
Reduce the threshold that defines oversized set outs to 8 CY consistent with benchmark cities.	●	▲	●	●	▲	▲	●
Adjust Mix of Collection Equipment							
Purchase 10 additional 60 CY rotocombo vehicles to support collection operations.	●	●	●	▲	●	●	●
Deploy rotocombos in areas with larger set outs where rotocombos and/or SA collection vehicles in areas with smaller set outs.	●	▲	▲	●	●	●	▲
Implement Separate Brush and Bulky Item Collection							
Implement Scenario 1 collection service with monthly yard trimming and brush collection and appointment-based bulky item collection.	●	▲	●	●	■	▲	■
Implement Scenario 2 with separated monthly yard trimming collection and alternating quarterly brush and bulky item collection.	●	▲	●	●	■	▲	▲
Implement Scenario 3 with separated collection of brush and bulky items on an every other month basis.	▲	▲	●	●	■	▲	▲

7.6.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **The 10 CY set out limit and fee assessment support brush and bulky item collection program development.** In FY 2021 the average oversized set out in FY 2021 was approximately 26 CY and was assessed an average charge of $191 per invoice.
2. **Material is collected and delivered to Bachman and the Landfill.** The majority of material is from District 3 and District 4 are delivered to Bachman and material from District 1, District 2 and District 5 are delivered directly to the Landfill.
3. **The City provides a high level of service compared to benchmark cities.** The City provides each 120 about 30,000,000 CY of brush and bulky item collection service annually to each customer annually. This is about double the amount of annual service that Austin and San Antonio provide (92 and 58 CY, respectively) on a CY basis provided by benchmark cities that collect brush and bulky items separately, less frequently, or on an appointment-based schedule.
4. **The City collects material on commingled basis, resulting in a higher pounds per household per year basis compared to benchmark cities.** The City collects about 1,099 pounds per household per year compared to other benchmark cities in the 500-750 pound per household per year range because they collect brush and bulky items separately, less frequently, or on an appointment basis.
5. **There are opportunities to more strategically deploy vehicle types to service areas with set outs they are best equipped to service.** Rotocombos are best equipped to service larger set outs and rotobooms or SA collection vehicles to areas with smaller set outs. Deploying vehicles in the manner would increase the efficiency of the brush and bulky item collection program.
6. **One-person collection crews on rotocomobos cause bottleneck in operations.** The current one-person collection crew on rotocombo vehicles is sufficient to meet service demand, but does not provide redundancy when an operator is out. If the crew leader is not available, the collection for that area is not able to proceed.
7. **Cost-Plus service is not widely used by residential customers.** The Cost-Plus service was requested 730 times in FY 2021. This may be a result of the ability for residents to commingle brush and bulky items under the current program and the Clean Curb initiative where crews collect any materials set out and apply applicable violations and fees if the set out includes prohibited items.
8. **Separated brush and bulky item collection pilot revealed key challenges with monthly brush and quarterly bulky item service frequency.** The resources required to service brush and bulky

items separately on weeks when material was set out in two separate piles by customers resulted in high numbers of violations (e.g., not adhering to the guidelines of the pilot) and required two crews to service the same customer location. Additionally, halfway through the pilot the space at Bachman was no longer available and material collected in the northern areas of the City could not be separately managed and transferred for processing and disposal.

7.6.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Maintain 10 CY set out limits.** The 10 CY set out limit and fee assessment support brush and bulky item collection program development and should be maintained in the near term. As a longer-term consideration, the City could decrease the set out limit to 8 CY to be more consistent with benchmark cities but should only do that if over time it becomes clear that the 10 CY set out limits are not effectively resulting in decreased oversized set outs.
2. **Deploy brush and bulky item collection equipment based on set out patterns.** The Sanitation Department should deploy the larger rotocombo vehicles to areas of the City that generally have the largest set outs and fewer individual or smaller items. The rotoboom crews should be deployed to areas with smaller items given the strengths of each particular equipment type. Support the decisions for deployment by conducting a multi-season set out study to identify collection areas that set out larger set outs and take this approach with any future appointment-based system that is implemented.
3. **Pilot two-person crew for rotocombo equipment.** In addition to deploying crews based on set out patterns, the City should pilot two-person crews in rotocombo, especially in collection areas with high route density.
4. **Increase capacity for managing brush and bulky items separately at Bachman and the Landfill.** Brush and bulky items currently commingled and cannot be hauled separately. Additionally, there is no dedicated areas at Bachman or the Landfill to separately store and transport brush and bulky items even if they were collected separately. Increasing the capacity to manage these materials separately in the near term is a key next step to advancing the City's brush and bulky item collection program and making progress toward the goals established in the 2011 LSWMP.
5. **Implement monthly yard trimmings and brush collection and appointment-based brush and bulky item collection service, contingent on applicable changes to other material management programs.** The City should implement a variation of Scenario 1 to scale separated brush and bulky

item collection, assuming that these program changes are compatible with any adjustments to the refuse and recycling collection program (e.g., transitioning from 4-10's to 5-8's) and the transfer station system is upgraded to manage brush and yard trimmings on a separated basis. To implement the appointment-based bulky item collection, the City should leverage the existing Cost-Plus program to provide appointment-based bulky item collection offering customers two four total free collections per year (either brush or bulky items, but not commingled) and charging fees per collection after each customer request beyond two four per year (consistent with the current minimum $50.00 fee for Cost-Plus service, subject to increase based on load inspection).

6. **Streamline compliance tools to support transition to appointment-based brush and bulky item collection and implement bulky item reuse or recycling program.** To implement brush and bulky item collection on an appointment basis, the City should streamline the various software platforms (e.g., Re-Collect, Survey123, Field Maps, etc.) by integrating with a platform that could receive bulky item collection requests via user-friendly interface, generate route sheets and have the capability to track violations and any compliance mechanisms implemented to support the program. Additionally, separately collected bulky items present the opportunity for reuse and recycling and the City should develop programs to identify products or materials that could be reused or recycled before disposal at the Landfill.

8.0 LANDFILL

The Landfill is critical to the long-term material management needs of the City and the revenue from the operations supports the capabilities of the services offered by the Sanitation Department. While the Landfill generates significant quantities of greenhouse gasses, the robust gas collection system diverts the potential emissions to a processing facility for sale and minimizes the impact on the local emissions inventory.

Additionally, maximizing the life of the Landfill is critical to for the City to provide the financial means to support current and future efforts to reach its Zero Waste goals. Although it may appear counterintuitive that ownership and operation of a disposal facility would be essential to the Zero Waste effort, the direct control over disposal provides the City strategic advantages to implement essential programs, policies and infrastructure to increase the recycling rate and make meaningful progress toward Zero Waste.

8.1 Current System Review

The Landfill manages a high tonnage and volume of daily customers. The City owns and operates the Landfill, located at 5100 Youngblood Road just north of the intersection of Interstates 45 and 20. The Landfill has a permitted boundary of 965 acres with a waste disposal footprint of 877 acres. There is approximately 70,713,556 CY of remaining airspace in the constructed and unconstructed areas of the Landfill (excluding final cover) based on the airspace analysis conducted October 2021. The Landfill accepts and processes an average of 6,400 tons of waste per day during a six-day work week and processes a range of 1,400 to 1,600 loads per day. The Landfill services cash customers, Sanitation Department, Commercial and discount accounts and City departments. The Landfill is administered as an enterprise fund.

As part of the LSWMP Update, a full working day of operations were observed including a review of key daily activities and discussions with Landfill staff and management. The following lists key challenges identified by Landfill staff and management:

- Management relies on overtime and has challenges approving time off for staff when requested due to the staffing demands of the facility.
- The shift to maintaining transfer trucks and trailers at the heavy shop has decreased the availability to maintain Landfill operating equipment.
- Manual data entry and point-of-sale transaction requirements at the Youngblood Scalehouse create long lines and high wait times at the Landfill, especially during surges of material.
- Traffic control personnel at the working face struggle to separate self-haul customers from Sanitation Department customers to minimize wait times.

- The configuration of the working face is space constrained and creates challenges operating safely and efficiently.
- The time required to conduct opening and closing procedures at the Landfill exceed an hour and exacerbate the challenges with long working days and overtime demand.
- Landfill slopes are not constructed to convey water to downchutes, and final cover has not been applied to completed cells causing challenges with effective stormwater management and rising volumes of leachate.
- Ancillary site infrastructure (CCC, administration building, etc.) are located within the disposal footprint and minimize the site life of the Landfill.

Further detailed information and analysis related to these challenges are provided in Appendix E. The following benchmarking and options evaluation present tactics to overcome the identified operational challenges and support the City's recycling goals.

8.2 Evaluation of 2011 LWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or programs. Additionally, this section identifies any fundamental changes that have been implemented related to programs, policies or forecasts as it relates to the Landfill.

Table 8-1 lists the recommendations from the 2011 LSWMP related to the Landfill with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 8-1: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress to date	Potential Next Steps
Assess methods to optimize the available disposal capacity.	Use of Enhanced Leachate Recirculation (ELR) for increased biodegradation.	Consider employing ELR in the future to further maximize biodegradation and maximize use of available capacity.
Continually assess the need for new waste disposal capacity.	Preliminary estimates show Landfill gained two years of life since 2011 LSWMP even with growing tonnage disposed.	Evaluate approaches to maximize capacity and potential long-term options for new disposal capacity.
Cooperate with neighboring municipalities that need disposal capacity.	City allows peer municipalities to dispose at the Landfill.	Explore incentivizing recycling/diversion through Landfill pricing structure.

Develop a Resource Recovery Park at Landfill: composting, expanded CCC, recycling processing.	Implemented FCC MRF in 2018 through a successful PPP.	Evaluate CCC expansion and composting operation at Landfill.
Develop Mixed Materials Processing Facility.	Resource Recovery Planning and Implementation Study evaluation indicated mixed waste processing was not the most cost effective processing infrastructure at the time.	Although this type of facility may be a future consideration as the City continues toward Zero Waste, it is not advancing this concept since the FCC MRF has been installed.

In the 2011 LSWMP the future Landfill life was projected using a sensitivity analysis to show various scenarios. The 2011 LSWMP results projected there would be 79,459,156 CY of remaining airspace in 2020; however, the actual available airspace of the Landfill in FY 2020 was 74,864,468 CY, about 4.5 million CY less than projected. The 2011 LSWMP estimated that the Landfill would reach capacity in 2053[73]. Even with 4.5 million fewer CY available compared to the 2011 LSWMP projections, the most recent annual report submitted to TCEQ estimates the Landfill will reach capacity in 2055. Achieving a longer useful life with less available airspace indicates the City has successfully increased operating efficiency or achieved high rates of biodegradation and settling.

The City will need to establish organics processing capacity to be in a position to achieve the goals for organic waste recycling and landfill reduction in the time frame established by CECAP. Evaluation performed as part of the 2011 LSWMP identified area within the disposal footprint (Cells 8 through 14) to be used for a City-operated composting facility; however, doing so limits the City's ability to maximize existing airspace for future disposal needs.

8.3 Benchmarking

This section benchmarks key components of landfill operations that have been incorporated by peer municipalities or private sector operators related to increasing the operational efficiency and meet long-term planning needs. The following sections provide perspective about the following topics, including select case studies, and is organized as follows:

- Landfill Operations
- Organics diversion
- Pricing strategy

[73] The 2011 LSWMP Waste Quantity Projections Technical Memo estimates the Landfill reaching capacity in the year 2053 assuming all the waste currently going to the Landfill will continue based on only the current users of the facility.

8.3.1 Landfill Operations

The Landfill's AUF is key to understanding how well waste disposal is being managed to conserve airspace. It is a critical component of projecting remaining Landfill life and planning for future cell constructions and closures. The average historical annual AUF for the Landfill based on data reported to TCEQ is approximately 1,600 pounds per cubic yard (lb/CY). Appendix E includes additional detail on the Landfill's AUF including annual factors presented in Table E-2. Based on industry experience, an AUF of greater than 1,400 lbs/CY is achievable if the staffing and equipment is deployed strategically. The City is currently exceeding this based on the report submitted to TCEQ. The City's performance also exceeds the average AUF for Type I landfills in the North Central Texas region, which averaged 1,375 lb/CY in 2020 based on information reported to TCEQ as part of annual reporting.

Landfill gas generated at the site is managed for beneficial use through a contract with Dallas Clean Energy McCommas Bluff, LLC (DCEMB) to upgrade landfill gas for pipeline injection. The City's contract with DCEMB is further described in Appendix E. Based on analysis of data from U.S. EPA, approximately 27 percent of landfills in the U.S. have landfill gas capture and collection systems (GCCS), with end uses ranging from electricity generation to combined heat and power (CHP) generation and natural gas vehicle fuel or pipeline injection.[74] Beneficial use systems are less common in the public sector (with 19 percent of landfills having a beneficial use system installed), and the City's partnership with DCEMB represents a high level of performance to capture environmental and financial value from landfill gas.

There are 29 landfill gas beneficial use projects in the state, and the City's is the largest in the North Central Texas region. The City's 12.5 percent revenue share is higher than other high-BTU landfill gas contracts in the area, which range from 3-12 percent of the gross revenue stream (e.g., landfill gas and constituent product gas sales and all related environmental credits). Efforts to divert organics from landfill may reduce landfill gas production and, in turn, the revenue to be shared by DCEMB and the City. The impacts of organics diversion from landfill are discussed in more detail in Section 8.3.2.

8.3.2 Organics Diversion

Diverting organics from diversion is an important consideration for the City to progress toward its long-term Zero Waste goals, but requires consideration of multiple operational impacts including:

[74] Analysis of LMOP and GHGRP Subpart HH databases performed by EREF.

- **Reduced gas generation.**[75] Degradable organic carbon, such as that in food waste and yard trimmings, results in the production of landfill gas. Food waste is responsible for 20-30 percent of methane yield (similar to that of various paper grades) and food waste diversion can impact methane production and yield curve noticeably for future cells. Yard trimmings are responsible for a relatively small portion of methane yield, and therefore diversion of yard trimmings typically has a minor impact on methane production and yield curve. However, it is unlikely that a large portion of methane from food waste will be captured due to the typical delayed timing of GCCS installation.

- **Decreased methane emissions.** Food waste degrades quickly in a landfill, and one quarter of methane may be produced in the first two years after disposal. During this time a GCCS is typically not yet installed because there has not been enough time for a critical mass of landfill gas to be generated. By reducing food waste disposal, these uncollected methane emissions from future cells are reduced.

- **Decreased settlement and increased landfill stability.**[76] Food waste diversion can result in enhanced internal stability within the landfill by reducing the amount of combustible material compared to inert waste materials.

- **Potential airspace savings.** Organics comprise a large portion of landfilled wastes, and diversion of materials provides airspace savings, extending the life of the landfill.

- **Leachate impacts.** Food waste diversion, specifically of protein food wastes, can significantly reduce leachate ammonia and UV absorbance. As a result, leachate treatment can be easier and potentially less expensive. Although the Dallas Southside WWTP has capacity to receive leachate quality, alternative treatment options should continue to be a long-term consideration as industrial wastewater sources including landfills may fall under increased scrutiny in the future.

Given the City's and DCEMB's investment in the Landfill's GCCS, a 10-15 percent drop in landfill gas production should be anticipated if a comprehensive food waste diversion program across all generator sectors is implemented. Based on analysis performed by the Environmental Research & Education Foundation (EREF),[77] aggressive diversion and organics policies enacted in San Francisco beginning in

[75] Based on studies on the composition of landfilled streams and the estimated resulting methane yield curves published in De la Crus & Barlaz (2010). *Environ. Sci. Tecnhol.* 44:4722-4728; Staley & Barlaz (2009). *ASCE Journal of Environ. Eng.* 135:901-909.
[76] Based on research published by Bareither et al. 2012
[77] "Trends in Beneficial Use of Landfill Gas & Potential Impacts of Organics Diversion" EREF presentation at 2014 SWANApalooza.

2001 resulted in a 16.8 percent decrease in landfill gas collection at the Altamont Landfill compared to a 3.3 percent decrease over the same period in nearby Scholl Canyon Landfill which was not subject to San Francisco diversion impacts.

8.3.3 Pricing Strategy

The City's current posted gate rate is $34.88 per ton for non-residents. Additional fees (as applicable) include fees for cash customer processing ($2.00/ton), uncovered loads ($10.00/load), tipper use ($91.50/load), and pull-offs ($48.80/load).

The City has implemented a discount structure for customers based on the guaranteed annual tonnage and contract length (see Appendix E, Table E-4). While some communities (such as the City) utilize a set discount structure or matrix to determine the percentage discount a customer receives, there are others in the North Texas region that opt to negotiate discount rates and on a case-by-case basis. A benefit of set discount structures formalized through ordinance is that they provide transparency; however, formalized structures introduce the potential to lose customers who are on the upper threshold of a pricing tier and cannot receive or negotiate a better rate. Additionally, unless expressly included in the ordinance, formalized rate structures can limit the ability to negotiate one-time discount contracts for desired large loads. Table 8-2 summarizes the City's approach to pricing and discount structure at the Landfill and provides regional perspective based on other landfills in the NCTCOG region.

Table 8-2: City Landfill Pricing Summary and Regional Perspective

McCommas Bluff Landfill		Regional Perspective
Rates and Fees		
Gate Rate	$34.88	Publicly-available posted gate rates range from $30 to $63 per ton at landfills in NCTCOG, with an average of $40.79 per ton. The City has the third lowest gate rate per ton in the NCTCOG region.
Resident Rate	Free	Within the NCTCOG, landfills may provide free disposal to residents on a limited (e.g., once per month) or unlimited basis. Other landfills charge a residential tip fee that reflects a discount from the posted gate rate.

McCommas Bluff Landfill		Regional Perspective
Fees	Unsecured Load: $10.00 Cash customer: $2.00/ton Tipper: $91.50 Pull-offs: $48.80	Other landfills in NCTCOG have similar fees for items such as unsecured loads, tipper use, pull-offs to off-set incurred costs or reduce issues such as litter. Additional fees at other NCTCOG landfills that may be appropriate for the City to consider include: • A fee for manual unload vehicles at the working face • A non-city landfill environmental fee to equalize the financial burden on rate payers to support long-term closure and post-closure costs.
Discount Contracts		
Contract Length	1-5 years	Some cities in NCTCOG (e.g., Garland) have historically renegotiated contracts every year rather than utilizing multi-year contract, while others (e.g., Denton) use a fixed-length multi-year contract and renegotiate all contracts in the same year. Multi-year contracts provide some predictability in budgets for both the city and the customer.
Guaranteed Tons per Year	Ranges from approximately 5,000-over 200,000 tons per year per contract	Recently, the City added a discount levels smaller contracts (5,000 to 9,999 tons per year). Within the region there are Cities that offer discount contracts for even smaller quantities (e.g., 2,000 tons per year).
Available Discounted Rates	Approximately $21-$31 per ton	The City's discounted rates are within the range of other discounts in the region, which are generally in the mid-$20 per ton range up to possibly $50 per ton depending on location in the Dallas-Fort Worth Metroplex. Lowest price is not the only factor in rate competitiveness; haulers also report that considerations such as distance, use of toll roads, travel time and turnaround time affect disposal contract decision-making.

The City's rates do not include a disposal surcharge, such as a landfill environmental fee or impact fee. Disposal surcharges can generate funding to support long-term landfill management as well as encourage diversion and help recycling to be more cost competitive. Disposal surcharges may be enacted at the state and/or local level.

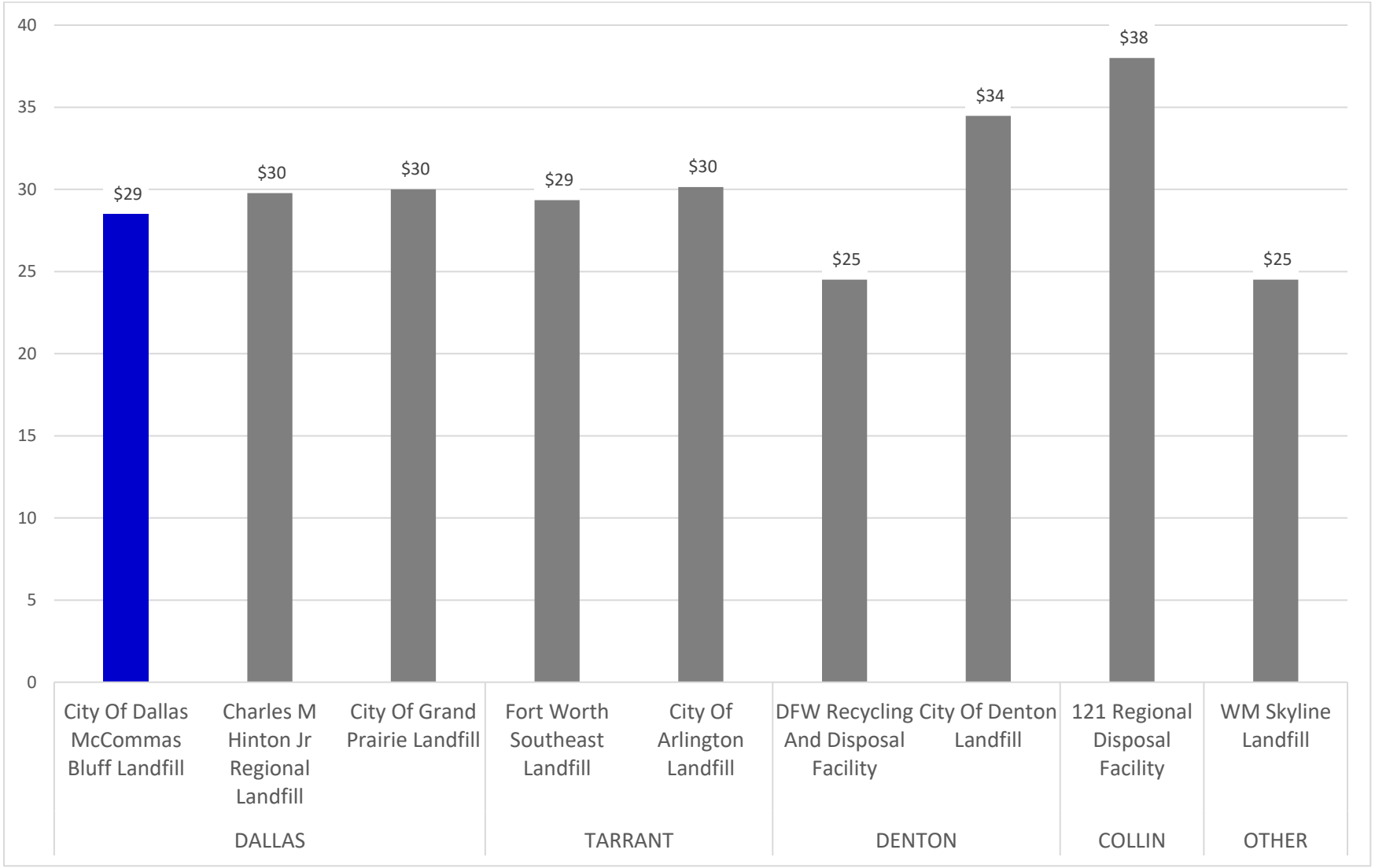
Case Study: City of Fort Worth. The City of Fort Worth's "Non-City Landfill Environmental Fee" (Ordinance 24533-11-2020) was adopted November 17, 2020 and became effective January 1, 2021. The fee adds $5.00 per ton of landfill environmental fee collected with the tipping fee at the Southeast Landfill. Prior to fee enactment, residents and permitted haulers contributed financially to the costs of the solid waste

disposal program through residential rates or permit fees; however, haulers disposing of non-city material did not contribute in a similar manner. Objectives of the Fort Worth's environmental fee include to preserving the remaining capacity for Fort Worth-generated materials and to equitably distribute the financial burden of responsible solid waste management among all users of the landfill.

Case Study: Lyon County, MN. The County operates both a MSW landfill and a construction and demolition debris C&D landfill with the MSW landfill serving an eight-county region. As part of the Minnesota Pollution Control Agency permit, the County is required to maintain a financial assurance fund to pay for closure, post-closure, and contingency action activities that are not covered by the operating budget. Beginning in 2005, the County implemented a $2 per ton Financial Assurance Solid Waste Surcharge to support this fund. The fee applies for both MSW and C&D loads received at the landfills.

Regional Market. Figure 8-1 shows the average rate charged at landfills in the vicinity of the Landfill based on information reported to the TCEQ, which ranged from $25-38 per ton. This facility-reported information differs from the posted gate rate, reflecting factors such as discount structures and/or additional fees. Based on the reported average rate, pricing at the Landfill is in line with the local disposal market. In recent years, the City has implemented price increases with little to no business falloff and the market can likely support continued increases in the City's landfill rates without driving significant tonnage to other landfills in Dallas County or the broader North Texas region.

Figure 8-1: Reported Average Gate Rates Charged in the NCTCOG Region (2020)[1]



[1]Average gate rate charged are as reported to the TCEQ as part of 2020 annual MSW reports

8.4 Options Evaluation

This section analyzes a series of options related to the Landfill that have been identified based on site visits of the Landfill, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and benchmarking.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Maximize site life and maintain sufficient revenues within currently permitted disposal footprint.** Describes pricing considerations to generate sufficient revenues and maximize site life within the currently permitted disposal footprint.
- **Divert self-haul customers from working face.** Describes approaches to divert small self-haul customers from the working face and evaluates the opportunity to develop an expanded CCC outside the permitted limits of waste.
- **Increase organics processing capacity.** Describes options and considerations for the Landfill to support organics diversion initiatives.
- **Develop long-term Landfill master plan.** Describes the capital improvements and operational planning the City could include in a long-term Landfill master planning effort.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 8.5 to support the key findings, recommendations and implementation and funding plan

8.4.1 Maximize Site Life and Maintain Sufficient Revenues

Overview. Maximizing site life will become increasingly important as there will be an increased demand for disposal as population grows in the region and the amount of available airspace decreases as facilities close or divert material. This option considers adjustments to the current pricing at the Landfill to balance the rate that site life decreases and revenue generated from various customer types utilizing the following tactics:

- **Increase operating efficiency.** There are opportunities to further maximize site life through continued operational improvements such as increasing the permitted size of the working face (permit modification currently in progress), filling staffing vacancies, deploying technology such as GPS integration in dozers for elevations and fill planning or drone use for LFG monitoring,

expanding to 24-hour operations to receive transfer loads at night, or maintaining the option for leachate and condensate recirculation when needed and as appropriate.

- **Continue to increase gate rates at the current rate consistent with regional landfill market.** The current gate rate is on the lower end of the regional market rates, indicating the City can continue to incrementally raise the gate rate to maintain Landfill revenues, even if there are small dips in tonnage delivered immediately following pricing increases.
- **Implement environmental fee (or similar) to fund long-term management of the Landfill in an equitable way.** As a strategy to increase revenue from the commercial customers of the landfill, the City could introduce a mandatory separate surcharge for non-city materials disposed at the Landfill. This surcharge would be designed to generate revenue from the tonnage disposed.
- **Incentivize diversion from third-party hauling customers by revising discount structures or implementing material-specific gate rates.** Shift the discount structure to provide more favorable pricing based on a documented level of diversion. As the City looks to establish on-site organics recycling opportunities, gate rates could be established for clean source-separated loads of clean yard trimmings and other desired materials. These material-specific gate rates, if set below the gate rate for mixed MSW, can incentivize diversion in the community while providing feedstock for the City's diversion activities.

Recycling potential. Pricing strategies that include increased costs of landfill disposal and pricing incentives for diversion (either as part of the discount structure or through material-specific gate rates for divertible materials) provides waste reduction and recycling potential. A discount structure based on diversion levels (e.g., single-stream material recycled) provides additional incentives for recycling of non-City materials in neighboring communities, driving increased volumes of material sent to FCC, non-City organics that may be accepted at a future City composting facility, and/or the Dallas County regional HHW program.

Operational impact. Increasing operating efficiency through increased staffing and technology deployment minimizes safety risks and reduces overtime demand required for daily opening and closing activities. Similarly, expanding to a 24-hour operation could reduce operational needs associated with daily cover and opening and closing activities. Deploying additional hardware and software technology can improve operational efficiency. For example, the Landfill recently began using GPS technology integration with Carlson in landfill equipment (one compactor and two dozers) to communicate compaction and number of passes to the operators. This technology can also be used to assist in more sophisticated ways such as for phase geometry and elevations (cell, lift and final intermediate). Based on recent Landfill survey data there are inactive cells under intermediate cover that are short of final waste grades, and use of on-

board GPS technology could improve filling of future cells to grade to completely utilize permitted airspace. Continuing the option of leachate and/or condensate recirculation when needed provides operational benefits of accelerated decomposition and maintains the flexibility of an on-site method for managing condensate and leachate in the event that off-site management options become temporarily or permanently limited. It is important that liquids addition is not overutilized to avoid operational challenges such as potential decrease in stability and potential seeps.

Financial impact. Any adjustments to the pricing strategy at the landfill will have potential financial impacts to the facility.

- Increases in gate rates typically have a short-term impact on received tonnages, though quantities rebound when gate rates are set appropriately relative to the market.
- Establishing a per-ton environmental fee (e.g., $2.50 per ton) applied to cash, commercial, and contract customers would more equitably fund closure and post-closure needs and lessen the future financial impact to residents and taxpayers to fund these activities. Based on 2019 scalehouse data, a $2.50 per ton environmental fee would have generated approximately $3 million in revenue from the outside users of the Landfill.

Increasing the use of technology will require the purchase of additional equipment (e.g., on-board GPS), but operational improvements can also result in financial savings through efficient use of airspace and improved execution of phase geometry, reducing the potential to install wells and long-term cover prior to reaching final grades.

Currently, the Landfill receives a significant portion of waste from outside third-party sources through discount contracts, commercial accounts, and cash customers (see Appendix E, Figure E-7 for customer summary); however, in the coming decades there may be pressure to limit outside waste to preserve capacity for the City's needs. Implementing a per-ton environmental fee in the near-term will generate closure and post-closure funds more equitably by including the third-party private-sector customers who dispose of significant tonnage in the Landfill. Implementing a fee to support closure and post-closure costs later in the Landfill's life may result in these costs being borne primarily or exclusively by City residents.

Environmental impact. The environmental impacts of landfilling, including GHG emissions, vary depending on the materials being landfilled as well as the landfill gas management approach. Operations at the landfill such as using diesel-powered equipment also result in emissions. Efforts to preserve landfill airspace through diversion and waste reduction (e.g., avoiding the creation of wastes that must be managed) reduce the City's carbon footprint through both the avoided landfill emissions and the associated benefits

of recycling or composting materials. Extending landfill life also provides avoids environmental impacts associated with developing additional land for landfill disposal.

Policy impacts. Landfill gate rates, increases, and discount structure are set through City ordinance, and changes to pricing and discount structure would require a relatively high level of effort to develop ordinances to be adopted by City Council. Some operational changes require TCEQ permit modification, such as SOP changes to increase the size of the working face or expand to 24-hour operation. Other operational changes, such as deploying technology or filling staff vacancies, should not have policy impacts.

Stakeholder "buy-in". There is medium stakeholder "buy-in" on this option because while there is an anticipated high level of "buy-in" from staff from an operational perspective especially for changes that would increase safety and reduce overtime, there is lower "buy-in" from an operational perspective related to space constraints of storing material in idle transfer trailers on site and hauling material at night.

Compatibility with existing programs. This option has a high level of compatibility with existing programs, as available approaches build from current landfill management approaches and programs, such as by revising existing discount and fee structures and incorporating additional technology into the planning and execution of current fill approach.

8.4.2 Divert Self-Haul Customers from the Working Face

Overview. Diverting self-haul customers away from the landfill working face would help to address traffic and safety considerations at the site. Self-haul customers such as residents and other manual unloading customers contribute to longer than desired wait times at the scalehouse and high traffic at the working face. The City's approach to diverting these customers to a separate portion of the working face from waste collection vehicles has improved conditions; however, the City can further improve safety and efficiency through the following approaches to divert self-haul customers:

- **Incentivize customers to utilize CCC.** Currently, residents and other manual unloading customers are instructed to use the existing CCC; however, many bypass this option and historically have filed complaints if they are turned away from the working face to use the existing CCC. These customers could be incentivized by receiving discounted disposal fees for use of the CCC.
- **Develop an expanded CCC and require its use by certain customer categories.** Self-haul customers infrequently use the existing CCC which is located within the permitted limits of waste and will need to be demolished and relocated to facilitate future fill. If the City were to develop an

expanded CCC outside the limits of waste, the City could use tactics such as traffic control, signage, and financial incentives to require and/or encourage its use.

- **Leverage transfer station system, contingent on upgrades**. The City could implement tactics such as directing self-haul customers to use the Bachman transfer station. Currently, residential self-haul may use satellite transfer stations on Wednesday and Saturday. One challenge to address with this approach is that self-haul customers decrease the efficiency of the transfer station system.

Recycling potential. Diverting self-haul customers to an expanded CCC has limited ability to increase diversion in the near-term; however, an expanded facility could facilitate long-term diversion in coordination with the CCRC and potential future organics diversion efforts at the Landfill.

Operational impact. Diverting self-haul and other manual unloading customers provides multiple operational benefits by:

- Eliminating safety risks at the working face for residents and others who are not specifically trained regarding potential hazards.
- Improving efficiency by diverting manual unload customers who contribute to long wait times and working face traffic.
- Weighing of transfer trailer loads to provide additional insight into the quantity of material received from residential self-haul customers and overall CCC use.

Financial impact. Developing a new, expanded CCC will requires capital investment and have high financial impact. While specific capital costs will depend on factors such as the number of bays and capacity needs, costs should be considered similar to those of a small transfer station and could likely be in the order of $1-3 million.

Environmental impact. There is limited anticipated environmental benefit directly associated with developing a new CCC, though improved traffic flow and decreased wait times can improve fuel use and reduce vehicle emissions at the site.

Policy impact. Developing a new, expanded CCC would have low policy impact.

Stakeholder "buy-in". A new, expanded CCC may result in mixed levels of "buy-in" from stakeholders. Operationally, the CCC would provide increased convenience and safety to residents and others who self-haul material to the Landfill. Self-haul customers may be incentivized through strategies such as a flat fee pricing structure allowing users to skip the line at the scalehouse when using the CCC, controlled traffic patterns, signage and gates. Additionally, the perception of the CCC as a new, more convenient facility could help overcome resident hesitancy to change.

Compatibility with existing programs. While the current CCC is functional, it is within the permitted limits of waste and must be demolished before Cell 15 can be developed. Developing a new, expanded CCC outside of the limits of waste therefore has a high level of compatibility with existing the existing permit and programs.

8.4.3 Increase Organics Processing Capacity

Overview. This option explores the considerations for the Landfill to support the City's broader efforts to implement organics diversion for materials such as yard waste, brush, or food waste. Organics processing technologies and options are described and evaluated in more detail in Section 10.0. The Landfill can be used to support increased organics processing capacity through several considerations and approaches:

- **Develop feasibility analysis for a composting facility at the Landfill.** Provide suitable location to site organics processing infrastructure north of the perimeter berm in coordination with the U.S. Army Corp of Engineers (USACE**).** The Landfill permit allows for on-site composting. Consideration for the feasibility analysis include identifying:
  - **Material grinding, pre-processing, and processing needs and costs.** Composting requires pre-processing of materials, such as grinding and de-packaging. There is a brush grinding operation at the Landfill for volume reduction, but there is not space or processing capacity to manage significant increases in volumes of material. To process additional quantities of clean brush (or other organics), the Landfill will need to expand green waste/brush processing capability. One option to do so is by leveraging the existing master agreement to process City-collected green waste from the separate brush/bulky collection pilot program and then further expand to process future City-collected and commercial green wastes.
  - **Staffing and equipment needs for the City to operate the facility.** Composting operations will require additional staffing support, though the level of staffing needs will vary depending on the selected organics processing technology (e.g., windrow composting, anerobic digestion, etc.) and potential public-private partnership to develop and operate the facility.
  - **End markets for compost and mulch finished product(s).** Finished composting and mulch products could be sold or provided for free to residents, additional end markets could include local landscaping companies and state agencies (e.g., TxDOT).
- **Develop and release a procurement for organics processing in conjunction with upgrading the transfer station system.** Releasing a procurement for organics processing that meets the anticipated timeline of upgrades to the transfer station system would allow the City to evaluate costs and the level of effort to implement the infrastructure to effectively divert separate yard

trimmings and brush collected. Additionally, portions of this effort may be eligible for funding from the NCTCOG.

Recycling potential. Organic waste is a large portion of disposed material and expanding organics processing capacity would increase the City's ability to make meaningful progress toward its long-term Zero Waste goals.

Operational impact. Implementing organics diversion at the Landfill would have a high operational impact, including the need to allocate space to receive source-separated loads of clean organics (brush, green waste); process through grinding, composting, and/or another technology; and store finished product (e.g., compost) as needed. These activities will also require additional equipment and staff.

Financial impact. While specific costs vary depending on the selected organics processing technology, operating an organics processing facility at the Landfill would incur capital, equipment and operational financial impacts. These impacts would be high for a City-owned and operated facility. If a public-private partnership were leveraged to develop and operate the facility, the financial impact to the City would be less, however there would still be financial impacts such as tipping fees for material processing. Additionally, organics diversion from landfill can reduce gas generation potential (described in Section 8.3.2). In the event of reduced gas generation, there would be financial impacts to the revenue share provided to the City as part of the landfill gas contract with DCEMB.

Environmental impact. Generally, environmental benefits associated with diverting organics from landfill include reduced landfill emissions and improved soil and nutrient benefits from use of the resulting compost product. The level of benefit varies depending on the type of organics diverted (e.g., food waste compared to brush), processing technology used (e.g., composting compared to AD) and the landfill gas management practices used (e.g., landfill gas flaring compared to aggressive gas capture and conversion to high-BTU fuel).

Policy impact. Supporting organics processing efforts at the Landfill would require a moderate level of effort related to policy, regulatory requirements, and adjustments. The primary regulatory impact is related to citing an organics management facility north of the landfill berm, which would require approval of the USACE and modification of the wetlands permit. If approval cannot be obtained from USACE, alternative locations would need to be explored.

Stakeholder "buy-in". There is a mixed level of stakeholder "buy-in" related to this option because although it would support increasing recycling, the capital and operational needs to develop an organics processing facility at the Landfill may interrupt existing operations. As described in Section 8.3.2, diversion

of degradable organics from the landfill has potential gas generation impacts affecting the level of "buy-in" from DCEMB.

Compatibility with existing programs. There is a moderate level of compatibility with existing brush grinding operations and contracts, which have potential for expansion on a pilot-scale but additional space and equipment would be required to expand operations into a more robust composting or other organics processing facility.

8.4.4 Undertake Long-term Operations and Development Planning

Overview. This option explores the long-term planning needs for the Landfill, specifically to:

- **Create a facility master plan.** This type of plan is valuable to identify and optimize site development phasing, capital improvement projects, and infrastructure needs (e.g., stormwater, leachate forcemain, electrical). A master plan will allow the City to coordinate and plan for capital and operational needs and changes as it explores relocation of buildings (e.g., administration building, maintenance building, scalehouse, CCC) outside the limits of waste, continues cell development to the north (and associated traffic and utility needs), and considers the timeline for funding and installing the final cover system.
- **Explore needs for future permit modification to revise to the final grading plan and permitted heights.** The current permitted final grades are designed with the typical 4(H):1(V) side-slopes and a shallow crown, which can be subject to ponding due to the large footprint of the Landfill. The City should consider pursuing a permit modification to revise the final grading plan to maintain 4:1 side-slopes but use 7:1 slopes on the crown to mitigate any stormwater management challenges.
- **Move structures outside the permitted limits of waste.** The maintenance building, administration building, and CCC are all located within the permitted limits of waste (Cell 15) and will need to be demolished for future cell development.

Recycling potential. While long-term planning will support effective use of existing landfill resources, it will not necessarily provide additional recycling potential.

Operational impact. Long-term operations planning can provide significant operational benefits at the Landfill by forecasting operational and capital needs throughout the site life. A long-term landfill masterplan can also support Landfill staff with site development efforts (e.g., weekly and daily fill plans). Modifications to final grades can be used to mitigate future operational challenges with stormwater management. Moving structures outside the permitted limits of waste can be disruptive to operations, and careful evaluation, planning and phasing as part of a long-term master plan can help to mitigate these

impacts. The new facilities will benefit operations by addressing challenges with the existing aged buildings (e.g., electrical and size constraints at the maintenance building).

Financial impact. Moving structures outside of the permitted limits of waste represent large capital expenses for design, permitting, and construction activity. Once developed, a master plan will assist the City by establishing capital post milestones for Landfill needs, including relocating these structures. Costs associated with long-term operations planning include costs associated with developing a facility master plan, permitting and design of revised slopes.

Environmental impact. Long-term planning efforts, including development of a landfill masterplan, will support environmentally responsible operations of the Landfill; for example, exploring modifications such as revisions to the final grades to improve stormwater management.

Policy impact. Policy impacts with long-term planning are limited to permitting needs associated with facility modifications.

Stakeholder "buy-in". There is medium stakeholder buy-in on this option. Long-term master planning will provide valuable information for the City's and operational challenges will be addressed through the relocation of buildings outside of the limits of waste. However, construction associated with moving these buildings could create congestion and challenges at the Landfill, reducing customer "by-in." While a potential regrade of final elevations will address potential operational challenges, it would result in an increase in the Landfill's maximum elevation. This increase, and any similar recommendations that result from a Landfill master plan, could be viewed unfavorably by residents.

Compatibility with existing programs. There is a high level of compatibility with existing programs, as one purpose of long-term master planning is to optimize continued operation of the existing Landfill and prepare of potential challenges.

8.5 Key Findings and Recommendations

This section presents a summary of the options evaluation followed by key findings and recommendations related to program and policy approaches to increasing diversion from the City's multi-family and commercial sectors. Table 8-3 summarizes the results of the options evaluation for each of the tactics presented.

Table 8-3: Summary of Landfill System Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Maximize Site Life and Maintain Sufficient Revenues							
Implement hardware and/or software tools for continued increases in operational efficiency.	N/A	●	▲	N/A	●	▲	●
Continue to increase gate rates to meet market prices and continue to perform periodic market studies to ensure that tonnage is not driven away to the extent that revenues become insufficient to fund operations at the facility.	N/A	●	●	N/A	●	▲	●
Implement diversion-based discount structure to incentivize diversion from third-party hauling customers.	●	●	●	●	▲	▲	▲
Implement environmental fee for more equitable generation of closure and post-closure funds.	N/A	N/A	●	N/A	▲	▲	■
Divert Self-Haul Customers from the Working Face to an Expanded CCC							
Develop an expanded CCC outside of permitted limits of waste to divert small self-haul customers away from the working face for safety, improved efficiency, weighing of loads, and to facilitate long-term diversion.	N/A	●	▲	N/A	▲	▲	●
Increase Organics Processing Capacity							
Develop a feasibility study (permit implications, layout, potential PPP, timing, etc.) in coordination with upgrades to the transfer station system.[1]	N/A	●	●	N/A	▲	▲	N/A
Establish composting capacity to support organics diversion initiatives under current permit provisions.[1]	●	■	▲	●	▲	▲	■
Undertake Long-Term Operation and Development Planning							

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Create facility master plan to address long-term site development phasing, CIP, and infrastructure needs (e.g., stormwater, electrical).	N/A	●	▲	N/A	●	●	●
Explore the needs for future modifications such as revisions to final grading plan and permitted heights to address current or anticipated operational challenges and provide additional airspace.	N/A	●	▲	●	▲	▲	●
Move structures including the maintenance building, administration building, and CCC outside of the permitted limits of waste.	N/A	▲	■	N/A	▲	N/A	●

1. Environmental impact depends on factors such as the type of organics diverted (e.g., food waste, yard trimmings, brush, soiled paper), the timing and collection efficiency of the GCCS system in new cells, and the end use of LFG. For some materials, diversion to composting may provide limited greenhouse gas-related benefits but will provide other environmental benefits related to soil health and water conservation from compost use.

8.5.2 Key Findings

Each of the following key findings supports the recommendation in the subsequent section.

1. **Airspace utilization (AUF) suggests that staffing and equipment are being deployed effectively.** The AUF for the Landfill is approximately 1,600 pounds per cubic yard, which exceeds the regional average (1,375 pounds per cubic yard) and a typical industry performance benchmark of 1,400 pounds per cubic yard.
2. **The local and regional disposal market could likely support increased rates at the Landfill.** The current gate rate ($34.88) is the third lowest in the NCTCOG region, and the average tipping fee charged ($29) at the Landfill is comparable the average prices of landfills in the regional market and support ongoing effort to increase tip fees.
3. **Buildings are located within the permitted limits of waste, limiting availability of valuable airspace.** The CCC, maintenance building, and administration building are located within the permitted limits of waste at Cell 15. These buildings must be demolished and relocated in the future in order to develop Cell 15 for waste disposal.
4. **The CCC is underutilized and self-haul and manual load customers at the working face represent a potential safety risk and lead to longer wait times.** The CCC provides a safer alternative to the working face for self-haul and manual load customers. Currently, these customers are instructed to use the CCC rather than proceeding to the working face; however, the majority of customers do not comply with this request. The recent implementation of separate working faces and traffic control stands on the landfill road have resulted in improvements, but safety and turn-around times could still be improved by requiring self-haul and manual load customers to use the CCC.
5. **None of the Subtitle D cells have received final cover, and many with intermediate cover and GCCS system installed have areas not filled to final limits of waste elevation.** Installation of the final cover system over older Subtitle D cells can provide operational benefits such as reduced leachate generation through reduced infiltration and increased LFG capture efficiency. There are potential operational challenges associated with recapturing permitted airspace for disposal, such as the need to navigate heavy equipment around a highly-packed well-field. However, for future cells on-board technology can be used to bring cells to final limits of waste elevations.
6. **Landfill generates significant quantities of greenhouse gasses but the GCCS diverts the potential emissions to a processing facility for sale.** The robust GCCS at the Landfill minimizes the impact the Landfill would otherwise have on the local emissions inventory.

7. **Closure and post-closure reserves are currently unfunded.** Closure and post-closure care can represent significant cost for materials, installation, and monitoring. Currently closure and post-closure reserves are unfunded, which presents some financial risk to the City.
8. **There are valuable opportunities to expand the City's current use of on-board technology in vehicle equipment to more effectively manage operations in real-time.** The Landfill recently began using GPS technology integration with Carlson in landfill equipment (one compactor and two dozers) to communicate compaction and number of passes to the operators. This technology can also be used to assist in more sophisticated ways such as for phase geometry and elevations (cell, lift and final intermediate) to improve filling of future cells to grade to completely utilize permitted airspace.

8.5.3 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Continue to increase gate rates to meet market prices.** The City's current gate rates are lower than some nearby facilities, even when accounting for recent 20 percent increases in gate rate for FY 2021. With appropriate pricing, the City can control the amount of non-contract third-party waste accepted for disposal while maintaining adequate revenues for short- and long-term operational needs.
2. **Conduct periodic market assessment to determine support future pricing increases.** The regional market price for disposal is driven by many factors and facility pricing dynamics are ever changing. As nearby facilities change their respective pricing and discount strategies the market will shift. Given the number of factors, including price, that influence the flow of refuse throughout the region, the City should conduct routine market studies to track disposal capacity market price and set rates accordingly to balance incoming tonnages with revenue needs.
3. **Implement environmental fee (or similar) to fund long-term management of the Landfill equitably.** The City should implement an environment fee to increase revenue from the commercial entities and develop a new revenue stream to support funding for closure and post-closure care. It is possible that commercial haulers would continue disposing at the Landfill if the tip fee with a new surcharge brings the total per-ton cost to a rate comparable with the regional disposal market. Likely, commercial haulers would pass increased costs along to their customers by changing collection rates.
4. **Implement pricing strategies to incentivize diversion from third-party hauling customers.** Include level of discount. The Landfill is an important disposal resource not just for the City but

also for the broader region as other landfills near capacity. The City can leverage its discount structure to incentivize third-party communities to divert by implementing a discount structure that provides an increase discount rate based on documented diversion tonnages. This put-or-pay approach could be used to attract increased volumes of recycling material to the FCC MRF and other documented activities taken to minimize the waste sent to the Landfill. Discount levels should be carefully set based on the recommended landfill market studies.

5. **Incentivize self-haul customers to utilize the CCC then develop an expanded CCC outside the permitted limits of waste.** The City should implement an incentive for self-haul customers to utilize the CCC that decreases wait time by bypassing the scalehouse and assessing a flat fee. The material would need to be weighed before the transfer trailers dispose in the Landfill, but would allow the City to track the increased usage of equipment to determine when an expanded CCC would need to be built outside the permitted limits of waste.
6. **Implement key operational adjustments and capital upgrades to maximize existing capacity at the Landfill.** The City should expand the use of on-board GPS technology to improve efficiency of lift planning, compactions, and construction and integrate scalehouse data collection platforms with the transfer station system.
7. **Develop and release procurement for the development and operation of a composting facility.** The City should release a procurement determine most effective approach to developing organics processing capacity through PPP. As part of this effort, the City should coordinate the procurement with the upgrades of the transfer station system and potentially offer one or more sites where vendors to process material rather than attempting to identify a location to process all the material at the Landfill.
8. **Develop a long-term master plan for the Landfill**. A long-term master plan can be used to prepare the City for operational, Capital Improvement Plan (CIP), and other needs at the site and coordinate activities and needs (e.g., landfill road, utility, traffic control, and construction based on cell phasing). As part of the master plan, the City will be better prepared to:
    a. **Discontinue building in the permitted limits of waste and move buildings that are in footprint.** The long-term master plan will allow the City to coordinate the timing of capital needs and new building development (design, permitting, construction) with cell phasing and development to minimize disruptions to Landfill operations. While some of the current buildings (e.g., maintenance shop, CCC) have significant wear and could use improvement, there does not appear to be an immediate need to relocate these structures. Although buildings do not need to be moved immediately, no new buildings should be constructed in the permitted limits of waste, and existing buildings should be relocated to other areas of the site over time.

b. **Undertake design and permitting modification to address operational challenges.** This includes re-grading the crown by increasing the final grade of the crow from 4:1 to 7:1 to prevent stormwater run-off challenges and increase airspace.

c. **Revise traffic flow patterns.** If the City shifts to using the north entrance for the scalehouse, CCC, maintenance building and/or organics processing, a master plan should be utilized to support the development of roads to the working face and other areas of the facility and new scalehouse or other infrastructure.

d. **Explore options when currently-permitted airspace is consumed.** A masterplan would consider and compare options such as a potential vertical expansion, new landfill, or additional transfer station(s) for long-haul to an existing landfill.

9.0 RECYCLING PROCESSING

Effective recycling processing infrastructure capacity and programs support the City's efforts to increase diversion from disposal. Processing services for recycling material collected by the Sanitation Department are provided at the FCC MRF under a public-private partnership agreement that began in 2015.

This section presents information, and analysis and evaluation regarding the City's recycling processing agreement.

9.1 Recycling Processing Agreement Overview

Leading up to the expiration of the processing contract with Waste Management Recycle America in 2016, the City evaluated processing technologies including single-stream recycling, mixed waste processing, gasification and anaerobic digestion. As a result of the analysis, a Request for Competitive Sealed Proposals (RFCSP) was issued to identify viable partnership options to increase recycling. Vendors had the option to develop proposals based on either or both of the following options:

- Vendor constructs and operates MRF at the McCommas Bluff landfill (building ownership transfers to City at the end of the contract)
- Vendor provides processing services at its own location (vendor site option).

The City offered a 15-acre site and initiated a permit modification to include a MRF at the Landfill. As a part of its proposal to the City, FCC agreed to the City's proposed terms and did not request any exceptions to the contract. FCC designed the sitework and constructed the buildings at no cost to the City. At the termination of the contract, building ownership will vest with the City. The City will also have the option to purchase equipment from FCC at termination of the contract. FCC designed and built the MRF from November 2015 through December 2016, and the processing agreement between the two parties started on January 1, 2016 and has been in place since.

Sanitation Department vehicles deliver recycling directly to the FCC MRF, but the majority of material is delivered by transfer trailers. FCC hauls contamination and process residue for disposal at the Landfill. Table 9-1 presents the annual tons delivered to the FCC MRF by collection location from FY 2018 – FY 2020.

Table 9-1: Annual Tons Delivered to FCC MRF

Description	FY 2018	FY 2019	FY 2020
District 1	6,483	7,260	7,926
District 2	27	199	209
District 3	0	8	3
District 4	26	42	10
District 5	8,632	8,308	8,406
Transfer	38,454	37,040	41,805
Other[1]	538	632	601
Total[2]	**54,160**	**53,490**	**58,960**

1. Represents non-City collected tonnages that are received and processed at the FCC MRF (e.g., commercial recycling).
2. Total may not sum exactly due to rounding.

The Landfill permit was modified to accommodate this facility in the disposal footprint, resulting in a "airspace swap[78]." Figure 9-1 shows an overhead of the FCC MRF processing building, scalehouse, administration building, and parking lot located in the northwest corner of the Landfill.

Figure 9-1: FCC MRF and Ancillary Infrastructure and Buildings

[78] Landfill Permit No. 62 was amended to re-allocate airspace to other areas of the Landfill so even though the MRF and associated buildings are located in the disposal footprint, the disposal area of the Landfill did not lose any permitted airspace. The area directly behind the FCC MRF was included in the airspace swap for future use or facility expansion.

FCC designed and built the MRF with the intention of processing up to 120,000 tons[79] annually. Inside the MRF building there are climate-controlled cabins for employees and a viewing gallery to be used for educational tours to provide a "bird's eye" view of the processing system from a safe and climate-controlled area.

The initial term of the agreement is 15 years, with optional renewals (up to 10 additional years). Recently, the initial term of contract has been extended by an additional three years and will terminate in 2035. There may be conditional extension option or options for a period from one to ten years at the conclusion of the initial term. This provides the flexibility to extend the operating agreement for the time frame that best suits both the City and FCC upon the expiration of the initial term of the agreement.

Rather than dictate specific processing requirements (such as equipment types or methods), the agreement includes performance-based processing requirements. Section 2.1 of the RFCSP requires FCC to process a minimum of ninety-five percent (95.0%) by weight of Program Recyclable Materials into recovered materials and that glass shall be processed to achieve greater than 75 percent usable glass.

To administer the performance-based specifications, the agreement calls for FCC to conduct a MRF audits twice annually. These audits are necessary to determine the composition for the revenue share, levels of contamination and whether the processing equipment is achieving a 95 percent recovery rate. The contract includes audit procedures; additionally, the City and FCC have agreed to conduct the audit based on a more detailed guideline based on the audit procedures. The audit procedures have been refined over the course of multiple audits, and it serves as an effective resource.

During each MRF audit the City collects and stores between 75 and 120 tons of recycling material that is processed through the facility on a dedicated basis to evaluate the composition of the material, contamination and recovery rate of the equipment. The most recent MRF audit in October 2021 indicated that contamination levels are in the low 20 percent range and the recovery rate is at or above the 95 percent minimum.

FCC charges the City a processing fee of $73.46 per ton of recycling delivered that adjusts annually based on a contractually-based rate adjustment (that only applies to the operational component of the rate). The City receives 50 percent of the revenue from sales of processed recyclables. The revenue sharing agreement is based on the higher of actual sales or index pricing, and FCC agreed to set a floor price so the City would not be required to compensate FCC in the case of negative revenues from low commodity market prices.

[79] Based on information in the capacity section of FCC's proposal to the City, included on pages 91-92.

Based on the results of the MRF audits, the City provides for the disposal of residuals and contamination from materials delivered by the City at no cost to FCC. FCC also receives a discounted disposal rate for the first 20,000 tons of non-City residue and contamination.

FCC pays the City $15.58 per ton host fee for all third-party tonnage; this amount also increases based on the same percentage as the processing fee. Via a contract addendum, the City and FCC agreed to exclude certain third-party tonnage from the host fee, as these tonnages are subject to a lower host fee amount. These tonnages are limited to source separated cardboard that can be baled and sold without extensive processing. The reason for the lower amount for the "bale and sale" tons is that FCC only receives revenue based on a percentage of the value of the material (similar to a brokering fee).

FCC currently pays $1.06 per household annually to the City to support its public education and outreach program. This amount also increases based on the same percentage as the processing fee. FCC also committed to an additional $40,000 annually for community outreach plus $25,000 annually for FCC managerial education support; these amounts are not paid directly to the City and are provided as in-kind services.

9.2 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policy and/or program. Additionally, this section identifies any fundamental changes that have been made since related to programs, policies or forecasts as it relates to brush and bulky item collection.

Table 9-2 lists the recommendations from the 2011 LSWMP related to recycling processing with a brief description of progress to date and next steps as part of the LSWMP Update.

Table 9-2: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress To Date	Potential Next Steps
Collection of residential recyclable items.	The City continues to collect and process material.	Increase generation rate of recycling while decreasing the current contamination rate in the 20-25 percent range.
Adding materials to the recycling program (textiles, durable plastics, film plastic, scrap metal)	The City works closely with FCC to identify opportunities to increase recycling while balancing the operational and safety requirements of the MRF.	Leverage the recent increase in market prices to explore opportunities for increased diversion of materials that are currently not accepted as part of the recycling program.

9.3 Recycling Processing Agreement Evaluation

This section provides an evaluation of key components of the City's recycling processing contract. This evaluation is intended to serve as the basis for the following key findings and recommendations. While tactics and strategic options related to recycling processing are included in the Implementation & Funding Plan, this section does not contain a high-level table that reviews each tactic provided in other sections of the LSWMP Update.

Table 9-3 provides an evaluation matrix that compares key components the agreement and based on strengths, weaknesses and opportunities.

Table 9-3: Recycling Processing Agreement Evaluation Matrix

Processing Agreement Component	Strengths	Weaknesses	Opportunities
Facility Location, Infrastructure and Equipment	The FCC MRF is co-located with Landfill and designed so the area adjacent to the current facility could be used when the facility needs to be expanded or if a new processing technology system would be built. The FCC MRF contains climate controlled cabins and gallery viewing area. FCC installed state of the art Van Dyk/Bollegraaf processing equipment that is designed to process approximately 30 – 40 tons per hour.	The current footprint of the processing building results in FCC sometimes storing unprocessed materials outside during surges of material. In 2021, FCC installed push walls in the MRF to keep material in the facility. Additionally, FCC uses the area adjacent to the processing building for parking its collection vehicle fleet. With any MRF processing equipment, its capabilities can be impacted based on the material composition and maintenance efforts.	Determine how FCC can use the area where its collection fleet is currently parked, including the express understanding that use of the area for parking collection vehicles is only allowed by the City as a courtesy and consider entering into a lease with FCC for the use of the site as a parking area. Additionally, increase the overall safety of the operation, especially as tonnage continues to grow, by installing proximity monitors and lights on rolling stock and minimizing the number of bales stored on-site to reduce the need to store bales outside during surges in material. Request that FCC maintain the climate control in the cabins as communicated in its proposal and utilize the viewing gallery more frequently for educational tours.
Contract Length and Administration	There is a dedicated staff member from the Sanitation Department responsible for managing the agreement between the City and FCC. The length of this term allows FCC to depreciate the cost of its capital for the buildings, processing equipment, rolling stock and site work and supports the long-term needs of FCC and the City as part of the public-private partnership. The renewal term is flexible between one and ten years, allowing the City to structure any renewal to its needs at that time.	While managing the contract is a primary responsibility for the dedicated City staff, the employee has other responsibilities within the Sanitation Department and may not be able to dedicate full attention to contract administration.	Begin internal discussions about whether to renew the agreement when there is about four years remaining on the extended initial term (in 2031). Since the City will ultimately assume ownership of the facility when the contract terminates, ensure that FCC provides for the upkeep and maintenance of the equipment and facilities. The Sanitation Department Director and an Assistant Director should continue to have direct responsibility for contract management issues.
Processing Fees	The City has very beneficial financial terms for the MRF, and it is unlikely that the City would be able to replicate the terms of the contract in the future.	Options to reconsider financial terms are limited since the agreement was a result of a competitive procurement process.	Proactively collaborate with FCC (within the boundaries of the contract) to facilitate efforts for FCC to be as successful as possible.
Revenue Sharing/Host Fee	Current agreement allows both parties to realize benefits from favorable market conditions and minimize risk in depressed markets based on the composition and value of the inbound material. The agreement stipulates the revenue sharing and host fee calculations in a transparent way and the revenue sharing component is not the sole source of revenue that supports the City's recycling program operational costs.	FCC originally misinterpreted the financial calculation for the revenue share portion of the agreement by discounting the revenue to be paid to the City. This issue has since been corrected. The City has conceded some contract terms given challenging financial recycling markets such as agreeing for reductions in host fees from "bale and sale" materials and third-party tons that exceed the annual minimum requirements.	Diligently review revenue sharing calculations, host fees and other sources of revenue in the provisions of the recycling processing agreement.
Material Value Determination	Published sources of secondary commodity material pricing are identified as part of the recycling processing agreement and are explicit that material values are determined based on the higher of actual sales price or published index prices. This incentivizes FCC to seek the highest pricing for materials.	The recycling processing agreement details MRF material sales are to be updated on a quarterly basis requiring audits to be conducted on a quarterly basis. While this provides accurate revenue sharing percentages, each audit requires significant resources to conduct.	Starting in 2017, the recycling industry has experienced extremely low commodity markets and FCC requested financial relief from the City. Although FCC agreed to the financial terms in the contract with the understanding that recycling commodities are subject to pricing fluctuation, the City should continue to work with them in good faith to overcome unanticipated market challenges.
Acceptable Materials Mix	The materials the MRF is obligated to accept, process and market are clear and contain the flexibility to change based on established procedures in the recycling processing agreement (e.g., allowing adjustments to acceptable materials based on mutual agreement). The accepted materials take into account diversion goals, collection procedures, markets and the current and future capability of the MRF to process and market each type of materials.	The general trend has been for recycling processing agreements to include an expansive range of materials in hopes of reaching higher diversion targets and has created challenges for MRFs to effectively operate their facilities and sell materials that meet increasingly rising quality standards. Including more materials that are unable to be effectively separated by equipment and staff at the MRF causes challenges meeting contractual obligations related to processing efficiency.	There have been times when FCC has communicated challenges processing or marketing certain program recyclable materials (such as rigid plastics and household metals). Additionally, even though FCC communicated a desire to recover plastic bags in the RFCSP, they have experienced challenges separating and marketing this material. Continue to hold FCC accountable for the recovery of rigid plastics and household metals as program recyclable materials, as well as plastic bags and film as a material that FCC said would be recovered.

Processing Agreement Component	Strengths	Weaknesses	Opportunities
Material Audit	MRF audit procedures allows for a full system audit of outgoing MRF residue compared with the quantities of sold commodities to measure the MRF's operating performance. The agreement explicitly establishes the frequency, protocols, and intended uses of material audits to evaluate contamination rate, revenue sharing percentages, and processing equipment efficiency.	The City has encountered challenges ensuring that staff from both SAN and OEQS are made to be available to support audit efforts. There have been challenges conducting the audit event within a single working day (e.g., some tasks need to be conducted the following day). Also, there have been times when FCC or the City have requested for an audit to be rescheduled due to weather, equipment processing issues or other priorities. With the impacts of COVID-19, FCC has agreed that up to four personnel representing the City may be present to conduct audits. This is not sufficient staff to oversee the audits and in 2020 the minimum two audits had not been conducted.	Continue to conduct audits on a semi-annual basis to maintain a clear understanding of both the composition of the incoming recyclable material stream and outgoing residue to evaluate the effectiveness of ongoing and future program efforts to decrease contamination and increase the capture of acceptable materials from residential customers. Going forward, the City should continue to monitor the performance of the processing equipment, as under-recovery of key materials can financially impact the City and FCC. Comparing historical audit results and having experienced MRF consultants are strategies to evaluate MRF performance.
Material Quality, Rejected Loads and Residue Disposal.	The City only pays for the contamination/residue generated from the material it delivers based on the results of the MRF audits and there have only been a small number of loads delivered by the City and rejected by FCC. While this is not a frequent occurrence, it indicates that minimizing the contamination collected from residents is an important part of the City's education and outreach program going forward.	Specific conditions related to levels and types of contamination expressed as a percentage of the inbound material should be established based on a combination of historical contamination amounts and reflect the efforts or practices in place to decrease contamination. There is no contractual threshold that results in a load being rejected.	The City should continue to work diligently to reduce contamination from its residential customers to minimize the cost of its disposal. An innovative approach to maintaining material quality and minimizing contamination is to adjust the processing fee relative to the level of contamination (e.g., if base processing fee is $80.00 per ton based on a 20 percent contamination threshold, the processing fee would rise to $85.00 per ton if the contamination increases to 25 percent or fall to $75.00 per ton with a 15 percent contamination level).
Facility Performance	The agreement requires that FCC meet a 95 percent processing efficiency requirement. Additionally, the agreement requires that FCC always maintain adequate open tipping floor space, prioritize City vehicles by using a dedicated late, and that City vehicles would be provided adequate space to unload in a safe and timely manner.	With increased quantity of inbound material, City collection vehicles and transfer trailers sometimes experiencing wait times that exceed the daily average vehicle turnaround time of 25 minutes or less for City transfer trailers and 15 minutes or less for all other City vehicles, as required by the recycling processing agreement. The traffic plan submitted by FCC indicates there will be a dedicated lane for the City's vehicles but struggles to provide this during surges in material.	Continue to monitor performance requirements during future audits and hold FCC accountable to meet the established turnaround times established, potentially enforcing administrative charges if FCC does not meet these requirements.
Education and Outreach	The recycling processing agreement defines the resources that FCC is obligated to provide to the City for conducting effective outreach with direct payment and in-kind services. The financial support provided by FCC is consistent with other peer cities in the region, ranging from $1.00 to $2.00 per household.	While it is positive that FCC provides financial and in-kind support for education and outreach, the cost to minimize contamination will increase as the City continues to grow and may outpace the increases in annual adjustments to the per household payment provided to the City.	Continue to work with FCC to support and develop education and outreach content to increase the efficiency of the recycling processing operation, leveraging the financial commitment and in-kind services provided as part of the recycling processing agreement.
Contingencies	There are clear guidelines established on the procedures in the event of service disruptions from unforeseeable events (e.g., accidents, inclement weather, natural disasters, equipment failure, business failure, etc.) should be included in recycling processing agreements. These contingency provisions protect both parties from the unexpected events by providing direction, guidance, and assignment of responsibilities in emergencies and other negative situations.	There are times when the MRF tipping floor is full or the system is down due to maintenance issues. FCC has not communicated where material would be processed in the case of unforeseen events or material surges.	To ensure the continuity of service to the City, work with FCC to identify alternative processing facilities to recover and divert recycling. FCC has verbally stated that it has reciprocal agreements in place with multiple other MRFs, but has not provided this information in writing to the City.
Reporting and Communication	The agreement provides regular and productive sharing of information between the City and FCC that supports the long-term viability of the public-private partnership. Communications include a combination of written reports, with the specific type and frequency of reporting outlined in the contract including inbound tonnage, operational reports including staffing, financial reports, audit results, and unacceptable loads rejected.	FCC reports the tonnages for the City and non-City quantities. City has not independently audited the quantities communicated by FCC.	The City may consider conducting an independent audit of the quantities in the future (as allowed in Section 14B of the contract) and taking a more proactive role proactive to ensure that FCC is operating in compliance with TCEQ regulations and other requirements.

1. As of 2019 the City of Austin is charged a processing fee of $71.78 per ton and the City of Fort Worth is charged $84.00 per ton as part of their recycling processing agreements.

9.4 Key Findings and Recommendations

This section presents the key findings and recommendations related to the recycling processing agreement collection based on the overview and options evaluation.

9.4.1 Key Findings

Each of the following key findings support the corresponding recommendations in the subsequent section.

1. **The public-private partnership utilized to develop the FCC MRF is an example for future facility development.** Conducting an RFCSP to solicit and evaluate proposals to both design, build and operate the MRF has allowed the City to successfully enter into an agreement with favorable terms.
2. **The recycling processing agreement has terms that support the City's recycling goals.** The FCC MRF provides the capacity to process current and future anticipated volumes of City-collected materials and other commercial recyclables for diversion. Additionally, the building will transfer ownership to the City at the conclusion of the agreement.
3. **The initial term of the recycling processing agreement terminates in 2035.** The City extended the initial term by three years and has a flexible extension option to extend the agreement between one and ten years based on the City's processing needs at that time.
4. **The City has conducted regular MRF audits throughout the life of the agreement.** Although there have been times when the MRF audits have been postponed, the City and FCC have collaborated to conduct regularly recurring MRF audits processing only City material to establish key figures to monitor processing efficiency and update composition data related to the agreement's revenue sharing provision.
5. **When material commodity prices have fallen, FCC has requested concessions from the City.** Prices on the secondary materials commodity markets have been extremely volatile in the past few years, falling to historic lows and recently rebounding to historic highs. When the prices fell starting in 2017, FCC requested financial relief from the City.
6. **FCC has not identified an alternative processing facility.** FCC has verbally stated that it has reciprocal agreements in place with multiple other MRFs, but has not provided this information in writing to the City. An alternative facility would ensure that in the case the MRF experiences unanticipated downtime they would be able to process the City's recycling without service interruption.

9.4.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Establish a public-private partnership for future infrastructure development needs.** The successful procurement, construction and operation of the FCC MRF presents a model that can be utilized for the development of an organics processing facility.

2. **Maintain current terms and conditions of the agreement and hold the contractor accountable to maintain them.** The current terms of the agreement are favorable, and the City should continue to hold the contractor to account to meet these terms. There have been challenges for the contractor to meet certain provisions during surges of material such as consistently meeting minimum turnaround times for City vehicles and storing material outside. While these occurrences have been remedied, the City should diligently administer the terms of the agreement and hold the contractor to them, including requesting confirmation of agreements with alternative facilities in the case of unplanned downtime.

3. **Re-evaluate recycling processing agreement four years before conclusion of initial term.** In advance of potentially renewing the agreement in 2035, the City should re-evaluate the agreement to determine if the financial terms are still favorable (e.g., processing fee and revenue sharing provision), if the contractor has maintained compliance (e.g., regularly scheduling MRF audits, meeting reporting requirements, storing materials inside the processing building) and the state of the processing equipment. Based on this evaluation, the City would determine to execute an extension of the agreement or solicit proposals for other options.

4. **Work with FCC to expand facility as needed in the future.** Although there is sufficient capacity at the MRF to meet the annual tonnage delivered by the City, the plot of land directly adjacent to the facility is earmarked to expand the facility as needed. Given the growing volumes of recycling of residential material, the implementation of the MFRO, and the need for increased diversion from commercial sector generators, there may be a need to expand the FCC MRF in the future. This expansion could be designed to increase the processing capacity of single-stream material or could become the site of a processing facility that compliments the FCC MRF but is designed to accept other material types (e.g., organics). The City should work with FCC to identify the timing and needs of any future facility expansion.

10.0 ORGANICS MANAGEMENT

Organic materials comprise a significant amount of the total waste stream generated from the City's single-family, multi-family and commercial sectors. Given that organics represents such a large portion of the collective, it is a key focus of the LSWMP Update. Increase the recycling of organic materials is a throughline of the LSWMP Update, as it requires a coordinated effort among multiple facility types and City departments. This section presents information and analysis regarding options to recycle organics to achieve long-term recycling Zero Waste goals.

10.1 Current System Review

This section describes the current management system of various organic material types including reduction, donation and recovery efforts. Recycling organics material can reduce the amount of waste that is sent to the landfill, generate renewable energy through anaerobic digestion, create a valuable compost product, and/or return nutrients to the soil.

10.1.1 Organics Material Types

Organic materials include yard waste, food waste, biosolids, wood waste, and other materials as defined below. Table 10-1 lists organic material types, their definition and how they are currently managed.

Table 10-1: Organic Material Types, Definition and Management

Material Type	Definition and Management
Brush and Yard Trimmings	Dry leaves, grass clippings, brush, tree branches, stumps, and other plant trimmings generated by residential customers or commercial landscaping contractors are collected from residences comingled with bulky items and disposed. This material is also delivered directly to the Landfill for grinding and on-site use.
Food Waste	Putrescible fruits, vegetables, meats, dairy, coffee grounds, and food-soiled paper products generated by residential, multi-family and commercial sector generators. Pre-consumer food waste is considered kitchen waste from food preparation and post-consumer food waste is plate waste discarded after food has been served. Some food waste is collected by private sectors haulers that provide this service and composted at private sector processing facilities, but most food waste is discarded with refuse.
Wood Waste	Non-C&D wood materials such as pallets or other uncontaminated dimensional lumber is processed at the Landfill and used for on-site use.
Fats, Oils, Grease (FOG)	Liquid material generated by cooking or processing organic material generated by residential, multi-family and commercial sector generators. FOGs are typically collected by servicing grease traps at commercial establishments and are delivered to facilities that can de-water or digest the material in anaerobic digestion facilities.

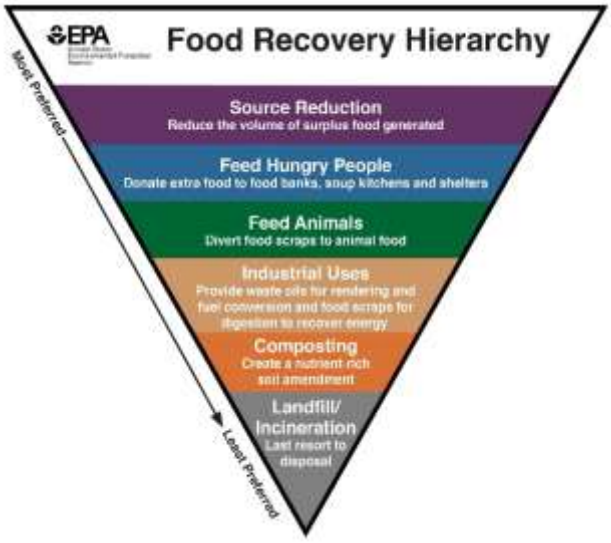
Agricultural Waste	Surplus organic material generated as part of agricultural operations is typically land-applied and re-introduced to the agricultural operations.
C&D	Construction and demolition debris that contains organic material such as uncontaminated wood waste or gypsum board is hauled to processing facility that can segregate and recycle key materials or is disposed.
Biosolids	Solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in treatment works. Sewage sludge that has been treated or processed to meet Class A, Class AB, or Class B pathogen standards for beneficial use can be land-applied or further processed for biogas generation.
Other	"Other" organics represent waste streams that are not currently readily able to be recovered for recycling such as textiles, leather, shoes, diapers, natural fibers, and rubber products. These materials are donated or disposed.

10.1.2 Food Waste Reduction, Donation and Recycling

Growing volumes of food waste is an issue throughout the entire country, in every sector including residential, multifamily, commercial, and industrial. In the U.S. an estimated 30 percent of food goes from farm to table to landfill[80]. This presents not only an issue downstream to manage this food waste, but also economic and environmental impacts along every step of the production, distribution, and consumption chain.

The U. S. EPA Food Recovery Hierarchy (Figure 10-1) prioritizes actions organizations can take to prevent and divert wasted food. Each tier of the Food Recovery Hierarchy focuses on different management strategies for wasted food. The top levels of the hierarchy are the most preferred methods to prevent and divert wasted food because they create the greatest benefit for the environment, society, and the economy. This hierarchy is used as a tool in implementing an approach to food waste management.

Figure 10-1: Food Recovery Hierarchy



Source reduction (e.g., smart purchasing), feeding hungry people (e.g., food donation) and feeding animals, are the highest priorities on the hierarchy. However, diverted food waste is most commonly processed at composting facilities. High-quality compost is a valuable product that enriches soil, helps retain soil moisture, minimizes erosion, promotes heathier plant

[80] US Department of Agriculture, *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States.* 2010 Economic Research Service.

growth and creates higher resistance to diseases and pests. Using compost can reduce the need for chemical fertilizers.

There are private companies providing food waste collection and composting services in the North Central Texas region, but it is unknown if they are providing services to any commercial entities in the City and how many customers they service.

The City is developing a program to support commercial organics recycling with the funding from a grant provided by the United States Department of Agriculture (USDA) that will target special events and food service establishments. The City is in the process of procuring an organics collection and processing service provided to collect material from businesses and events on a pilot basis. This material will be processed by the collection contractor and the finished product is intended to be used at the Dallas County gardens. This program in partnership with Dallas County increases to support its healthy food initiative.

A key consideration related to diverting organic materials that are currently disposed is collecting data to provide an understanding of the existing recycling levels. Leveraging and expanding on the City's existing programs to collect data from food service entities is further discussed in Section 11.0.

10.1.3 Processing Infrastructure

Organics processing infrastructure is a critical component of recycling organic materials. Further information about composting facilities in the region and the SS WWTP located in the region are provided in Section 4.0. The varying generators, types and processing needs makes it challenging to recycle on a comprehensive basis. Each material type may require various screening or pre-processing before it becomes compatible with the infrastructure that can convert it to a product that does not require landfill disposal. For example, brush material collected by City crews would need to be mechanically screened before or after any composting or mulching operation to ensure that the product could be utilized by other City departments or sold. Additionally, if City collection crews separately collect brush the transfer station system does not have the capacity to separately store or transfer brush material as a fourth material stream (refuse, recycling, bulky items and clean brush). With limited available processing infrastructure within 20 miles of the City, the need to consolidate material for transfer becomes even more critical.

Currently, clean brush and yard trimmings delivered by customers at the Landfill are ground for volume reduction and are used as part of disposal operations on an as-needed basis. If the existing organic material delivered to the Landfill were to increase by the estimated tonnage of brush material that could be separately collected by City crews (approximately 69,000 tons per year), the storage and processing requirements would exceed the designated space at the Landfill. As part of the 2011 LSWMP analysis, composting brush

material separately collected by City crews was estimated to require about 50 acres for windrows, not including storage space for unprocessed material, finished material or equipment storage.

10.2 Generation and Recycling Potential

Organic materials represent a significant fraction of the material that is currently generated and disposed in the City and is the "low hanging fruit" of material that the City is targeting to meet its recycling goals. Table 10-2 presents the FY 2021 and FY 2040 projected City and non-City collected tonnages delivered to Landfill by material type.

Table 10-2: Projected FY 2021 and FY 2040 City and Non-City Collected Tonnages

Material Type	FY 2021 Tons	FY 2040 Tons
City Collected		
Refuse	289,257	343,772
Brush and Bulky Items	153,041	181,884
Subtotal	**442,298**	**525,656**
Non-City Collected		
Refuse	953,478	1,133,174
C&D	177,025	210,388
Other	4,256	5,059
Subtotal	**1,134,760**	**1,348,620**
Total[1]	**1,577,058**	**1,874,276**

1. Totals may not sum exactly due to rounding

Table 10-3 calculates the fraction of the City and non-City collected tons of organic materials currently disposed at the Landfill that could be diverted through organics processing.

Table 10-3: Estimated FY 2021 and FY 2040 Divertible Organics Tonnage

Divertible Organics Material Type[1]	Percentage of Materials Disposed[2]	Estimated Divertible Tons	
		FY 2021	FY 2040
City Collected			
Refuse			
Non-recyclable paper	11.5%	33,163	39,413
Yard Waste	5.6%	16,081	19,112
Wood (non-C&D)	0.2%	589	699
Food Waste	26.2%	75,881	90,182
Other Organics	16.1%	46,634	55,423
Subtotal	**59.6%**	**172,348**	**204,829**
Brush and Bulky Items			
Brush and Yard Trimmings	45.0%	68,869	81,848
Subtotal	**45.0%**	**68,869**	**81,848**
Non-City Collected			
Refuse			
Non-Recyclable Paper	11.1%	105,836	125,782
Yard Trimmings, Brush, and Green Waste	3.2%	30,511	36,262
Food and Beverage Materials	18.5%	176,394	209,637
Subtotal	**32.8%**	**312,741**	**371,681**
C&D			
Drywall/ Gypsum	3.9%	6,904	8,205
Yard Trimmings, Brush and Green Waste	3.3%	5,842	6,943
Wood Packaging	2.7%	4,780	5,680
Scrap Lumber	7.4%	13,100	15,569
Subtotal	**17.3%**	**30,625**	**36,397**
Other	**100.0%**	**4,256**	**5,059**
Total		**588,839**	**699,814**

1. Divertible organics material types include materials that would be able to be diverted if it were separated, hauled, and processed as feedstock for composting or anaerobic digestion, and does not include recyclable materials (e.g., clean paper) that is collected as part of the existing recycling program.
2. The brush and yard trimmings percentage is based on the estimated volume of brush and yard trimmings compared to bulky items during the separated collection pilot. Observations at the transfer stations indicate brush percentage may be higher at times, but 45 percent is used as a conservative estimate for planning purposes. Non-City collected refuse and C&D compositions represent aggregated percentages from multiple waste compositions, as described in Sections 3.5.1 and 3.5.2.

The tonnage of City and non-City collected organic material that could potentially be diverted is estimated at about 588,000 tons and is projected to rise to about 670,000 tons by 2040. The projections do not take into account significant behavior change that would reduce the tons per capita generated. The tonnage of non-City collected material disposed at the Landfill represents a significant opportunity to increase recycling, if there is sufficient infrastructure to effectively capture and divert this material. Table 10-4

shows the FY 2021 tonnage of organic materials that could be diverted if they were captured for organics processing at 20, 40, 60 and 80 percent.

Table 10-4: FY 2021 Potential Divertible Organic Materials by Capture Rate Efficiency

Material Type	Capture Rate Efficiency			
	20%	40%	60%	80%
City Collected	48,243	96,487	144,730	192,973
Non-City Collected	69,525	139,049	208,574	278,098
Total	**117,768**	**235,536**	**353,304**	**471,071**

These divertible tonnages, ranging from about 118,000 to 471,000 annually depending on the capture rate, represent the recycling potential of the organic fractions of City and non-City collected tons that are delivered to the Landfill. This demonstrates the order of magnitude of recycling potential from organic materials currently delivered for disposal at the Landfill.

While the existing processing facilities owned and operated by the private sector in the region are operating at or near capacity, given the anticipated population growth and emphasis on recycling of organic materials there is an interest to develop a new facility that could potentially accept the City's separately collected brush or future source separated food waste which could be located at the Landfill or a separate site.

There are various technologies for processing organic materials that each have different minimum requirements related to inbound feedstock composition, facility footprint, and output. Table 10-5 provides describes select organics processing technologies for both wet and dry organic waste.

Table 10-5: Organics Processing Technologies

Organics Processing Technologies	Description	Example
Aerated Windrow Composting	Outdoor windrow composting able to accept green waste, biosolids, fats, oils, greases and animal by-products. Food waste can be incorporated, but requires specific infrastructure requirements (runoff control, odor control) to minimize challenges related to moisture content, odor and vector control. Windrows are turned mechanically, and material must be screened of contaminants (either before or after composting) to ensure that it meets market specifications.	

Aerated Static Pile Composting	Composting operation similar to windrows that utilizes perforated piping to provide air circulation for controlled aeration of the material. Composting piles do not require mechanical turning, but material must be screened of contaminants (e.g., cannot accept fats, oils greases, or animal by-products) either before or after composting to ensure that it meets market and TCEQ specifications.	
In-Vessel Composting	Composting operation in a fully enclosed concrete systems that can be incorporated into a building or used as individual enclosed vessels that may be moved. This composting method offers complete process control over temperature, aeration, odors, and leachate. In-vessel composting produces a finished product faster than other methods but has a higher capital cost but lower operating cost because of the automated system.	
Dry Anaerobic Digestion	Anaerobic digestion designed to manage organic materials managed in solid waste collection systems, as opposed to wastewater collection systems. These "garage-style" digesters accept green waste, biosolids and food waste and degrade material to create biogas that can be used to generate electricity, fuel for boilers or furnaces, pipeline quality gas or compressed natural gas that can be sold as a vehicle fuel. Digestate material must be screened of contaminants before it is cured or used as soil amendment.	
Wet Anaerobic Digestion	Anaerobic digestion designed to manage organic materials in wastewater systems. These systems are typically installed in existing wastewater treatment plants and can accept material that has been macerated and is pumped into the system. Biogas is generated from these systems and can be used in the same way as dry anaerobic digestion systems. Digestate material must be screened of contaminants before it is cured or used as soil amendment. AD and in-vessel systems can be co-located to process by-products.	

The NCTCOG is in the process of developing a study that will identify future pilot projects throughout the region to divert residential and commercial food waste and wastewater biosolids and to generate Renewable Natural Gas (RNG) as a source of vehicle fuel. This study will utilize research from University of Texas at Arlington's (UTA) Center for Transportation Equity, Decisions and Dollars (CTEDD) and its POWER model.

The City worked with UTA in the past to use the POWER model to evaluate scenarios for adding anaerobic digestion to its system including (1) installing AD capacity at the Dallas Central WWTP and using the exiting AD capacity at the SS WWTP; and, (2) expanding the capacity of the SS WWTP existing AD

capacity. The results indicated that the existing digesters at the SS WWTP would not be large enough to process the volume of food and yard waste that could be separately collected and that the material would need to be preprocessed through a grinder. [Insert description/results of Dallas iteration of the POWER Model, if available]

10.3 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or programs. Additionally, this section identifies any fundamental changes that have been related to programs, policies or forecasts as it relates to the organics management.

Table 7-13 lists the recommendations from the 2011 LSWMP related to organics management with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 10-6: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress To Date	Potential Next Steps
Provide separate collection for organics.	There has been limited progress toward implementing source separated collection for organics beyond separate brush collection as part of the City's collection operation.	Continue efforts to divert brush and yard trimmings, then consider separate collection and processing of food waste from residential customers.
Implement C&D diversion ordinance.	There has been no progress toward implementing a C&D diversion ordinance.	Policy considerations related to future ordinance development for C&D materials are a long-term consideration, but is less of a priority than other policy initiatives evaluated as part of the LSWMP Update.
Develop resource recovery park.	The City evaluated the development of a resource recovery park and moved forward to develop the FCC MRF in a public-private partnership.	The development of a resource recover park is a longer-term consideration that will be considered after maximizing the options available utilizing existing infrastructure.
Develop mixed materials processing facility.	The City evaluated the feasibility of a mixed waste processing facility and decided not to implement based on cost.	The development of a resource recover park is a longer-term consideration that will be considered after maximizing the options available utilizing existing infrastructure.

A composting analysis of source separated organics had been completed as part of the 2011 LSWMP including an evaluation of the available feedstocks, site capacity, and throughput analysis. This analysis assumed that a City-owned and operated composting facility would receive separated brush and yard

trimmings from residents, brush and yard trimmings from private haulers and biosolids generated by DWU totaling about 82,500 tons per year (or 372,000 CY per year).

The site of this facility was planned to be on cells 8 through 14 within the disposal footprint of the Landfill, totaling about 100 acres. A total of 58 acres would be used to locate 240 windrow piles that and the rest of the land would be developed into the requisite infrastructure (e.g., scale, entrance/egress roads, etc.). The 2011 LSWMP notes that not all of the 100 acres would be viable for a composting facility because it is prone to flooding.

Based on the throughput analysis, this sized facility would be able to process the inbound material in three to six months. Although the brush, wood, yard trimmings and biosolid inputs would have a high carbon to nitrogen ratio, the facility would be viable and would produce about 185,000 CY of compost product per year. If higher nitrogen feedstocks were added (e.g., food waste), the facility could produce up to 250,000 CY of product per year.

While the technical components of this analysis still hold true, utilizing cells 8 through 14 of the disposal area of the Landfill would not be feasible because those cells are required to manage the expected future inbound disposal tonnages. Additionally, the analysis assumed that a separate brush and bulky item collection program would be in place and while the City is working to establish this program, it is not currently in place. Further discussion related to separate brush and bulky item collection is provided in Section 7.0.

Another assumption of the analysis was that material would be able to be transferred and direct hauled to a future composting site; however, the transfer station system is not able to store or process organic material outside and has limited space in the transfer buildings to receive separated brush or other organics. In the past, semi-clean loads of separated brush had been stored outside but this could not continue on a consistent basis unless the material were stored under cover, on top of a pad, and the sites were configured to manage runoff from the material. Further discussion about the capability of the transfer station system to manage organic materials is provided in Section 5.0.

10.4 Case Studies

This section provides overviews of practices that have been incorporated by municipalities in the region and nationally related to organics management for the City's consideration and to inform the options evaluation that follows. The case studies are presented by topic and organized as follows:

- Source reduction initiatives
- Organics collection and processing
- Organics disposal bans

10.4.1 Source Reduction Initiatives

Source reduction initiatives the most effective approach to diverting material from disposal and minimizing the resources required to manage material. The Natural Resources Defense Council (NRDC) developed a campaign to raise awareness about the economic and environmental impacts of wasted food and encourage Americans to take easy and actionable steps to reduce food waste in their homes. The Save the Food campaign provides all materials for free on their website to partnering organizations and has distributed a series of public service announcements and other tips and tools to help consumers take action. More information related to the Save the Food campaign can be found at www.savethefood.com, where visitors can learn how to better plan, store, and cook their food.

There are several resources additional available in the region including the following:

- The U. S. EPA has several great resources available to share with businesses including a food waste audit tool, safety regulations and guidance for food donations, and a legal guide for feeding animals leftover food[81].
- FoodSource DFW is a nonprofit organization that strives to reduce waste and distribute food and resources to people and families in need[82].
- Melissa Feeders is a family-owned company specializing in all areas of the beef and dairy beef industries that uses food waste for animal feed[83].

Another key initiative related to source reduction is backyard composting so that organic materials are not disposed in the waste stream. Since 2010, Johnson County, Kansas has supported a backyard composting program for residents. For the first three years, the program included selling heavily discounted compost bins. The program also includes hosting educational classes and attending community events. The Johnson County partners with their local extension office through Kansas State University to develop backyard composting guidance and provide education and outreach to the community. The backyard composting program won an award from the local regional planning agency for the significant number of individual participants it has reached with its message through classes, events, and compost bin sales. Additionally, the effort to promote backyard composting supports the yard waste disposal ban in place in Johnson County.

[81] https://www.epa.gov/sustainable-management-food/tools-preventing-and-diverting-wasted-food
[82] https://www.foodsourcedfw.org/
[83] http://www.melissafeeders.com/environmentalstewardship/valueaddedfeeds.html

10.4.2 Organics Collection and Processing

The ongoing NCTCOG Know What to Throw campaign to increase recycling and decrease contamination in the region has been active for about two years. The NCTCOG is considering how to build on this effort to support municipalities to increase the amount of organics that are diverted from landfill in the region.

Several peer cities separately collect and compost yard waste material including Fort Worth, Plano, McKinney and Frisco. This material is processed among the available processing facilities in the region including at the 121 Landfill where it is sold as Texas Pure Products compost and at Fort Worth's Southeast Landfill where Living Earth processes the material where it is sold or provided back to the City on a discounted basis. A key challenge with these processing facilities is that they are operating near capacity and are not designed to take wet organics (e.g., food waste). Additionally, the area of the Southeast Landfill where Living Earth processes yard trimmings is in the disposal footprint of the facility and will eventually need to be moved when that area becomes an active disposal cell.

Other cities in Texas collect and process food waste from residential customers including the cities of Austin and San Antonio. Austin implemented curbside composting collection of food scraps, yard trimmings, food-soiled paper, and natural fibers from single-family residential customers in phases over four years. The final expansion of the program was recently completed, and all customers have been provided 48-gallon organics collection roll carts for collection on a weekly basis and is a key part of Austin's pay-as-you-throw system, where customers can separate organics for collection and downsize the size of their refuse roll cart. Organics collected are delivered to the Hornsby Bend facility for processing into compost product.

San Antonio has a comprehensive curbside collection organics program. Residents are provided a green cart (96- or 48-gallon) for items that can be composted into nutrient-rich material that is made available back to the community. San Antonio accepts all food waste (pre- and post-consumer), non-recyclable paper, and yard waste in their collection cart for composting. Materials may be either loose or placed in paper bags in the cart. When unaccepted items (contamination) are in the green cart, the material is landfilled and customers incur a fee. Fees are collected through the resident's utility bill and most violation fees are $25-50. In 2020, participation in this program helped divert 70,000 tons of material from the landfill where it is composted by Atlas Organics, San Antonio's contracted processing facility operator.

There are also efforts to divert organic materials from commercial sector generators by processing material at wastewater treatment plants with anaerobic digestion technology and available capacity. The business unit of Insinkerator called Grind2Energy develops programs to service commercial customers that generate high quantities of food waste. The Grind2Energy program installs commercial-grade macerator equipment and holding tanks on site where food waste is mechanically processed and stored. Then, vacuum trucks are deployed to service the holding tanks and are delivered to local wastewater treatment facilities with

anaerobic digestion processing capacity. Insinkerator has developed and deployed these programs for many institutional and commercial customers in the northeastern and midwest regions of the U.S. such as Notre Dame College, Emory College, University of Illinois, Ohio State University, Whole Foods grocery, J.D. Smuckers, AT&T and the Omni Hotel Group.

10.4.3 Organics Disposal Bans

Increasing recycling of organic material types by banning disposal is a policy/regulatory approach that has been proven to increase recycling. Arlington, TX implemented a yard waste disposal ban in 1993 as a program that is not included in its municipal code. The City's program, also known as "Don't Bag It," encourages households to leave grass clippings on the lawn and prohibits grass disposal with refuse. Grass clippings mixed with household waste are not collected. The City educates residents on the natural benefits that grass clippings can have on their lawn and how to set up backyard composting systems.

In 2014, the state of Massachusetts passed a state-wide ban to reduce the disposal of commercial organic waste. The law requires any business or institution which disposes of one ton or more of food waste per week to divert it through donations, feeding animals, composting, or anaerobic digestion. A total of 1,700 businesses and institutions were impacted by the ban. Two years after the implementation of the law, the total reported recycling of food waste was 260,000 tons. In 2017 the Massachusetts Department of Environmental Protection released an economic impact analysis on the commercial food waste ban which found that in two years the commercial food waste ban created more than 900 new jobs, and $175 million in economic activity resulting from more composting facilities, food rescue organizations, and waste haulers to keep up with demand[84]. Based on the success of the law, the state is lowering the threshold of the ban so that it applies to businesses and institutions generating one-half ton or more food waste per week, effective November 1, 2022.

Despite the success of the disposal ban, there have also been some unintended consequences through increased nutrient pollution from composting facilities. Some facilities are discharging nutrient rich leachate into local waterways, causing water quality impairments in local communities. Leachate samples collected from one composting facility showed very high total nitrogen concentrations[85]. This highlights the need for clear standards and oversight on composting facilities to protect water quality and conservation efforts.

[84] "Massachusetts Commercial Food Waste Ban Economic Analysis." ICF. 11/14/2016. https://www.mass.gov/files/documents/2016/11/vz/icfrep.pdf

[85] More information on the State of Massachusetts' organics disposal ban is provided at the following hyperlink: https://www.epa.gov/snep/composting-food-waste-keeping-good-thing-going

Recently, several laws and ordinances have gone into effect to divert food waste and other organics from landfill. The most notable is California's SB 1383 law, which requires that 75 percent of all organic waste streams be diverted from the landfill by 2025. Also, in effect as of January 1 are New York State's Food Donation and Food Scraps Recycling Act and Hennepin County, Minnesota's food waste recycling ordinance[86].

The New York State law requires businesses and institutions that generate an annual average of two tons of wasted food per week or more to donate excess edible food, and recycle all remaining food scraps if they are within 25 miles of an organics recycler (composting facility, anaerobic digester, etc.). In Hennepin County, all cities are required to make curbside organics recycling service available to all households, through Ordinance 13. Cities with 10,000 residents or less will be given the additional option to meet the ordinance requirement through a drop-off location(s).

10.5 Options Evaluation

This section analyzes a series of options related to organics management that have been identified based on analysis of recycling potential from these sectors, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and case studies.

The following summarizes the key takeaways from the community survey and other outreach activities conducted as part of the LSWMP Update. Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

- 35 percent of respondents indicated that they currently separate organics from their garbage to divert the material from disposal through methods such as backyard composting, subscription services for food scraps collection or drop off at local farmers markets.
- If the City were to develop a separate organics collection program, 53 percent of respondents indicated they would support separate yard trimmings collection in a City-provided cart and 45 percent indicated they would support comingled food and yard waste collection in a City-provided cart.
- 45 percent of respondents indicated they would participate in a comingled food and yard waste collection program, but about the same percentage of respondents indicated they would need more information about the program before they would participate. About 70 percent of respondents

[86] "Organics Recycling Truisms." Biocycle Magazine. 1/25/22. https://www.biocycle.net/organics-recycling-truisms/

indicated they would support a monthly rate increase of at least $1.00 for the City to establish an organics recycling program.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Expand source reduction efforts.** Presents options to expand the source reduction efforts by emphasizing the backyard composting and other existing food donation programs and leveraging NCTCOG resources to increase the reduction of organic wastes.
- **Increase organics processing capacity across operations.** Evaluates the requirements and impacts to increase organics processing capacity across the City's existing infrastructure and operations.
- **Leverage public-private partnership for third-party composting.** Describes the opportunity and impacts to establish a public-private partnership with a third-party organics processing operator and/or facility.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 10.6 to support the key findings, recommendations and implementation and funding plan.

10.5.1 Expand Source Reduction Efforts

Overview. As part of this option, the City would increase the promotion of source reduction of food waste and yard trimmings by increasing awareness and understanding of existing programs that customers can participate in and offer technical assistance to expand promotion of these programs. Promoting source reduction of yard waste includes encouraging residents to mulch grass clippings and leaves and leveraging existing Code Compliance Department inspections to evaluate commercial food service purchasing practices and collect data related to organic material generation. There are organizations promoting backyard composting that the City can leverage as resources to increase the promotion of this source reduction technique including the State of Texas Alliance for Recycling (STAR), which serves as the statewide administrator for the Texas-based Master Composter programs and can provide resources and technical assistance to communities hosting Master Composter training events. Texas A&M AgriLife Extension also provides research-based information and educational materials as well as classes on backyard composting. The City could also promote resources for food donation such as programs developed by North Texas Food Bank.

Recycling potential. Reduction of organic material minimizes the amount of organic material that enters the waste stream and allows processing facilities in the region to accept more organic materials, providing the capacity to divert more organic materials from disposal.

Operational impact. Since the City is already resource constrained with its existing programs, emphasizing backyard composting and leveraging existing Code Compliance Department inspections or technical assistance programs will minimize the resources required to introduce new organics recycling or data collection programming in the future resulting in a low operational impact.

Financial impact. Increasing the promotion of existing programs and leveraging technical assistance opportunities would have minimal financial impact to the City.

Environmental impact. Reducing the generation of organic material for disposal or processing has the greatest environmental impact, because it minimizes the resources required to manage, collect, process and/or dispose organic materials. This results in a significant reduction in vehicle emissions and/or point source emissions from composting operations, eliminates methane emissions if the material were landfilled and therefore has a low environmental impact.

Policy impact. There is minimal policy impact to leverage the existing programs to encourage more backyard composting and food donation. Code Compliance Department inspections may need to adjust their data collection procedures.

Stakeholder "buy-in". There is a high level of stakeholder "buy-in" related to this option, where residents and commercial entities support minimizing food waste and donating materials.

Compatibility with existing programs. This option is highly compatible with existing programs including ongoing education and outreach efforts and Code Compliance Department inspections.

10.5.2 Increase Organics Processing Capacity Across Operations

Overview. As part of this option, the City would increase the capacity to receive and process organic materials such as yard trimmings, brush and food waste among the transfer station system, wastewater treatment plants and Landfill. Currently the transfer station system is not able to separately manage organic materials because of a lack of space in the transfer buildings and inability to store organic materials outside without developing a dedicated cover or pad. While the SS WWTP plant has capacity and ability to process organic materials through its anaerobic digestion system (reference Section 4.1.4.2), the facility is not designed to accept material from solid waste collection vehicles and food waste must be ground to a slurry

and pumped into the system. Currently, there is a brush grinding operation at the Landfill but it does not have the space or processing capacity to manage the volume of material from a separated brush and bulky item collection program. Additionally, even if material were able to be processed at the transfer stations or Landfill, the City would need to overcome the challenge of developing a clean product that could be reliably sold to market.

Recycling potential. Expanding the organics processing capacity across operations among the transfer station system, SS WWTP and Landfill would increase capabilities of the City's existing facilities and would increase the ability to realize the high recycling potential of organic materials. Table 10-7 shows the recycling potential of organic materials if processing capacity were expanded across operations to accept separately collected brush and yard trimmings and source separated green waste and food and beverage material from commercial generators.

Table 10-7: Recycling Potential Based on Increasing Organics Processing Across Operations

Divertible Organics Material Type[1]	Percentage of Materials Disposed[2]	Estimated Divertible Tons	
		FY 2021	FY 2040
City Collected			
Brush and Bulky Items			
Brush and Yard Trimmings	45.0%	68,869	81,848
Subtotal	**45.0%**	**68,869**	**81,848**
Non-City Collected			
Refuse			
Yard Trimmings, Brush, and Green Waste	3.2%	30,511	36,262
Food and Beverage Materials	18.5%	176,394	209,637
Subtotal	**21.7%**	**206,905**	**245,899**
Total[3]		**275,773**	**327,747**

1. Divertible organics material types include materials that would be able to be diverted if it were separated, hauled, and processed as feedstock for composting or anaerobic digestion.
2. The brush and yard trimmings percentage is based on the estimated volume of brush and yard trimmings compared to bulky items during the separated collection pilot. Non-City collected refuse and C&D compositions represent aggregated percentages from multiple waste compositions, as described in Sections 3.5.1 and 3.5.2.
3. Sums may not calculate exactly due to rounding.

If the transfer station system was able to manage and transfer separately collected brush to a composting facility and the SS WWTP were configured to pre-process and accept organic materials from commercial generators, this would increase the recycling potential of the system by about 276,000 tons in FY 2021.

Operational impact. There would be a high operational impact to the City to expand the organics processing capacity. The transfer station system would require capital improvements and adjustments to permits to be able to accept, transfer and/or process brush collected by City crews. The SS WWTP does

have additional capacity to accept material, but the infrastructure is not designed to accept material delivered by solid waste collection vehicles; therefore, there would need to be capital upgrades to the site to develop the roadways so vehicles hauling organic materials could enter and staff would need to direct them to locations that are developed to either deposit material for preprocessing on site, or pump slurry that has been preprocessed off-site into the anaerobic digestion system. At the Landfill, space would need to be dedicated to receive loads of clean brush material from transfer trailers, Sanitation Department vehicles, and third-party haulers. Additionally, staff would need to be hired and equipment purchased to manage inbound organic materials and packaging or transporting finished product to market.

Financial impact. There would be a high financial impact to increase the capacity of organics across the operations given the capital cost requirements to establish or upgrade the transportation and processing infrastructure at among the transfer station system, SS WWTP and Landfill.

Environmental impact. If the City expands the organics processing capacity there would be significant potential to increase recycling there would be a low environmental impact. Since this organic material is currently hauled for disposal, the adjustment in hauling requirement would have negligible environmental impact and be significantly outweighed by the positive impact of diverting the organic materials from disposal.

Policy impact. There would be moderate policy impact related to accepting organics for processing at the transfer station system and SS WWTP, and low policy impact related to accepting organics at the Landfill. Currently the City is not able to store brush material among the transfer station system and would need to amend its permit to expand its operations. Additionally, the City does not accept organic materials from the solid waste stream at the SS WWTP.

Stakeholder "buy-in". There is a mixed level of stakeholder "buy-in" related to this option because although it would support increasing recycling, the capital and operational requirements to upgrade the transfer station system and SS WWTP may interrupt existing operations, causing challenges to manage the current stream of materials.

Compatibility with existing programs. At the transfer station and SS WWTP there is low compatibility with existing infrastructure, operations and programs. Conversely, at the Landfill there is already a brush grinding operation that could be leveraged to phase in a more robust composting operation.

10.5.3 Leverage Public-Private Partnership for Third-Party Composting

Overview. As part of this option, the City would contract with a third-party composting operator to accept separately collected brush and yard trimmings. Entering into a public-private partnership could take the form of hauling and transferring material to an existing composting facility in the area, or working with a

company to develop a new facility. Appendix A shows the existing organics processing facilities in the region and Section 4.2 provides further discussion of public-private partnerships. Table 10-8 shows the potential arrangements for entering into a public-private partnership for third-party composting.

Table 10-8: Public-Private Partnership Options for Third-Party Composting

Responsibility	City-Owned with Private Operations	Privately Owned and Operated on City Land	Privately Owned and Operated on Private Land
Agreement Type	Design, Build, Operate and Processing Agreement	Land Lease and Design, Build, Operate and Processing Agreement	Processing Agreement
Land Ownership	City	City	Private
Capital Investment	City	Private	Private
Operations	Private	Private	Private
Marketing	Private	Private	Private

Based on discussions with private-sector processors in the region, the City would need to deliver a minimum of about 40,000 CY of material that contains less than five percent contamination to meet private-sector operators needs to establish a cost-effective operation. Additionally, the City could partner with interested parties to develop a new facility by offering land where operations could take place, either at the Landfill or in other areas of the City. Based on discussions with private-sector processors in the region, there is an interest to partner with municipalities to develop new organics processing operations.

Recycling potential. Establishing a public-private partnership to deliver organic materials would have a high recycling impact, depending on the quantity of material that a third-party processor could accept and the type of material that could be accepted. If the processor only accepts brush and yard trimmings there would be less potential than if they could accept food waste as well.

Operational impact. There would be minimal operational impact to establishing a public-private partnership because the private-sector operator would manage operations even if the City provides land as part of the agreement.

Financial impact. There would be a medium financial impact to establishing a public-private partnership to process organics because the City would need to pay a tip fee to deliver or transfer materials but would not need to provide staffing to operate the facility or market material. Based on other public-private partnerships in the region, tip fees range from $15-$30 per ton and vary based on the quantity of material delivered and other components of the public-private partnership. To leverage a public-private partnership utilizing space at the Landfill, the City would need to devote resources to maintain the continuity of operations during construction and provide staff to direct material to the composting site.

Environmental impact. There would be low environmental impact to establishing a public-private partnership for third-party composting, since that material would be diverted from disposal. Since this material is currently hauled for disposal, the adjustment in hauling requirement would have negligible environmental impact and be significantly outweighed by the positive impact of diverting the organic materials from disposal.

Policy impact. There would be no policy impacts to entering into a public-private partnership for third-party composting services.

Stakeholder "buy-in". There would be moderate stakeholder "buy-in" because even though there would be increased recycling, if a facility is established on another site besides the Landfill, there may be backlash from the surrounding community that is opposed to the development of a composting facility near them.

Compatibility with existing programs. There is moderate compatibility with existing programs because currently brush material is not separately collected, but there is a brush processing operation active at the Landfill. The City would need to separately collect brush to effectively engage in a public-private partnership, but could also leverage the existing brush processing operation to expand it into a more robust composting facility.

10.6 Key Findings and Recommendations

This section presents the key findings and recommendations related to program and policy approaches to increasing recycling of organic materials based on the results of the overview, evaluation of case studies and stakeholder engagement. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Further description of the criteria is provided in Section 1.4.3. Table 10-9 summarizes the results of the options evaluation for each of the tactics presented.

Table 10-9: Summary of Organics Material Management Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Expand Source Reduction Efforts							
Increase the promotion of source reduction by increasing awareness of existing programs and offer technical assistance to expand participation in these programs.	●	●	●	●	●	●	●
Increase Organics Processing Capacity Across Operations							
Upgrade the transfer station system to have the capacity to accept brush collected by City crews.	●	●	●	●	▲	●	■
Upgrade the SS WWTP to accept organic materials delivered by third parties.	●	■	■	●	▲	■	■
Establish a composting operation at the Landfill to accept loads of organic materials.	●	●	■	■	●	●	●
Leverage Public-Private Partnership for Third-Party Composting							
Enter into a processing agreement to haul and transfer material to a third-party organics processor under a processing agreement.	●	●	▲	●	●	●	▲
Establish a public-private partnership to develop an organics processing facility.	●	▲	▲	▲	●	●	●

10.6.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

2. **Source reduction and food donation are most important efforts to minimize impacts of organic waste.** The U. S. EPA Food Recovery Hierarchy (reference Figure 10-1) prioritizes prevention and recycling of food waste. Source reduction (e.g., smart purchasing), feeding hungry people (e.g., food donation) and feeding animals, are the highest priorities on the hierarchy and have the most positive impact on the financial and environmental aspects of organic materials management.
3. **Stakeholders are supportive of the City to developing organics recycling programs.** Based on the results of the survey, respondents support the development of separate collection and process of organic materials, and are willing to sustain a rate increase of at least $1.00 per household per month for the increased levels of service and recycling.
4. **The City is establishing a pilot program to minimize, collect and process food from commercial districts.** The City is in the process of procuring an organics collection and processing service to collect organic materials from businesses in a designated district of the City and special events on a pilot basis. The finished compost product will be used by Dallas County in community gardens to establish a closed loop system.
5. **There is significant recycling potential for organic materials that are currently disposed but limited third-party processing capacity to effectively divert materials.** The tonnage of City and non-City collected organic material that could potentially be diverted is estimated at about 588,000 tons and is projected to rise to about 670,000 tons by 2040.
6. **The City's existing infrastructure is not equipped to manage and process organic materials.** The tonnage of non-City collected material disposed at the Landfill represents a significant opportunity to increase recycling, but there is insufficient existing processing infrastructure to effectively capture and divert this material.
7. **Organic material disposal bans are effective policy mechanisms to increasing recycling.** As part of a long-term approach to increasing recycling from disposal, the considering organics disposal bans would support increasing recycling from disposal; however, this policy approach is only effective if there is sufficient processing capacity to manage the material prohibited from disposal. Currently, there is insufficient infrastructure to support such a policy approach.

10.6.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

8. **Emphasize backyard composting, food donation and source reduction programs as part of future data collection and the development of education and outreach programs.** Focusing education, outreach and program development to expand backyard composting and food donation is a critical first step to make the most impact related to recycling from landfill while maximizing existing City resources without requiring hiring more personnel or purchasing more equipment.
9. **Pilot windrow composting project outside the permitted disposal areas of the Landfill for yard trimmings and brush only.** As part of the ongoing considerations to adjust the location of key infrastructure at the Landfill, identify areas that could be used to pilot a windrow composting operation to gauge the feasibility of transitioning the existing organic material processing operation at the Landfill to compost rather than just grind brush and yard trimmings for use by other City departments or Landfill customers.
10. **Engage with private-sector processors in the area to identify the feasibility of developing a public-private partnership.** Reach out to composting operators in the region to identify parties that would be interested in accepting separately collected brush material, developing a new composting facility in the area or operating a composting facility at the Landfill. If there is interest, develop and release a Request for Competitive Sealed Proposals (RFCSP) to evaluate opportunities and identify the best value proposal to determine how the City should move forward to establish processing capacity for separately collected brush and yard trimming materials.
11. **Evaluate the capital cost requirements at the SS WWTP to be able to accept organic materials.** Develop a feasibility study that evaluates the traffic and tonnage flows if the SS WWTP were to accept material delivered by either vacuum trucks or solid waste collection vehicles. The feasibility study should assess the capital and infrastructure upgrades required to effectively receive and manage third-party organic materials.

11.0 MULTI-FAMILY AND COMMERCIAL

Solid waste and recycling management planning efforts categorize the commercial sector into two generator categories – multi-family and commercial. Multi-family properties are occupied by the residential sector; however, waste from these locations is managed similarly to commercial generators and is often comingled with commercial material upon collection. Private sector haulers co-mingle material to increase routing efficiency based on the location of the properties and similar management practices. This section identifies the significant opportunity for the City to drive diversion of the high volumes of divertible material generated from multi-family and commercial generators and details the limitations related existing data reporting and verifications mechanisms. This section presents information and analysis regarding the multi-family and commercial sector.

11.1 Current System Review

11.1.1 Multi-Family Sector

The multi-family sector consists of apartment complexes with three or more units and over half of the residential population of the City resides in multi-family properties. Material from the multi-family sector is not managed the same way as the single-family sector and although a significant amount of refuse, recycling and bulky items are generated, effectively diverting this material presents significant challenges due to the transient nature of multi-family tenants and the diversity of property owners and types.

There are about 1,800 multi-family properties with eight or more units and about 205,600 total units within the City (reference Section 3.1.2) and the current multi-family population of about 698,000 is expected to increase to about 830,000 by 2040.

Ensuring that multi-family residents have equitable access to recycling services is critical to achieving the City's diversion goals; however, material generation and diversion data specific to multi-family dwellings had been unavailable to the City until the 2020 adoption of the MFRO.

Understanding how much material from multi-family dwellings is currently diverted as a baseline is essential to setting realistic diversion goals, and the implementation of the MFRO is a key first step to ensure that as much recyclable material as possible is captured for diversion from multi-family generators.

11.1.2 Multi-Family Recycling Ordinance

As part of the 2011 LSWMP, a key recommendation was to increase access to recycling for multi-family tenants and City staff began working with stakeholders to advance recycling programs at multi-family properties and increase availability of recycling to tenants. City staff engaged with several key stakeholders

in the development of the MFRO to identify the scope of the policy, including the Apartment Association of Greater Dallas (AAGD), Hotel Association of North Texas (HANTx), Building Office Managers Association (BOMA) Dallas, and Texas Campaign for the Environment (TCE).

Based on the reporting of multi-family properties, before MFRO was adopted only 24 percent of properties had registered online for multi-tenant permits[87] indicating that only about a quarter of properties were providing access to recycling service at that time. Additionally, without policy and programmatic support, this would likely not change due to several barriers identified by stakeholders including increased cost, lack of space, and lack of demand from both tenants and property managers. As part of this stakeholder engagement, City staff also explored the option of a commercial recycling ordinance on a parallel track. Further discussion of staff's evaluation and considerations related to a commercial recycling ordinance is provided in Section 12.2.

City staff compared multi-family recycling ordinances implementation from peer cities in Texas including Austin, San Antonio and Fort Worth to identify the covered entities, required materials and capacity, reporting requirements, staffing demand and implementation approaches that would be most effective for the City. Based on this evaluation the City considered phased approaches, targeting high quantity and value material types, allowing exemptions under certain conditions, and annual inspections combined with cross-departmental enforcement support.

The MFRO was ultimately adopted and was implemented on January 1, 2020, covering multi-family complexes of eight units or more. The ordinance provides the reporting mechanism, so the City has the capability to increase access to recycling for multi-family tenants. The ordinance requires that multi-family property managers provide access and contract with private sector haulers to collect and transporting this material to processing for diversion. The management of the MFRO is a collaborative and cross-departmental effort supported among the Sanitation Department, OEQS and Code Compliance to leverage the City's existing multi-tenant permit and inspection program to effectively enforce and implement the program[88]. Specific requirements for multi-family property managers and haulers are outlined in Table 11-1.

[87] Any person who owns, operates or controls a multi-tenant property is required to register at least thirty days before expiration of the prior year's registration or upon taking ownership or control of the property. Additionally, multi-tenant properties must be inspected at least once every three years. For detailed information regarding minimum housing standards please refer to Chapter 27 of the Dallas City Code at the following link: https://codelibrary.amlegal.com/codes/dallas/latest/dallas_tx/0-0-0-11034

[88] More information about the City's multi-tenant registration and inspection program, including the VGOV system can be found at the following link: https://dallascityhall.com/departments/codecompliance/Admin1/ApplyforaPermit/Pages/Multitenantpermit.aspx

Table 11-1: Multi-Family Recycling Ordinance Requirements[1]

Requirements	Multi-Family Property Managers	Haulers
Service Type[2]	• Offer access to either valet, dual stream, or single stream recycling service for tenants. • Use a City-permitted recycling collector for recycling collection service.	• Provide valet, dual stream, or single stream recycling collection services. • Transport recyclables collected to a recycling facility authorized to operate in the State of Texas.
Level of Service	• Provide a minimum capacity of 11 gallons per unit per week. • Provide weekly collection at a minimum. • Collect recycling material consistent with material accepted as part of the City's residential recycling collection program.	• Offer weekly collection of recyclables at a minimum. • Collect recycling material consistent with material accepted as part of the City's residential recycling collection program.
Reporting	• Register the property with the City's Multi-tenant permit and inspection program. • Submit an annual recycling plan along with an affidavit of compliance.	• Apply and receive a recycling hauler permit from the City. • Submit a recycling collector annual report by the February 1 deadline.
Education	• Educate apartment management staff on recycling procedures bi-annually and within 30 days of hire. • Educate tenants on recycling procedures upon move in, biannually, and within 30 days of significant changes in service. • Provide information (poster, signs) in common areas of the property.	• Educate multi-family property managers on recycling procedures and the requirements of the MFRO upon contracting and on an annual basis. • Provide color-coded recycling containers with specific signage for multi-family property managers to use onsite.

1. There are no requirements placed on the residents through the MFRO and participation is voluntary.
2. Valet service is collection of refuse or recycling at the customer's door, dual stream recycling indicates that some or all of the materials are stored and collected separately (e.g., glass, metal and plastic collected separately from paper), and single-stream service indicates the recyclable materials can be co-mingled for collection.

The first reports from haulers under the MFRO were due February 1, 2021 for the time period between January 1, 2020 and December 31, 2020. Table 11-2 summarizes the results of the initial reporting provided by permitted haulers on an aggregated basis including the total number of haulers, information about their customer, material collected, number of recycling processing facilities utilized, and the tonnage information reported.

Table 11-2: Aggregated MFRO Reported Information

Description	CY 2020	CY 2021
Number of Haulers	20	14
Service Multi-family and Commercial Customers	12	9
Service Multi-family Only Customers	8	5
Recycling Materials Accepted		
Paper, Plastic, Metal, Glass Containers and Other[1]	4	6
Paper, Plastic, Metal and Glass Containers	9	6
Paper, Plastic, Metal only	4	1
Paper and Plastic only	2	0
Paper only	1	1
Total Processing Facilities	16	13
Total Recycling Tonnage Collected[2]	10,631	68,800
Estimated Multi-family Recycling Tons[3]	7,094	48,773
Percentage of Multi-family Recycling Tons	67%	71%
Average % Contamination Reported[4]	10%	3%

1. Other material includes cartons, Styrofoam or other specific items that haulers accept from their customers.
2. Includes combined recycling tonnage figure from multi-family and commercial customers.
3. As part of the reporting requirements, haulers estimate the percentage of reported recycling tonnage.
4. As part of the reporting requirements, haulers estimate the contamination of material delivered to the recycling processing facility. The average percent of contamination includes haulers that indicated they collected material with zero percent contamination.

Table 11-3 lists the recycling processing facilities and/or companies where haulers reported delivering recycling material collected by multi-family and commercial customers.

Table 11-3: CY 2020 Reported Recycling Processing Facilities

Recycling Processing Facility	Facility/Company Type[1]
Pratt (Denton Landfill)	MRF
FCC	MRF
Waste Management Dallas Metroplex Recycling	MRF
Community Waste Disposal	MRF
Waste Management - Arlington	Commercial MRF
Balcones Recycling	Commercial MRF
Smurfit Kappa	Commercial MRF
Evergreen	Commercial MRF
Premier Waste Services LLC	Commercial MRF
Champion Waste & Recycling Services	Commercial MRF
Strategic Materials	Glass processing facility
Action Metals	Scrap yard and metal recycler
DART Containers	Sytrofoam manufacturer
Echo Fibers	Materials management broker
Federal International	Materials management broker

Bachman Transfer Station	Transfer station
Fair Oaks Transfer Station	Transfer station

1. Commercial MRF indicates the facility does not process recycling generated by single-family residents; materials management brokers indicate that they do not necessarily have a dedicated processing facility but may receive, bale, and market recycling materials.

Based on discussion with MRF and commercial MRF processors in the area, the majority are 60-100 percent utilized, indicating that there is limited available capacity to increase the recycling tonnage that flows to these facilities. Additionally, the facilities are located throughout the City and wider metroplex which may increase the cost to provide recycling service to commercial generators due to longer travel times depending on where customers are located.

The locations of the facilities where permitted recycling haulers deliver material collected from multi-family and commercial customers are spread across the City and beyond, limiting the ability of permitted recycling haulers to take advantage of route density and economies of scale related to the provision of recycling collection service.

11.1.3 Commercial Sector

The commercial sector consists of a wide variety of properties, facilities and business operations. Material from the commercial sector is not managed the same way as the single-family sector and although a significant amount of materials have diversion potential, effectively segregating and diverting this material presents significant challenges due to the broad set of entities and material types in the commercial sector.

There are 1,259 commercial entities within the City representing about 347,500 total employees. Understanding the volume and type of material generated from commercial entities that is currently diverted as a baseline is essential to updating the diversion goals that were previously set in the 2011 LSWMP.

As part of the 2011 LSWMP, a key recommendation was to increase diversion from the commercial sector as part of a potential universal recycling ordinance. City staff began working with stakeholders to advance discussions of a universal recycling ordinance that would support increased diversion from the commercial sector on a parallel track to advance recycling programs at multi-family properties. Additionally, City staff compared commercial recycling ordinances from 12 cities to identify opportunities, constraints and implementation considerations[89].

Based on the research and stakeholder engagement some peer cities have found success by encouraging, but not requiring, commercial recycling while others require single-stream recycling related to primary business operation, along with some C&D and vegetative waste. A key challenge to increasing commercial

[89] "Update on Current Recycling & Diversion Initiatives." Presented to the City of Dallas Quality of Life, Arts & Culture. June 10, 2019.

recycling is limited space or inconvenient configuration of enclosure stalls on commercial properties restricts collection providers.

Most of the benchmark cities allowed for variances for hardships and for facilities that generate small quantities of recyclable and have policy that covers both multi-family and commercial entities as part of the same ordinance. Based on the experience of benchmark cities, a phased implementation is preferable given the total commercial entities and various types of businesses. Key challenges related to adopting and implementing a universal recycling ordinance include the diversity of entities that would be covered, impacts to both front of house and back of house operations, and high demand for education and outreach with no central enforcement authority.

Based on the benchmark cities experiences with commercial recycling and the results of the stakeholder engagement, the City determined to develop the MFRO rather than implement a commercial requirement for recycling or material diversion at that time. The City's intention is to revisit the opportunity to develop policy that drives diversion from commercial sector generators.

11.1.3.1 Generators

Commercial properties include restaurants, retail, offices, schools, hospitals, and industrial facilities and material generated from this sector represents a significant portion of the City's waste stream. While this presents an opportunity for increased waste diversion, there are challenges to ensure that diversion occurs due to the diversity among many different industries and that make up the City's commercial sector. Key industries in the commercial sector are currently regulated by the Code Compliance Department as it relates to obtaining their certificate of occupancy and regular code compliance inspections. All commercial properties are required to obtain a certificate of occupancy before operations can commence. Typically, commercial properties manage solid waste using front-load bins that are kept in enclosures and Code Compliance inspections are focused on confirming that the enclosures and solid waste management practices conform with City code.

The Consumer Health Division of Code Compliance regulates commercial entities that provide food service by health. Entities that are deemed high risk are inspected by the consumer health division of Code Compliance twice per year, and less risky establishments (e.g., serving pre-packaged or non-perishable items) are inspected on a less frequent basis.

Food service entities must also submit a health permit application and the information is updated as necessary as part of routine inspections. During inspections, sanitarians gather information to confirm that the business has the equipment and ability to store and serve food items at the temperature required to prevent spoil and that the material management enclosures are set up to prevent attracting vermin. Based

on discussions with the Consumer Health Division of Code Compliance, there is an opportunity to adjust the inspection or health permit application forms to request targeted information about food surplus donation, food waste recycling or single-stream recycling.

To encourage commercial generators to become more sustainable, the City implemented the Green Business Certification program in 2019, new service offered to businesses to assist and recognize entities that implement programs that prevent waste, incorporate recycling, or promote reuse, reduce, and composting in their business operations[90]. Any business which supports sustainability efforts can be recognized through the Green Business Certification program. To date, 16 businesses have been certified and recognized for their excellence in sustainability. Awardees include a variety of facility and business types including hotels, schools, retail locations, offices, material collection services, and non-profits.

Applicants must submit a form identifying their recycling, education, leadership and policy, transportation, water conservation and energy efficiency efforts. The City provides limited technical assistance to the commercial sector upon request. This includes phone consultation to businesses interested in starting a recycling program, online technical guidance, and downloadable educational print materials. Further discussion of the education and outreach efforts related to the Green Business Certification program are provided in Section 13.0.

The City would like to expand the Green Business Certification program to work with more businesses over time and increase its capabilities to provide technical assistance. This may require increased staff time and result in hiring or dedicating more FTEs to the program.

11.1.3.2 Franchise Haulers

The City transitioned to the current non-exclusive franchise system in 2007 from the previous hauler permitting system[91]. Private sector haulers operating in the City are granted approval to collect and haul material as part of a non-exclusive franchise system. Currently there are 109 franchise haulers operation in the City. As part of the application process, franchise haulers must provide information regarding the number of vehicles, description of service, and liability insurance related to their collection operations. Franchise haulers enter into individual ordinance agreements and are required to submit monthly reports and remit four percent of gross revenues from their collection operations to the City[92]. This revenue flows

[90] More information related to the Green Business Certification program is available here: https://dallascityhall.com/departments/sanitation/Pages/greenbusiness.aspx

[91] The previous system for regulating haulers required annual sticker/decal replacement of approximately 1,000 vehicles and 20,000 containers City-wide.

[92] Franchise haulers submit a Solid Waste Operator Franchisee Monthly Report on a monthly basis that identify the gross receipts during the reporting period. Receipts for disposal fees of solid waste collected in the City and

directly to the City's general fund. Table 11-4 shows the franchise fees received by the City from FY 2018 - FY 2020.

Table 11-4: Historical Annual Franchise Fees Collected

Year	FY 2018	FY 2019	FY 2020
Total Franchise Fees	$4,479,055	$4,746,886	$5,152,897

Franchise haulers are also required to file an annual report to include the following solid waste and recyclable materials collected by the franchisee within the city:

- Total tons of wet and dry solid waste collected, with separate figures for total residential waste and total commercial waste.
- Total tons of recyclable materials collected and recycled, with separate figures for total recycled residential waste and total recycled commercial waste.
- A description and the total tons of each type of material recycled by the franchise.

Franchise haulers operating in the City provide the following services to commercial customers:

- **Refuse and recycling collection.** Franchise haulers service the City's commercial sector typically via front load containers. Recycling is an optional service and is not provided by all commercial haulers. There are currently no requirements for the provision of recycling services to commercial properties although, some properties choose to subscribe to recycling collection services. A limited number of commercial properties are serviced by the Sanitation Department via roll carts.
- **Roll-off collection**. Franchise haulers provide roll-off containers and service them for commercial customers. Roll-off containers may contain a wide variety of materials including C&D material, bulky items, or other organic materials.

Table 11-5 presents the total reports sent to franchise haulers by the City, the total reports returned and the percent reporting from CY 2016 – CY 2020.

disposed at the Landfill, revenues collected for services provided on behalf of the City through a written contract, documented bad debt write-offs due to uncollectible accounts within the City (not to exceed 3 percent of gross receipts) and revenues directly received from the processing of recyclable materials are exempt from the fees due to the City.

Table 11-5: Franchise Hauler Reporting Efficiency

Year	Reports Sent	Reports Returned	Percent Reporting
CY 2020	96	19	20%
CY 2019	99	26	26%
CY 2018	96	60	63%
CY 2017	92	84	91%
CY 2016	74	64	86%

Based on the total number of reports submitted, the reporting efficiency of from the non-exclusive franchise hauler program has declined from 2017 to 2020. Although the reports do include the tonnages of residential (non-City customers) and commercial collected solid waste and recycling, the location of where this material is delivered is not required to be reported. Understanding the flow of the collected material is critical to establishing targets for diversion of material from the commercial sector.

11.1.3.3 Material Types

Similar to the number of generators in the commercial sector, there is a broad set of material types that are generated. The following defines the material types that are generated in the commercial sector, with brief descriptions:

- **Refuse.** Garbage contained in plastic bags similar to the material generated by single-family residents. Refuse generated by the commercial sector also includes bulky items.
- **Single-stream recycling.** Paper, plastic, metal and glass materials similar to the composition of single-stream recycling generated by single-family residents.
- **Organics.** Solid or liquid waste originated from living organism that biologically decomposes such as pre- or post-consumer food waste, grease, non-dimensional lumber wood waste, landscape trimmings, agricultural waste, sewage sludge, manure, textiles, and carpeting.
- **C&D.** Material generated from construction and/or demolition activities including concrete, asphalt paving, asphalt roofing, dimensional lumber, engineered wood, pallets, gypsum board and other inert materials including dirt, soil or rocks.
- **Industrial waste.** Material generated from mechanized manufacturing facilities or treatment facilities including wet and dry process residue, out of spec products, scrap metals, oil filters, and industrial film.

- **Hazardous material.** Material that may not be disposed without prior treatment including hospital and/or medical waste, ash, special wastes[93], electronics, batteries, vehicle and equipment fluids, and tires.

Facilities and business types produce quantities and categories of waste material that vary between industry and business. For example, professional, scientific and technical service businesses may produce material typical of an office setting, where transportation, warehousing and postal service businesses may produce large quantities of cardboard packaging and film wrap. This presents a challenge implementing policy initiatives that require all businesses to recycle, since there is such variability in the way that material is generated and managed across the commercial sector.

11.2 Diversion Recycling Potential

As indicated in the 2011 LSWMP, there is a significant amount of material disposed from multi-family and commercial sector generators and represents a key opportunity for the City to increase the amount of material diverted from disposal each year. Unfortunately, the total amount material generated by the multi-family and commercial sectors cannot be calculated because there is no comprehensive reporting mechanism that requires franchise haulers to report tonnage data to the City. Although there are some reporting requirements as part of the MFRO and hauler permit process (e.g., recycling tons collected from multi-family complexes, refuse tonnage from commercial customers), it does not provide enough information for the City to accurately quantify a baseline figure for what is currently recycled and disposed from each sector and limits the ability to set and work towards its Zero Waste goals. The following sections present information on estimated material generation and diversion potential from the multi-family and commercial sectors.

Accounting for material generated by multi-family and commercial entities is challenging based on the data limitations regarding material that is imported and exported (e.g., material generated in the City hauled to landfills outside the City or material generated outside the City hauled to the Landfill) and the open market for commercial recycling. To support the goals and objectives of the 2011 LSWMP, the City had passed an ordinance in September 2011 mandating that all waste collected inside its borders would be hauled to the Landfill; however, this policy was contested and ultimately removed as part of a legal settlement.

[93] Special waste is a waste that requires special handling, trained people and/or special disposal methods as defined in Title 30 Texas Administrative Code (30 TAC), Chapter 330.

Based on the evaluation presented in Section 3.0, about 70.2 percent of the tons that arrived at the Landfill and FCC MRF in FY 2021 were delivered by non-City customers[94]. Table 11-6 presents the projected FY 2021 and FY 2040 non-City collected tonnages delivered to the Landfill by material type (reference Table 3-4).

Table 11-6: Projected FY 2021 and FY 2040 Non-City Collected Tons

Material Type	FY 2021 Tons	FY 2040 Tons
Refuse	953,478	1,133,174
C&D	177,025	210,388
Contaminated Soil	46,903	55,742
Other[1]	4,256	5,059
Recycling[2]	761	904
Total[3]	**1,182,423**	**1,405,266**

1. Other materials include dead animals, slaughterhouse waste, grit trap grease, and septage waste
2. Recycling materials include bulk metal and other materials delivered to the Landfill and diverted from disposal.
3. Totals may not sum exactly due to rounding

Table 11-7 calculates the fraction of the non-City collected tons currently disposed at the Landfill that could be diverted based on the refuse and C&D composition information presented in Section 3.5.1 and 3.5.2.

Table 11-7: Estimated FY 2021 and FY 2040 Divertible Tonnage

Divertible Material Type[1]	Percentage of Materials Disposed[2]	Estimated Divertible Tons	
		FY 2021	FY 2040
Refuse			
Cardboard	9.2%	87,720	104,252
Office Paper	1.3%	12,395	14,731
Mixed (Other recyclable)	6.7%	63,883	75,923
PET#1	1.7%	16,209	19,264
HDPE #2	1.4%	13,349	15,864
Plastics #3-7	0.9%	8,581	10,199
Plastic Bags & Film Wrap (Recyclable)3	0.6%	5,721	6,799
Ferrous	1.9%	18,116	21,530

[94] As provided in Table 3-4, in FY 2021 the City collected material (including refuse, brush and bulky items, and recycling) totaled 503,095 tons and non-City collected material (including refuse, C&D, contaminated soil, other, and recycling) totaled 1,182,423 tons. The fraction non-City collected material represents 70.2 percent, calculated by dividing 1,182,423 by 1,685,518 (total tons delivered to the Landfill). These tonnages do not represent the total amount of material generated by the multi-family and commercial sector, as there may be material that is generated in the City and exported for processing or disposal outside the City. Also, some of the incoming material to the Landfill is coming from outside of the City.

Divertible Material Type[1]	Percentage of Materials Disposed[2]	Estimated Divertible Tons	
		FY 2021	FY 2040
Non-Ferrous	1.2%	11,442	13,598
Glass	3.9%	37,186	44,194
Yard Trimmings, Brush, and Green Waste	3.2%	30,511	36,262
Food and Beverage Materials	18.5%	176,394	209,637
Textiles	2.7%	25,744	30,596
Subtotal	**53.2%**	**507,250**	**602,849**
C&D			
Concrete/Cement	28.5%	50,452	59,960
Bricks/Cinder Blocks	6.5%	11,507	13,675
Asphalt	5.4%	9,559	11,361
Drywall/ Gypsum	3.9%	6,904	8,205
Cardboard	5.9%	10,444	12,413
Ferrous	5.0%	8,851	10,519
Yard Trimmings, Brush, and Green Waste	3.3%	5,842	6,943
Wood Packaging	2.7%	4,780	5,680
Scrap Lumber	7.4%	13,100	15,569
Subtotal	**68.6%**	**121,439**	**144,326**
Other	**100.0%**	**4,256**	**5,059**
Total		**632,946**	**752,233**

1. Divertible material types include materials that would be able to be diverted if it were separated, hauled, and processed as feedstock for end-users (e.g., paper mill, textile re-grader, metal refinery, etc.).
2. The refuse and C&D compositions represent aggregated percentages from multiple waste compositions, as described in Sections 3.5.1 and 3.5.2. The refuse composition percentages are an appropriate proxy for the composition of the non-City collected material because the figures are based on aggregated residential, commercial, and industrial, composition profiles.

The tonnage non-City collected material that could potentially be diverted is estimated at about 633,000 tons and is projected to rise to about 752,000 tons by 2040. The tonnage of non-City collected material disposed at the Landfill represents a significant opportunity to increase diversion, if there is sufficient infrastructure to effectively capture and divert this material. Table 10-4 shows the FY 2021 tonnage of refuse, recycling and other materials that could be diverted if they were captured at 20, 40, 60 and 80 percent.

Table 11-8: FY 2021 Potential Divertible Tons by Capture Rate Efficiency

Material Type	Capture Rate Efficiency			
	20%	40%	60%	80%
Refuse	101,450	202,900	304,350	405,800
C&D	24,288	48,576	72,863	97,151
Other	851	1,703	2,554	3,405
Total	**126,589**	**253,178**	**379,768**	**506,357**

These divertible tonnages, ranging from about 126,500 to 506,400 annually depending on the capture rate efficiency, represent the diversion potential of non-City collected tons that are delivered to the Landfill. Even if only 20 percent of these material streams were diverted at a MRF or composting facility, it would represent about double the tonnage or City-collected recyclables that are currently diverted. This demonstrates the order of magnitude of diversion potential from these material stream that consist largely of material generated by the multi-family and commercial sectors.

11.2.2 Processing Infrastructure

Processing infrastructure is a critical component of diverting material from disposal. Further information about the processing facilities located in the region are provided in Section 4.0. The different material types generated in the multi-family and commercial sectors may require different types of processing for diversion. For example, to brush material needs to be ground, screened, mulched and/or composted to be diverted and C&D material needs to be processed at a C&D material recovery facility to segregate potentially recyclable materials.

While there are some processing outlets for commercially generated materials (e.g., commercial MRFs, commercial composting facilities, private sector C&D processing facilities), multi-family and commercial generators are not obligated to segregate materials (except for entities covered under the MFRO) for recycling or cause them to be delivered to available processing outlets. There are commercial generators that separate and recycle material, although the City is unable to quantify the total tonnage diverted. Franchise haulers operating in the City do report tonnages of refuse, recycling and other materials collected and diverted, they are not required to indicate where this material is taken for processing. Additionally, the reporting from commercial generators that do not utilize a franchise hauler for recycling (e.g., self-haul, backhaul) would not be captured in these reported figures.

If commercial generators and haulers were required to separate and divert materials, the magnitude of material would likely exceed the available processing capacity in the region given that many existing MRFs in the region are operating at or close to capacity. From Table 11-6, if 20 to 80 percent of the divertible

refuse, C&D and other material currently delivered to the Landfill were separately collected and diverted, the existing collection and processing infrastructure in the region would need to anticipate receiving and processing an additional 126,000 to 506,000 tons each year. Given the limited number processing facilities in the region and challenges securing labor, effectively diverting this material would cause significant strain on the existing MRFs and composting facilities in the region. Further discission related to the processing capacity of the region is provided in Section 11.7.3.

11.3 Evaluation of 2011 LSWMP Recommendations

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or programs. Additionally, this section identifies any fundamental changes that have been related to programs, policies or forecasts as it relates to the multi-family and commercial sectors.

Table 7-13 lists the recommendations from the 2011 LSWMP related to the multi-family and commercial sectors with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 11-9: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress To Date	Potential Next Steps
Provide commercial technical assistance.	The Green Business Certification program is a key first step to providing commercial technical assistance.	Expand the number of certified businesses and increase the program capacity to support technical assistance based on the need of program participants.
Encourage commercial haulers to provide recycling services to all of their customers.	There has been limited progress toward requiring commercial haulers to provide service to their customers.	Increase the City's data collection capabilities to support the introduction of requirements for franchise haulers to provide recycling service to applicable customers and report this to the City annually.
Consider requirements for mandatory separation of recyclables and compostable from trash.	There has been no progress toward implementing requirements for the mandatory separation of recyclables and compostable materials.	Increase the City's data collection capabilities to support the introduction of policy that targets high volume generators of divertible materials (e.g., single-stream recycling materials, organics).
C&D Debris Ordinance.	There has been no progress toward implementing a C&D Debris Ordinance.	While C&D material makes up a significant portion of material disposed in the Landfill, the development of policy to divert this material is a long-term consideration for future infrastructure, policy and program development.

Single-use Plastic Bag Fee	The City passed a plastic bag ordinance in 2015 that required retailers to charge a five-cent fee for the purchase of single-use plastic bags. Unfortunately, the ordinance was repealed based on a ruling passed by the Texas Supreme Court in 2018[1].	While the City will not be able to pass another single-use plastic bag fee pursuant to the Texas Supreme Court decision, the LSWMP Update will evaluate potential opportunities to fund programs in a similar way that the single-use plastic bag fee supported the funding to develop CECAP.
Extended Producer Responsibility (EPR).	There has been no progress toward implementing extended producer responsibilities.	There are several ongoing EPR laws under consideration at other states, the City will work with government affairs resources to identify opportunities to support this type of effort in the Texas State legislature.

1. Further information on the Texas Supreme Court ruling can be found at the hyperlink here: https://dallas.culturemap.com/news/city-life/06-22-18-bag-ban-trashed-texas-supreme-court-ruling/

Based on the diversion estimates presented in the 2011 LSWMP, the City would be able to divert 81 percent and 84 percent of the material generated by the multi-family and commercial sectors, respectively, once all the key initiatives were implemented[95]. As shown in the table above, there has been limited progress on these initiatives and in combination with changes in the policy and recycling market landscapes since the 2011 LSWMP was adopted limit the City's ability to meet these targets.

Without policy directives requiring multi-family and commercial generators to report tonnages disposed and diverted, the City has limited capabilities to identify how much progress has been made toward the diversion goals set as part of the 2011 LSWMP for the multi-family and commercial sector generators. As a result, any recycling currently occurring in the commercial sector is driven by market forces (e.g., individual generators making business decisions to recycle material because it represents a cost savings) and neither haulers nor generators are obligated to inform the City about the volume or processing facilities where material is recycled.

11.4 Case Studies

This section provides overviews of practices that have been incorporated by municipalities in the region and nationally related to increasing diversion from the multi-family and commercial sectors for the City's consideration and to inform the options evaluation that follows. The following sections provide perspective about the following topics, including select case studies, and is organized as follows:

- Technical assistance programs

[95] Diversion estimates from the 2011 LSWMP indicate that upon implementation of all initiatives would result in 539,000 diversion tons and 123,000 disposal tons (81 percent) from the multi-family sector and 1,307,000 diversion tons and 257,000 disposal tons (84 percent) from the commercial sector.

- Hauler permit requirements
- Universal recycling ordinances (UROs)
- Exclusive or zoned franchise systems

11.4.1 Technical Assistance Programs

Technical assistance programs are designed to support commercial or multi-family generation sectors to implement recycling programs, reduce waste generation, and achieve other sustainability-related goals (e.g., water use reduction, environmentally preferred purchasing, etc.). While the City has successfully implemented the Green Business Certification program, there are opportunities to expand the capability of these efforts to provide technical assistance to program participants.

The City of San Antonio has established a business certification and technical assistance program called ReWorksSA to provide the local business community with consultancy, resources, materials, and training at no cost. This program is a joint endeavor between San Antonio's Solid Waste Management Department (SWMD) and the Office of Sustainability (OS), similar to the City's Sanitation Department and OEQS, serves as a promotion and recognition tool for organizations that successfully complete the program and that receive certification as a sustainable business.

ReWorksSA helps local businesses either start or improve recycling programs in the workplace and supports the City of San Antonio's climate initiatives by improving the environmental and economic profile of the business community. The certification process evaluates the number of programs and policies a business has in the areas of recycling, energy conservation, water conservation, travel & transportation and a reduction in multiple types of consumption. Points are awarded for both the number and the effectiveness of the best practices.

Applicants can create an account on a dedicated web portal and review the best practices that are available. City staff conduct an initial assessment with the business before they submit a formal application for certification. After the application is reviewed, businesses are awarded bronze, silver, gold or pinnacle status and certifications are valid for two years. More information related to ReWorksSA is available here: https://www.reworkssa.org/

The City of Plano also provides technical assistance in the form of waste-stream audits, recycling training, and assistance in preparation for Green Business Certification. These value-added services are provided to Plano businesses at no cost. These programs are implemented by a staff of four employees who are each responsible for a defined quadrant of the community. Plano's Green Business Certification (GBC) program was developed to recognize green businesses and is managed by the Environmental Waste Services Division. The GBC program verifies these businesses are upholding a commitment to conduct their daily

practices to reduce the impact on our environment. The program also focuses on a checklist of green operational practices designed for consumer businesses with a walk-in clientele.

11.4.2 Hauler Permit Requirements

Policy approaches that require commercial recycling are implemented to increase recycling efforts and support infrastructure development to separate, processing and divert recycling generated in the commercial sector. As part of the City's non-exclusive franchise system, haulers are required to meet standards and submit reports regarding the number of vehicles, and liability insurance related to their collection operations.

Implementing changes to the franchise hauler registration requirements would provide a mechanism to allow the City to collect data and confirm the capability of franchise haulers to support increased recycling from commercial sector generators. These changes could also include requiring that franchise haulers offer recycling service to customers at a specified price point, support customers to establish a recycling or composting program, or specify that customers must be charged for all services on a single bill (rather than multiple bills for refuse, recycling and/or organics collection).

The City of Boston, Massachusetts has implemented commercial recycling requirements where every hauler operating in the City is required to provide recycling services. The intent of the policy is to ensure that all businesses have access to recycling programs and increase the accountability of haulers to offer recycling to commercial businesses. These policies serve to support Boston's Zero Waste goals and incentivize the infrastructure and program development to divert material from commercial sector generators. Additionally, the policy supports the statewide waste ban of key materials including commercial food material, recyclable materials, and other divertible materials[96].

Haulers are required to renew their permit annually by submitting the following:

- Completed application and registration fee
- Registration number of each vehicle
- Signed waste hauler affidavit certifying compliance with City of Boston ordinance CBC 7-13.8 "Recycling Requirements for Waste Hauler"[97]
- The completed commercial hauler recycling data report

[96] More information on the state of Massachusetts waste ban is provided at the following hyperlink: https://www.mass.gov/guides/massdep-waste-disposal-bans#-about-the-waste-bans-

[97] Failure to offer recycling services under CBC 7-13.8.5, failure to obtain alternate procedure approval from the Commissioner under CBC 7-13.8.5, or failure to comply with the education requirements in CBC 7-13.8.6 shall result in a one hundred fifty ($150.00) dollar fine for the first violation, three hundred ($300.00) dollar for the second violation, and on a third violation the hauler's permit will be revoked by the Commissioner.

The commercial hauler recycling data report requires permitted haulers to provide the total number of commercial customers, the number and percentage of customers that utilize recycling service, the total amount of solid waste and recycling collected from Boston customers and a description of the hauler's education materials related to recycling service.

11.4.3 Universal Recycling Ordinances

A Universal Recycling Ordinance (URO) is a comprehensive policy approach that requires recycling from multi-family and/or commercial generator sectors. This differs from other commercial recycling requirements because it targets generators rather than haulers of recycling material.

The City of Austin adopted a URO in 2010, with the first set of requirements becoming effective in 2012. Implementation was tiered and based on size (square footage) of a business, with larger businesses becoming subject earlier, and smaller businesses becoming covered in later phases of implementation. Austin's URO was fully implemented in 2018 and currently covers 17,000 entities within the City including:

- Multi-family properties (five or more dwelling units)
- Commercial properties (all non-residential properties)
- Food-permitted properties (entities required to have a food service permit)

Austin provides guidance and resources to support owners and managers of affected premises in understanding and complying with the URO through a dedicated URO website and a business outreach team[98]. Affected premises subject to the URO must meet the following requirements:

- **Convenient access to services.** Affected premises are required to provide employees and tenants of the property with access to collection receptacles for single-stream recyclable materials and for organic materials if the property is food-permitted. The URO does not include requirements to provide diversion opportunities to the public (e.g., customers or patrons of the property or business) and does not include requirements for actual diversion of materials or a minimum diversion rate.
- **Collection and diversion.** Access to diversion opportunities for recyclable and organic materials must be provided; however, property owners may choose the method by which materials are collected and diverted such as contracting with a licensed hauler, self-hauling materials, or source reduction (e.g., food donation, backyard composting, etc.)

[98] More information about Austin's URO is provided at the following hyperlink: https://www.austintexas.gov/uro

To comply with the URO, affected premises must meeting a 50 percent recycling diversion minimum by volume or an 85 percent minimum by weight. Multi-family properties must provide a minimum amount of service capacity of per unit per week and food-permitted entities must provide one or more organics diversion options (including waste reduction) to employees. URO organics diversion requirements do not address businesses that generate organic materials (e.g., from landscaping activities) but are not food-permitted businesses.

Generators covered by the URO must also provide education regarding recycling and diversion and submit an annual diversion plan for single-stream or organics that includes the list of materials to be diverted, service capabilities available, and collection methods for diverted material. Annual diversion plans provide a reporting mechanism for Austin to compile data regarding compliance with the URO service requirements. Generally, businesses do not report data on material quantities, so Austin relies on semi-annual hauler reports for material tonnage data. Haulers are required to provide Austin with semi-annual tonnage reports to maintain a hauling license with the City.

Since its implementation in 2012, the URO has driven Austin's progress in increasing diversion activities within the commercial and multi-family sectors and has supported progress toward reaching its Zero Waste goal. However, Austin has faced challenges in data collection and evaluation for both generator- and hauler-provided data. Challenges encountered in URO data collection and evaluation include

- **Large numbers of commercial entities.** Austin's business outreach team is responsible for ensuring compliance from 17,000 commercial entities including engagement, compliance, and enforcement that requires significant investment of staff time and financial resources.
- **Variety in commercial entities.** The types and sizes of commercial and multi-family entities within the City vary widely among needs, available resources and levels of engagement in diversion activities. Due to this variation, a uniform approach to administering URO requirements, reporting, education, and enforcement is not feasible.
- **Self-reporting.** Receiving responsive submissions and maintaining data quality is challenging because businesses self-report, leading to inconsistencies or reporting error[99]. The representative who submits annual reports (such as a property manager) may have limited day-to-day involvement in waste, recycling, and organics management and therefore may not have full knowledge of actual activities, leading to inaccurate reporting.

[99] For example, reporting forms for multi-family properties differ from reporting forms for commercial properties (non-multi-family). In 2019, approximately 15 percent of multi-family properties submitted a commercial property reporting form, resulting in City Staff being unable to calculate service capacity compliance for those properties. Additionally, 349 businesses submitted blank reports.

- **Reporting and data management system.** The City's online and annual report submission was designed to be convenient for commercial properties to encourage compliance with reporting requirements. However, analysis of annual report data is time- and labor-intensive staff and there is not a centralized database for generator-provided data.

11.4.4 Exclusive or Zoned Franchise Systems

The City currently has a non-exclusive franchise system for haulers operating in the City, which has the benefits of allowing customers to select which haulers to contract with. If the City were to transition to an exclusive or zoned (limited) franchise systems, there would be a single hauler or several haulers among designated zones that would be selected to provide service. To transition to this type of franchise system, the City would release a competitive procurement for one exclusive hauler to operate within the City, or define multiple geographic zones and select one or more hauler per zone.

A typical franchise agreement grants rights to a company to haul material from specified properties (i.e., commercial, multifamily) and it sets specific standards, requirements, and responsibilities for the company such as:

- Specifying where materials are to be delivered
- Stipulating the collection services that need to be offered and minimum collection frequency
- Stipulating certain operating details, such as hours of operation, condition of vehicles, condition of containers, etc.
- Enforcing penalties and remedies for poor or non-performance
- Requiring tonnage reporting
- Requesting liability insurance information.

Franchises are commonly established over a long period of time. Contracts typically last for a base period (usually between three and 10 years) and have one or two optional renewal periods. Some long-term franchises may involve an annual renewal fee or a renewal fee every five years. Several municipalities in Texas have exclusive franchise systems covering one or more generators.

The main benefit of a franchise agreement is a standardized collection system and quality of service. The competitive bid process typically results in lower rates, even more so in an exclusive franchise. Other environmental benefits include reducing the number of trucks on the road, reducing wear and tear and associated greenhouse gasses. There are drawbacks to be considered as well. The transition from an open

market system to a franchise system could mean that some haulers are excluded from business opportunities in the City and smaller haulers may not be able to compete with larger providers.

Table 11-10 provides an overview of Texas municipalities with exclusive franchises over the multi-family and/or commercial generators.

Table 11-10: Overview of Texas Municipalities' Franchise Collection Systems and Requirements

Municipality	Commercial Recycling System	Commercial Recycling Participation	Multifamily Recycling System	Multifamily Recycling Participation
Georgetown, TX	Exclusive Franchise	Optional	Exclusive Franchise	Optional
Grapevine, TX	Exclusive Franchise	Optional	Exclusive Franchise	Mandatory
Lewisville, TX	Open Market	Optional	Exclusive Franchise	Mandatory
Allen, TX	Open Market	Optional	Exclusive Franchise	Mandatory

The City of Georgetown, Texas has an exclusive franchise agreement with a contractor to provide refuse and recycling collection services to all commercial and multifamily customers within the city limits. The City's contractor serves approximately 1,000 commercial refuse customer accounts, though in some instances multiple entities may be serviced by a single account. Commercial recycling is an optional service. The City oversees the administrative oversight of billing and customer service for the services.

The City of Grapevine has had an exclusive franchise with a private contractor since 1995 to provide refuse, recycling, and organic material collection for residential, commercial, and industrial customers. Participation in the commercial recycling program is optional. The contractor oversees the administrative duties of billing and customer service and the rates are set with the City. The City charges a franchise fee of 12 percent which has remained the same since the beginning of the contract. The hauler is required to provide monthly reports which includes tonnage, diversion, complaints, and container swaps. Enforcement is performed through a "multi-sector" environmental audit program which selects commercial properties at random for a multi-sector inspection. Typically, 40-50 inspections are completed each year and includes 2-4 multifamily dwellings. Enforcement is also performed through complaint-based reporting by either a tenant or manager.

Outside of Texas, the Cities of New York, NY and Los Angeles, CA developed, or are in the process of developing, zoned franchise collection systems. In New York City, commercial solid waste and recycling services were provided through a highly competitive open market system with 90+ haulers providing a range of services to commercial establishments. New York City's Department of Sanitation (DSNY) and Business Integrity Commission (BIC) found that the open market system resulted in heavy truck traffic and

related inefficiencies and worker safety incidents. Additionally, the open market system had little transparency in customer pricing while a zoned system would provide more predictable pricing for the City's businesses, especially with the City imposing a rate cap. Between 2017-2020 New York City performed stakeholder engagement, environmental reviews and released competitive solicitations, initially for processing and disposal contracts, then for carting services in 2021. The phased transition to the zoned franchise system is underway, and planned to be complete by 2023.

In Los Angeles, commercial solid waste and recycling services were provided through a competitive open market with 144 permitted waste haulers. The City identified the open market system as a challenge to reach its Zero Waste goal as many businesses and multi-family apartment tenants did not receive recycling services through their refuse haulers. As part of the development of an exclusive franchise system, city-wide rate tables were developed to ensure predictable pricing for customers for each service. Recycling costs are embedded in the solid waste service costs, while organics are offered at a discount from solid waste rates. Los Angeles hired six additional FTEs to ensure adequate staffing to develop the franchise system, administer the competitive procurement process, oversee contracts, certify facilities, manage customer care, and conduct field inspections.

The eight exclusive franchise haulers were selected in 2018 and currently service multi-family and commercial generators. The contracts with franchise haulers rely on extensive liquidated damages for nearly all requirements, coupled with intensive City enforcement. Additionally, intensive technical assistance is provided to customers. The exclusive franchise haulers are also required to submit education and outreach plans, conduct regular waste assessments with all customers over the life of the contract.

11.5 Options Evaluation

This section analyzes a series of options related to the multi-family and commercial sectors that have been identified based on analysis of diversion potential from these sectors, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and case studies.

The following summarizes the key takeaways from the community survey and other outreach activities conducted as part of the LSWMP Update.

- 66 percent of the respondents to the multi-family questions of the survey were tenants, and 33 percent were property owners or managers. 90 percent of the property owners/managers indicated they have implemented recycling services at their properties but only 72 percent of tenants indicated that their apartment complex provides recycling collection. 67 percent of respondents indicated multi-family recycling service is provided by dumpster or cart and 21 percent indicated they receive valet service.

- 71 percent of respondents that manage or own businesses in the City indicated they do not participate in the Green Business Certification program, and 58 percent would need more information about the program to determine if they would be willing to participate in the future. 58 percent of businesses receive regular recycling service, and those that do not or only have recycling services provided on an as-needed basis identified constraints including not having enough space to store material hesitation to increase costs or dedicate staff to separate material.
- 57 percent of respondents indicated that they are very supportive of leveraging the Green Business Certification program and 61 percent are very supportive of receiving technical assistance as compared to increasing. Businesses were much more opposed to more mandatory requirements, where 46 percent of respondents were very opposed to increased reporting requirements and 43 percent were very opposed to recycling requirements.
- Franchise haulers already provide multiple services to meet the needs of their customers including collection of containers including 95-gallon carts, front load containers, compactors, balers, and semi-truck containers for industrial generators. Not all haulers provide each of these services, but all haulers offer a variety of collection container sizes and collection frequencies. Some haulers may offer a rebate for specific materials if generation meets defined specifications such as quality and volume. A City enforced mechanism for better accountability and uniformity would improve the current commercial recycling system by ensuring minimum service standards and prohibitions on disposal of recycling material.

Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Adjust franchise hauler permit requirements.** Builds on the policy mechanisms established by the MFRO to support the City's ability to gather and verify tonnages of refuse and recycling from haulers servicing multi-family and commercial generators and establish minimum service requirements for franchise haulers operating in the City.
- **Expand Green Business Certification program.** Evaluates the opportunity to expand the program to include more capability for technical assistance through cross-departmental collaboration.
- **Implement targeted commercial diversion requirement.** Describes a phased approach to developing a diversion requirement for commercial generators that builds on adjustments to the

existing franchise hauler permit requirements and requires large quantity generators of divertible material to meet diversion targets.

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 11.6 to support the key findings, recommendations and implementation and funding plan.

11.5.1 Adjust Franchise Hauler Permit Requirements

Overview. Based on the City's existing reporting requirements, franchise haulers submit annual reports indicating the annual tonnages collected and permitted recycling haulers submit the tonnages diverted from multi-family customers. The challenge is that the annual reports submitted by franchise haulers do not break out tonnages collected between multi-family and commercial customers and the permitted recycling haulers are not required to submit refuse tonnage data. This leaves the City with partial data sets and limits the ability to build a comprehensive baseline that identifies the total amount of material collected from multi-family and commercial generators within the City and where that material is transported for processing or disposal.

Without comprehensive baseline data, the City is unable to establish tonnage based diversion goals or capture rate goals in the multi-family and commercial sectors. To collect data that provides a comprehensive baseline, adjusting the existing reporting requirements to establish the data gathering and verification mechanisms is a critical first step. Franchise haulers would need to be required to report both refuse tonnage and recycling tonnage, broken out by customer type (either multi-family or commercial). If franchise haulers are unable to break out tonnage by customer type (since material may be collected on a co-mingled basis), the City would require estimates of the percentage of the reported material that is collected from multi-family and commercial sector customers consistent with the current reporting requirements as part of the MFRO.

Additionally, there are no requirements that franchise haulers provide recycling collection or organics diversion service to customers. Requiring that franchise haulers offer recycling or organics diversion services to customers at a price point that is not prohibitively expensive (compared to refuse collection service) as a minimum permit requirement would support the City's goal to increase diversion from the multi-family and commercial sector. Implementing this requirement would need to be supported by data to confirm there are sufficient customers in the multi-family and commercial sectors generating high enough quantities of divertible material to (1) justify generators developing diversion programs and hiring franchise haulers to collect and divert material; and to (2) assure franchise haulers that if they purchase the equipment

and hire staff to provide this service there will be customer demand for the service. The City would need to implement enforcement mechanisms to ensure the adjustment are adopted and have the intended effect. The following provide the types of enforcement activities that could be taken sequentially to ensure compliance:

- Announced/unannounced inspections
- Written warning of the violation
- Citation or fine that increase in amount with each consecutive offense
- Increase in franchise fee, and finally
- Loss of hauling franchise.

Recycling potential. Implementing this option would increase the diversion potential by providing the City with baseline tonnage data that ultimately supports requiring franchise haulers to offer recycling or organics diversion services to commercial customers.

Operational impact. Adjusting the permit requirements to increase the data provided by franchise haulers followed by requirements to provide recycling or organics service to customers would result in a corresponding increase in the demand on City staff to verify and enforce the permit requirements. If the City does not enforce the data collection or service provision requirements, franchise haulers will be less likely to comply because there would not be a level playing field amongst haulers competing for business (e.g., if franchise haulers are able to realize a competitive advantage by not providing data or required service and are still allowed to operate in the City, other franchise haulers may follow suit). Based on the experiences from the implementation of the MFRO, and given the commercial sector is much larger than the multi-family sector (in terms of number of franchise haulers servicing businesses and the volume of material generated), there would be a significant demand to administer and enforce the adjusted hauler permit requirements from resources in the Sanitation Department and OEQS.

Financial impact. There would be a fairly significant financial impact to the franchise haulers that would need to update data tracking and reporting procedures and dedicate resources to analyzing and submitting information to the City. Additionally, if franchise haulers are required to offer recycling or organics diversion services, they would need to dedicate existing equipment and personnel to providing collection service and identify processing facilities that could effectively divert material. If franchise haulers are unable to leverage existing processing capacity for recyclables or organics, they would need to build a facility resulting in potentially significant capital investment. Additionally, if existing processing facilities are not near customer bases, haulers would not be able to take advantage of route density and operational costs would increase.

Environmental impact. There is no environmental impact related to adjusting data reporting requirements, but if franchise haulers are required to offer recycling or organics diversion services, depending on the demand for service there would be, on one hand, increased diversion and, on the other hand, additional collection vehicles deployed. For example, if a customer only had refuse collection service on a once per week basis and then adds recycling service at the same frequency, there would need to be two vehicles deployed to this customer which doubles (depending on the final destination of the disposal and/or processing facility) the vehicle emissions and road miles traveled but mitigates the emissions from the avoided disposal of the recycling or organic materials[100].

Policy impact. The main benefit of adjusting permit hauler requirements is that it can increase the provision of and participation in recycling programs without completely revamping the existing collection system. This can be easier to implement both politically and logistically because properties still have the freedom to select their own hauler. There may be policy impacts if the adjusted requirements disproportionally increase the barriers to entry for haulers seeking to enter the market.

Stakeholder "buy-in". If the adjustments to the franchise hauler permits create an even playing field by requiring a minimum level of service, reporting requirements, specified insurance and approved disposal and/or processing facilities that guarantee they can accept material, the stakeholders of the system would likely support the City in this effort. However, the current non-exclusive franchise system does not incentivize investments in commercial recycling because it does not require that generators divert recycling or organics diversion service. To invest in new equipment and staffing to service commercial entities in the City, franchise haulers would seek assurances on the demand and volume of recycling or organics diversion and that the City would have the capacity to effectively enforce the program.

Compatibility with existing programs. Adjusting the tonnage reporting requirements is highly compatible with existing programs, but requiring minimum service from franchise haulers would not be compatible with existing programs and would require a significant effort on City staff to administer and enforce the adjusted program requirements.

11.5.2 Expand Green Business Certification Program

Overview. The City currently has 16 participants in the program that have been certified a green business. Expanding this program to increase the number of certified businesses and increasing the offering of the

[100] While increased vehicle emissions should be considered, the environmental benefit of avoided disposal from recycling single-stream items and composting organics typically outweighs increased emissions from vehicles; however, this would need to be further evaluated to quantify the environmental benefits specific to the City's system.

programs to provide technical assistance would support the other initiatives to increase diversion from the commercial sector. Technical assistance programs include initial consultation for setting up a successful recycling program as well as evaluating existing recycling programs for improvement. Services include identifying materials generated to be diverted and providing a pathway for successful collection, storage, and transfer of materials. Programs typically include the following activities:

- Waste audits to assess the waste stream;
- Identify haulers of recyclables;
- Develop collection infrastructure (e.g., collection areas, enclosures); and
- Develop employee and/or tenant educational materials.

Guidance and support from the City can shape proper participation and positive recycling program engagement for commercial generators which increases customer satisfaction and enables progress toward the City's goals. Additionally, the City could leverage cross-department collaboration between the Sanitation Department, OEQS, Development Services and code compliance to expand the capacity to provide technical assistance and support the enforcement efforts related to future adjustments to the franchise hauler permit requirements. Oftentimes, commercial entities have a desire to implement a recycling program but lack the knowledge, time, or resources to initiate a program. Expanding to include technical assistance would assist generators with proper recycling program engagement and the awards and recognition would continue to reinforce and encourage the desired activities by the commercial generators.

Diversion Recycling potential. Expanding the program to include more dedicated technical assistance as a cross-departmental effort would increase the number of diversion programs developed by commercial entities and support adjustments to requirements from franchise haulers to collect and divert material from generators.

Operational impact. Although expanding the program to provide technical assistance would require more resources, if the City could capture synergies by expanding the program as a cross-departmental effort among the Sanitation Department, OEQS, Development Services and code compliance the additional efforts could be spread across departments to minimize the operational impact of expanding the program. An example would be to leverage code compliance inspectors and sanitarians to identify businesses that are interested in receiving technical assistance to divert as part of their recurring inspections so that OEQS would not have to contact each business individually and could take a more targeted, focused approach. Another example would be to leverage code compliance inspectors that issue certificates of occupancy to identify businesses that are interested in receiving technical assistance.

Financial impact. The City would need to dedicate more resources to expand the program, but if the City could capture synergies by expanding the program as a cross-departmental effort among the Sanitation Department, OEQS, Development Services and code compliance the additional efforts could be spread across departments to minimize the financial impact.

Environmental impact. By expanding the program, more businesses would establish diversion programs and ultimately divert more material from disposal, allowing the City to realize environmental benefits from the avoided disposal.

Policy impact. There is no policy impact to expanding the program.

Stakeholder "buy-in". Since this program would be expanded on a voluntary basis, businesses would have a high level of "buy-in" compared to more mandatory policy approaches.

Compatibility with existing programs. Expanding the program is highly compatible with existing the existing program.

11.5.3 Implement Targeted Commercial Diversion Requirements

Overview. Implementing commercial diversion requirements can be contentious because it places a burden on generators and/or haulers, but would support increasing material diversion from disposal. Any commercial diversion requirements should be targeted given the wide variety of businesses and materials in the City. Diversion requirements would ultimately target commercial generators, but there would be challenges setting quantitative diversion requirements because (1) the City does not have a comprehensive baseline of the volume and type of material collected or where material flows; and (2) there is limited processing capacity available to divert recycling and organics.

For these reasons, the City would only be able to implement targeted commercial diversion requirements after adjusting franchise hauler permit requirements, expanding the Green Business Certification program to include technical assistance, receiving comprehensive collection, disposal and diversion reports from franchise haulers and confirming there is sufficient processing capacity in the region to divert material.

Taking these critical steps first will provide the data to create the framework for how a targeted commercial diversion program would take shape by identifying the volume of divertible materials that are currently collected and where the material currently flows. Additionally, requiring haulers to offer diversion service would support them to justify making the business decision to develop additional processing capacity that would ultimately support the implementation of targeted commercial diversion requirements. At this point,

the City could consider the benefits of developing an exclusive or zoned franchise system to support the implementation of a mandatory targeted commercial diversion requirement.

With these first steps in place, the City would be able to develop a phased approach to implementing commercial diversion requirements of businesses that generate high quantities of divertible material, are over a certain size (in terms of either square footage or number of employees), or are in areas with high route density (e.g., downtown as compared to outlying areas of the City).

Recycling potential. Implementing commercial diversion requirements would increase the diversion potential to capture more material from the commercial generators, but may cause a corresponding increase in contamination.

Operational impact. It is critical that any commercial diversion requirements placed on generators take into account the operational impact on businesses, particularly small businesses or those that lease space, since the property owner/landlord may restrict the type of materials that their organizations are allowed to recycle. Additionally, if operational decisions are determined through a business' corporate office and is not managed at the local level, complying with any potential requirements or changing service providers may be challenging. From the City's perspective, there would be a significant increase in the outreach, data collection, data verification, and enforcement responsibility and would require additional resources are hired or dedicated to administering the program.

Financial impact. Similar to the operational impacts, there would be a significant financial impact on businesses that are not equipped to separately manage recycling or organics although the financial impacts may be mitigated based on the schedule for phasing in the requirements. If there is a long lead time, businesses may have the opportunity to prepare for the requirements and identify solutions to come into compliance in a cost-effective way. From the City's perspective dedicating the resources required to administer and enforce requirements would be a consistent challenge, particularly related to educating affected businesses of new requirements and verifying data received.

Environmental impact. There would be increased vehicle traffic to separately collect material for diversion, but depending on the phasing schedule the volume of diverted material may offset the negative environmental impact of increased vehicle emissions.

Policy impact. There would be a significant policy impact related to a targeted commercial diversion requirement including requiring businesses to comply by ordinance and potentially adjusting the existing non-exclusive franchise system to an exclusive or zoned system.

Stakeholder "buy-in". Targeted commercial diversion requirements would be mandatory and there would likely be low stakeholder buy-in among the business community. Without the buy-in from the business community, there would likely be increased contamination among the covered entities. However, environmental groups would support the requirements because they would divert a high volume of material from disposal.

Compatibility with existing programs. Targeted commercial diversion requirements would require significant changes to the current programs and how City departments interact with entities in the business sector. There is a low level of compatibility with the current program.

11.6 Key Findings and Recommendations

This section presents a summary of the options evaluation followed by key findings and recommendations related to program and policy approaches to increasing diversion from the City's multi-family and commercial sectors. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Further description of the criteria is provided in Section 1.4.3. Table 11-11 summarizes the results of the options evaluation for each of the tactics presented.

Table 11-11: Summary of Multi-Family and Commercial Options Evaluation

Description	Diversion Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Adjust Tonnage Reporting Requirements							
Adjust tonnage reporting requirements to collect data that provides a comprehensive baseline including both refuse tonnage and recycling tonnage, broken out by customer type (either multi-family or commercial).	●	■	●	●	■	■	●
Require Franchise Haulers Offer Recycling and/or Organics Diversion Service							
Require that franchise haulers offer recycling or organics diversion services to customers at a price point that is not prohibitively expensive (compared to refuse collection service) as a minimum permit requirement.	●	■	■	▲	■	■	■
Expand Green Business Certification to Provide Technical Assistance							
Increase the offering of the programs to provide technical assistance would support the other initiatives to increase diversion from the commercial sector.	●	●	●	●	●	●	●
Implement Targeted Commercial Diversion Requirements							
Develop a phased approach to implementing commercial diversion requirements of targeted businesses.	●	■	■	●	■	■	■
Implement Exclusive or Zoned Franchise System							

Description	Diversion Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Develop an exclusive or zoned franchise system that supports the targeted commercial diversion requirements implemented by the City over time.	●	■	■	●	■	■	■

11.6.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **The MFRO implemented is critical step toward increasing diversion in the multi-family and commercial sector.** The data reporting mechanism and requirements of multi-family property owners/managers and permitted recycling haulers provides a policy platform the City can leverage to divert more material from the multi-family and commercial sector.
2. **There are opportunities to require more comprehensive reporting from franchise haulers.** While the City receives some data, having a comprehensive data set of multi-family and commercial refuse, recycling and other divertible tons collected and the facilities where material is processed or disposed would support future efforts to increase the City's diversion rate.
3. **The Green Business Certification program provides an excellent platform to support diversion from commercial sector generators.** Although there are currently only 16 businesses certified, the City will continue to expand the number of participants in the program over time, and can leverage the program to build cross-departmental capacity to provide technical assistance services.
4. **There is significant diversion potential from the multi-family and commercial sectors, but limited processing infrastructure to effectively divert material from disposal.** Although there is an estimated 633,000 tons of divertible material currently delivered to the Landfill on an annual basis, there would be insufficient processing capacity to divert this material if it were required to be diverted.

11.6.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Maintain the MFRO and continue to increase the percentage of covered entities in compliance year-over-year.** Continue to implement and increase the compliance from generators and haulers as part of the MFRO, monitoring new developments that come online and continuing to support affected entities with education and outreach.
2. **Adjust franchise and permitted recycling hauler reporting requirements to include more comprehensive tonnage data reports.** Require the submission of more comprehensive data to include refuse, recycling and other divertible tonnages currently collected and the location with they are processed and disposed.

3. **Require franchise haulers offer recycling and organics diversion services.** After the requirements of franchise hauler reporting has been implemented and analyzed, determine the requirements for haulers to offer diversion services to customers and establish the enforcement mechanisms to ensure that this maintains a level playing field among franchise haulers. The City should consider incentivizing haulers to recycle by providing credits on franchise fees for haulers that recycle single-stream and/or organic materials.
4. **Expand the Green Business Certification to provide technical assistance leveraging cross-departmental synergies.** Expanding this program to increase the number of certified businesses and increasing the offering of the programs to provide technical assistance would support the other initiatives to increase diversion from the commercial sector. Additionally, leveraging cross-department collaboration between the Sanitation Department, OEQS, Development Services and code compliance would expand the capacity to provide technical assistance and capture efficiencies by spreading the demand on staff time across multiple departments and streamlining efforts.
5. **Implement targeted commercial diversion requirements on a phased basis.** After adjusting the franchise and permitted recycling hauler requirements and ensuring that the available processing capacity for recycling and organics diversion would support increased tonnage, determine the threshold of material generation quantity, facility size (square footage) or business size (number of employees) that would make the most impact on the City's diversion recycling rate as part of a phased approach, where more generators are included over time and are required to contract with franchise haulers to divert material.
6. **Consider exclusive or zoned franchise system to support targeted commercial diversion requirements.** Implementation efforts of targeted commercial diversion requirements may receive pushback from the hauler community indicating that requirements minimize their ability to achieve efficiencies related to route density and significantly increase their cost to provide service while prohibiting them from increasing rates for certain services. Over time, establishing an exclusive or zoned franchise system that establishes geographic areas where service is provided to commercial generators based on the existing customer base and location of processing infrastructure would support the implementation of targeted commercial diversion requirements.

12.0 HHW AND ELECTRONICS MANAGEMENT

The purpose of a HHW and electronics management program is to provide residents with access to safe and proper disposal options for household materials that are not suitable for disposal in a landfill or for collection with other curbside residential programs. Local provision of convenient HHW and electronics disposal options decreases the potential for improper disposal of material or illegal dumping of environmentally harmful materials[101].

As part of the LSWMP Update, City staff visited the HCCC to review operations and have discussions with County management. This section presents information and analysis regarding HHW and electronics management

12.1 Current System Review

This section reviews the City's HHW and electronics management programs including the HCCC facility and the City's Battery, Oil, Paint and Antifreeze (BOPA) mobile collection program.

Dallas County began offering a regional program for the collection of HHW and electronics in 1997 and has owned and operated its permanent HCCC since 2002. Reference Appendix B showing the location of the HCCC among the other facilities in the region. The HCCC is located in the northeast area of the City at 11234 Plano Rd, Dallas, TX 75243 and sits on three quarters of an acre of land accepts residential customers three days per week on Tuesdays, Wednesdays and Thursdays and two Saturdays per month. Figure 12-2 shows the Dallas County HCCC.

[101] Reference Section 1.2.1 for further description on the usage of HHW and electronics material and the HCCC throughout the LSWMP Update.

Figure 12-1: Dallas County HCCC

The HCCC is staffed by three FTEs with eight to twelve temporary employees working per week. The most critical employee is the staff chemist that allows the facility to manage regulated materials. Based on the current configuration and size of the HCCC, the County has expressed challenges accepting material on days where material is being managed and shipped out due to space constraints. The days when material is not accepted from residential customers are used to manage and bulk material to be shipped out of the facility for disposal or recycling.

When customers arrive at the HCCC, County staff receives them and tracks handwritten customer data that is later entered into a digital format. Customers unload material in the parking lot and then exit the facility. There are no covered areas available, a reuse center or wireless internet to support more efficient data tracking at the HCCC.

Residents of participating member cities are required to bring their driver's license and water bill or other utility bill as proof of address in a participating member city. Residents of all other cities must pay a minimum $95.00 waste management fee.

The County manages ILAs with municipalities that participate in the program to use the facility and other events. Table 12-1 shows the 16 participating member cities and their populations.

Table 12-1: Participating Member Cities in Dallas County ILA

Member City	Population
Dallas	1,331,000
Irving	239,783
Garland	238,418
Mesquite	143,456
Richardson	116,432
Rowlett	63,793
De Soto	53,090
Duncanville	39,415
Farmer's Branch	39,039
Sachse	25,607
Seagosville	16,514
Addison	15,302
Highland Park	9,168
University Park	9,168
Sunnyvale	6,484
Wilmer	4,383

Participating cities are billed on a monthly basis after actual costs are assessed. Costs for each city are divided into operating costs, based on the member city's population, and disposal costs, based on the city's actual participation for each billing period.

Both the City and County host mobile collection events for HHW and electronic materials. The County provides two turn-key events per year for member cities that are located in the southern part of the County. The City hosts BOPA mobile collection events and support HHW collection events held by the Code Compliance department. The material collected during HHW collection and BOPA events is delivered to the HCCC. Figure 12-2 shows the mobile BOPA event vehicles used to collect and manage material delivered during events.

Figure 12-2: BOPA Event Vehicle

Table 12-2 presents the annual number of HHW collection events and BOPA events held between CY 2017 and CY 2019 and the tonnage collected at these events and annually at the County HCCC[102].

Table 12-2: HHW and Electronics Collection Events and Participation

Description	CY 2017	CY 2018	CY 2019
Annual Events			
HHW	1	2	1
BOPA	10	9	8
Number of Participants			
HHW	293	408	113
BOPA	1,045	1,494	635
HCCC Drop-off	12,339	11,032	11,121
Total Participants	**13,677**	**12,934**	**11,869**

The education and outreach efforts supporting the events and HCCC program is provided by the City. The County does not have dedicated staff to provide education and outreach about the program and are solely focused on program administration and operations. There are challenges communicating the program

[102] There City was unable to host events during the COVID-19 pandemic limiting the number of HHW and BOPA collections held in FY 2020 and FY 2021.

requirements and services provided to the City's residents among the various City-operated events and County operated HCCC facility. The key challenge is communicating which materials are accepted among the various events and HCCC facility, especially as the types of HHW and electronics continually change over time (e.g., increasing volumes of lithium-ion batteries that have limited recycling outlets).

Materials accepted at the City-hosted events and the County HCCC are not identical because HHW and BOPA events do not have an on-site chemist. include the following items and tonnages delivered by City residents. Table 12-3 describes the accepted materials, indicating if they are accepted at City-hosted events and presents the FY 2020 tons collected.

Table 12-3: Accepted Material Descriptions at HCCC and City-Hosted Events

Accepted Materials	Description	FY 2020 Tons Collected
Flammables	Flammable materials such as gas-aerosols, cylinders, gasoline, diesel, kerosine, paint thinner, adhesives, roofing tar, fiberglass, resin, rust removers, charcoal.	81
Corrosives	Corrosive acids and bases such as bleach and cleaners.	28
Oxidizers	Oxidizers such as pool chemicals and hydrogen peroxides.	8
Pesticides, Herbicides, Fertilizers	Toxic materials such as pesticides, herbicides, fertilizers, and paint strippers.	112
Batteries	All types of batteries. Batteries are accepted at HHW and BOPA events.	17
Automotive Fluids	Non-regulated oil and antifreeze. Automotive fluids are accepted at HHW and BOPA events.	41
Oil Filters	Non-regulated oil filters. Oil filters are accepted at HHW and BOPA events.	3
Paint	Oil and latex-based paint and paint related material. Paint is accepted at HHW and BOPA events.	809
Used Electronics	Used electronics such as computers, cell phones, and other small electronics.	62
Compact Fluorescent Lamps and Mercury-Containing Material	Toxic materials such as mercury containing light bulbs, thermostats, and elemental mercury.	8
Other	Non-flammable gas and other non-regulated materials such as asbestos, helium, oxygen, carbon dioxide cylinders and other miscellaneous materials. Other materials are accepted at HHW and BOPA events if they are able to be handled without an on-site chemist.	55
Total		**1,224**

Acceptance of these materials at the HCCC serves to minimize litter and illegal dumping of material. In 2018 the City completed the Litter and Illegal Dumping Assessment Study which provided recommendations for how the City can implement a more strategic and preventative approach to combatting litter and illegal dumping including:

- Develop a geographically-focused approach
- Improve local/regional collaboration
- Implement proactive and preventative methods
- Increase community engagement and public education
- Reduce illegal dumping from construction activities and commercial sources
- Enhance enforcement of litter and illegal dumping policies.

Since the development of this study, the City has advances some, but not all of the recommendations provided.

Table 12-4 shows the annual costs charged to the City by the County, where the operational costs are based on the number of City residents that use the facility and the disposal costs are the expenses incurred for managing and disposing HHW and electronics material.

Table 12-4: Annual Dallas County HCCC Program Costs[1]

Description	FY 2018	FY 2019	FY 2020
Operational Cost	$380,693	$378,780	$378,744
Disposal Costs	$530,078	$542,624	$564,797
Total	**$910,771**	**$921,404**	**$943,541**

1. Costs are only reflective of costs incurred as part of the ILA, and not staff or equipment costs for hosting HHW or BOPA events.

Based on the annual operating and disposal costs as part of the ILA, the cost per participant is estimated at $84[103].Based on a recent evaluation of cost of the City's services, there is about $1,250,000 in expenses required to manage HHW and electronics including payment to the County as part of the ILA and City resources required to host and support HHW and BOPA events. The additional dollars above the payment to the County include staff costs to administer, train staff and drivers and attend HHW and BOPA mobile collection.

[103] Cost per participant figure calculated by dividing the FY 2020 cost of $943,541 by the 11,121 residents that utilized the HCCC in CY 2019

Electronics and other types of materials are accepted at the Landfill's Customer Convenience and Recycling Center (CCRC) and facilities among the transfer station system. Further description of the CCRC and materials accepted are provided in Section 8.0 and Appendix E. Further description of electronics and other materials accepted at transfer stations is provided in Section 5.0 and Appendix C.

12.2 Case Studies and Benchmarking

This section provides descriptions of programs or operational considerations from peer cities that would support the City's long-term planning needs related to the future of refuse and recycling collection. The following sections provide perspective about the following topics, and is organized as follows:

- Program types and participation rates
- Curbside collection
- Facility expansions

12.2.1 Program Types and Participation Rates

Table 12-5 compares the program types, service frequency and participation rates of benchmark cities followed by additional of each benchmark city's HHW collection programs facilities, events, fee model and annual program costs. The following benchmark cities were selected to provide an understanding of programs that are both larger and smaller than the City's, and program that have a permanent facility only, events only and a combination of the two.

Table 12-5: Benchmarking Cities Programs and Days of Service

Description	Dallas, TX	Fort Worth, TX[1]	Frisco, TX
Residential Customers	250,000	238,738	86,088[2]
Service Frequency	Year-round	Year-round	Year-round
Type of Service	Permanent Facility/ Collection Events	Permanent Facility/ Collection Events	Permanent Facility/ Collection Events
Days of Service	T, W, Th	Th, F, S	W, S
Annual Participants	11,869	16,789	12,913
Participation Rate	4.8%	7.0%	15.0%

1. Fort Worth residential customers based on single-family residents and annual participants reflects only Fort Worth residents that utilize the Environmental Collection Center, although there are residents from Arlington, Grand Prairie, Grapevine, Keller and other cities that deliver material to the facility.
2. Includes all households in Frisco, Prosper, Little Elm, Melissa, Celina and Anna provided by the City of Frisco.

Fort Worth, TX. The City of Fort Worth operates a permanent Environmental Collection Center (ECC) drop-off facility that allows residents of Fort Worth and 52 participating cities to dispose of hazardous and electronic waste. The ECC is open Thursdays from 11am to 7pm, Fridays from 11am to 7pm and Saturdays

from 9am to 3pm. Additionally, Fort Worth hosts 75 mobile collection events per year. Additionally, the program includes facilitating mobile collection events in partner cities and the option for partner cities to perform their own door-to-door collection or mobile collection and subsequently drop off materials at the City of Fort Worth's permanent facility. The program utilizes a voucher system, billing participating cities on a quarterly basis for the actual number of vouchers used during the billing period. Additionally, Fort Worth has three drop off stations that accept HHW and electronics material from residents that is transferred to the ECC. Based on a recent evaluation of the Forth Worth's cost of service, the total annual cost to operate the ECC is about $1,938,500, where Fort Worth residents represent $796,000 of the total annual cost, or $47 per participant. Overall at Forth Worth's ECC, the annual cost per ton to manage all materials (including non-Fort Worth resident tons) delivered is about $917 per ton compared to the City's $771 per ton.

Frisco, TX. The City of Frisco operates a Household Chemical Disposal facility for its residents and residents of surrounding cities that have entered into a partnership to use the facility. The facility is open Wednesdays from 2pm to 5pm (extended to 6pm during the summer) and Saturdays from 8am to 1pm. The facility accepts HHW and electronic waste from residents presenting a water bill and driver's license (or vouchers[104]). The annual cost to operate the facility and programs in 2020 was $335,700, or $26 per participant. Frisco proactively minimizes the cost of disposal of HHW material collected by working with Habitat for Humanity and Smarter Sorting to provide equipment, data management, and HHW reuse and recycling services. The equipment provided by Habitat for Humanity is used to organize material and software provided by Smarter Sorting is used to track the processing and reuse of HHW material handled to minimize disposal costs.[105] Figure 12-3 shows the scanning and weighing equipment used to process and handle HHW material.

[104] The City provides vouchers for residents from partnering cities use the Household Chemical Disposal facility for $50 per year.
[105]See more information about Smarter Sorting here: https://www.smartersorting.com/

Figure 12-3: Smarter Sorting Scanning and Weighing Equipment

12.2.2 Curbside Collection

A municipality may contract with a service provider that collects material directly from residents' homes. As with other contract curbside collection services, at-your-door collection service is most feasible in areas with higher population densities. Specific service terms are negotiated between the private hauler and the contracting municipality. Service frequencies typically vary from once per month to unlimited service requests and may be provided on set service days or via a call-in program.

The primary consideration for an at-your-door HHW collection service is the monthly cost impact to residents. Typically, costs for this type of service are assessed on a per household per month basis and are included as a component of a resident's monthly solid waste and recycling services bill. Based on discussions with national haulers that offer this service, a cost of $1.00 per household per month is an appropriate planning-level cost for an at-your-door HHW and electronics collection services (once per month to unlimited collection frequency). However, this cost may be higher in less densely populated areas of the City.

There are several peer cities that have incorporated curbside collection of HHW and electronic materials. The Cities of Plano and Allen have implemented curbside collection program where the material is collected by a contract service provider. Additionally, the City of Addison collects HHW and electronics material from residents and brings the material to the Dallas County HCCC.

To understand what actual program costs would be and if any haulers would offer this service in the Planning Area, the City would need to release a RFP to obtain pricing and confirmation that the service

could be procured. Then, if a service provider were responsive, the cost for this service would need to be communicated to residents to understand the likely level of participation in the program to evaluate the full cost impact to the City.

In response to the COVID-19 pandemic and temporary closure of its permanent HHW and electronics management facility, the City of Austin has been providing door-to-door collection on a call-in basis to all residents. The call-in service utilizes a pick-up truck to serve a limited number of single- and multi-family residents each day, with collections scheduled based on location for routing efficiency. Based on discussion with City staff, the number of customers that can be served is currently limited by collection vehicle space and additional staff. The program has proven successful and has remained cost-effective for Austin and the City is considering expanding the program due to the positive feedback generated by stakeholders.

12.2.3 Facility Expansions and Relocations

This section provides descriptions of municipalities that have permanent HHW and electronics collection facilities that are considering expanding or relocating.

As described in Section 12.2.1, the City of Frisco has a 15 percent participation rate and faces challenges managing the volume of customers and tonnage of HHW and electronics received. In anticipation of the growing number of customers due to expected population growth, the City is relocating its Household Chemical Disposal, reuse center, and office space to a larger location in the City. The new facility is intended to be co-located with a solid waste transfer station and will allow the City to manage growing demand for HHW and electronics collection going forward.

Johnson County, Kansas has a population of 600,000 and owns and operates a permanent HHW and electronics collection facility. The facility operates year-round and is available for all residents of the county. Additionally, the City of Olathe, located within the boundaries of Johnson County, also owns and operates a year-round, permanent HHW facility for city residents. The two facilities are located on opposite ends of the County to provide the most convenient access to customers. The County provides funding to the City of Olathe to allow for residents from anywhere in the County to also drop off at the Olathe facility which provides a convenient drop off location in both the northern and southern areas of the County. Both facilities process relatively the same amount of material annually. The County facility is in the process of being relocated to increase the capacity while allowing the program hours of operation and staffing to remain consistent with the current operation.

The City of Kansas City, Missouri owns and operates a permanent year-round HHW facility. The facility serves a three county region including dozens of participating municipalities. The program also hosts twelve satellite collection events around the community each year. The City's permanent facility is aging and,

similar to the Dallas County HCCC, is struggling to manage growing service demand. The City is in the process of evaluating its program to develop an understanding of what facility assets are acceptable for use or in need of repair replacement over the next several years, to determine an appropriate cost of services for Kansas City, Missouri and their stakeholders and to review the safety and efficiency of the facility.

12.3 Options Evaluation

This section analyzes a series of options related to the HHW and electronics management that have been identified based on the current system review, stakeholder engagement, evaluation of recommendations from the 2011 LSWMP, and benchmarking.

The following summarizes the key takeaways from the community survey and other outreach activities conducted as part of the LSWMP Update.

- 55 percent of respondents indicated that they use the HCCC facility once or twice per year and 36 percent of respondents indicated that they participate in HHW and BOPA events once or twice per year.
- 45 percent of respondents indicated that the location and operating hours were prohibitive or very prohibitive and negatively impacted their willingness and ability to utilize the HCCC.
- 66 percent of respondents indicated they would be supportive or very supportive of a more conveniently located HCCC and 60 percent of respondents indicated they would be supportive or very supportive of at-home collection.
- 57 percent of respondents indicated they would support a monthly rate increase of at least $1.00 to have enhanced service levels of HHW and electronics management.

Further information about the methodology of the stakeholder engagement is described in Section 1.0 and the comprehensive detailed results are provided in Appendix A.

The following presents options that are evaluated in the following sections including a brief description of the option and evaluation approach:

- **Enter new agreement with County.** Evaluates the impact of entering into a new agreement with the County with strategic adjustments to operations.
- **Develop a new HCCC facility.** Evaluates the needs and impact to develop a new HCCC facility in partnership with the County to support meeting the long-term needs of the program participants.
- **Increase number and materials accepted at HHW and BOPA collection events.** Describes the impact and considerations of expanding the material types accepted at HHW and BOPA events.

Each of the following sub-sections provides an overview of the option and specific tactics and evaluates the impact of each options' components based on the following criteria, with brief descriptions:

Each of the following sections provide an overview of each option and specific tactics and evaluates the impact of each options' components based on the criteria detailed in Section 1.4.3. A high-level summary of the evaluation criteria for each tactic within the options is provided in Section 12.4 to support the key findings, recommendations and implementation and funding plan.

12.3.1 Enter New Agreement with County

Overview. This option would have the City enter into a one-year agreement with three one-year optional extensions. This agreement would be similar to the existing ILA with adjustments to increase the receiving hours at the HCCC, automate the data-tracking at the HCCC.

Recycling potential. Increasing the receiving hours would allow more material to be accepted and ultimately recycled. This option would have a medium impact on recycling potential.

Operational impact. This option would have a high operational impact because increasing the receiving hours at the HCCC would minimize the County's ability to manage and ship out material during non-receiving days and potentially limit the amount of material or customers that could be accepted at the HCCC if there are challenges moving material for recycling or secure disposal. If the County were to automate data tracking, it would minimize the administrative burden of data entry and analysis, but the current operations do not have the infrastructure to implement this immediately (e.g., no wireless internet at the HCCC or covered areas to receive customers).

Financial impact. This option has a medium financial impact because if the facility is open longer the operating costs will be higher and if more City residents use the HCCC, the County will assess higher operating and disposal costs. Automating data-tracking at the HCCC may require interim capital upgrades including installation of wireless internet and a covered area to receive customers.

Environmental impact. There are low environmental impacts related to this option.

Policy impacts. As part of this option the City would need to develop and adopt a new contract with the County, but otherwise has low policy impacts. Having the agreement structured similarly to the existing ILA on a one-year basis ensures that the short-term needs of the City will be met but provides the flexibility to explore other options to minimize future costs as the City continues to grow.

Stakeholder "buy-in". There is medium stakeholder "buy-in" related to this option because even though the County is open to expanding hours at the HCCC the decision is ultimately up to the member cities and if they are willing to bear the cost of increasing the receiving hours.

Compatibility with existing programs. There is high compatibility with the existing program because it would require little changes to the current ILA program structure.

12.3.2 Develop New HCCC and/or Satellite Facility

Overview. This option includes developing a new HCCC facility or a satellite facility to increase the accessibility for City residents since the current facility is not convenient for those located in the south areas of the City. A satellite facility would be smaller than a larger facility but provide more convenient access to City residents or member cities in the south area of the County where material is packed and transported to the HCCC. A new HCCC or satellite facility would require a number of specialized building needs due to the nature of the operation including a fully ventilated building, sprinkler system for fire suppression, spill containment, adherence to fire codes for material storage capacity and traffic flow, adequate storage area, and safety equipment (e.g., eyewash site, fire extinguishers, personal protective equipment). The County is actively exploring the ability to fund a new HCCC facility and indicated they would look toward the southwest area of the County in conjunction with their internal real estate team. A new facility would include expanded receiving area, storage area, and potentially a reuse store.

Recycling potential. An expanded facility or satellite facility would have a medium impact on recycling potential, since it would potentially allow for increased receiving hours and capability to accept materials that are currently unable to be processed at the existing HCCC.

Operational impact. This option would have a low operational impact because the new facility would be able to have more streamlined vehicle flow, more space to manage and ship materials, and the ability to receive more customers. With a satellite facility to support a permanent HCCC, the County would have more space at the permanent HCCC to accept customers since bulking and transferring material would be completed at the satellite facility.

Financial impact. A new HCCC or satellite facility would have a high financial impact because of the high capital costs for construction that would be passed along to participating member cities. Capital cost estimates are not provided because there are several locations and/or configurations that may be considered as part of a permanent facility (e.g., land purchase, site configuration) that could significantly alter the capital cost requirements of a facility. Based on a recently constructed facility for Clay County, MN, the capital costs could range from $1.5 to $5 million.

Environmental impact. With a new facility and/or satellite facility there would be less need for customers to drive across the County to deliver materials. There would be a low environmental impact related to this option.

Policy impacts. There would be a low policy impact related to this option.

Stakeholder "buy-in". There is high stakeholder "buy-in" because the development of a new facility or satellite facility could be leveraged to attract new members to the ILA. Additionally, there is support from City customers to pay a higher monthly rate for more convenient or expanded services.

Compatibility with existing programs. The construction of a new HCCC or satellite facility would take time to design, procure and construct. If the current HCCC and program is able to remain operational during construction, there would be high compatibility with the existing program.

12.3.3 Increase Number and Materials Accepted at HHW and BOPA Collection Events

Overview. This option would increase the number of HHW and BOPA collection events and material types that could be accepted at HHW and BOPA collection events to be consistent with the HCCC. Based on the feedback from the stakeholder engagement, there is confusion among customers about which materials can be accepted at the HCCC and which can be accepted at HHW and BOPA events and customers feel that the current location of the permanent HCCC facility is prohibitively far. Increasing the number of events would provide greater access to this service for customers that are located in the southern areas of the City and potentially minimize illegal dumping in the City.

Recycling potential. Increasing the number of events accepted at the HHW and BOPA events would increase the amount of material that could be recycled and would have a medium impact.

Operational impact. Increasing the number of events would potentially require additional staff to be trained to operate HHW and BOPA events (including managing specialized materials and delivering material to the HCCC). Increasing the number of materials accepted at HHW and BOPA events to include the full list of material accepted at the HCCC would require a chemist present at the events. This option would have a high operational impact.

Financial impact. Increasing the number of staff and equipment to host more events and hiring a dedicated chemist to attend for each HHW or BOPA event would increase the cost to host these programs and have a high financial impact. This would require a potentially significant budget increase to the program to support bringing on additional staff and equipment.

Environmental impact. The increased amount of collection events would decrease the amount of driving customers had to do to get to the HCCC and would have a low environmental impact.

Policy impacts. There would be a medium policy impact related to this option since the accepted materials at City-hosted collection events would be adjusted. Additionally, the location of the additional events would

need to be determined to ensure that they effectively increased access to services to those that are prohibitively far from the existing HCCC facility.

Stakeholder "buy-in". This option would have high stakeholder "buy-in" because there is support from the residents to increase the number of HHW and BOPA events, even if it means increased monthly costs.

Compatibility with existing programs. This option has a medium compatibility with existing programs because increasing the material types accepted at HHW and BOPA events would require programmatic changes and additional staffing.

12.4 Key Findings and Recommendations

This section presents the key findings and recommendations related to program and policy approaches to increasing the City's ability to provide comprehensive HHW and electronics management services based on the results of the overview, evaluation of case studies and stakeholder engagement. Depending on the specific option and/or tactic, the evaluation may include both quantitative and qualities assessments which support the assigned relative ratings for the criteria of each tactic. The meaning of the rating differs for each option and/or tactic but can generally be described as "green circle is favorable or low impact," "yellow triangle is neutral or medium impact," and "red square is less favorable or higher impact." Further description of the criteria is provided in Section 1.4.3. Table 12-6 provides a summary of HHW and electronics management options evaluation.

Table 12-6: Summary of HHW and Electronics Management Options Evaluation

Description	Recycling Potential	Operational Impact	Financial Impact	Environmental Impact	Policy Impact	Stakeholder "buy-in"	Compatibility with Existing Programs
Enter new agreement with County							
Enter new one year agreement with strategic operational adjustments.	▲	■	■	●	●	▲	■
Develop new HCCC and/or Satellite Facility							
Develop a new HCCC and/or satellite facility to increase accessibility for City residents.	▲	●	■	●	■	●	▲
Increase number and materials accepted at HHW and BOPA collection events							
Increase frequency and material types accepted at HHW and BOPA collection events to be consistent with materials accepted at HCCC.	▲	■	■	●	▲	●	▲

12.4.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **There are challenges providing comprehensive access to customers.** Customers located in the southern areas of the City struggle to have convenient access to service. Although there are mobile collection events, the limited number of materials accepted at events makes it challenging for these residents to dispose of all their material at one time.
2. **The City has advanced some, but not all of the recommendations provided as part of the Litter and Illegal Dumping Assessment Study.** As the City considers options for the future of the HCCC and BOPA programs, minimizing the amount of litter and illegal dumping activities is critical to sustaining public health and community cleanliness.
3. **There are increasing amounts of material that the existing HCCC is unable to recycle.** As material types change, there are more materials that the HCCC is unable to recycle cost-effectively (e.g., lithium-ion batteries).
4. **Other cities in the region are implementing curbside collection.** Curbside collection of HHW and electronics are being implemented by other cities in the region. This may be an approach the City considers in the future but is not an approach that would be further considered at this time given the existing program in place.
5. **Participation rate of HCCC facility higher than other benchmark cities.** The participation rate of 4.7 percent is lower than benchmark cities, indicating that other programs attract a higher percentage of its customers to utilize HHW and electronics collection facilities compared to the City.
6. **The cost per participant per year is higher than benchmark cities.** The City's cost per participant per year is $84 for use of the HCCC, higher than Fort Worth ($74) and Frisco ($26) program costs per participant per year.
7. **There are challenges communicating program and service availability to customers.** The County does not provide education and outreach services to minimize confusion or mixed delivery of information, but there are challenges communicating program and service offerings to customers because the County operates the HCCC facility and multiple City department host mobile collection events.

12.4.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Enter new one year contract with the County that includes three, one-year optional extensions.** Extending the current agreement in a similar structure to the existing ILA on a one-year basis with multiple available extensions ensures that the short-term needs of the City will be met but provides the flexibility to explore other options to minimize future costs as the City continues to grow. Given that the cost per participant per year is higher than other benchmark cities, the City should explore ways to minimize the annual operating or disposal cost components of the agreement or seek other in-kind services from the County (e.g., marketing and communications support) to bring all-in program costs in line with benchmark cities.
2. **Explore the ability for the County to extend operating hours and automate data tracking and analysis.** Extending operating hours and automating data tracking would streamline operations at the existing facility but may require capital upgrades including installation of wireless internet and a covered area to receive customers.
3. **Work with the County to increase materials that can be cost-effectively recycled to minimize disposal costs.** The City's cost per participant is higher than peer cities in part because of the HCCC is unable to recycle materials cost effectively and is required to dispose. The City should work with the County to proactively establish recycling outlets for materials that are currently disposed to minimizing disposal costs passed through as part of the ILA. This is challenging with the existing space constraints at the HCCC, but may be more feasible at a new HCCC or satellite facility.
4. **Collaborate with the County to identify locations where new HCCC or satellite facility could be located in the southern part of the County.** This collaboration should include working together with the County and its stakeholders to establish the needs (e.g., challenges managing service demand, rising operating costs, changing material types and recycling outlets) and benefits (e.g., more convenient access for residents, managing costs over time) that would justify upgrading the existing facility or developing a satellite facility. A key consideration is to ensure current participating members support the approach and understand the benefits to their residential customers.
5. **Coordinate with the County to support increasing frequency and materials accepted at HHW and BOPA events.** The key challenges to increasing the frequency of events is the additional cost of equipment and staff time. The key challenges to increasing the materials accepted at events is the requirements to have a chemist on site and additional staff training. The City should coordinate with the County to identify opportunities where the County could support these needs (e.g., providing use of its full-time chemist at some or all mobile collection events) may allow the City to increase the number of collection events without incurring the full cost burden of the program expansion.

13.0 PUBLIC EDUCATION, OUTREACH AND COMPLIANCE

Public education, outreach and compliance is critical to managing the City's material management system and making progress toward its recycling goals. Guidance and support from the City can shape proper participation and positive program engagement experiences for customers in the single-family, multi-family and commercial generation sectors. Effective education, outreach and compliance is a multi-departmental effort that generates feedback from customers to inform the direction of current and future programs and policies to work toward the City's Zero Waste goals. This section presents information and analysis regarding education, outreach and compliance programs.

13.1 Overview of Components of a Successful Program

The following provides an overview of key components of a robust materials management education, outreach and compliance program as follows:

- **Establish program goals.** This is a critical first step for any successful education, outreach and compliance program that dictates how the program will be evaluated over time and the intended outcomes of the program. Specific quantitative metrics, programmatic improvements, and definitions of success should be determined to ensure that targeted action is taken to work toward the established program goals.
- **Determine financial commitment.** Determining the ability to support the program financially will ultimately dictate the long-term success of any education, outreach and compliance program. Target annual costs, dedicated staffing, and funding sources should be established before content is generated and distributed to ensure that a sustained effort is possible.
- **Identify target audience(s).** Depending on the program goals and financial commitment, the next component of a successful education, outreach and compliance program is identifying the target audiences. Audiences may include broader categories of customers including residential customers, multi-family, and commercial customers or focus on more targeted audiences such as specific housing types, collection routes, businesses, or home-owner associations.
- **Develop messaging content.** Generally there are two types of communication that are deployed as part of education, outreach and compliance programs: specific program information (e.g., dates of service, acceptable materials, set -out instructions) and general environmental services information (e.g., why recycling is beneficial, impacts of contamination). The messaging content should be determined based on data-driven analysis and crafted with simple and easily understood language and graphics to communicate information in a succinct and effective manner.

- **Content distribution and public outreach.** The distribution channels of content as part of any successful education, outreach and compliance program should be based on the target audience and the type of content. The most effective approach to reaching the target audience and impacting behavior change is distribute the content where the audience already consumes information. This may require many diverse forms of content distribution, including traditional bill stuffers, traditional advertising (e.g., billboards, bus stops, radio advertising), in-person meetings or events, social media platforms (e.g., Facebook, Instagram, NextDoor) or other publications such as newsletters or other local print media.
- **Evaluate program effectiveness.** This is a critical step to having a successful long-term program that is able to maintain consistent messaging to the target audience over a sustained duration of time, even as members of the selected target audience change. Evaluation of program effectiveness may include activities such as tracking data (e.g., program costs over time, engagement from target audience), establishing a meaningful feedback loop, and consistently evaluating progress toward goals.
- **Deploy compliance measures.** Holding material generators accountable is a component of having a successful long-term education, outreach and compliance program. Compliance activities may include cart tagging, skipping service or removing carts from consistently bad actors, implementing service fees, and/or otherwise enforcing local regulations or ordinances.
- **Regional collaboration.** Approaching solid waste and recycling from a regional perspective is the final component of having a successful long-term education, outreach and compliance program. Regional collaboration activities include coordinating with other municipalities on the consistency of messaging, timing of content deployment and channel(s) of distribution. NCTCOG has developed and deployed a regional education campaign intended to support regional collaboration among communities in North Central Texas, and is described in further detail as part of Section 13.3.2.

13.2 Current System Review

Responsibilities for public education, outreach and compliance are shared between the Sanitation Department and OEQS. Historically these services were provided primarily through the Sanitation Department, but the City changed its overall approach for environmental educational and outreach efforts. Rather than have individual departments have distinct programs, the City reorganized by moving educational and outreach staff from multiple departments to OEQS. The purpose of the change was to provide the opportunity to develop more comprehensive programs and to increase economies of scale (e.g. ability to share a graphics designer). The Sanitation Department is still responsible for certain aspects of

the education, outreach and compliance programs that are specific to service information (e.g., service delays, adjustments to collection service schedule, etc.). Additionally, OEQS and the Sanitation Department coordinate closely with Code Compliance.

The City uses a variety of programs and services to provide public education, outreach and compliance. This section provides a detailed summary of activities as part of the City's program organized by the components of a successful education, outreach and compliance program as described in the previous section.

- **Establish program goals.** The City has qualitative goals to reduce contamination in the single-stream material collected by City crews and increase the volume and frequency of material set out for collection by residential customers. There are specific quantitative goals set by the 2011 LSWMP and CECAP to increase the recycling rate. Additionally, the City has qualitative goals to provide a consistently high level of service to residential customers and continue to implement and track compliance with the MFRO.
- **Determine financial commitment.** In addition to the division manager, there are five full-time positions for education and outreach efforts in OEQS including a recycling coordinator, three administrative specialists, and an event services specialist. The staff conducts research and is responsible for compliance related to hauler registration, the MFRO, marketing, social media, inter-departmental educational outreach efforts and coordination with event services. The Sanitation Department also has three four staff dedicated to education and outreach related to service-based communications and has hired an additional 10 FTEs to provide code compliance service related to brush and bulky item set outs and enforcing compliance with prohibited or oversize set outs. Further discussion about brush and bulky item set outs is provided in Section 7.0. There are other direct expenses related to education and outreach including marketing materials and cost for events that are supported, in part, from annual payments provided by FCC as part of the recycling processing contract.
- **Identify target audience(s).** The City's current communications target single-family customers, multi-family residents and building managers, and commercial establishments.
- **Develop messaging content.** Messaging content related to environmental stewardship is developed by OEQS and messaging related to collection service is developed by the Sanitation Department.
- **Content distribution and public outreach.** The City utilizes a variety of traditional marketing efforts for recycling education and outreach. Examples include but are not limited to Twitter, Facebook, ReCollect App, direct mail, utility bill inserts, web site (www.DallasZeroWaste.com), and attending special events. Additionally, the City provides presentations to homeowner

associations (HOAs). Based on the results of the survey conducted as part of the stakeholder engagement for the LSWMP Updated, respondents ranked direct email (65 percent), utility bill inserts (37 percent), and social media (27 percent) as the preferred ways to receive communications from the City about solid waste programs and educational information. In FY 2020 the City initiated community based marketing efforts to conduct more grass roots outreach in places where City residents frequent (e.g. community centers, grocery stores, etc.), but transitioned away due to COVID-19 concerns to focus on virtual communication and social media approaches through partnerships with public libraries and universities. The City has an educational game on the website to educate the public, but does not have a major presence educating the community in public spaces (e.g., parks and downtown areas).

- **Evaluate program effectiveness.** The City gauges the effectiveness of the blue roll cart program by tracking the total annual volume of single-stream material collected by City crews. The City calculates the percentage of single-stream material collected compared to all the material collected among the blue and grey roll carts. Additionally, program effectiveness is tracked by the contamination rate of single-stream materials, the reporting compliance as part of the MFRO, and reporting compliance as part of the City's non-exclusive franchise hauler system. Further detail regarding the reporting compliance related to the MFRO and non-exclusive franchise system is provided in Section 11.0
- **Deploy compliance measures.** In an effort to better understand contamination levels across the City, the Sanitation Department developed the "Take-a-Peek" program where staff will identify areas with presumed high contamination levels and will inspect recycling carts for contamination. With limited staff resources, the goal was to "peek" into the carts of 100 households per district each year (500 total). Given COVID-19 concerns, the program has been suspended and will eventually shift to a route-based approach, with a goal to check every household along a specific route (about 1,500 total households) in four phases. Additionally, the City implemented compliance measures related to oversize brush and bulky item set outs. Further discussion related to oversize brush and bulky item collection is provided in Section 7.0.
- **Regional and institutional collaboration.** The City actively coordinates with NCTCOG, other peer cities and local educational institutions (e.g., Dallas Independent School District) to develop and distribute education and outreach content in an effort to improve the performance of its recycling system.

13.3 Education, Outreach and Compliance Evaluation

This section evaluates the recommendations presented in the 2011 LSWMP, indicating the progress that has been made toward the recommended policies and/or program and any fundamental changes that have been made related to programs, policies or forecasts as it relates to public education, outreach and compliance. Additionally, this section evaluates the current efforts against the components of a successful education, outreach and compliance program.

13.3.1 2011 LSWMP Recommendations

Table 13-1 lists the recommendations from the 2011 LSWMP related to public education, outreach and compliance with a brief description of progress to date and potential next steps as part of the LSWMP Update.

Table 13-1: Evaluation of 2011 LSWMP Recommendations

2011 LSWMP Recommendation	Progress to date	Potential Next Steps
Undertake social marketing campaign.	In 2020, the City initiated community based marketing efforts to conduct more grass roots outreach in places where City residents frequent (e.g. community centers, grocery stores, etc.).	Due to COVID-19 the City transitioned to focus on virtual communication and social media approaches through partnerships with public libraries and universities. The LSWMP Update will evaluate the balance between virtual and in-person approaches to social marketing.
Provide commercial technical assistance.	The City has established the Green Business Certification program and has certified 16 businesses.	Reference Section 11.5.3 for further discussion on expanding the Green Business Certification Program to provide commercial technical assistance.

Since the adoption of the 2011 LSWMP, key initiatives have been implemented including the City taking more control of its recycling processing system with the FCC partnership (as detailed in Section 9.0) and the 2020 implementation of the MFRO. As part of the 2011 LSWMP, the City utilized several alternative metrics (e.g., greenhouse gas reduction, capture rate, etc.) to evaluate potential programs and diversion potential; however, the City has not implemented them as part of their annual data analysis and reporting practices.

Additionally, since the 2011 LSWMP NCTCOG regional “Know What to Throw” Campaign was developed and deployed in June 2019 to provide information and context about how cities in the region can continue to actively participate in the regional campaign and incorporate its overall approach to campaign

development as the City seeks to advance its outreach, engagement and public education programs. The campaign's target audience includes residents that live, work and play in the North Central Texas region and to increase collaboration among municipalities, streamline messaging and minimize confusion for residents that may live in a different municipality than they work. Figure 13-1 shows an example of the support content provided to member municipalities in the region.

Figure 13-1: Social Media and Example Bill Insert from the NCTCOG Regional Campaign

Social media content (top) and example bill insert (bottom).

After the campaign was launched in 2019, NCTCOG staff have actively collected engagement data, incorporated feedback from municipalities and residents, and hosted recycling roundtable events to support further coordination and collaboration among municipalities in the region, amplify the collective messaging being distributed, and discuss next steps to continue working to achieve the goals of the campaign.

13.3.2 Current Programs

This section evaluates the City's current efforts against the components of a successful education, outreach and compliance program. While tactics and strategic options related to recycling processing are included in the Implementation & Funding Plan, this section does not contain a high-level table that reviews each tactic like other sections of the LSWMP Update. Table 13-2 provides an evaluation matrix indicating the strengths, challenges, and opportunities associated with each of the program components of the City's current system.

Table 13-2: Evaluation Matrix of City's Education, Outreach and Compliance Efforts

Program Component	Strengths	Challenges	Opportunities
Establish program goals	City has high-level goals for the program to increase recycling and decrease contamination, and quantitative recycling goals as part of the 2011 LSWMP and more specific material-based goals for the single-family sector as part of CECAP.	The multiple sets of quantitative recycling goals are not based on specific programs that would allow the City to realize tangible results. Additionally, the City does not include organics in its recycling rate calculation, limiting the potential to increase the recycling rate beyond the single-stream program and does not have individual goals for each generator sector (e.g., single-family, multi-family and commercial).	While an important part of Zero Waste planning is to have long-term visionary goals, it is equally important to develop short-term goals that can realistically be achieved. Specifically identify programmatic changes to be made and the associated potential increase in diversion quantities to determine more realistic and achievable goals. For example, increasing the capture rate of single-stream recycling to 60 percent by 2030 would allow the City to realize the CECAP goal of recycling 60 percent of paper from the single-family sector by 2030.
Determine financial commitment	The City's current program receives public education and outreach support from FCC (further description of the public education and outreach contribution is provided in Section 9.0), has the resources required to operate current programs, and capability to leverage multi-departmental coordination and support.	Expanding programs to increase the impact of education, outreach and compliance may require additional resources. Additionally, determining how funding is provided among various departments may present challenges to implement new programs.	The City can leverage the programs and alternative performance metrics identified as part of the LSWMP Update to justify increasing the resources dedicated to deploying education, outreach and compliance efforts.
Identify target audience(s)	The City identifies target audiences and distributes environmental stewardship and service-based messaging designed for their consumption, including in both English and Spanish. Additionally, the City targets key program participants of the MFRO.	The City's general target audiences are not segmented by generator sector (e.g., single-family, multi-family and commercial) or other target audience groups (e.g., age, gender, demographics, location).	Continue to refine the target audience to customize education and outreach content to increase engagement and behavior change of key audiences based on recycling performance metrics, particularly multi-family residents and building managers. There is an opportunity to increase education and outreach efforts in public spaces.
Develop messaging content	City has multi-departmental collaboration and timely content creation, using feedback from the community to influence messaging content.	The City faces challenges to determine which content is causing intended behavior change, and if behavior changes are having the intended impact on program performance. Additionally, many residents do not fully understand the full breadth of programming provided (e.g., drop-off of up to six tires at the Landfill).	The City can leverage recycling performance metrics to inform the development of content on a more regular basis, coordinating closely with FCC and other local commercial recycling facilities. The City has the opportunity to more effectively educate residents about all the programs and services that are available to them.
Messaging distribution and public outreach	Research by the Recycling Partnership has also shown that efforts to connect with people about recycling within their community or "space" can enhance opportunities to improve recycling participation. The City takes a community-based marketing approach to education and outreach efforts.	COVID-19 limited the ability of the City to advance its community-based marketing program, but pivoted to virtual programming which proved to be effective in cost-effectively reaching new audiences (e.g., education materials distributed through NextDoor to parents to supplement the sudden need for homeschool materials).	The City can work to find a balance between community-based marketing in areas of the City where greater contamination is occurring (pending expansion of the Take-a-Peek program) and a virtual and social media approach given the effectiveness of the current efforts. There are also opportunities to distribute messaging with a regional focus by leveraging current and future resources from NCTCOG.
Evaluate program effectiveness	City tracks and leverages data from social media and the Re-Collect App to inform content development. Additionally, the City's MRF audits provide information about the contaminants that are delivered to the MRF.	City has limited regular tracking of some key metrics and does not establish a consistent feedback loop to improve program effectiveness. The City's MRF operator does not provide feedback regarding specific routes or generators that are delivering contaminated materials. Additionally, the City does not leverage on-board vehicle technology to track metrics such as set out and participation rates.	The City can set quantitative goals including a recycling rate that includes organics, contamination rate, capture rate, pounds per household generation rate, to track key performance metric data to establish a more impactful feedback loop and more consistently evaluate progress toward interim milestones/goals.

Program Component	Strengths	Challenges	Opportunities
Deploy compliance measures	The City has taken the first step to implement its "Take-a-Peek" program but has not been able to scale the program on a routed basis. This program removes carts from households with highly contaminated set outs, which can be returned after the customer completes an online course focused on proper set outs.	Although the City initially intended to remove carts from customers that consistently do not meet compliance related to the roll cart based programs, this has not been comprehensive implemented since there are limited resources to deploy the "Take-a-Peek" program.	The City can scale up the "Take-a-Peek" program, deploying more resources in coordination with the Sanitation Department and Code Compliance to generate a more comprehensive feedback loop from the single-family sector. This could be used to target education and outreach to specific areas of the City or collection routes with high contamination or low compliance in the City. Also, removing the recycling cart for repeat high contamination residential set -outs and implementing a penalty (that can be waived with further educational efforts) may result in positive behavior change. Achieving these opportunities would require additional staffing and equipment resources dedicated to scaling these programs.
Regional and institutional collaboration	The City has generally reviewed regional campaign content and uses it as one of several factors in developing messaging, aligning its content to be consistent with the information distributed on a regional basis. The City actively partners with DISD to provide educational material to support recycling efforts.	The City engages in regional collaboration to develop messaging consistent with peer municipalities and the NCTCOG campaign but has not synchronized messaging content and timing on a regular basis to take advantage of digital and social media amplification and virality.	The City can collaborate more closely with the NCTCOG regional campaign to coordinate timing and content of messaging with peer municipalities and drive further engagement in its distributed material by amplifying unified messaging. The City is in a position to become a leader in that effort to synchronize messaging with peer cities and advance the effectiveness of the regional campaign.

13.4 Case Studies and Benchmarking

This section provides descriptions of programs or operational considerations from peer cities that would support the City's long-term planning needs related to the future of education, outreach and compliance programs. The next sub-sections provide perspective about the following topics:

- Targeted education, outreach and compliance efforts
- Compliance strategies
- Interactive online learning modules
- Technology integration for program feedback
- Recycling market development

13.4.1 Targeted Education, Outreach and Compliance Efforts

Targeting key audiences as part of education, outreach and compliance efforts is an approach that is based on an effective feedback loop to understand exactly which customer types,

After conducting a waste characterization study the City of Atlanta found that one-third of residential curbside recycling was contamination, with half of contamination being due to recycling being bagged. Based on this data collection and analysis, Atlanta deployed cart checkers in four target areas of the city to check and reject carts with contamination, distributing information through mail and nearby signage. Based on this targeted education, outreach and compliance effort, the overall contamination in the test areas fell by 57 percent following implementation of the strategy. Atlanta determined this by conducting a follow on waste characterization effort in these target areas to determine the effectiveness of the approach.

The City of Denver found that 48 percent of aluminum cans generated by households were not being recycled based on a waste characterization. The city developed a campaign to increase the capture of this specific material targeted nearly 5,000 households with messaging through social media, mailed postcards, collection truck signage, and half of targeted households receiving aluminum can-specific cart tags. Based on the results of a follow on waste characterization effort, the city determined that the targeted education and outreach effort resulted in a 25 percent increase in recycling of aluminum cans among households that received the cart tags.

The City of Denton works closely with its MRF operator to identify the loads and routes that are generating high levels of contamination and the types of contaminants present. This information is incorporated as part of Denton's feedback loop to inform the content and distribution of education and outreach materials and compliance efforts.

13.4.2 Compliance Strategies

The City of Fort Worth's "Blue Crew" checks the contents of residential set outs each day and leaves tags to inform the resident of any contamination that are found in recycling carts. The Blue Crew removes and bags items/articles that are identified as contaminated and attach a tag to the bag or cart explaining the situation to the customer. The Blue Crew staffing level of 6 to 7.5 full time employees (FTEs) allows Fort Worth to effectively educate customers at the point of generation collaboratively with its contracted recycling collection provider. Those who repeatedly are found to have put non-programmatic recyclable goods in the recycling carts can be charged additional garbage fees, and have their recycling carts taken away. Additionally, Fort Worth has found that by informing the community of the importance of reduction contamination, there are few complaints about the auditing of set outs from residents.

The Cities of San Antonio and Garland have policies that incentivize compliance with their solid waste and recycling programs. These policy approaches have been summarized to provide context as the City considers enhancing program compliance.

The City of San Antonio's SWMD issues violations and collects fees for cart contamination that are added to residents' monthly utility bills from CPS Energy. SWMD staff (consisting of 25 FTEs dedicated to planning, strategy, performance, education and outreach based on the analysis conducted as part of the Initial Operations Assessment) conducts cart audits and customers whose set outs are identified as contaminated are issued an initial warning tag on the cart and a letter sent in the mail that informs residents of the problem. SWMD staff members conducting the audit collect data including a picture of the cart, the serial number on the cart, a picture of the home and pictures of the contaminated items to ensure that violations are sent to the correct customer and information regarding the cart audit can be tracked. The second time that a cart is identified as contaminated, SWMD staff leave a contamination fee tag to indicate that a fee will be placed on the resident's next utility bill.

Generally, contamination fees are $25 but increases to $50 for diaper contamination. Increased fees for diaper contamination were added in 2018 because this specific contaminant represented a major problem for San Antonio's MRF. Another addition to the program has been the ability to wave a contamination fee. If a resident is assessed a fee, they can have it removed from the upcoming monthly utility bill by participating in an online educational activity within 10 days of the date of the fee notice letter. SWMD allocates the revenue collected through contamination fees to fund the dispatch of a collection truck to haul contaminated material for disposal rather than recycling.

The City of Austin has also implemented compliance strategies for its various programs including strict adherence to its separated yard trimmings, brush and bulky item collection program and targeted outreach to areas of the city that are identified has having low capture rate of recycling material including single-

stream and organics via roll cart collection. The planning, strategy, performance, education and outreach staffing includes 47 FTEs based on research conducted as part of the Initial Operations Assessment.

City of Garland residents receive recycling service and are able to opt out of their program, meaning they can ask the City not to provide recycling service. For this reason, only about 42,500 of the 63,000 total refuse collection customers receive recycling collection service. Garland collection vehicle operators identify and track customers that set out consistently contaminated carts by visually inspecting the carts and recycling material as it is tipped into the collection vehicle from the cab.

Garland employs a "three-strike" rule to incentivize compliance with the recycling program. If the driver encounters a contaminated recycling set out, the cart is tagged. If that same household has a second unacceptable set out, the resident is sent a letter in the mail providing an official warning. Upon the third unacceptable set out, the resident receives a call from the recycling outreach coordinator and their cart is removed.

Although cart removal provides an incentive to remain in compliance with the program requirements for minimizing contamination and proper set outs, if a resident's cart is removed they are able to get it back upon request from the City and there are no further penalties, financial or otherwise, to further enforce compliance.

13.4.3 Technology Integration for Program Feedback

Increasingly, cities and haulers are incorporating artificial intelligence (AI) into waste and recycling collection through on-board technology such as radio-frequency identification (RFID) enabled carts, on-board cameras and hopper cameras, and in-cab driver assistance to collect and analyze data that supports customizing education, outreach and compliance efforts to reach target audiences and support service verification. Integration of on-board technology allows for software assisted program and fleet management such as route optimization and service verification. These systems and software can also provide valuable information and feedback. For example, by identifying areas of low participation (based on set outs or RFID data) or high contamination (using hopper cameras and AI), cities can target campaigns and track changes in these metrics to understand the success of outreach, engagement, and public education campaigns.

The City of Denton has integrated data from its on-board technology provider, Rubicon Global (Rubicon) as part of its recycling contamination cart tagging campaign. The technology assists with the identification and tracking of contaminated residential recycling carts, allowing the Denton to hold customers accountable while also streamlining the process for its drivers. Denton has seen a decrease in contamination which has been associated with the integration of the Rubicon system into the City's outreach and compliance efforts.

The City of Fort Worth is working with its contract collection provider to install on-board technology to support service verification and provide data that staff can incorporate as part of its education and outreach efforts. Waste Management's "Smart Truck" technology equipped with proprietary technology designed to improve customer service by validating service by using GPS mapping and dedicated cameras to photograph or video every cart serviced. While the technology has not been rolled out across its fleet at this point, the intent is to deploy "Smart Truck" on-board equipment and software to increase knowledge of overloaded carts, participation rates, damaged carts, and other key visual data captured of the collection environments on route.

13.4.4 Interactive Online Learning Modules

Interactive online components, such as learning modules or quizzes, can drive engagement with a program's website and other information. The City of Plano provides multiple online learning modules to residents through its Live Green in Plano initiative. These online learning modules include content on a variety of topics (e.g., water conservation, stormwater, green building, solid waste and recycling), including three related to waste and recycling: "Taking Care of the Trash" about how to correctly participate the city's curbside and HHW programs, "Backyard Composting" about how to start composting yard trimmings, and "Composting Food Waste" about options to compost food waste at home. These innovative modules provide information through photos, behind-the-scenes videos (e.g., MRF processing), how-to instructions, interactive games, and quizzes. The modules also connect residents to additional resources to learn more (e.g., recommended books available at the public library). To incentivize participation, Plano ran a six-month drawing in which residents were could enter to win a $50 gift card by completing the "Taking Care of the Trash" module and submitting the certificate of completion.

13.4.5 Recycling Market Development

Recycling market development is a method of increasing the demand for recovered materials so that end markets for the materials are established, improved or stabilized and thereby become more reliable. The FCC MRF provides a critical outlet for the City and other entities in the region to recycle single-stream materials. Recycling market development efforts support the development of facilities that process potentially recyclable materials not collected as part of single-stream programs or that become process residue and contamination (e.g., Styrofoam, food, shredded paper, etc.). Table 13-3 presents material types that are challenging or cause concerns when introduced into the existing single-stream recycling processing system and could be targeted as part of recycling market development initiatives.

Table 13-3: Challenging Material Types

Material	Challenge or Concern
Plastic Film and Bags	FCC MRF has challenges segregating and marketing material when it is co-mingled with single-stream recycling.
Styrofoam (EPS)	
Food	Contaminates otherwise clean recyclables with moisture and organic residues.
Sharps	Safety concerns for operators when processed at the FCC MRF.
Batteries	Fire hazard when crushed by front-end loaders or compacted in balers at the FCC MRF.
Explosives	
Tanglers	Minimize operational efficiency of the FCC MRF when material wraps around equipment causing increased unplanned downtime.
Shredded paper	Recyclable but not suitable for MRF processing.
Textiles	
Bulky items	

Targeting key materials for recycling development initiatives and generally supporting the development of additional recycling processing and composting capacity would support the City's ability incentivize the multi-family and commercial sectors and focus long-term efforts on developing local markets to realize the economic benefits of processing discarded materials as feedstock and returned to use in the form of raw materials in the production of new product.

The TCEQ's recently published Recycling Market Development Plan highlights the following tools that can be used by local governments to support recycled material markets.

- **Partnerships.** Local governments may partner with a variety of entities to provide recycling services in a cost effective and sustainable way, including internal collaboration between departments, with local entities such as non-profits and universities, and with other local governments. Partnerships can help to collect sufficient material to meet market or community needs (e.g., donation) and achieve economies of scale and overcome potential cost barriers to recycling. An example of an opportunity for partnership is the Dallas Zoo, which is working to divert manure from disposal to create compost or partnering with local universities (e.g., Southern Methodist University) to support ongoing sustainability initiatives and provide experiential learning opportunities to students.
- **Preferential procurement.** Public purchasing policies can be used by local government to support demand for recycled material feedstocks, through incentivized or required use of recycled-content paper, compost, or C&D aggregates.

- **Service provision mandates.** Mandated service provisions are ordinances enacted by local government to require specific sectors (e.g., commercial, multi-family, C&D) to contract for recycling services. These policies can be effective in supporting recycling markets for materials in areas with low participation/access to recycling programs. Policies can include mandatory recycling of certain materials and universal recycling ordinances. Further discussion regarding the use of service provision mandates to increase recycling from the multi-family and commercial sectors is discussed in more detail in Section 11.0.
- **Economic development initiatives.** Cities may offer recycling-related businesses certain incentives to encourage the enhanced use of recovered materials from local, regional, or statewide sources. Example incentives include a reduced rate for waste disposal, reduced taxes/tax exemptions, and reduced utility rates. One approach local governments might consider is establishing recycling market development zones (RMDZs), which is particularly appropriate where local governments wish to concentrate such industry in one or more geographic areas.

13.5 Key Findings and Recommendations

This section presents the key findings and recommendations related to program and policy approaches to increasing the effectiveness of education, outreach and compliance approaches based on the results of the evaluation, case studies, benchmarking and stakeholder engagement.

13.5.1 Key Findings

Each of the following key findings supports the corresponding recommendation in the subsequent section.

1. **Education, outreach and compliance efforts are critical to the success of current and future policy, program and infrastructure developments.** Continued data collection, analysis and reporting and multi-departmental coordination are essential to establishing a consistent feedback loop that can be incorporated into the education and outreach content and compliance measures deployed by the City.
2. **The responsibilities for education, outreach and compliance efforts are split among three departments.** The Sanitation Department, OEQS and Code Compliance each manage a part of the education, outreach and compliance efforts. While this multi-departmental effort is effective to manage the current programs, the distributed effort may present challenges related to scaling future program implementation and compliance efforts.
3. **Existing goals should be adjusted to establish practical pathway to achieve success.** The City has the opportunity to align its current data tracking and program implementation to achieve the

recycling rate goals adopted as part of CECAP for the single-family sector and utilize more effective metrics in the multi-family and commercial sectors, where the City can only influence material management rather than directly controlling it. For example, the City could look to include organics in its recycling rate calculation for the single-family sector and set more granular, reporting compliance-based goals for the multi-family and commercial generator sectors.

4. **There are challenges deploying the resources to comprehensively expand the "Take-a-Peek" program.** The initial development of the program had been stalled by COVID-19 and is currently not robust enough to provide a consistent feedback loop to inform education and outreach content for the single-family sector.

5. **There is opportunity to expand education, outreach and compliance programs for the commercial sector.** Although a key focus to increase capture rate of single-stream material is on the single-family sector, there is opportunity to increase the focus on education, outreach and compliance for commercial customers to support future policy efforts to increase recycling from this sector.

6. **City has fewer planning, strategy, performance, education and outreach resources and compliance measures in place compared to peer cities.** While the City has implemented fees related to oversize brush and bulky item set outs, there are limited compliance measures related to contamination of single-stream recycling. Additionally, the "Take-a -Peek" program is limited based on the currently available resources to scale the program to become route-based. City has fewer staff among the Sanitation Department and OEQS (13 staff in Sanitation Department and five in OEQS, totaling 18) compared to San Antonio and Austin's 25 and 47 staff dedicated to strategy planning and education and outreach.

7. **On-board technology not in place to collect and track key performance metrics.** Although the City has installed on-board vehicle technology, the data collected is not currently used to track and evaluate key performance metrics such as service verification, participation/set out rate. Additionally, advanced data analytics such as AI to see what customers are setting out and levels of contamination are not evaluated to increase the effectiveness of education, outreach and compliance programs.

8. **Increasing the capture rate of single stream recyclables to 60 percent and separately collecting and recycling organics would support the CECAP goals of recycling 35 percent of organics, 60 percent of paper, and reducing landfill disposal by 35 percent by 2030.** Education, outreach and compliance efforts focused on the single-family recycling collection to increase

capture rate to 60 percent and implement organics separation and recycling would result in successfully achieving the goals set out by CECAP. This could be accomplished by leveraging the City's existing programs and coordinating with the NCTCOG regional campaign to increase capture rate and, most importantly, implementing separate collection and recycling of organics from the single-family sector.

13.5.2 Recommendations

Each of the following recommendations are components of the planning level Implementation & Funding Plan provided in Appendix F.

1. **Adjust performance metrics and recycling rate methodology.** Utilize performance metrics including contamination rate, capture rate, and pounds per household generation rate as key recycling performance metrics and update the City's recycling rate to includes organics. Evaluate these performance metrics on a consistent and recurring basis. Leverage these recycling performance metrics to inform the development of content on a more regular basis, coordinating closely with FCC and other local commercial recycling facilities to increase the effectiveness of education, outreach and compliance efforts.
2. **Expand "Take-a-Peek" program and other compliance efforts in the single-family sector.** Expand the "Take-a-Peek" program to increase the feedback loop generated from single-family customer set outs and target outreach to areas of the City or specific routes with high levels of contamination. Recycling carts should be removed from customers that are not in compliance, returning their cart if customers participate in online modules. Chronic offenders (e.g., after having their cart removed one or more times) setting out heavily contaminated carts should be cited with a service fee. To expand these programs to a similar scale to San Antonio or Austin, the City would need to consider hiring or re-purposing between seven and 29 additional FTEs with vehicles and data collection equipment (e.g., tablets). The City should also consider leveraging on-board vehicle technology to support with service verification and compliance efforts.
3. **Expand the Green Business Certification program.** Add more responsibility to the existing staff to provide technical assistance as part of the Green Business Certification program, as available. As the Green Business Certification program continues to grow, there may be a need to hire additional FTEs to provide technical assistance on a dedicated basis, coordinating closely with Code Compliance to increase the feedback look with commercial sector generators.
4. **Amplify regional NCTCOG campaign and coordinate with DISD.** The City should continue implementation of education, outreach and compliance measure in coordination with the NCTCOG

regional campaign and continue efforts to coordinate with DISD. The City is in a position to become a leader in that effort to synchronize messaging with peer cities and local educational institutions to advance the effectiveness of the regional campaign. Additionally, the City should leverage grant opportunities focused on regional collaboration to amplify education and outreach efforts to reach more generators among single-family, multi-family and commercial.

5. **Maximize voluntary programs in the near term to increase the single-stream capture rate from 50 percent to 60 percent.** Leverage voluntary programs including expanding the "Take-a-Peek" program and on-board vehicle technology to increase the effectiveness of the existing education, outreach and compliance programs to achieve an increase in capture rate from 50 to 60 percent. Increasing the feedback loop in the single-family sector to inform the development of programs and improve the effectiveness of the multi-departmental education and outreach program is essential to increasing the capture rate of single-stream recycling, organics recycling and moving the needle to achieving the City's Zero Waste goal.

6. **Support separate collection and recycling of organics with critical education, outreach and compliance measures.** Deploy education, outreach and compliance staff from the Sanitation Department to education customers about any new or adjusted separate collection programs and enforce compliance measures regarding separate collection of organics would position the City to achieve its goals of 35 percent organics recycling and 35 percent reduction of landfill disposal by 2030. Leverage these resources dedicated to brush and bulky item collection to support compliance efforts of single-stream recycling, as available.

7. **Implement mandatory programs in the long term to increase capture rate from 60 to 80 percent in the single-family sector.** When voluntary programs have been shown to drive up the capture rate from the single-stream recycling program, reduce disposal on a per household basis, and increase recycling quantities on a per household basis, the City should implement mandatory programs such as material bans and residential recycling requirements to increase the capture rate of single-stream recyclables from 60 to 80 percent. Mandatory programs should be considered after the City successfully implements the other recommendations described in this section. Implementing mandatory programs would increase the staff demand for compliance efforts and may require additional staff or resources to effectively hold customers to account and realize a further increase in the recycling rate.

APPENDIX A – STAKEHOLDER ENGAGEMENT SUMMARY

Throughout the LSWMP Update development process several virtual interviews were conducted by City staff and supported by Burns & McDonnell. The following communicates information about the interviews including when the conversation was held, who was present, and a brief summary of the discussion.

Apartment Association of Greater Dallas (AAGD

City staff and Burns & McDonnell representatives interviewed Jason Simon and Raphaella Silva of AAGD on July 29, 2021. City staff provided a background on the LSWMP Update and facilitated discussion on the Multi-family Recycling Ordinance (MFRO), tenant composting, Household Hazardous Waste (HHW) management and education and outreach efforts.

Dallas Regional Chamber (DRC)

City staff and Burns & McDonnell representatives interviewed Matt Garcia of the DRC on June 25, 2021. Garcia provided a background on the DRC and City staff facilitated a discussion on the DRC's interest supporting Zero Waste efforts and diverting material generated by the commercial sector from disposal. Garcia indicated that the DRC has an infrastructure task force that could coordinate with City staff to support efforts to increase education and outreach efforts to commercial sector generators.

North Dallas Neighborhood Alliance (NDNA)

City staff and Burns & McDonnell representatives interviewed Rod Scales of the NDNA on June 24, 2021. Scales provided a background on the NDNA and City staff facilitated a discussion on the single-family constituents' perspectives on the effectiveness of the City's roll-cart collection, brush and bulky item collection and alley collection programs.

Pleasant Grove Unidos

City staff and Burns & McDonnell representatives interviewed Juanito Arevalo, Delfino Lopes, Billie Lopez, and Franklin Ortega of Pleasant Grove Unidos July 28, 2021. The group provided a background on Pleasant Grove Unidos represented by Council Districts 5, 7 and 8 and City staff facilitated a discussion on single-family constituents' perspectives on the effectiveness of the City's roll-cart collection, brush and bulky item collection, litter mitigation, and HHW management programs.

Revitalize South Dallas Coalition (RSDC)

City staff and Burns & McDonnell representatives interviewed Ken Smith of the RSDC on June 14, 2021. Smith provided a background on RSDC and provided insight on challenges with solid waste management in south Dallas and challenged the systemic inertia that minimizes the capacity for the City to respond effectively to south Dallas resident needs. Smith indicated that increased compliance initiatives related to separate brush and bulky items in south Dallas may be ineffective due to perceived increased burden on residents that already struggle to maintain compliance with existing programs.

Texas Campaign for the Environment (TCE)

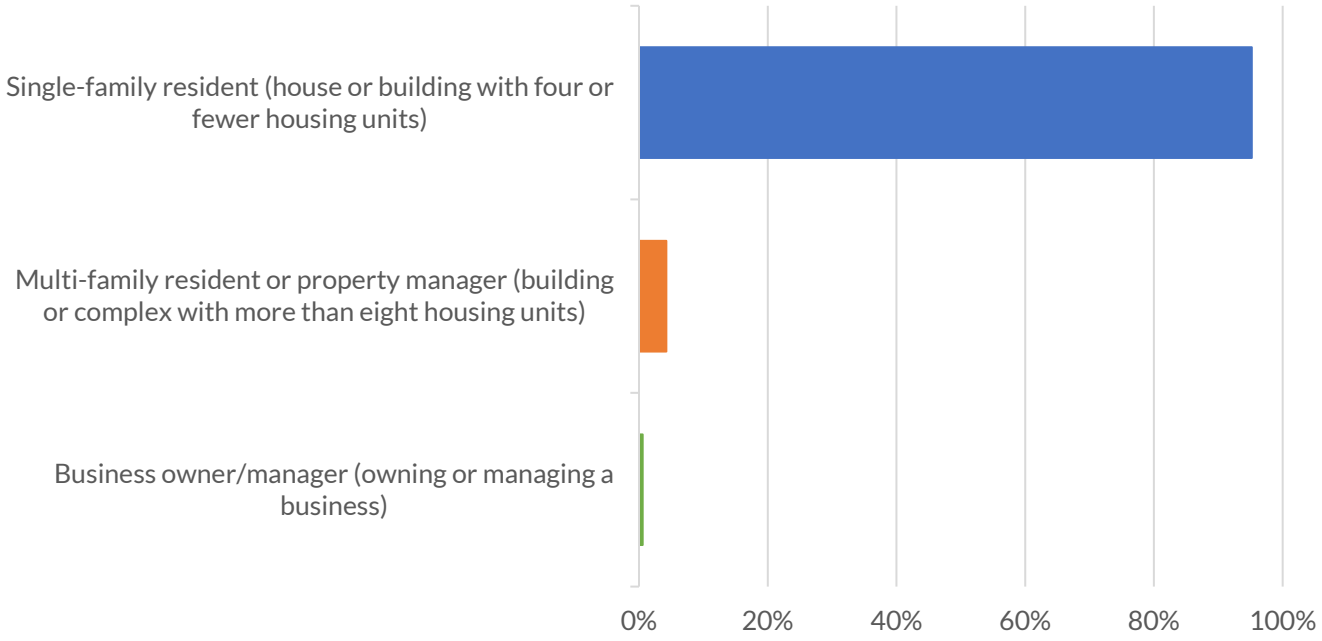
City staff and Burns & McDonnell representatives interviewed Kevin Richardson and Corey Troiani of TCE on July 1, 2021. TCE representatives provided a background on TCE and provided a listing of the key priorities that TCE would expect the City to include in the LSWMP Update such as mandatory commercial recycling, separate collection and processing of yard trimmings/brush, increased education and outreach efforts, and incorporating equity in the development process.

Texas Restaurant Association

City staff and Burns & McDonnell representatives interviewed Core Mobley, Chis Aslam, and Alicia Voltmer of the Texas Restaurant Association on June 30, 2021. Texas Restaurant Association representatives provided a background on the association and City staff facilitated a discussion about restaurants ability to recycle single-stream or organics materials. Texas Restaurant Representatives indicated that any additional requirements or costs related to Zero Waste would not be viewed favorably, especially as restaurants continue to recover from the challenges related to the COVID-19 pandemic.

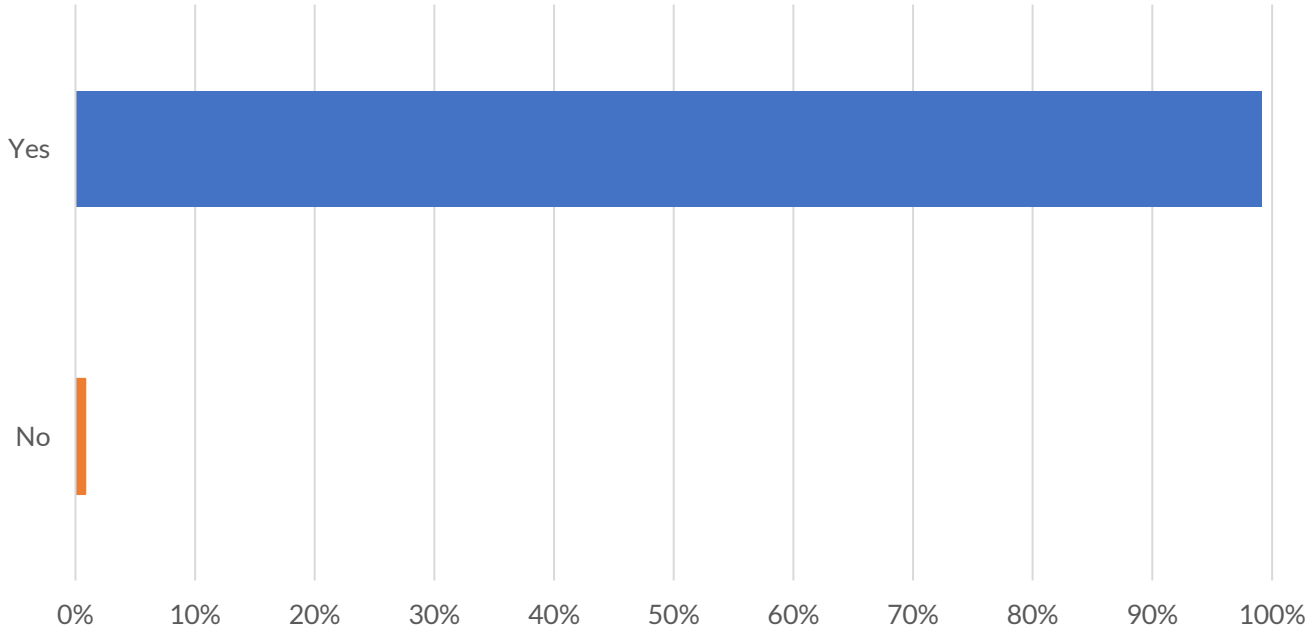
Demographic Questions

Q. Are your responding to this survey as a:



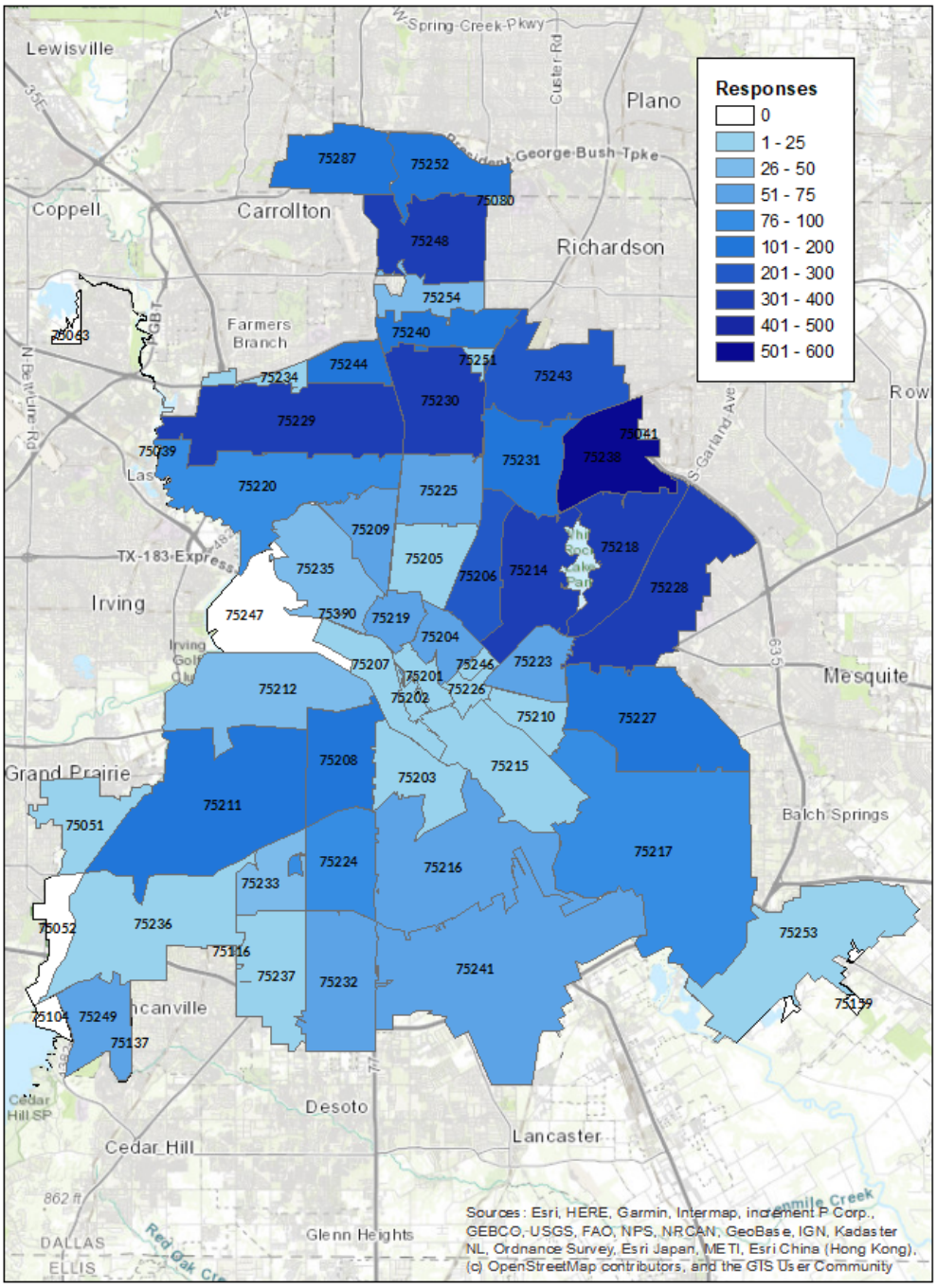
ANSWER CHOICES	RESPONSES	
Single-family resident (house or building with four or fewer housing units)	95.19%	5,259
Multi-family resident or property manager (building or complex with more than eight housing units)	4.25%	235
Business owner/manager (owning or managing a business)	0.56%	31
TOTAL		5,525

Q. Are you a Dallas resident?

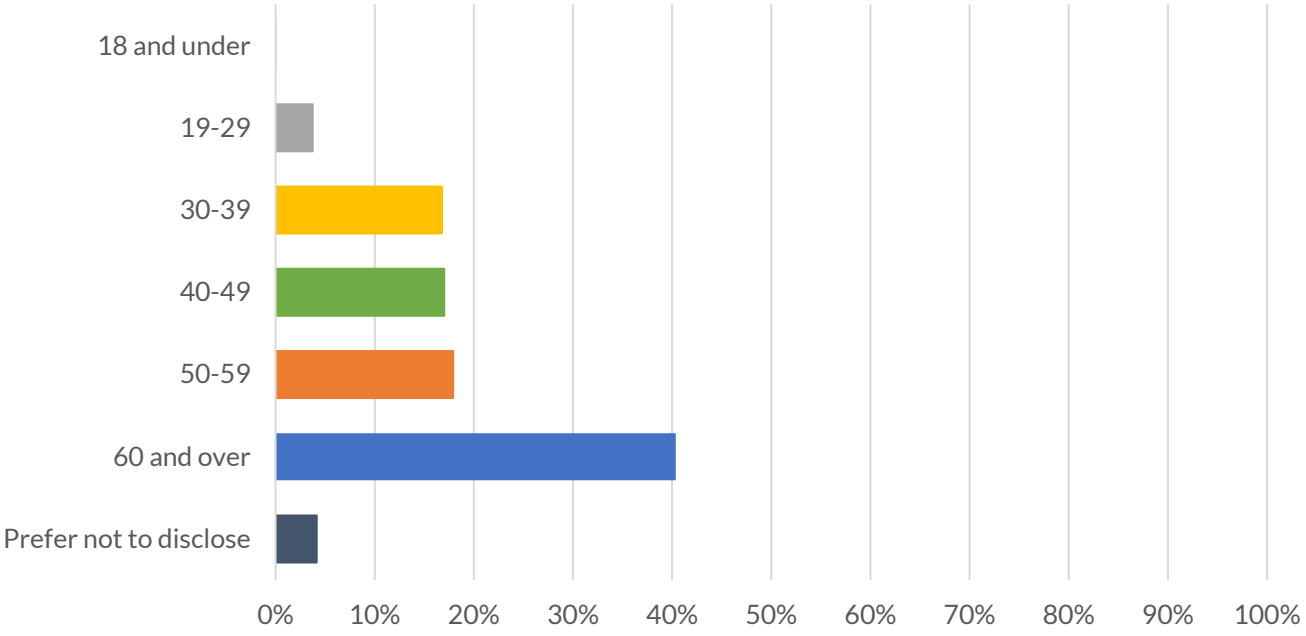


ANSWER CHOICES	RESPONSES	
Yes	99.19%	5,485
No	0.81%	45
TOTAL		5,530

Q. Please select the zip code for your residence or business.

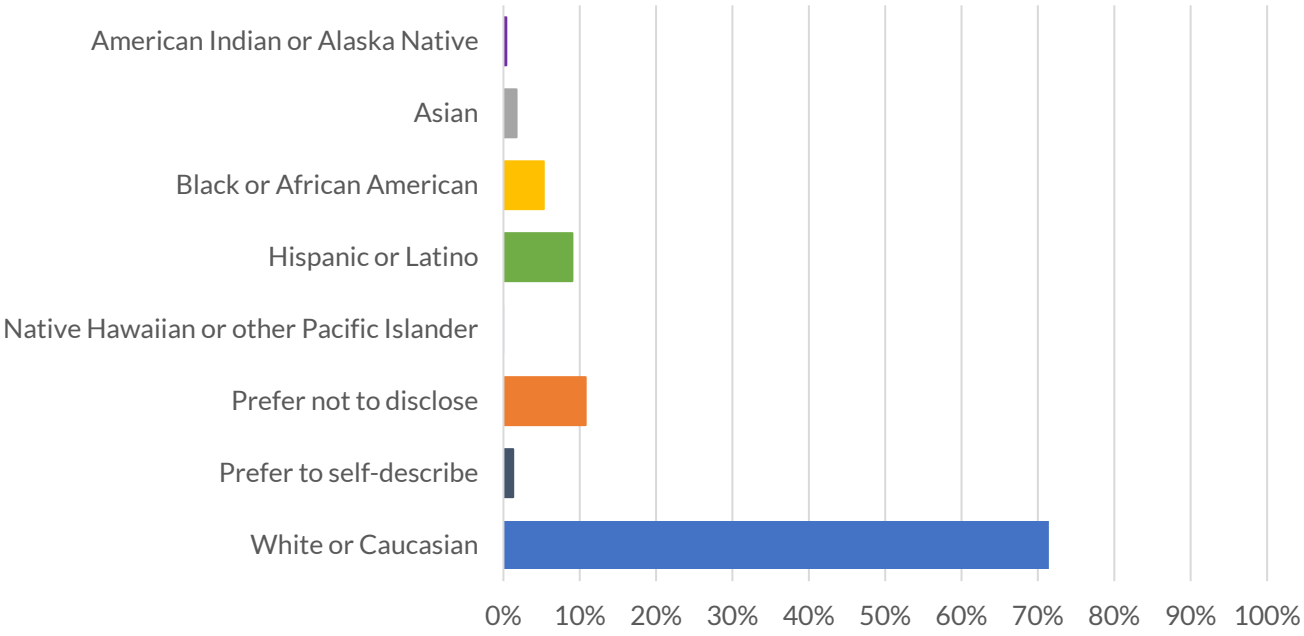


Q. Please provide your age range:



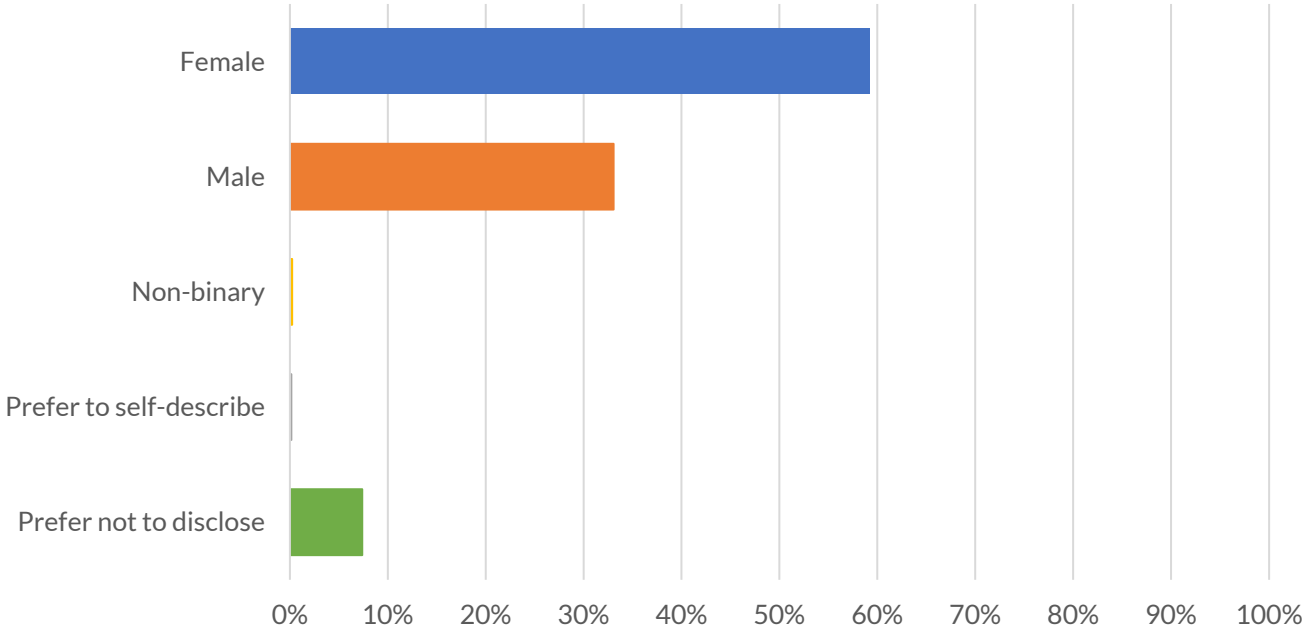
ANSWER CHOICES	RESPONSES	
18 and under	0.07%	4
19-29	3.73%	206
30-39	16.78%	927
40-49	17.01%	940
50-59	17.90%	989
60 and over	40.37%	2,231
Prefer not to disclose	4.14%	229
TOTAL		5,526

Q. Please provide your race.



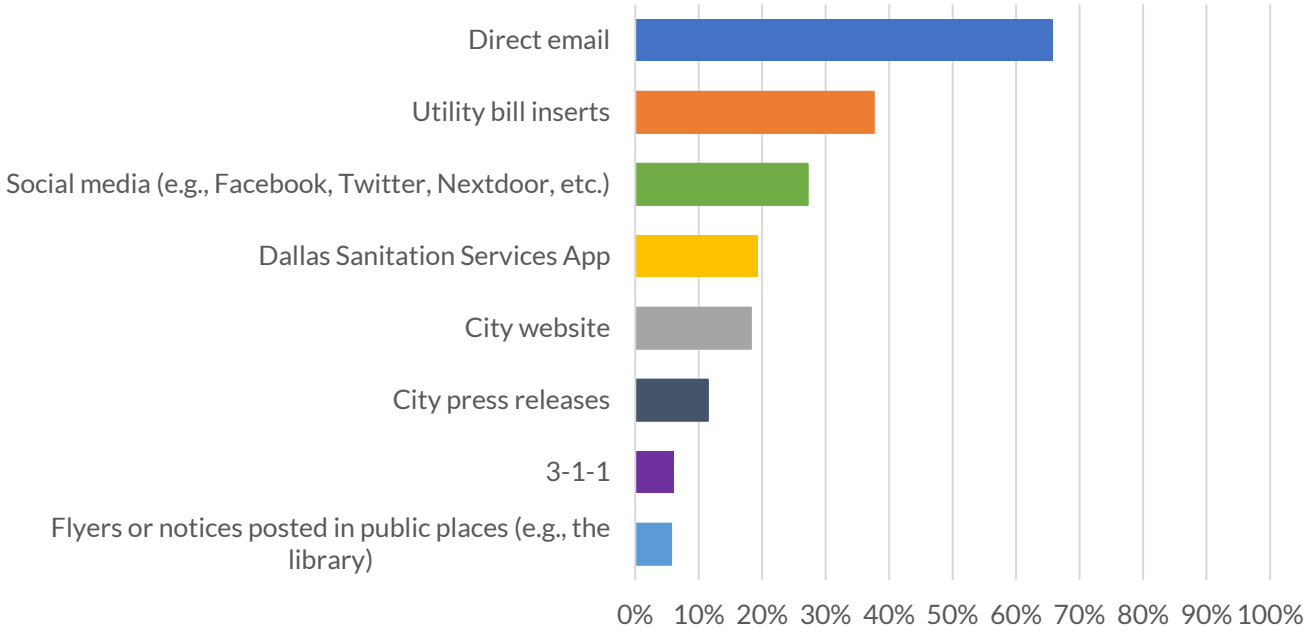
ANSWER CHOICES	RESPONSES	
American Indian or Alaska Native	0.38%	21
Asian	1.72%	95
Black or African American	5.28%	292
Hispanic or Latino	9.04%	500
Native Hawaiian or other Pacific Islander	0.09%	5
Prefer not to disclose	10.78%	596
Prefer to self-describe	1.28%	71
White or Caucasian	71.43%	3,951
TOTAL		5,531

Q. Please provide your gender.



ANSWER CHOICES	RESPONSES	
Female	59.18%	3,277
Male	33.05%	1,830
Non-binary	0.23%	13
Prefer to self-describe	0.14%	8
Prefer not to disclose	7.39%	409
TOTAL		5,537

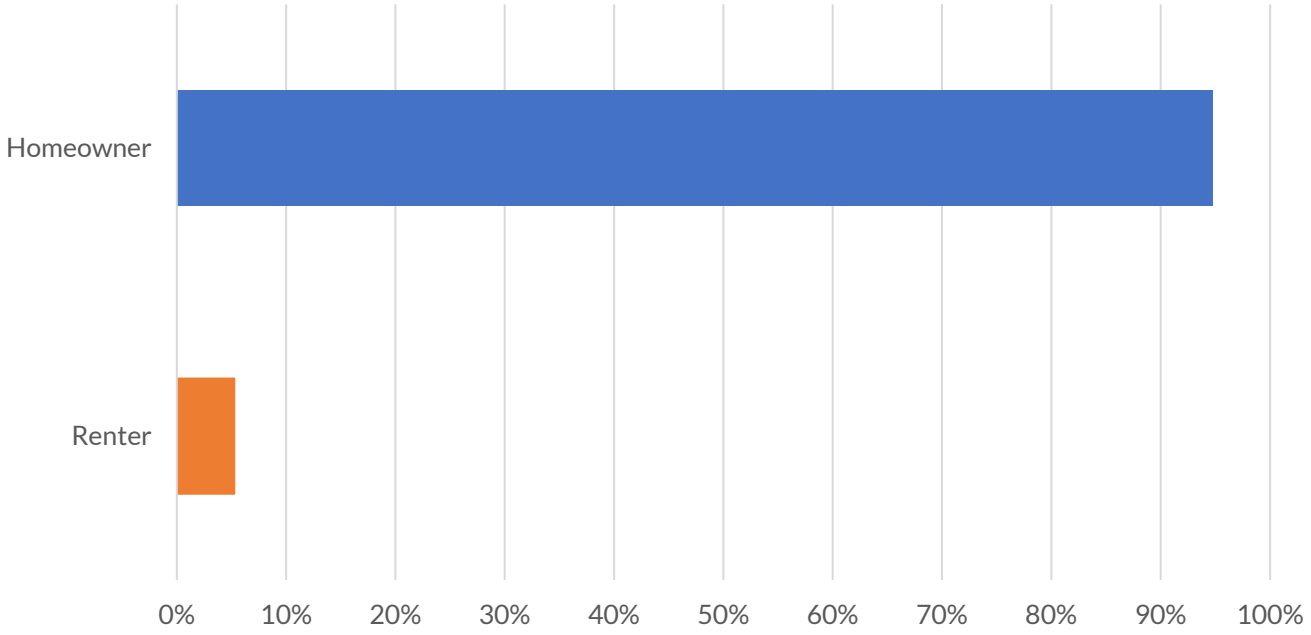
Q. How do you prefer to receive communications from the City about solid waste and recycling services and programs (e.g., changes to existing services, new services, reminders about upcoming events or service days, educational information, etc.)? Please check all that apply.



ANSWER CHOICES	RESPONSES	
Direct email	65.71%	3,624
Utility bill inserts	37.57%	2,072
Social media (e.g., Facebook, Twitter, Nextdoor, etc.)	27.16%	1,498
Dallas Sanitation Services App	19.29%	1,064
City website	18.22%	1,005
City press releases	11.44%	631
3-1-1	6.04%	333
Flyers or notices posted in public places (e.g., the library)	5.64%	311
TOTAL		5,515

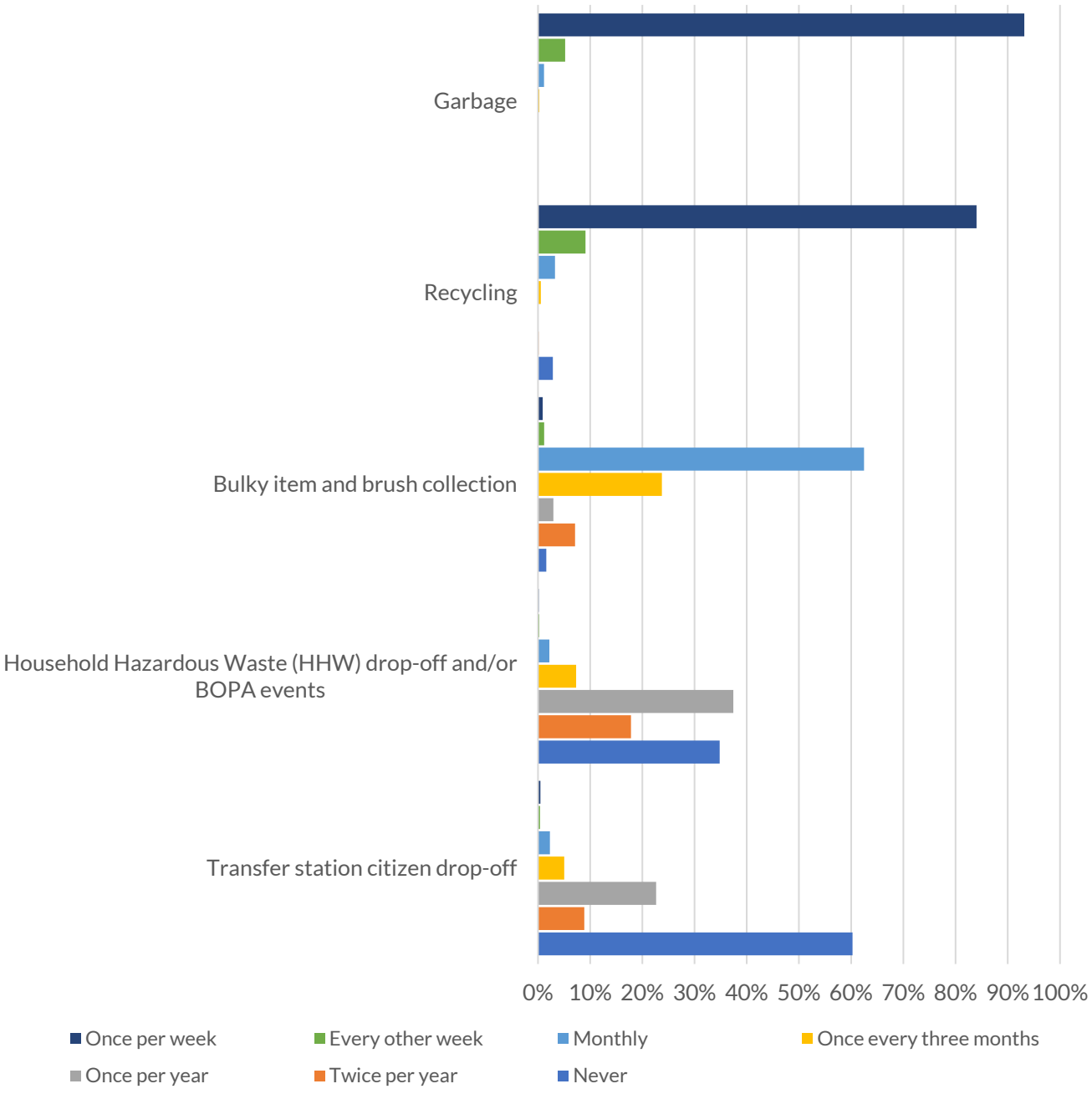
SINGLE-FAMILY RESIDENTS

Q. Are you a homeowner or renter?



ANSWER CHOICES	RESPONSES	
Homeowner	94.74%	4,985
Renter	5.26%	277
TOTAL		5,262

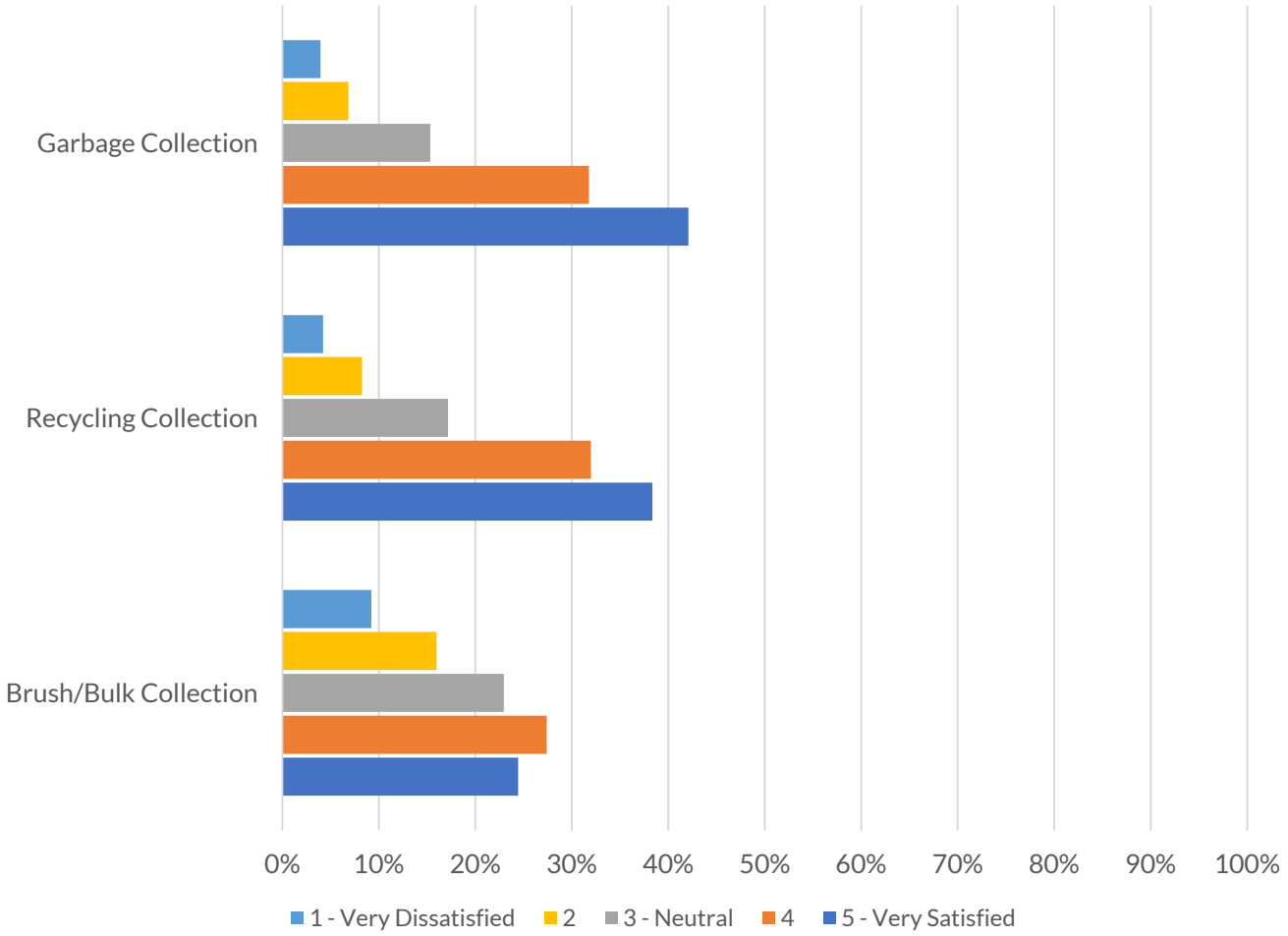
Q. On average, how often do you use each of the following City-provided services? Pick the option for each service that best applies to you.



Q. On average, how often do you use each of the following City-provided services?
Pick the option for each service that best applies to you.

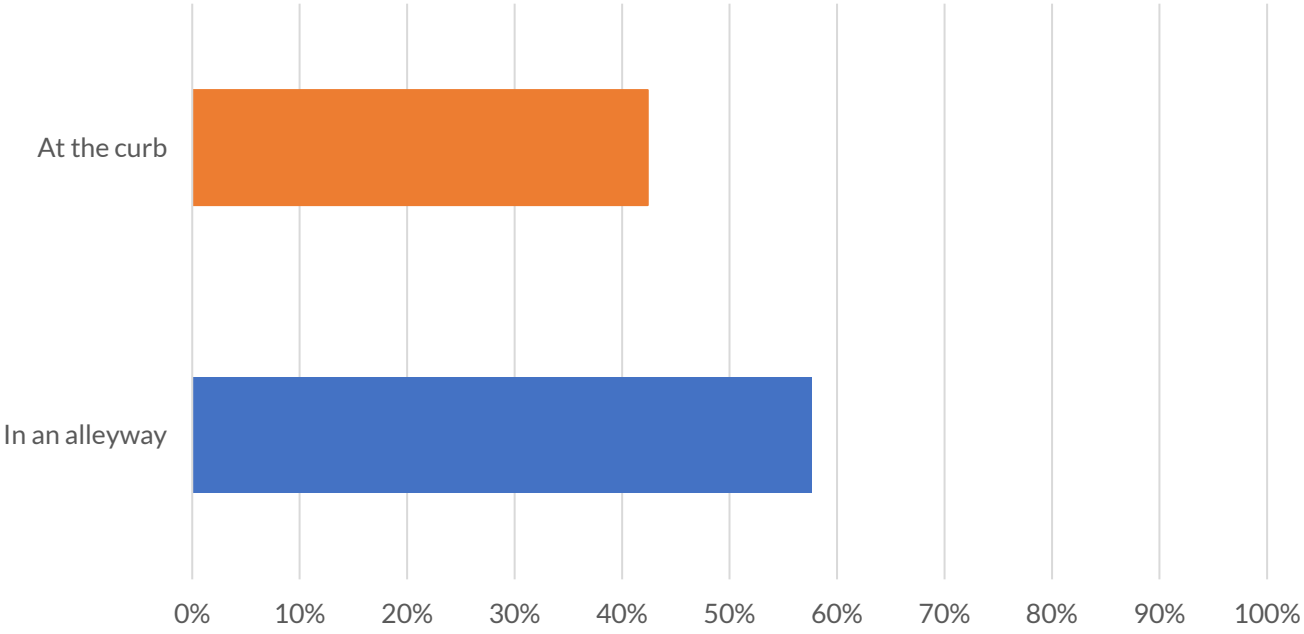
	Once per week		Every other week		Monthly		Once every three months		Twice per year		Once per year		Never		TOTAL
Garbage	93.17%	4,914	5.21%	275	1.16%	61	0.28%	15	0.06%	3	0.04%	2	0.08%	4	5,274
Recycling	84.03%	4,387	9.12%	476	3.26%	170	0.56%	29	0.06%	3	0.13%	7	2.85%	149	5,221
Bulky item and brush collection	0.91%	48	1.20%	63	62.46%	3,280	23.75%	1,247	2.95%	155	7.12%	374	1.60%	84	5,251
Household Hazardous Waste (HHW) drop-off and/or BOPA events	0.17%	9	0.25%	13	2.19%	114	7.31%	381	37.44%	1,951	17.83%	929	34.81%	1,814	5,211
Transfer station citizen drop-off	0.48%	25	0.39%	20	2.30%	119	5.03%	260	22.65%	1,171	8.88%	459	60.26%	3,115	5,169

Q. On a scale of 1 to 5, rank your level of satisfaction with the current solid waste and recycling programs and services offered by the City for single-family households.



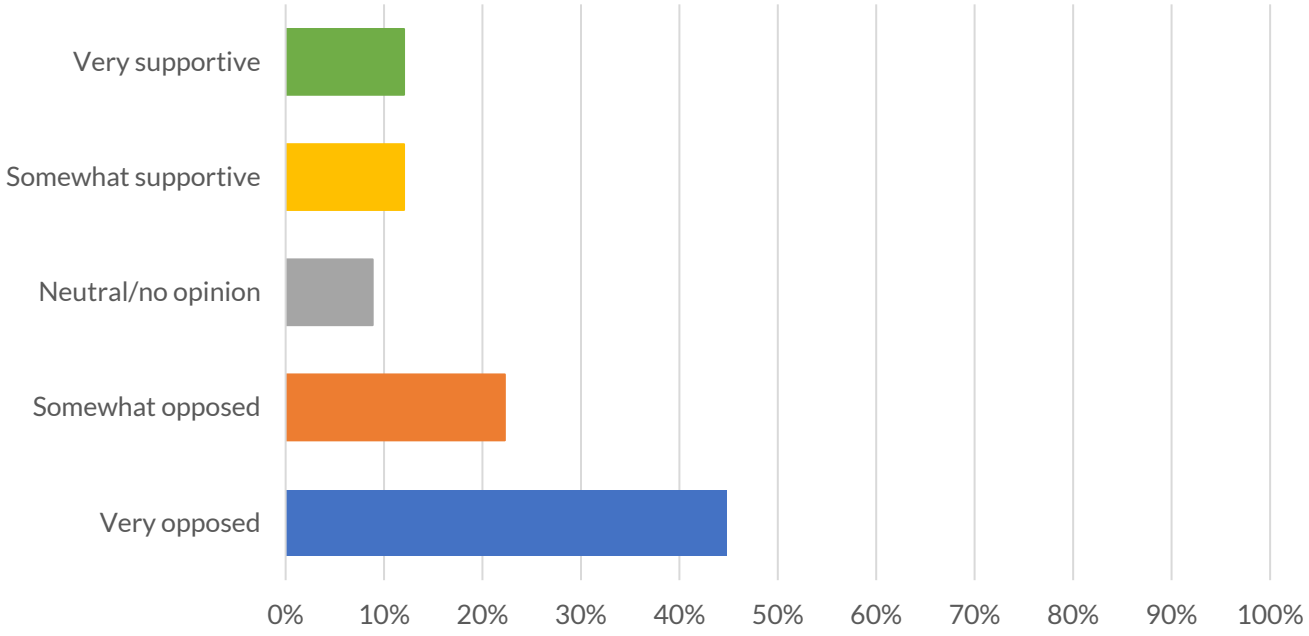
	1 Very Dissatisfied		2		3 Neutral		4		5 Very Satisfied		TOTAL
Garbage Collection	3.96%	209	6.84%	361	15.34%	809	31.77%	1,676	42.09%	2,220	5,275
Recycling Collection	4.22%	220	8.26%	431	17.18%	896	31.98%	1,668	38.35%	2,000	5,215
Brush/Bulk Collection	9.23%	483	15.99%	837	22.95%	1,201	27.40%	1,434	24.44%	1,279	5,234

Q. Please indicate how you set out your garbage and/or recycling cart based on your home's configuration:



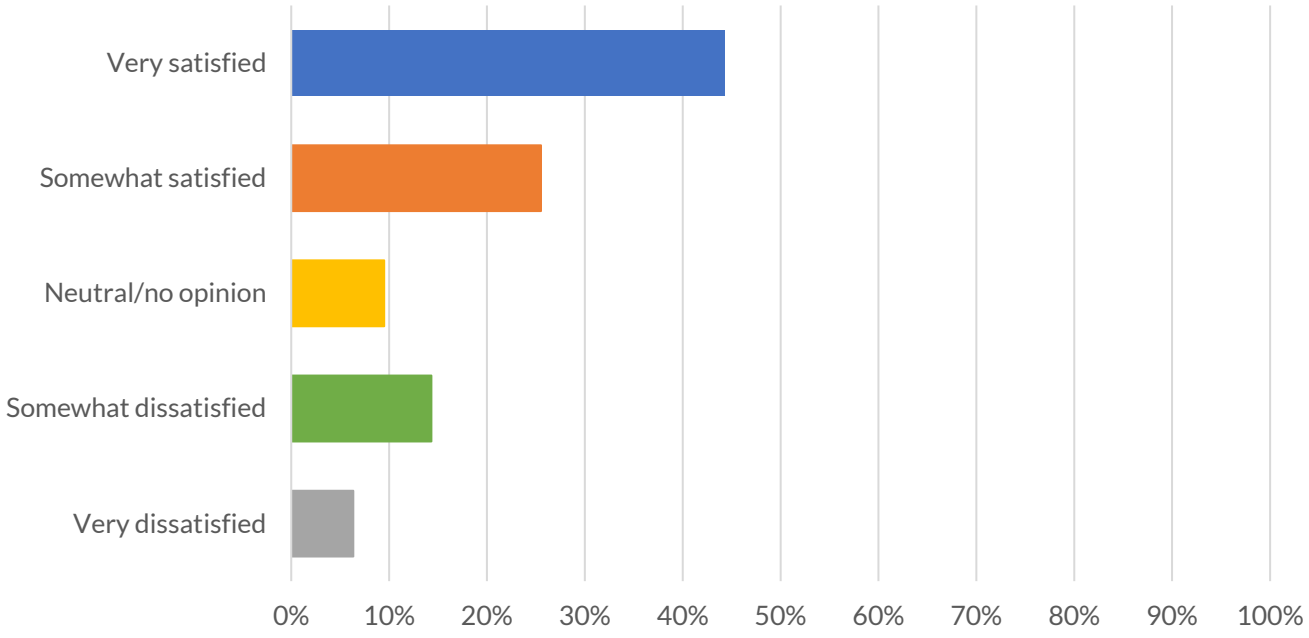
ANSWER CHOICES	RESPONSES	
At the curb	42.38%	2,234
In an alleyway	57.62%	3,037
TOTAL		5,271

Q. Collection in alleyways presents challenges for City collection vehicles that may be too large to travel down alleyways safely or without risk of property damage. To what extent would you be supportive of the City transitioning to curbside collection from alleyways that are not conducive to automated collection?



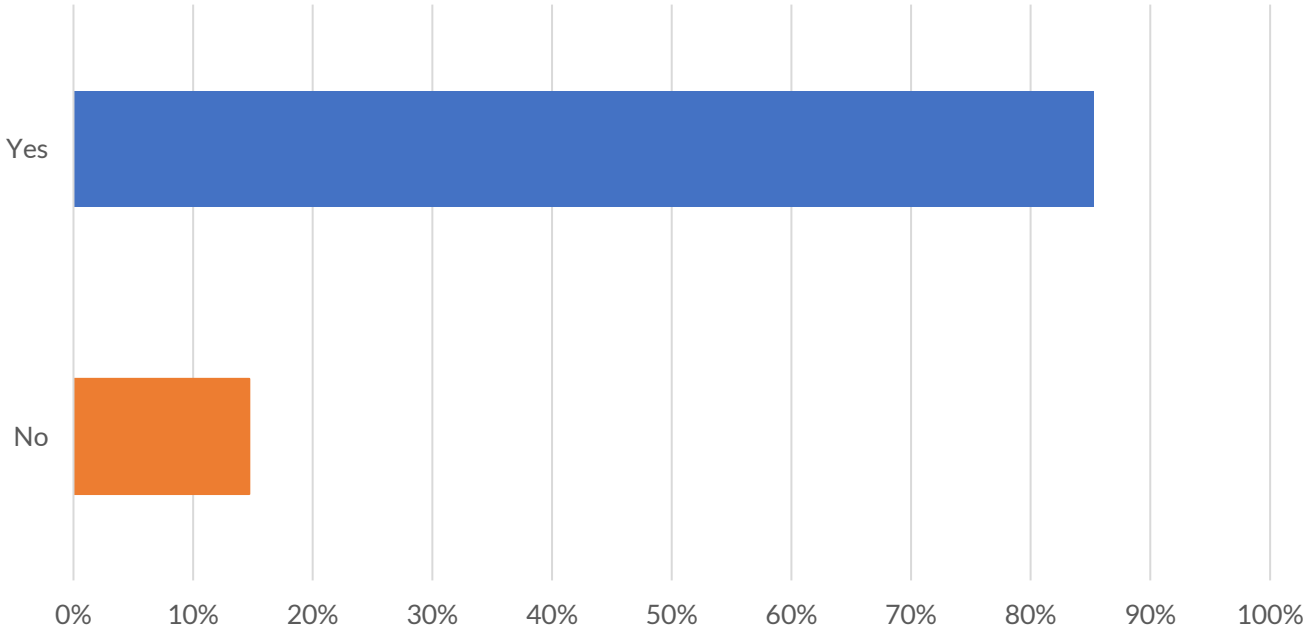
ANSWER CHOICES	RESPONSES	
Very supportive	12.03%	366
Somewhat supportive	12.03%	366
Neutral/no opinion	8.84%	269
Somewhat opposed	22.26%	677
Very opposed	44.84%	1,364
TOTAL		3,042

Q. The City currently provides bulky item collection on a monthly basis. How satisfied are you with the frequency of bulky collection service?



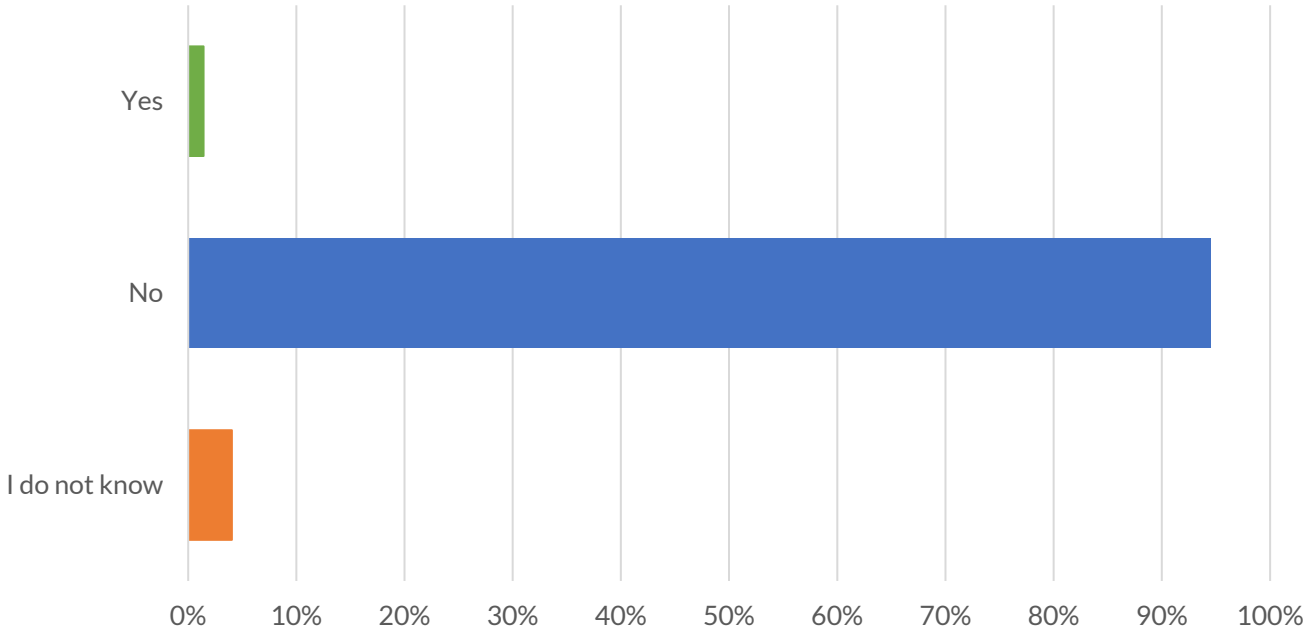
ANSWER CHOICES	RESPONSES	
Very satisfied	44.34%	2,336
Somewhat satisfied	25.51%	1,344
Neutral/no opinion	9.49%	500
Somewhat dissatisfied	14.31%	754
Very dissatisfied	6.34%	334
TOTAL		5,268

Q. Are you aware of the changes to the bulky item and brush collection program to incorporate set out limits at ten cubic yards?



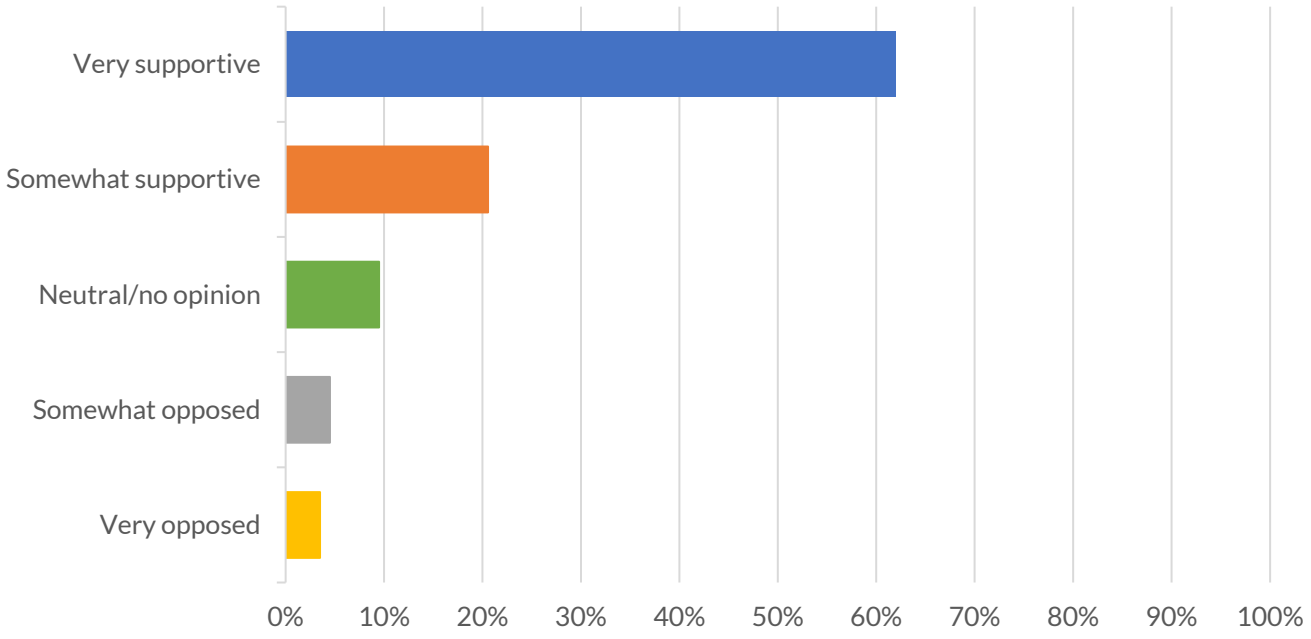
ANSWER CHOICES	RESPONSES	
Yes	85.30%	4,497
No	14.70%	775
TOTAL		5,272

Q. Have you been charged a fee for setting out too much brush/bulky material?



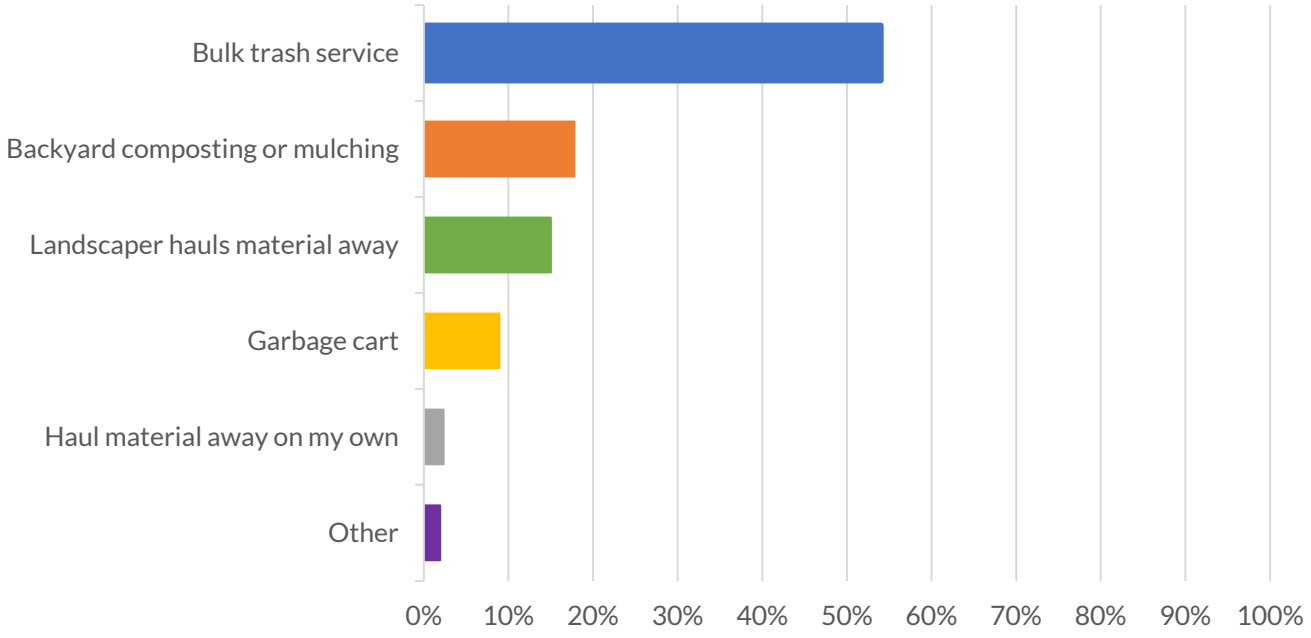
ANSWER CHOICES	RESPONSES	
Yes	1.42%	75
No	94.54%	4,987
I do not know	4.04%	213
TOTAL		5,275

Q. As a key effort to divert material away from the landfill, to what extent would you be supportive of the City requiring the separation of bulky items and brush material so they could be collected separately?



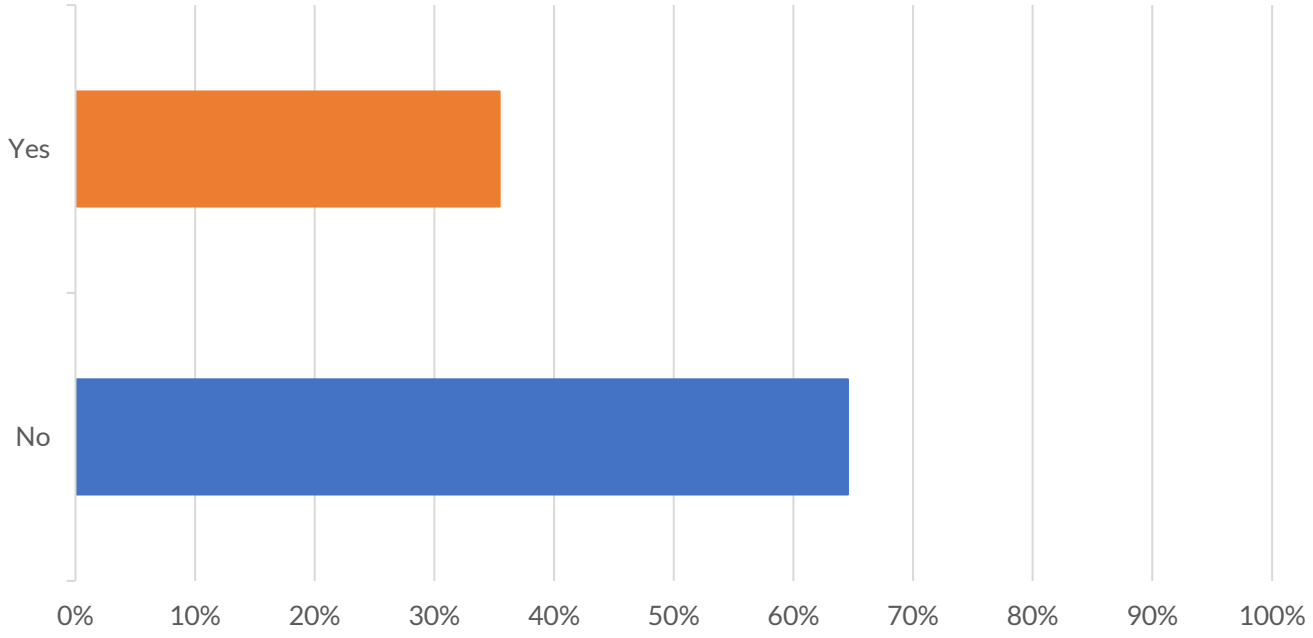
ANSWER CHOICES	RESPONSES	
Very supportive	61.99%	3,271
Somewhat supportive	20.56%	1,085
Neutral/no opinion	9.48%	500
Somewhat opposed	4.49%	237
Very opposed	3.49%	184
TOTAL		5,277

Q. When you have yard trimmings, how do you typically dispose of them?



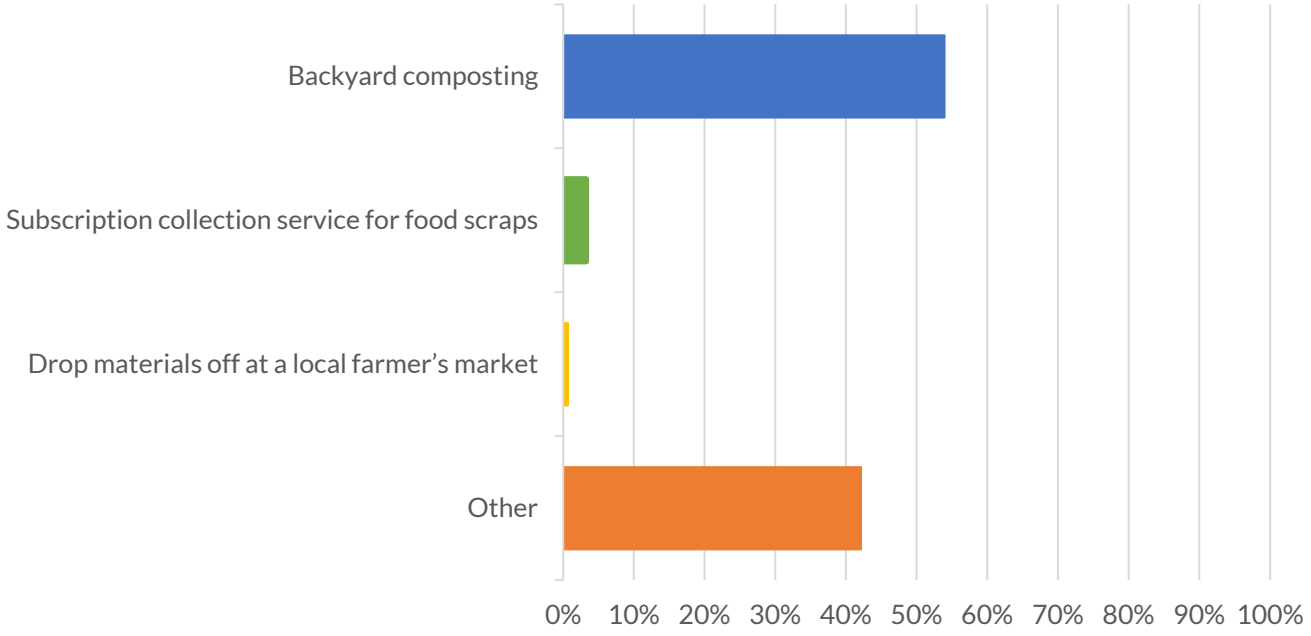
ANSWER CHOICES	RESPONSES	
Bulk trash service	53.99%	2,847
Backyard composting or mulching	17.79%	938
Landscaper hauls material away	15.02%	792
Garbage cart	8.93%	471
Haul material away on my own	2.33%	123
Other	1.93%	102
TOTAL		5,273

Q. Do you currently separate other organics such as food scraps from the garbage to recycle?



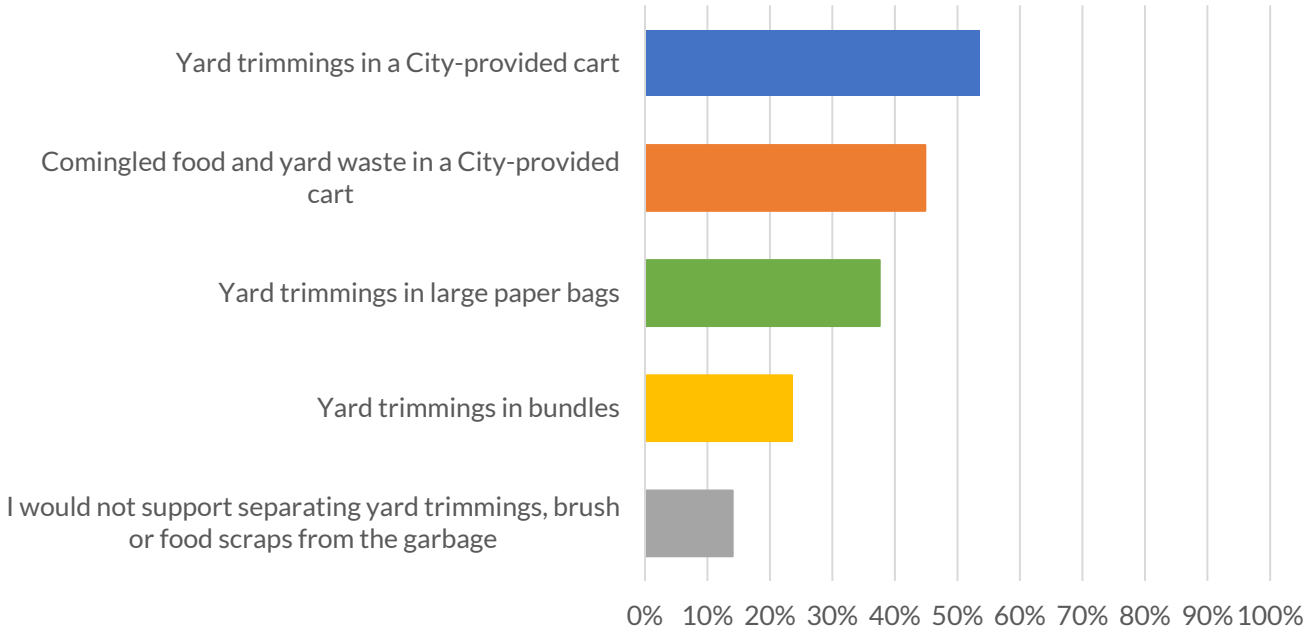
ANSWER CHOICES	RESPONSES	
Yes	35.44%	1,869
No	64.56%	3,404
TOTAL		5,273

Q. If yes, please indicate how you separate food scraps to recycle:



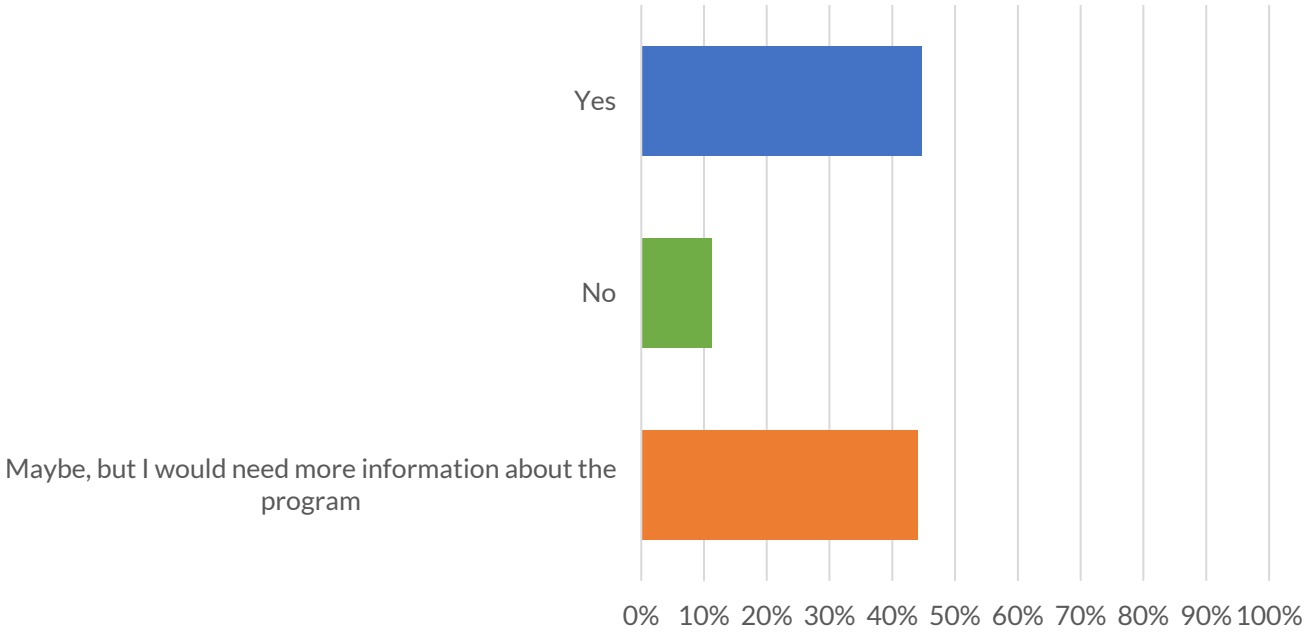
ANSWER CHOICES	RESPONSES	
Backyard composting	53.94%	1,265
Subscription collection service for food scraps	3.24%	76
Drop materials off at a local farmer's market	0.68%	16
Other	42.13%	988
TOTAL		2,345

Q. Which collection options would you support to separate yard trimmings, brush and food scraps from the garbage and help increase the City's recycling rate? Check all that apply.



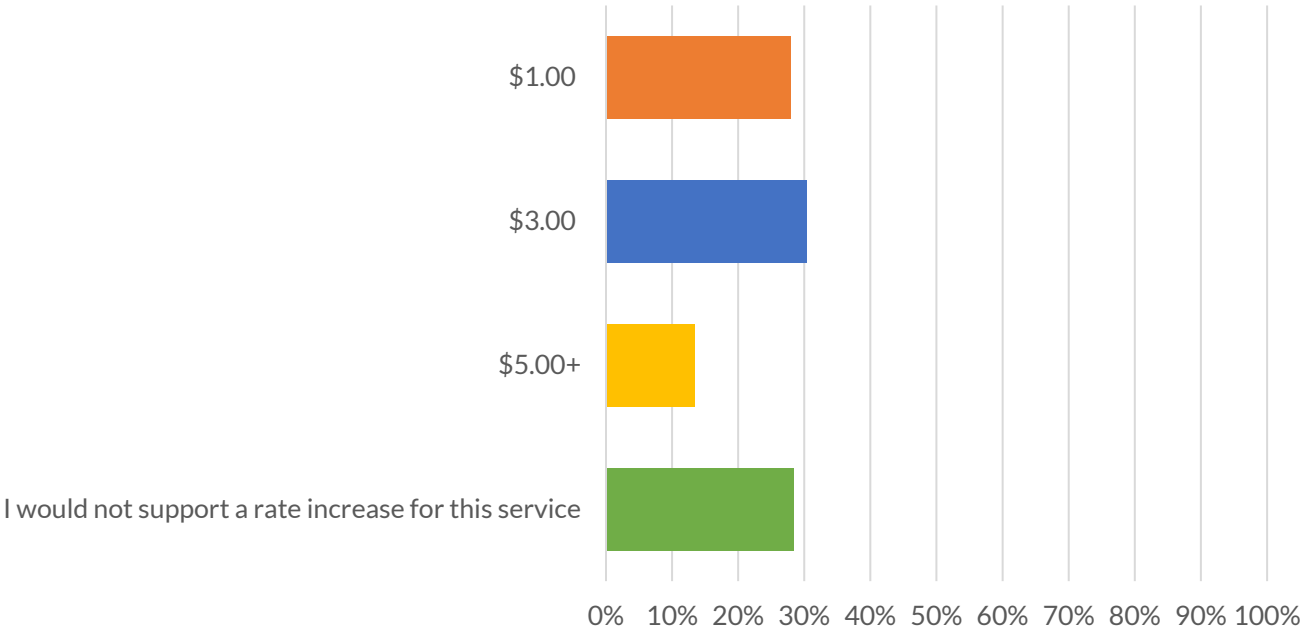
ANSWER CHOICES	RESPONSES	
Yard trimmings in a City-provided cart	53.47%	2,743
Comingled food and yard waste in a City-provided cart	44.85%	2,301
Yard trimmings in large paper bags	37.56%	1,927
Yard trimmings in bundles	23.53%	1,207
I would not support separating yard trimmings, brush or food scraps from the garbage	14.04%	720
TOTAL		5,130

Q. If the City were to implement a program to collect comingled food and yard waste from your home, would you be interested in participating?



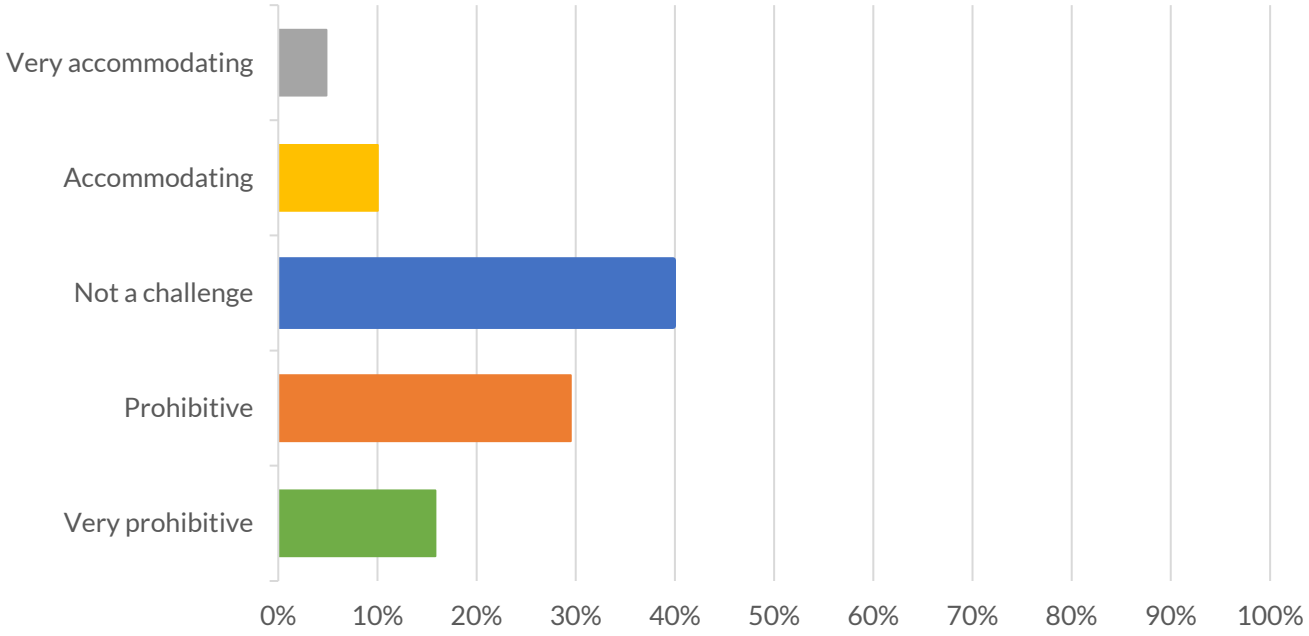
ANSWER CHOICES	RESPONSES	
Yes	44.73%	2,351
No	11.26%	592
Maybe, but I would need more information about the program	44.01%	2,313
TOTAL		5,256

Q. How much of a monthly rate increase would you support for the City to develop programs to divert yard waste, brush material and other organic waste (e.g., food waste) from the landfill?



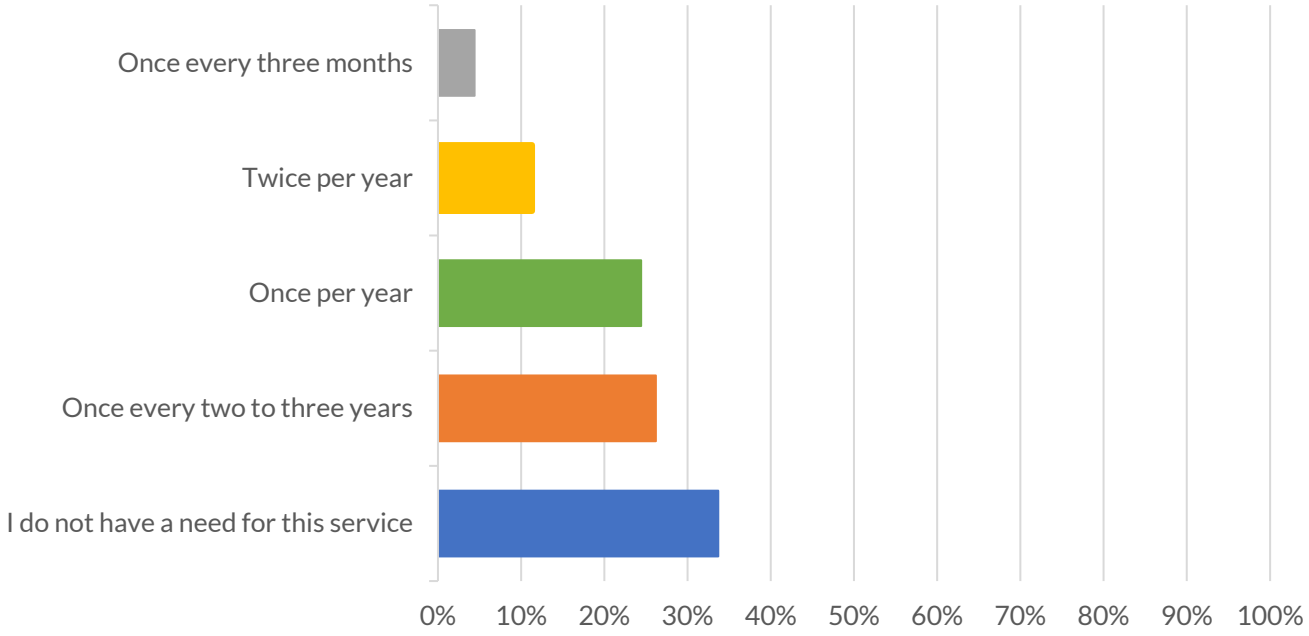
ANSWER CHOICES	RESPONSES	
$1.00	27.90%	1,463
$3.00	30.34%	1,591
$5.00+	13.41%	703
I would not support a rate increase for this service	28.36%	1,487
TOTAL		5,244

Q. The Home Chemical Collection Center is in the northeast region of Dallas County and operates on limited hours during the week due to COVID-19 on Tuesdays (9:00 a.m. – 7:30 p.m.) and Wednesdays (8:30 a.m. – 5:00 p.m.). Given the location and operating hours, how does this impact your willingness to utilize the Home Chemical Collection Center?



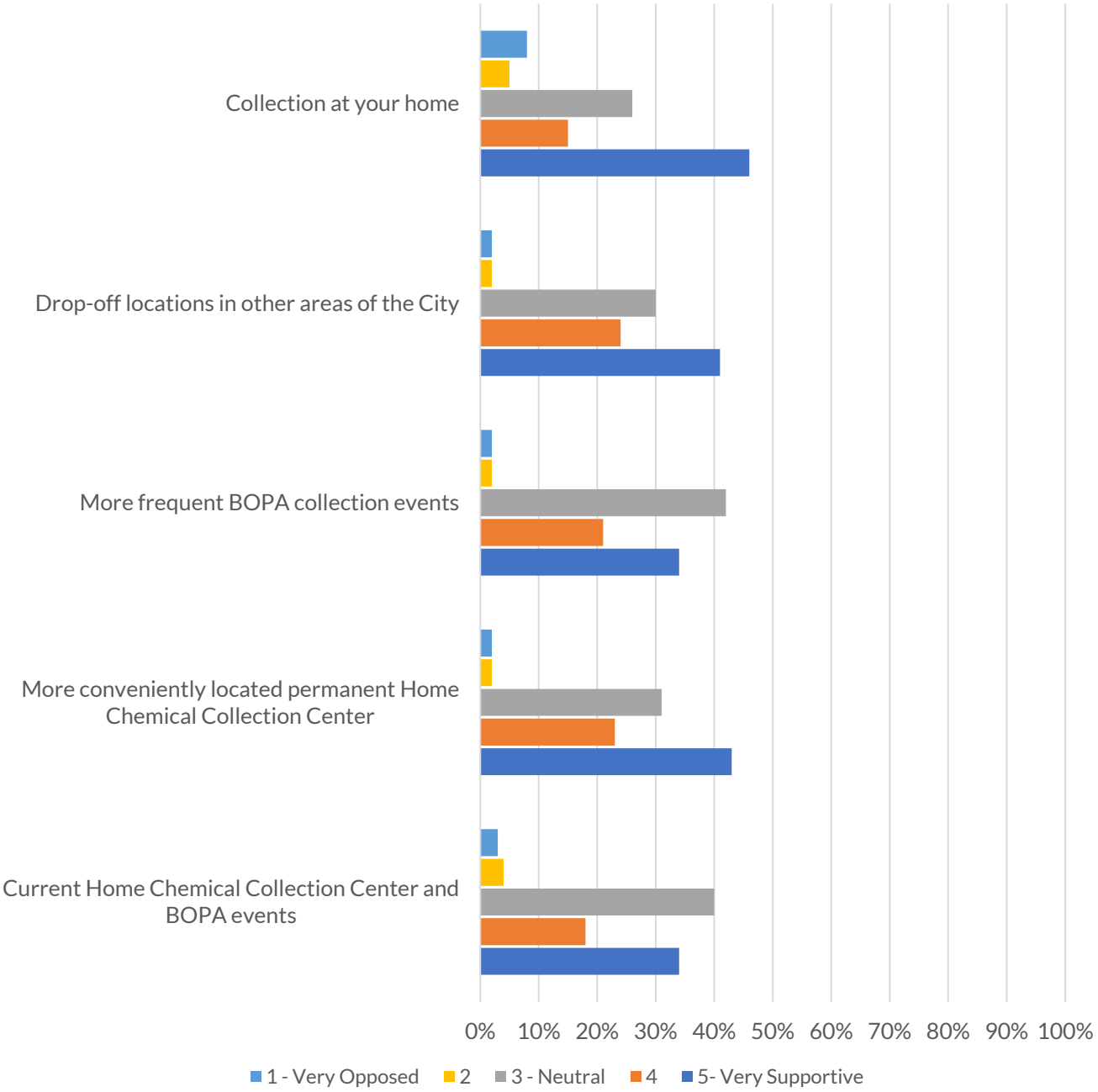
ANSWER CHOICES	RESPONSES	
Very accommodating	4.85%	52
Accommodating	10.02%	521
Not a challenge	39.80%	2,070
Prohibitive	29.49%	1,534
Very prohibitive	15.84%	824
TOTAL		5,201

Q. Before the COVID-19 pandemic caused the City to suspend service, how often did you attend BOPA (batteries, oil, paint and antifreeze) mobile collection events to dispose of hazardous household waste or other hard-to-recycle materials?



ANSWER CHOICES	RESPONSES	
Once every three months	4.41%	228
Twice per year	11.31%	585
Once per year	24.42%	1,263
Once every two to three years	26.18%	1,354
I do not have a need for this service	33.68%	1,742
TOTAL		5,172

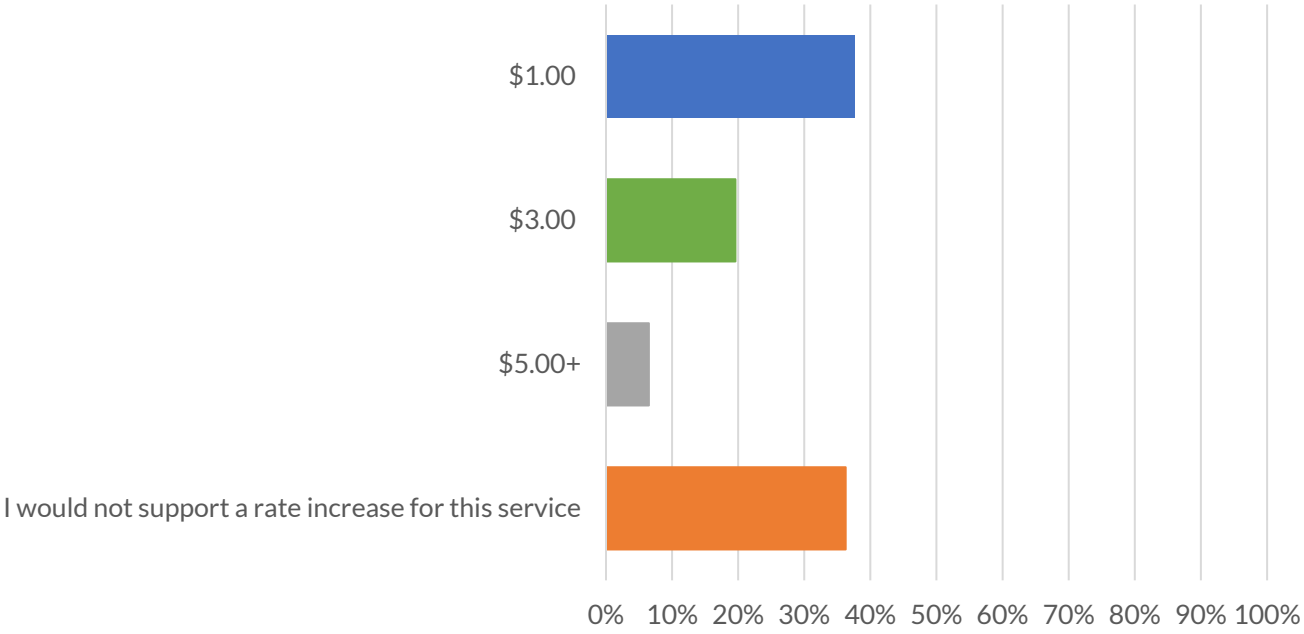
Q. On a scale from 1 to 5, how supportive would you be of the following types of household hazardous waste or hard-to-recycle materials collection services?



Q. On a scale from 1 to 5, how supportive would you be of the following types of household hazardous waste or hard-to-recycle materials collection services?

	1 Very Opposed		2		3 Neutral		4		5 Very Supportive		TOTAL
Current Home Chemical Collection Center and BOPA events	3.24%	165	4.44%	226	39.90%	2,031	17.92%	912	34.50%	1,756	5,090
More conveniently located permanent Home Chemical Collection Center	1.95%	100	1.64%	84	30.71%	1,571	23.08%	1,181	42.61%	2,180	5,116
More frequent BOPA collection events	1.56%	79	2.22%	112	41.64%	2,105	20.73%	1,048	33.85%	1,711	5,055
Drop-off locations in other areas of the City	2.02%	103	1.98%	101	30.05%	1,533	24.47%	1,248	41.48%	2,116	5,101
Collection at your home	7.74%	396	5.14%	263	26.01%	1,330	14.69%	751	46.41%	2,373	5,113

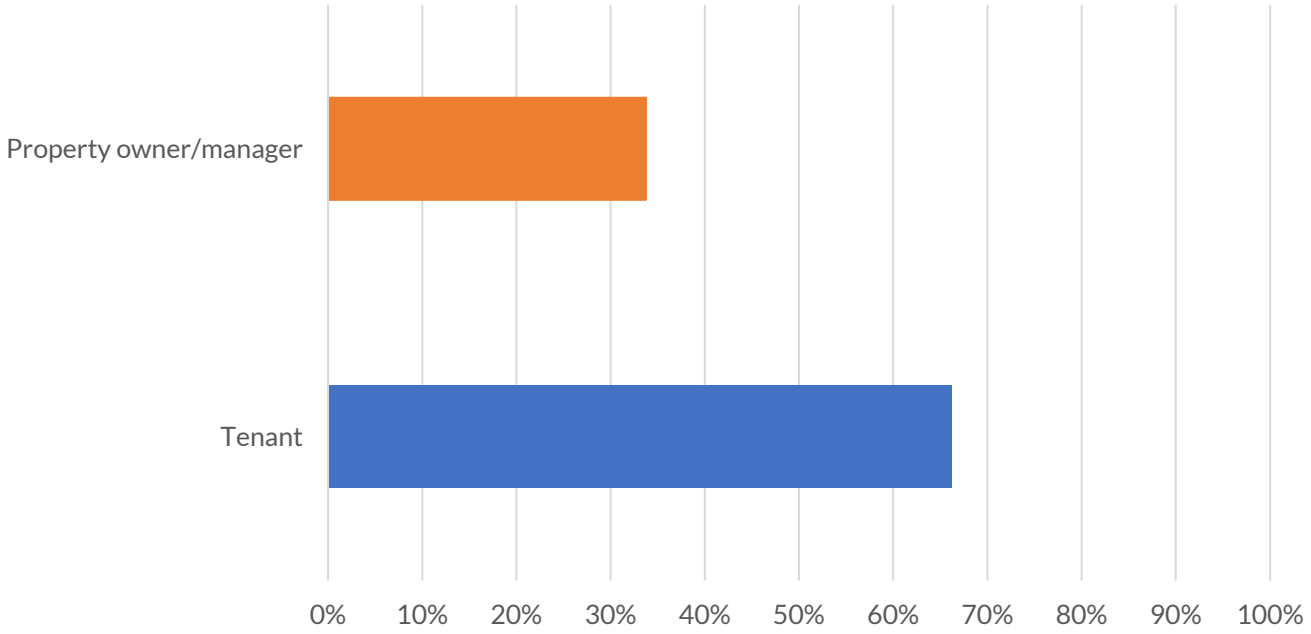
Q. How much of a monthly rate increase would you support to have enhanced service levels for household hazardous waste and hard-to-recycle materials?



ANSWER CHOICES	RESPONSES	
$1.00	37.67%	1,971
$3.00	19.59%	1,025
$5.00+	6.48%	339
I would not support a rate increase for this service	36.26%	1,897
TOTAL		5,232

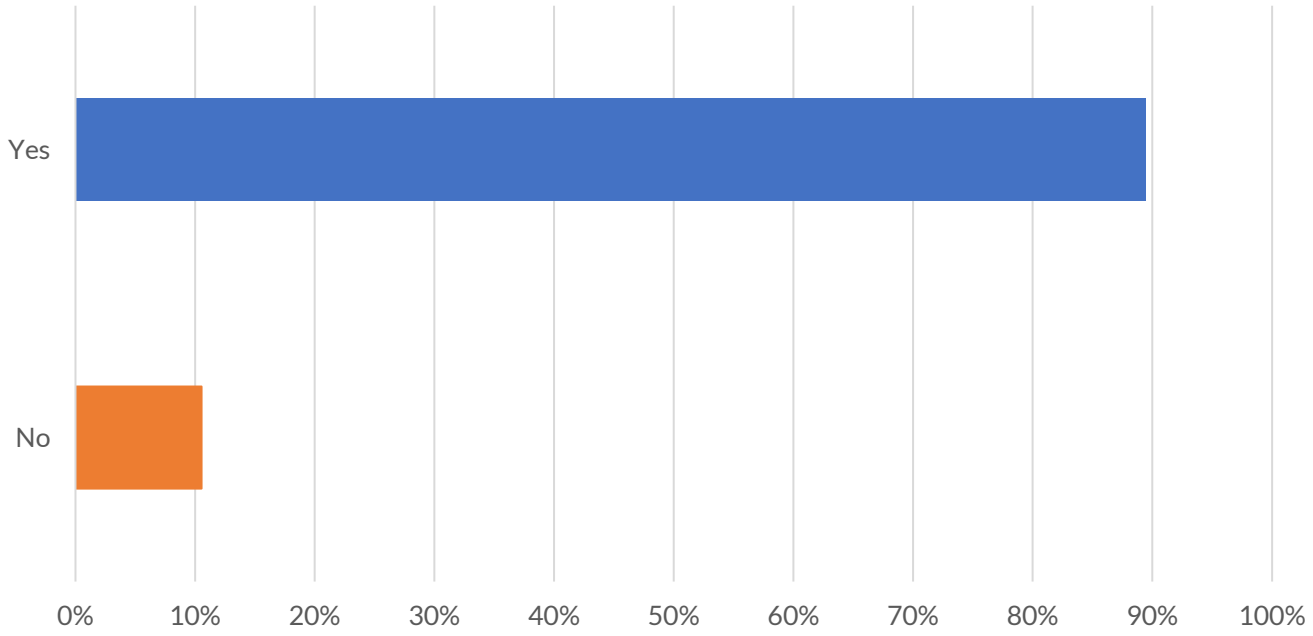
MULTI-FAMILY RESIDENTS

Q. Are you a tenant or property owner/manager of your apartment complex?



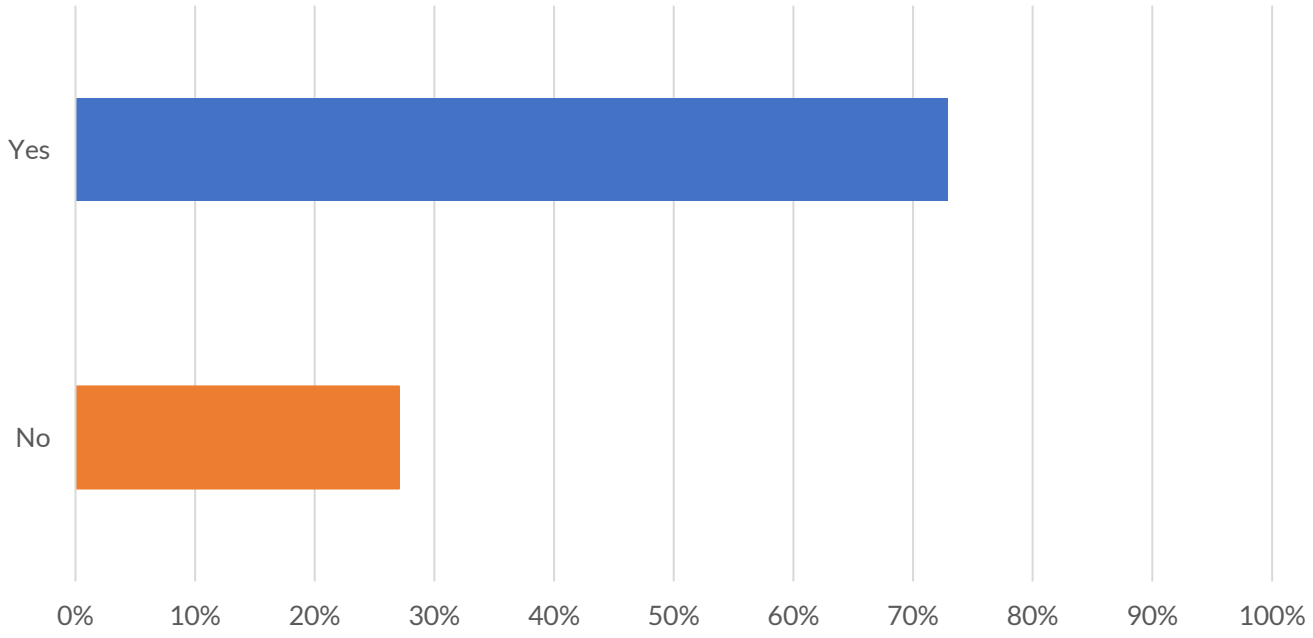
ANSWER CHOICES	RESPONSES	
Property owner/manager	33.75%	81
Tenant	66.25%	159
TOTAL		240

Q. If you are a property owner/manager, have you implemented recycling service at your property(ies)?



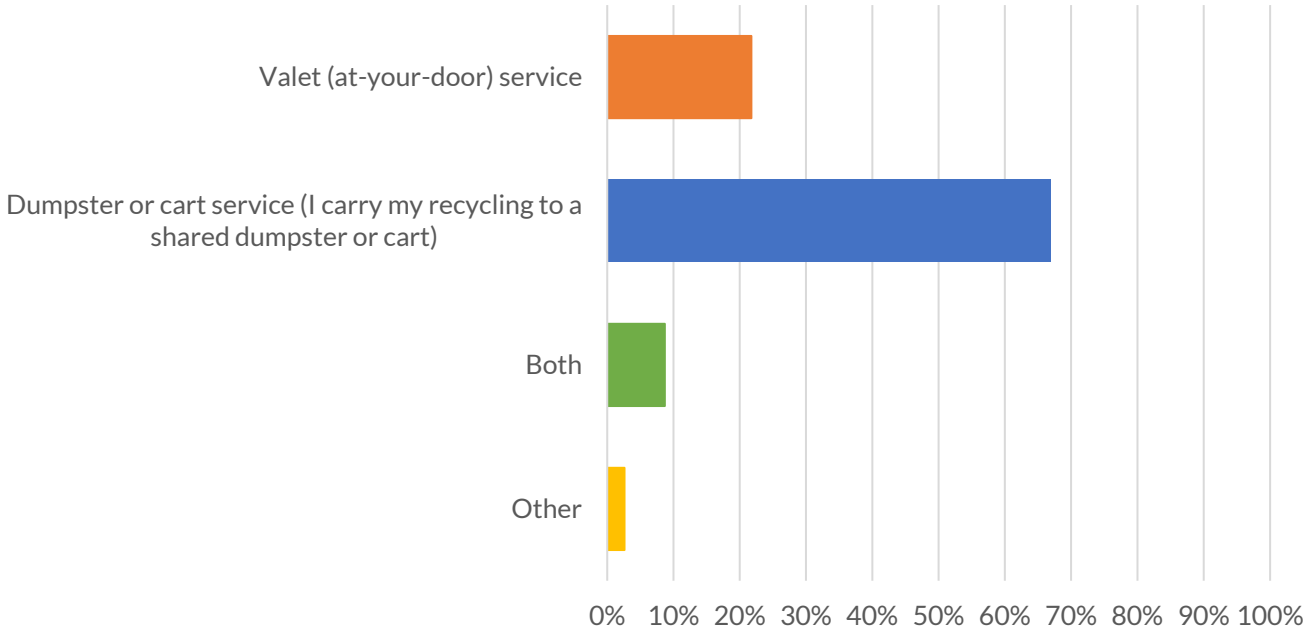
ANSWER CHOICES	RESPONSES	
Yes	89.47%	68
No	10.53%	8
TOTAL		76

Q. Is recycling collection service provided at your apartment complex?



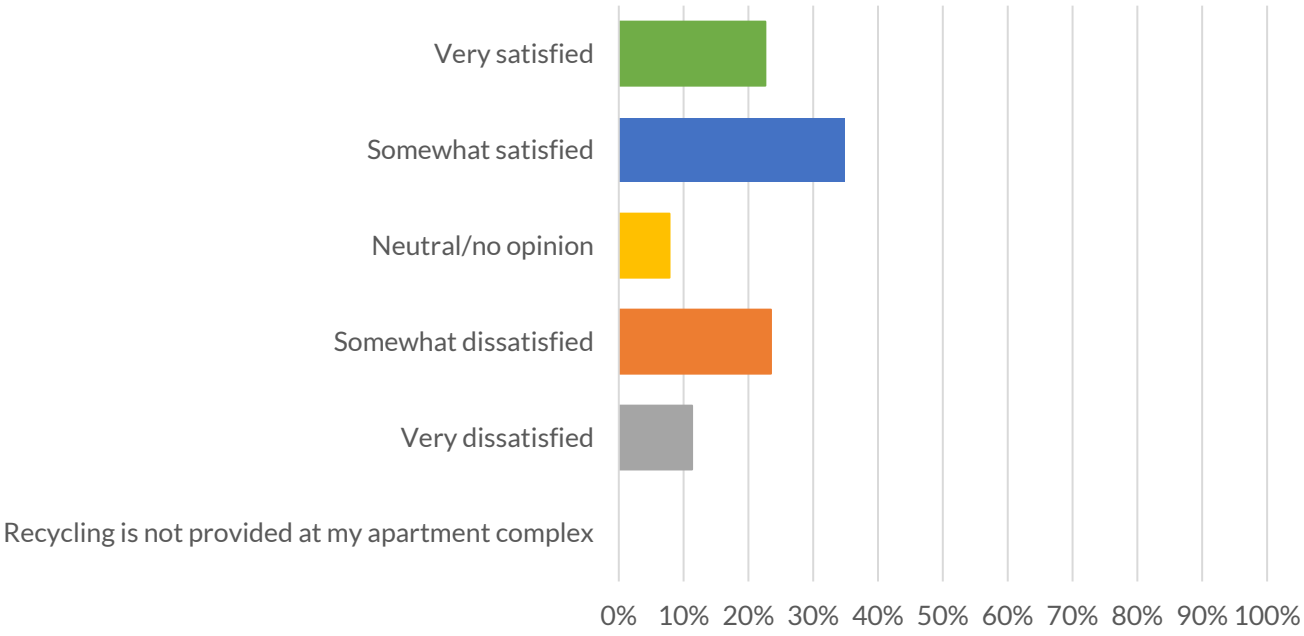
ANSWER CHOICES	RESPONSES	
Yes	72.96%	116
No	27.04%	43
TOTAL		159

Q. How is recycling service provided at your apartment complex?



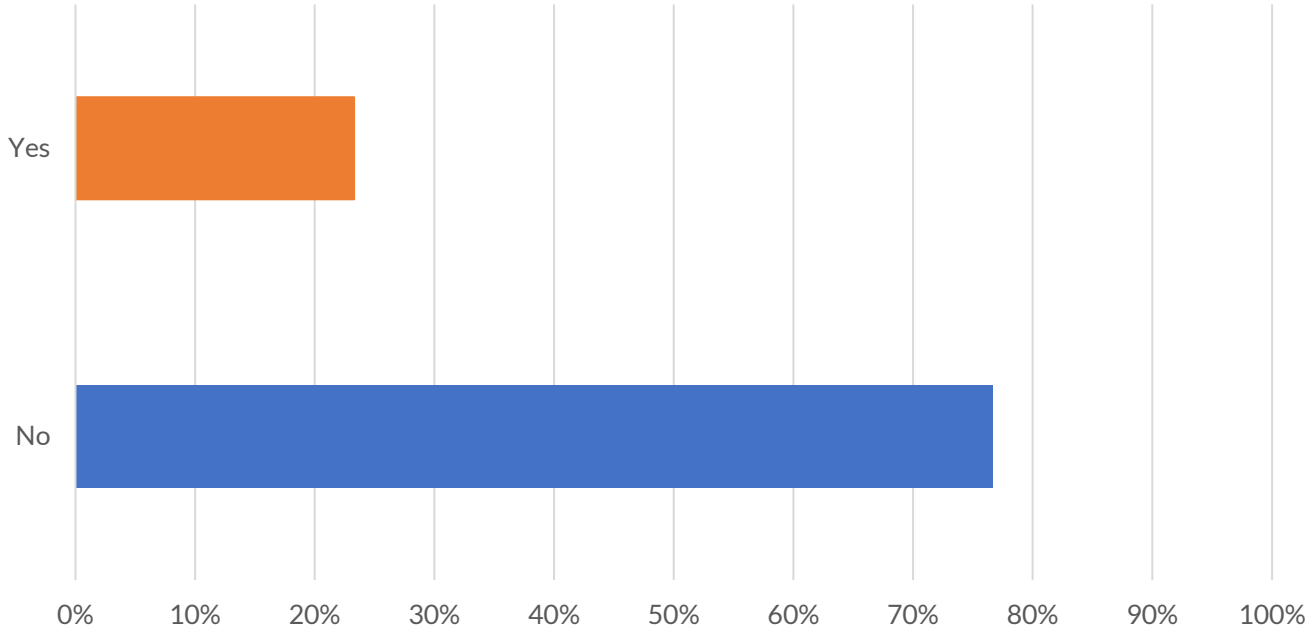
ANSWER CHOICES	RESPONSES	
Valet (at-your-door) service	21.74%	25
Dumpster or cart service (I carry my recycling to a shared dumpster or cart)	66.96%	77
Both	8.70%	10
Other	2.61%	3
TOTAL		115

Q. How satisfied are you with the recycling service at your apartment complex?



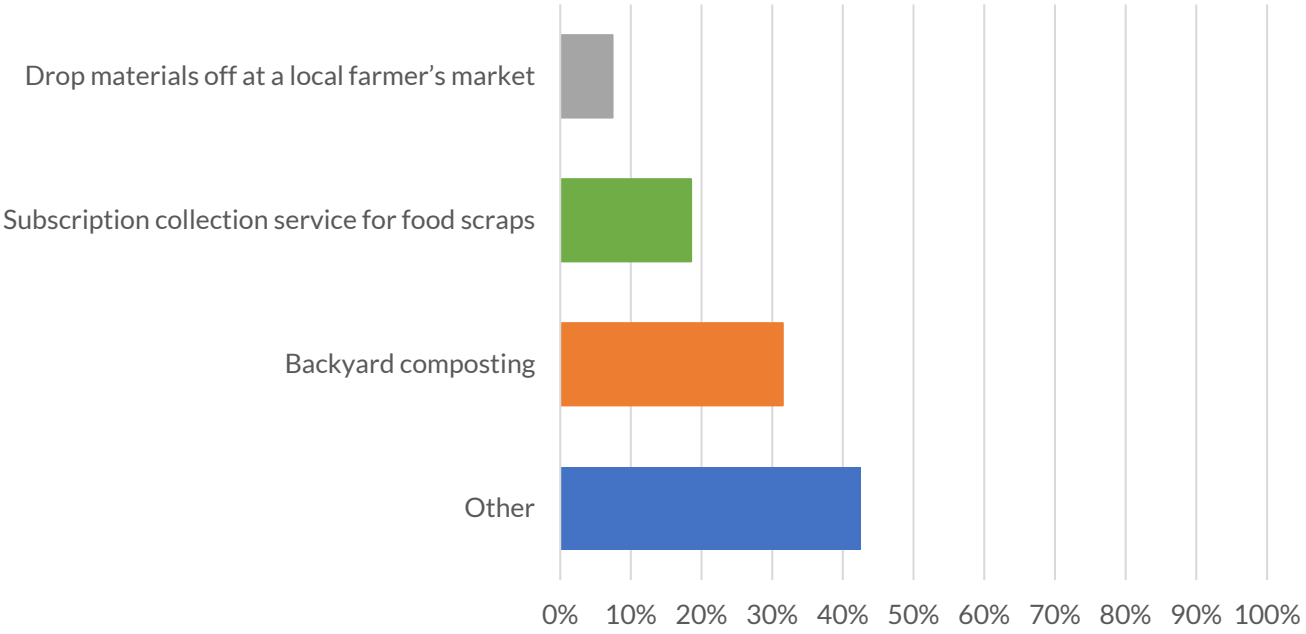
ANSWER CHOICES	RESPONSES	
Very dissatisfied	11.30%	13
Somewhat dissatisfied	23.48%	27
Neutral/no opinion	7.83%	9
Somewhat satisfied	34.78%	40
Very satisfied	22.61%	26
Recycling is not provided at my apartment complex	0.00%	0
TOTAL		115

Q. Do you currently separate other organics such as food scraps for recycling?



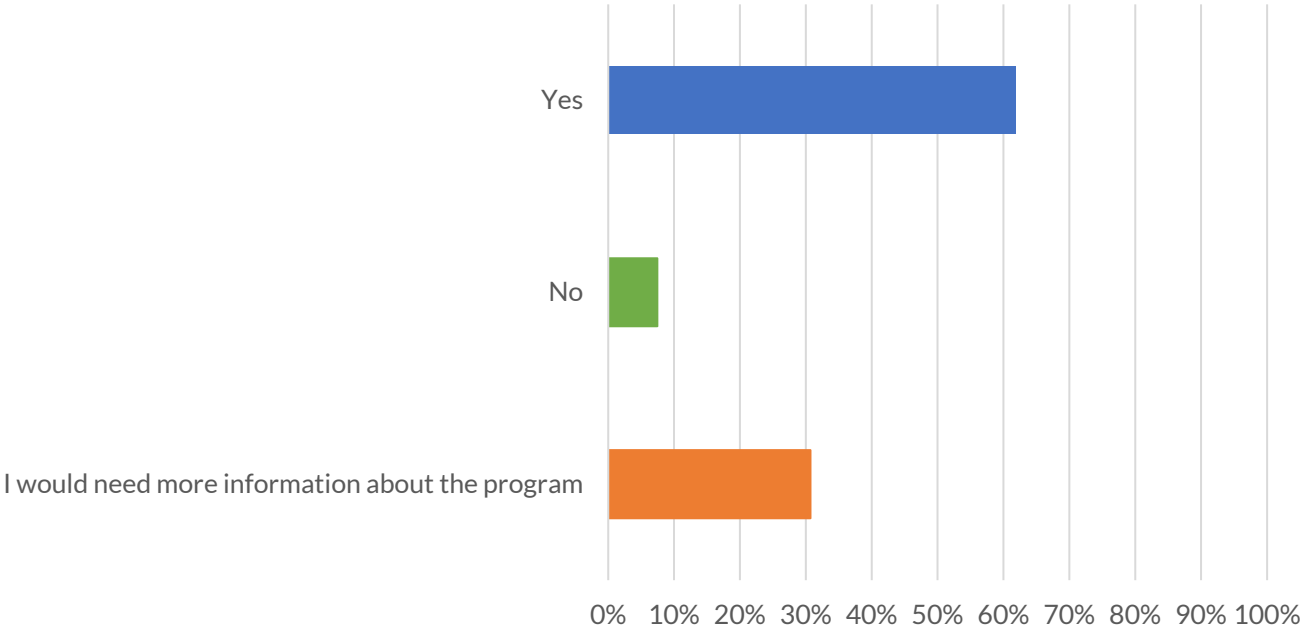
ANSWER CHOICES	RESPONSES	
Yes	23.28%	54
No	76.72%	178
TOTAL		232

Q. If yes, please indicate how you separate food scraps:



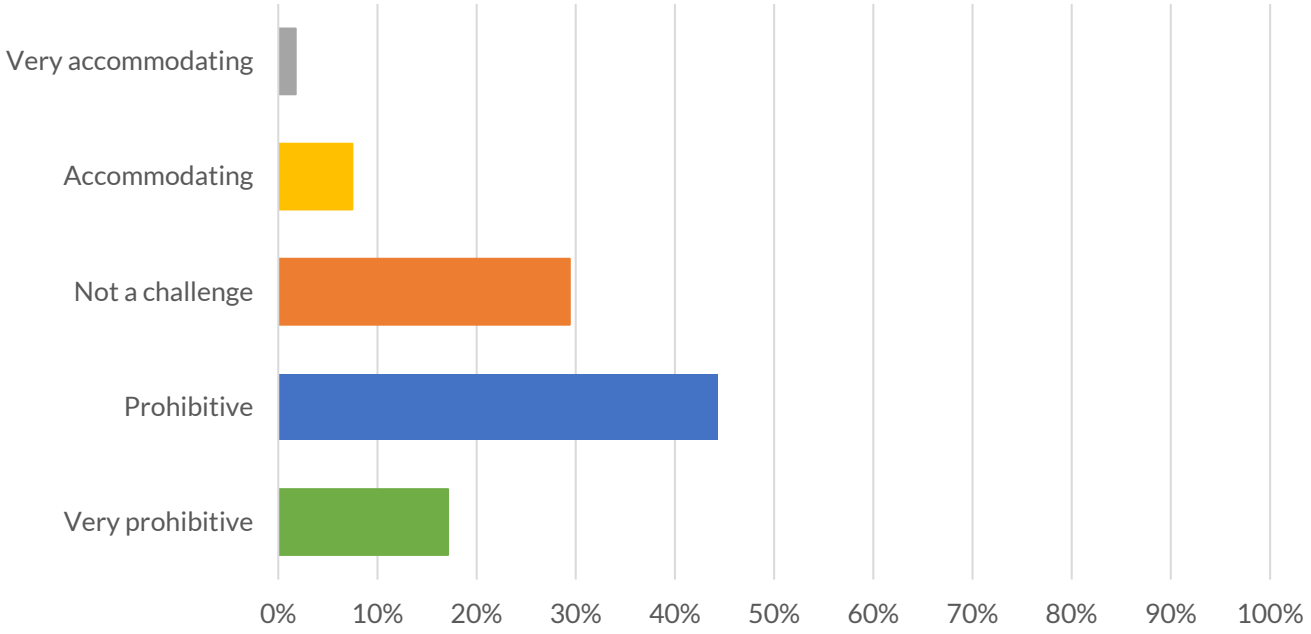
ANSWER CHOICES	RESPONSES	
Drop materials off at a local farmer's market	7.41%	4
Subscription collection service for food scraps	18.52%	10
Backyard composting	31.48%	17
Other	42.59%	23
TOTAL		54

Q. If the City were to implement a program to collect comingled food and yard waste from apartment complexes, would you be interested in participating?



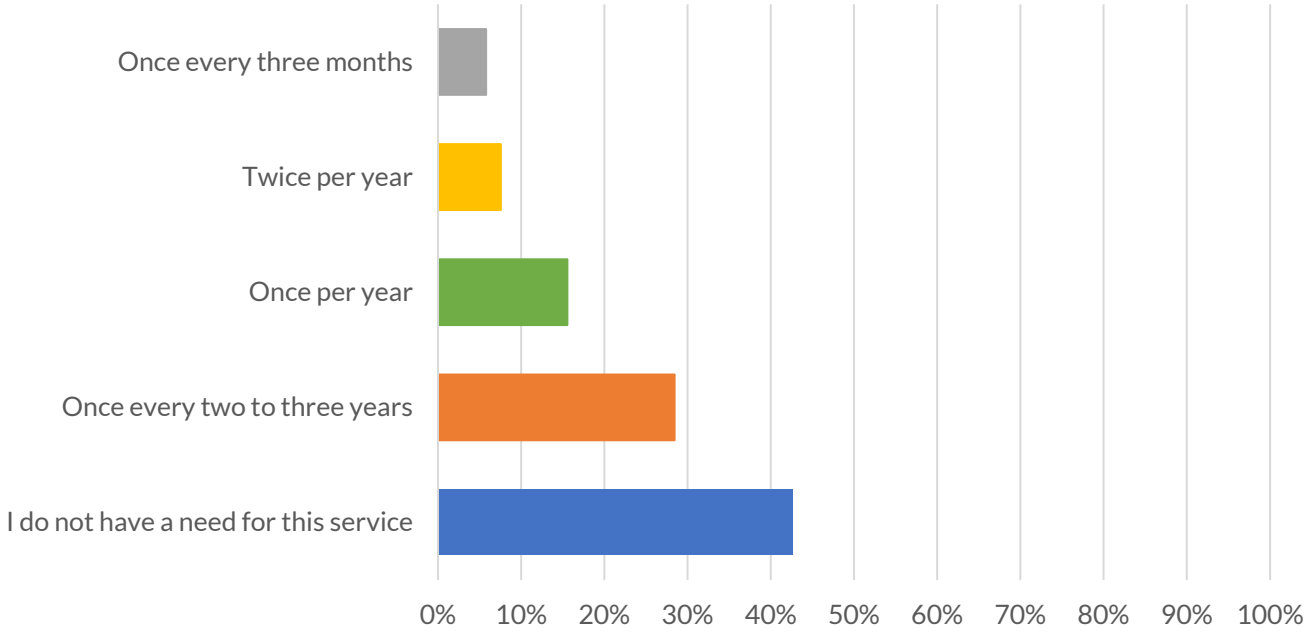
ANSWER CHOICES	RESPONSES	
Yes	61.84%	141
No	7.46%	17
I would need more information about the program	30.70%	70
TOTAL		228

Q. The Home Chemical Collection Center is in the northeast region of Dallas County and operates on limited hours during the week due to COVID-19 on Tuesdays (9:00 a.m. – 7:30 p.m.) and Wednesdays (8:30 a.m. – 5:00 p.m.). Given the location and operating hours, how does this impact your willingness to utilize the Home Chemical Collection Center?



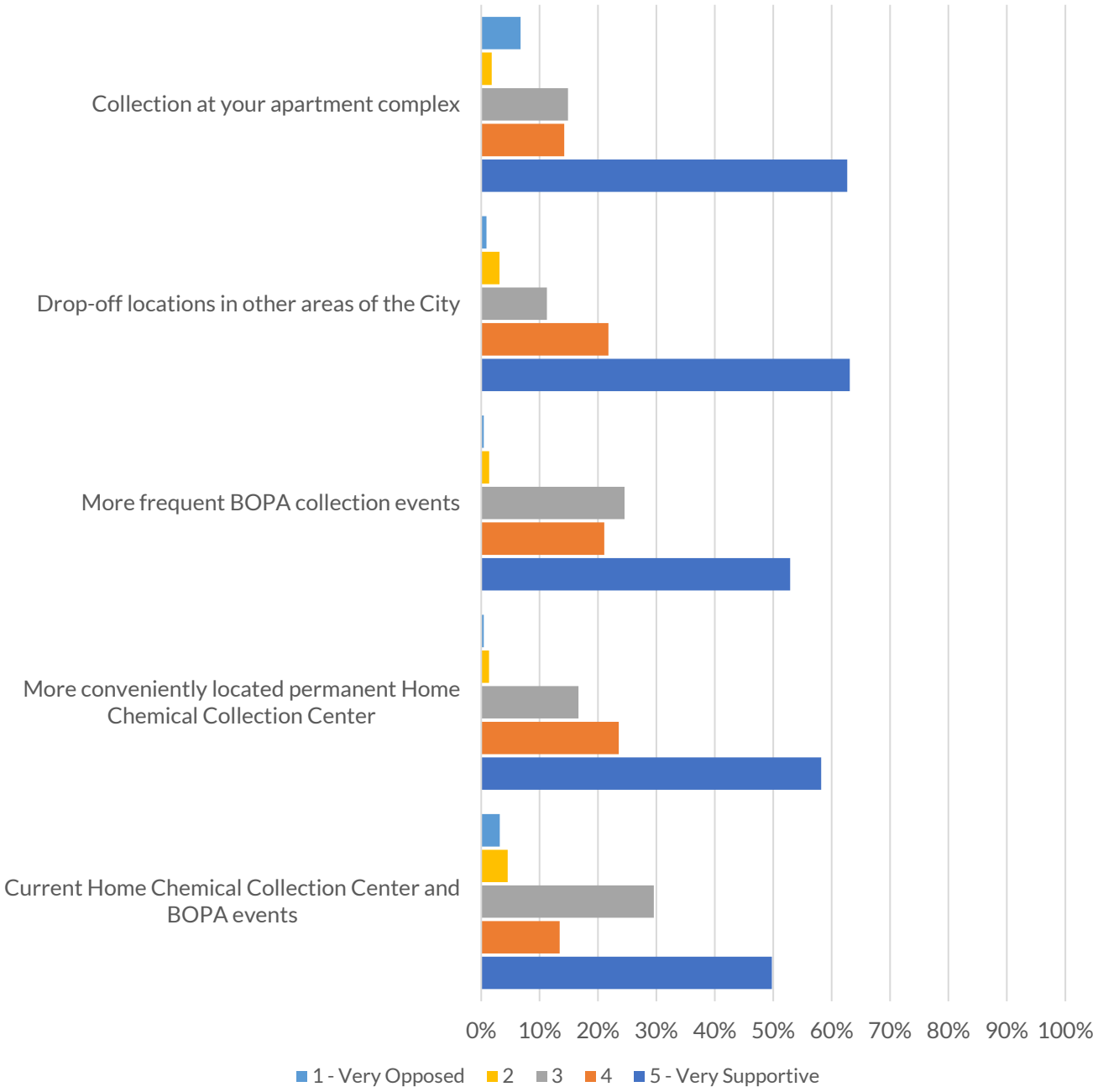
ANSWER CHOICES	RESPONSES	
Very accommodating	1.75%	4
Accommodating	7.46%	17
Not a challenge	29.39%	67
Prohibitive	44.30%	101
Very prohibitive	17.11%	39
TOTAL		228

Q. Before the COVID-19 pandemic caused the City to suspend service, how often did you attend BOPA (batteries, oil, paint and antifreeze) mobile collection events to dispose of hazardous household waste or other hard-to-recycle materials?



ANSWER CHOICES	RESPONSES	
Once every three months	5.78%	13
Twice per year	7.56%	17
Once per year	15.56%	35
Once every two to three years	28.44%	64
I do not have a need for this service	42.67%	96
TOTAL		225

Q. On a scale from 1 to 5, how supportive would you be of the following types of household hazardous waste or hard-to-recycle materials collection services?

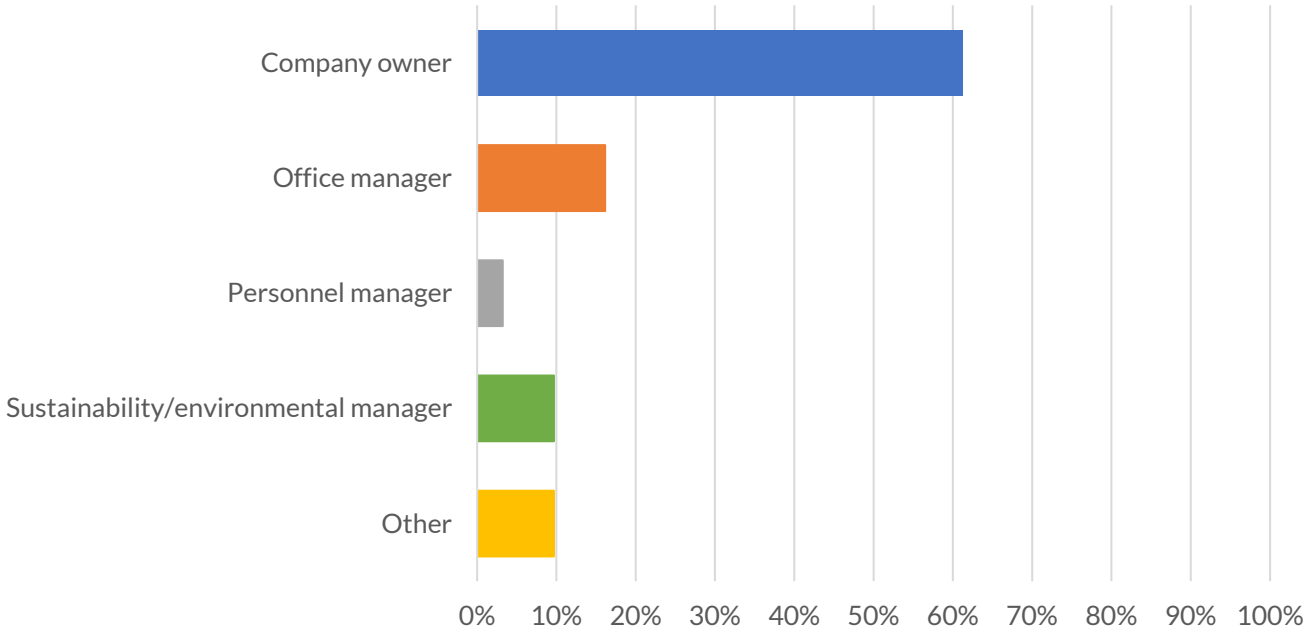


Q. On a scale from 1 to 5, how supportive would you be of the following types of household hazardous waste or hard-to-recycle materials collection services?

	1 Very Opposed		2		3 Neutral		4		5 Very Supportive		Total
Current Home Chemical Collection Center and BOPA events	3.18%	7	4.55%	10	29.55%	65	13.45%	30	49.78%	111	223
More conveniently located permanent Home Chemical Collection Center	0.45%	1	1.35%	3	16.67%	37	23.56%	53	58.22%	131	225
More frequent BOPA collection events	0.45%	1	1.36%	3	24.55%	54	21.08%	47	52.91%	118	223
Drop-off locations in other areas of the City	0.90%	2	3.15%	7	11.26%	25	21.78%	49	63.11%	142	225
Collection at your apartment complex	6.76%	15	1.80%	4	14.86%	33	14.22%	32	62.67%	141	225

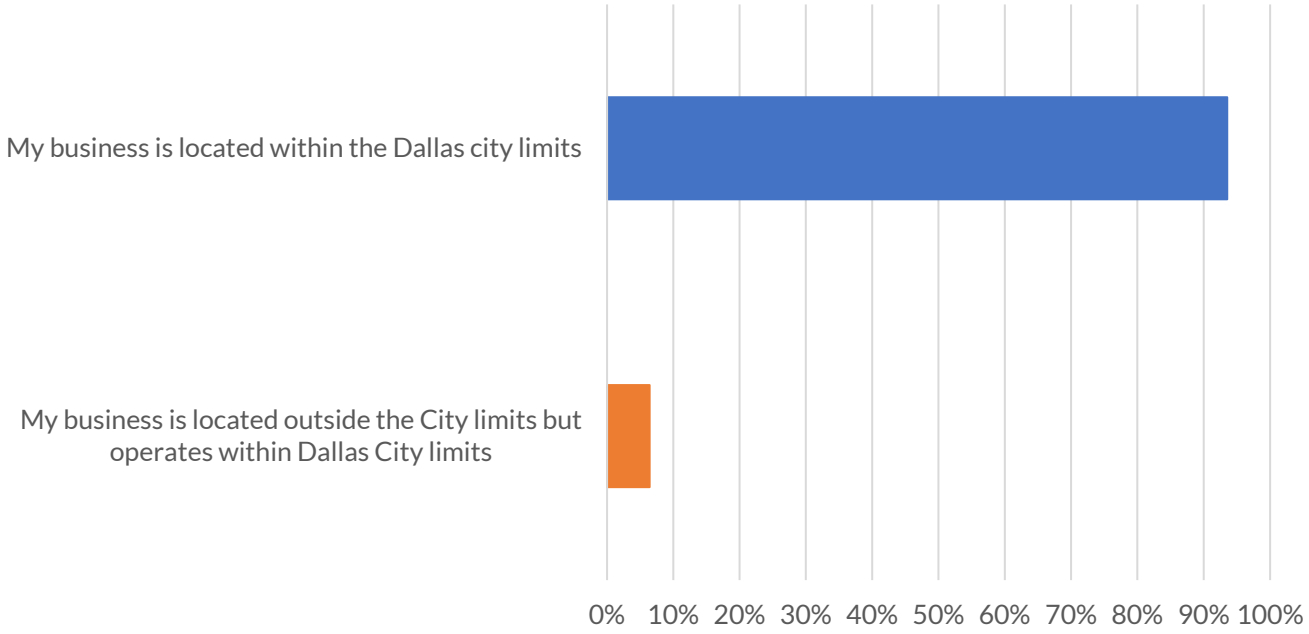
COMMERCIAL

Q. What is your role within your business?



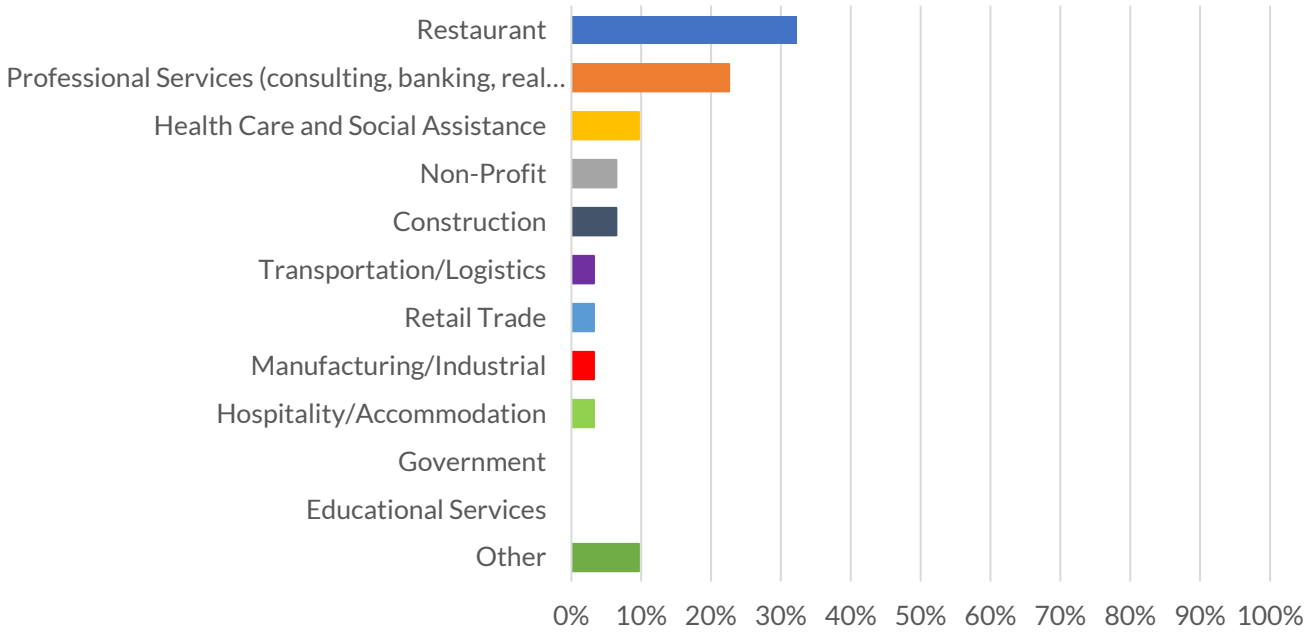
ANSWER CHOICES	RESPONSES	
Company owner	61.29%	19
Office manager	16.13%	5
Personnel manager	3.23%	1
Sustainability/environmental manager	9.68%	3
Other	9.68%	3
TOTAL		31

Q. Please select the statement that is applicable for your business:



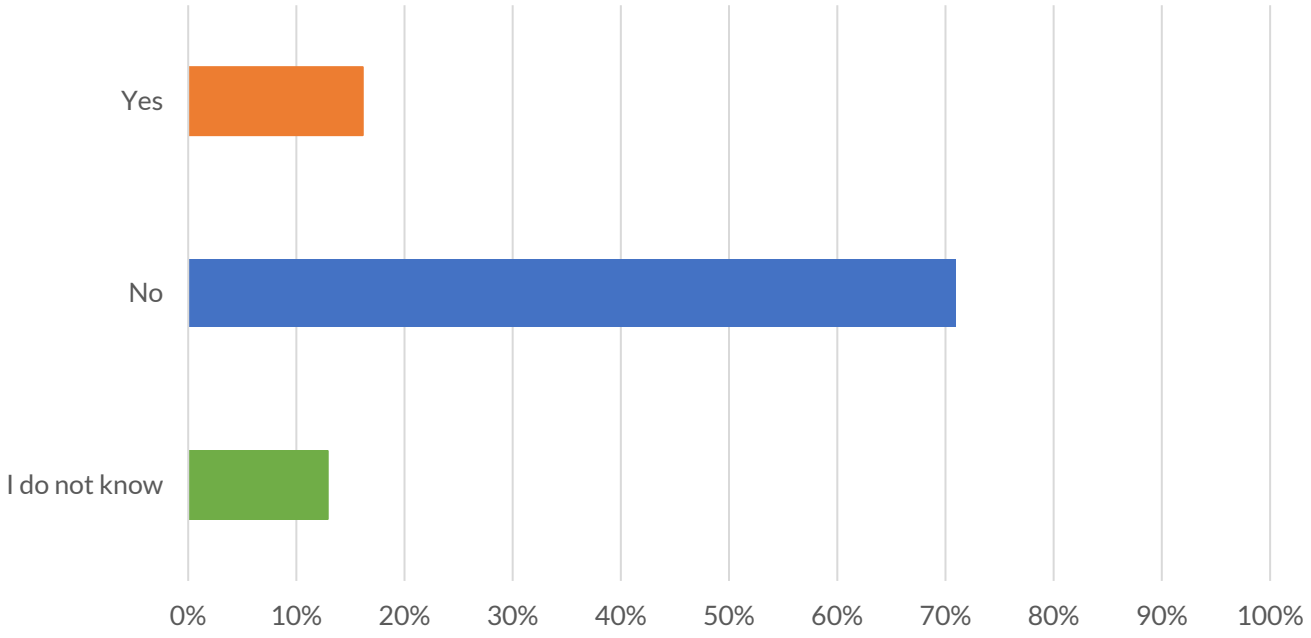
ANSWER CHOICES	RESPONSES	
My business is located within the Dallas city limits	93.55%	29
My business is located outside the City limits but operates within Dallas City limits	6.45%	2
TOTAL		31

Q. How would you describe your company/organization?



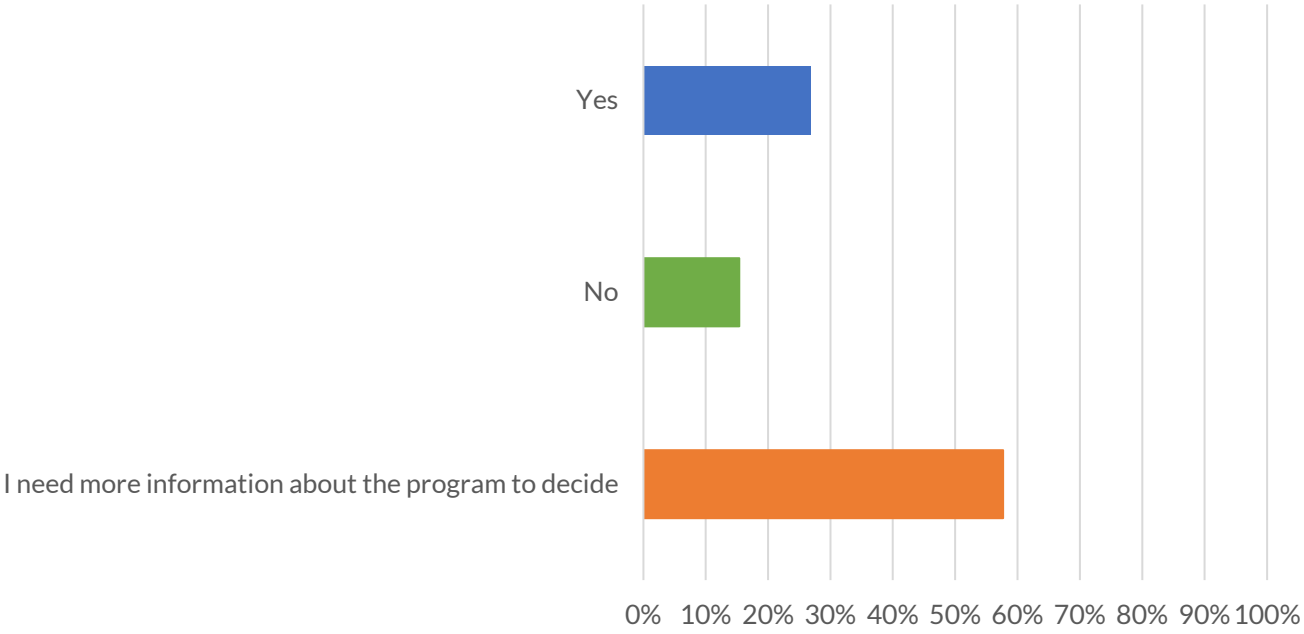
ANSWER CHOICES	RESPONSES	
Restaurant	32.26%	10
Professional Services (consulting, banking, real estate)	22.58%	7
Health Care and Social Assistance	9.68%	3
Non-Profit	6.45%	2
Construction	6.45%	2
Transportation/Logistics	3.23%	1
Retail Trade	3.23%	1
Manufacturing/Industrial	3.23%	1
Hospitality/Accommodation	3.23%	1
Government	0.00%	0
Educational Services	0.00%	0
Other (please specify)	9.68%	3
TOTAL		31

Q. Does your business participate in the City's Green Business Certification program?



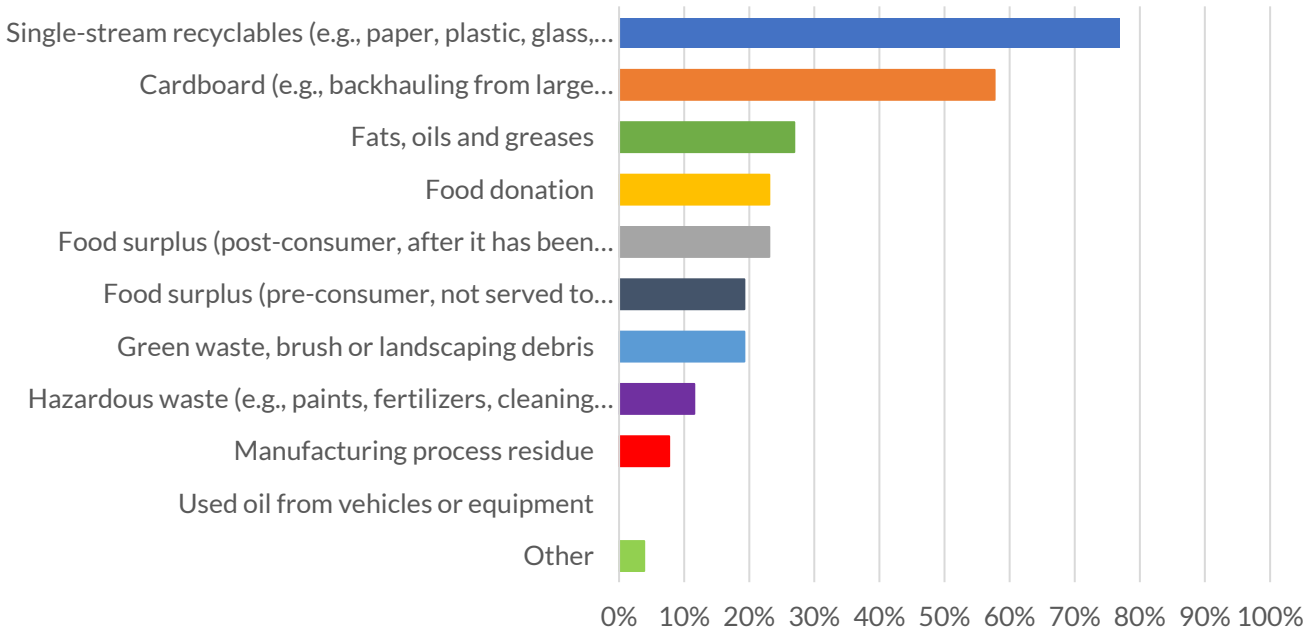
ANSWER CHOICES	RESPONSES	
Yes	16.13%	5
No	70.97%	22
I do not know	12.90%	4
TOTAL		31

Q. If not, would your business be willing to participate in the program?



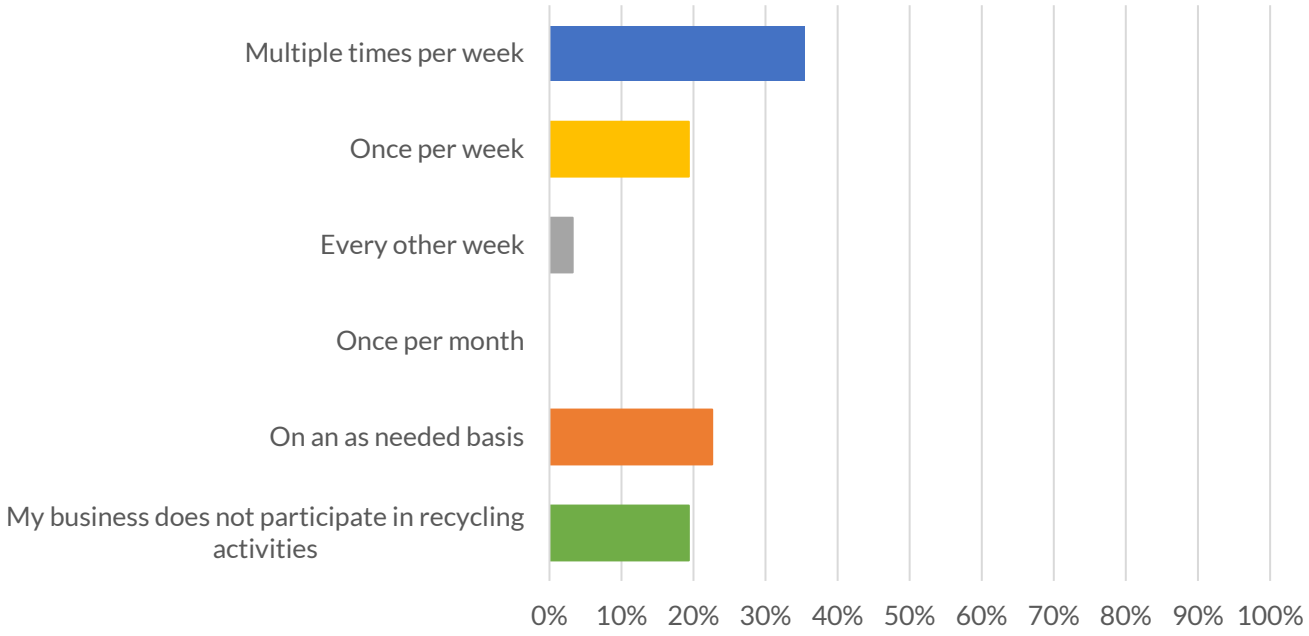
ANSWER CHOICES	RESPONSES	
Yes	26.92%	7
No	15.38%	4
I need more information about the program to decide	57.69%	15
TOTAL		26

Q. If your business participates in recycling activities, what types of materials do you recycle? Check all that apply.



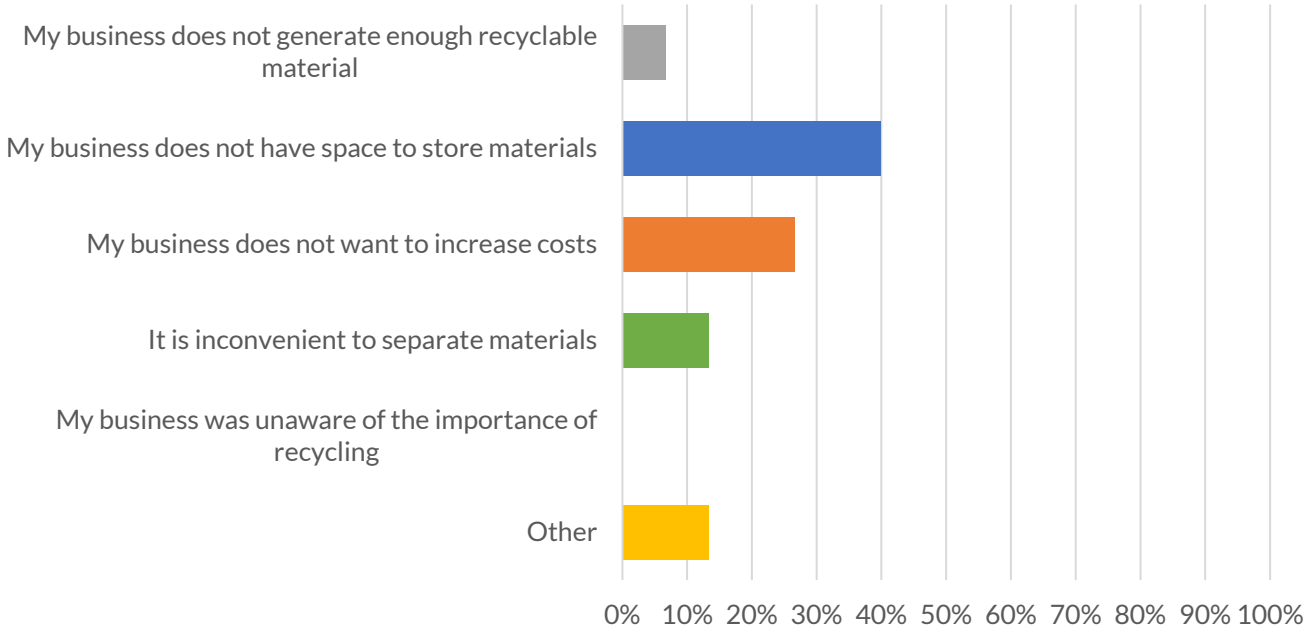
ANSWER CHOICES	RESPONSES	
Single-stream recyclables (e.g., paper, plastic, glass, metal, aluminum)	76.92%	20
Cardboard (e.g., backhauling from large department stores)	57.69%	15
Fats, oils and greases	26.92%	7
Food donation	23.08%	6
Food surplus (post-consumer, after it has been served to customers)	23.08%	6
Food surplus (pre-consumer, not served to customers)	19.23%	5
Green waste, brush or landscaping debris	19.23%	5
Hazardous waste (e.g., paints, fertilizers, cleaning chemicals)	11.54%	3
Manufacturing process residue	7.69%	2
Used oil from vehicles or equipment	0.00%	0
Other	3.85%	1
TOTAL		26

Q. How often does your business participate in recycling activities?



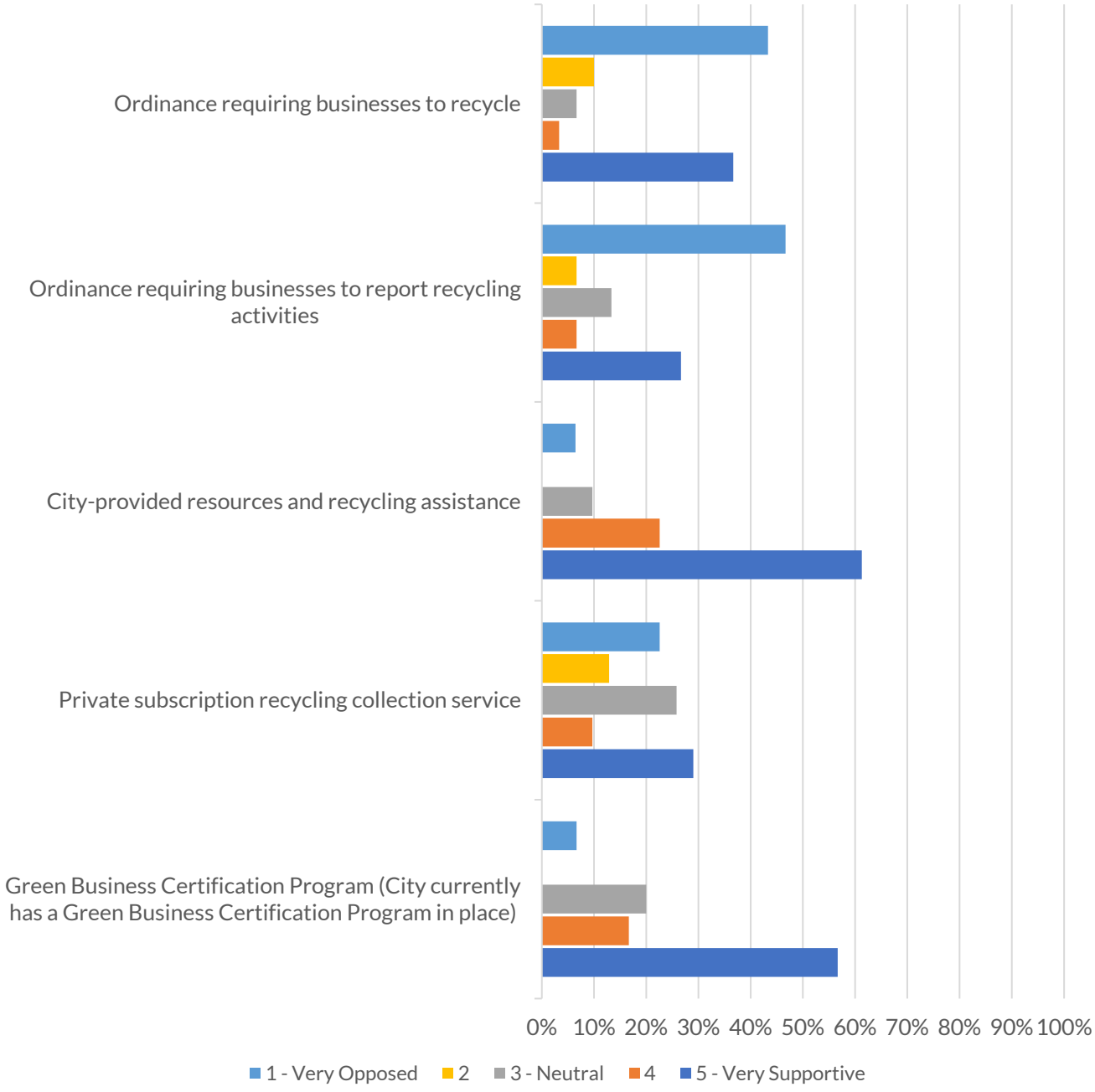
ANSWER CHOICES	RESPONSES	
Multiple times per week	35.48%	11
Once per week	19.35%	6
Every other week	3.23%	1
Once per month	0.00%	0
On an as needed basis	22.58%	7
My business does not participate in recycling activities	19.35%	6
TOTAL		31

Q. If your business does not currently recycle, what is the primary reason?



ANSWER CHOICES	RESPONSES	
My business does not generate enough recyclable material	6.67%	1
My business does not have space to store materials	40.00%	6
My business does not want to increase costs	26.67%	4
It is inconvenient to separate materials	13.33%	2
My business was unaware of the importance of recycling	0.00%	0
Other	13.33%	2
TOTAL		15

Q. To what extent would you support the following methods to increase business recycling?

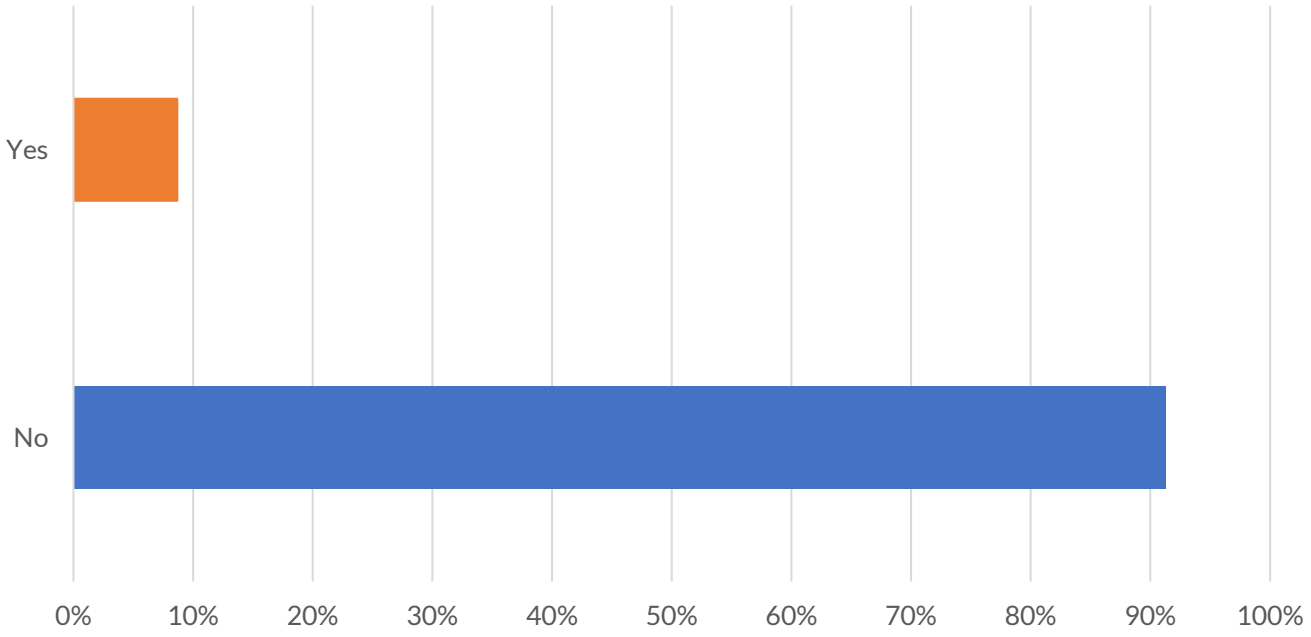


Q. To what extent would you support the following methods to increase business recycling?

	1 Very Opposed		2		3 Neutral		4		5 Very Supportive		TOTAL
Green Business Certification Program (City currently has a Green Business Certification Program in place)	6.67%	2	0.00%	0	20.00%	6	16.67%	5	56.67%	17	30
Private subscription recycling collection service	22.58%	7	12.90%	4	25.81%	8	9.68%	3	29.03%	9	31
City-provided resources and recycling assistance	6.45%	2	0.00%	0	9.68%	3	22.58%	7	61.29%	19	31
Ordinance requiring businesses to report recycling activities	46.67%	14	6.67%	2	13.33%	4	6.67%	2	26.67%	8	30
Ordinance requiring businesses to recycle	43.33%	13	10.00%	3	6.67%	2	3.33%	1	36.67%	11	30

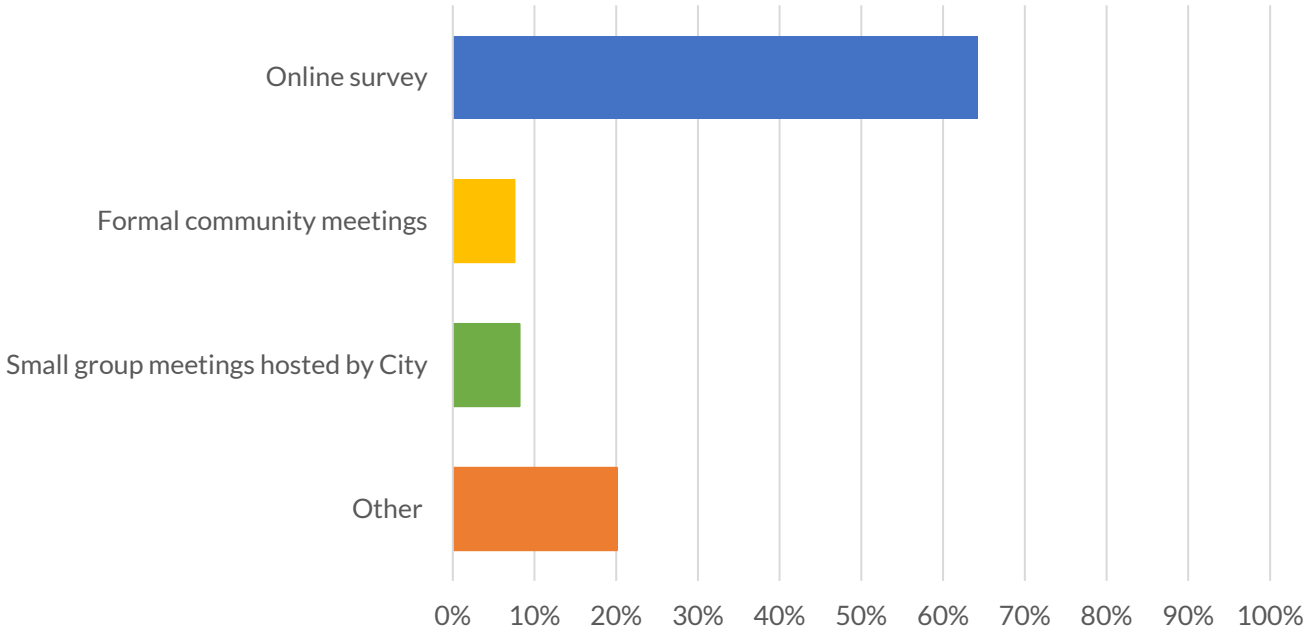
Climate and Environmental Comprehensive Action Plan (CECAP)

Q. Did you participate in any community outreach activities during development of the CECAP (e.g., online survey, formal community meetings, small group meetings hosted by City)?



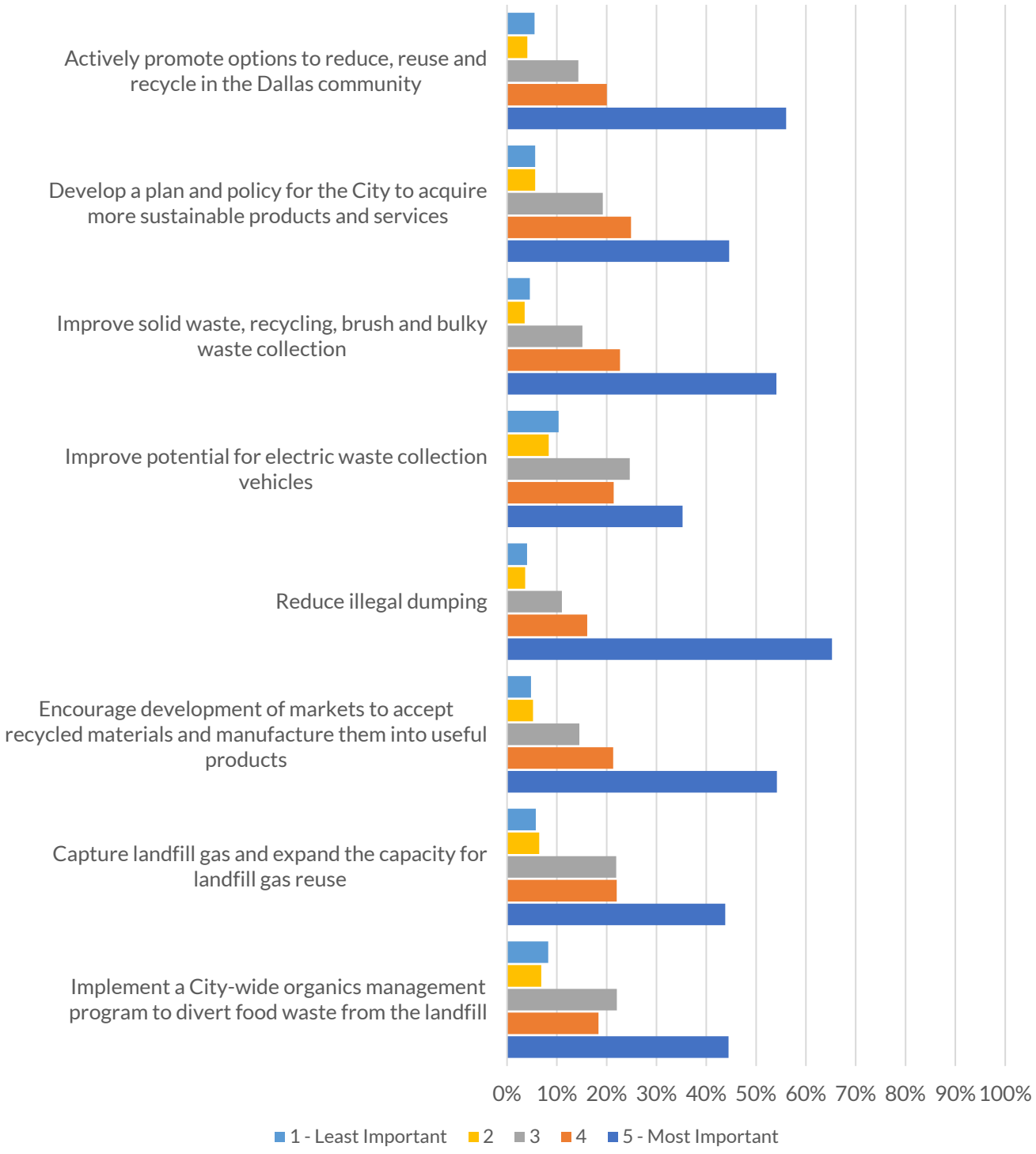
ANSWER CHOICES	RESPONSES	
Yes	8.68%	480
No	91.32%	5,052
TOTAL		5,532

Q. If so, how did you participate?



ANSWER CHOICES	RESPONSES	
Online survey	64.19%	527
Formal community meetings	7.55%	62
Small group meetings hosted by City	8.16%	67
Other	20.10%	165
TOTAL		821

Q. Please rank each of the following CECAP goals from 1 to 5, where 1 is least important and 5 is most important.

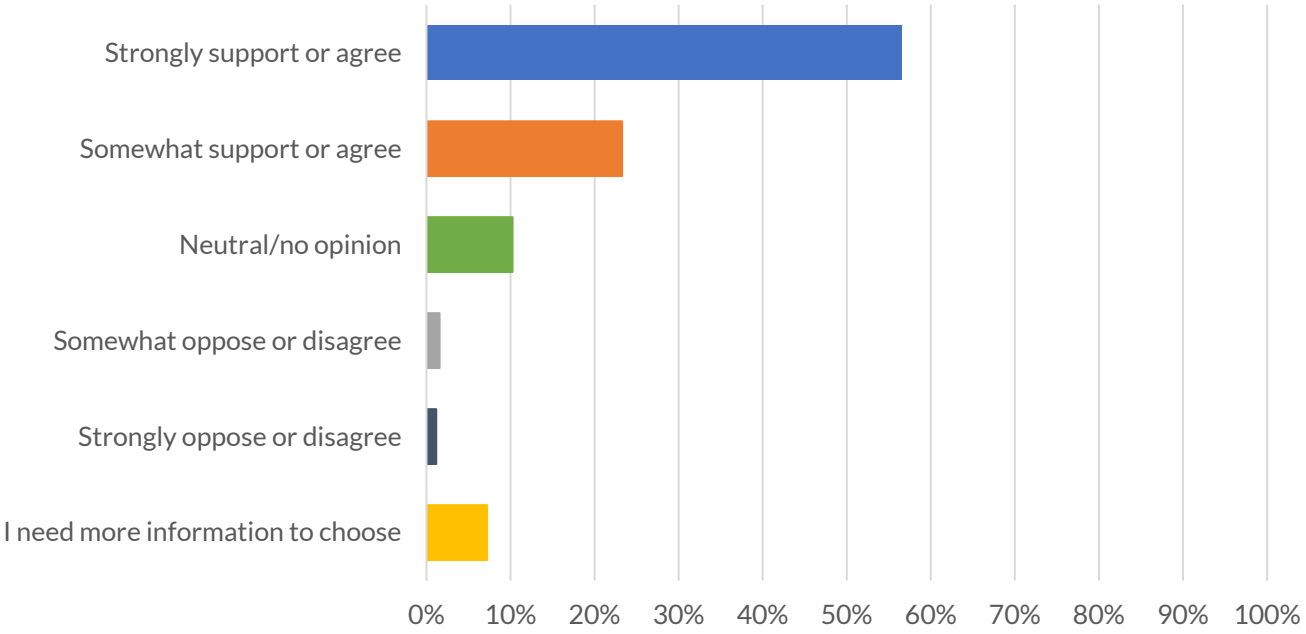


Q. Please rank each of the following CECAP goals from 1 to 5, where 1 is least important and 5 is most important.

	1 Least Important		2		3		4		5 Most Important		Total
Actively promote options to reduce, reuse and recycle in the Dallas community	5.53%	283	4.06%	208	14.32%	733	20.05%	1,026	56.04%	2,868	5,118
Develop a plan and policy for the City to acquire more sustainable products and services	5.64%	285	5.66%	286	19.22%	971	24.90%	1,258	44.59%	2,253	5,053
Improve solid waste, recycling, brush and bulky waste collection	4.59%	236	3.54%	182	15.12%	777	22.68%	1,166	54.07%	2,779	5,140
Improve potential for electric waste collection vehicles	10.35%	517	8.37%	418	24.64%	1,231	21.40%	1,069	35.24%	1,760	4,995
Reduce illegal dumping	4.02%	205	3.63%	185	11.01%	561	16.11%	821	65.23%	3,324	5,096
Encourage development of markets to accept recycled materials and manufacture them into useful products	4.80%	245	5.22%	266	14.51%	740	21.30%	1,086	54.17%	2,762	5,099
Capture landfill gas and expand the capacity for landfill gas reuse	5.77%	290	6.45%	324	21.93%	1,102	22.03%	1,107	43.81%	2,201	5,024
Implement a City-wide organics management program to divert food waste from the landfill	8.27%	419	6.88%	349	22.04%	1,117	18.35%	930	44.47%	2,254	5,069

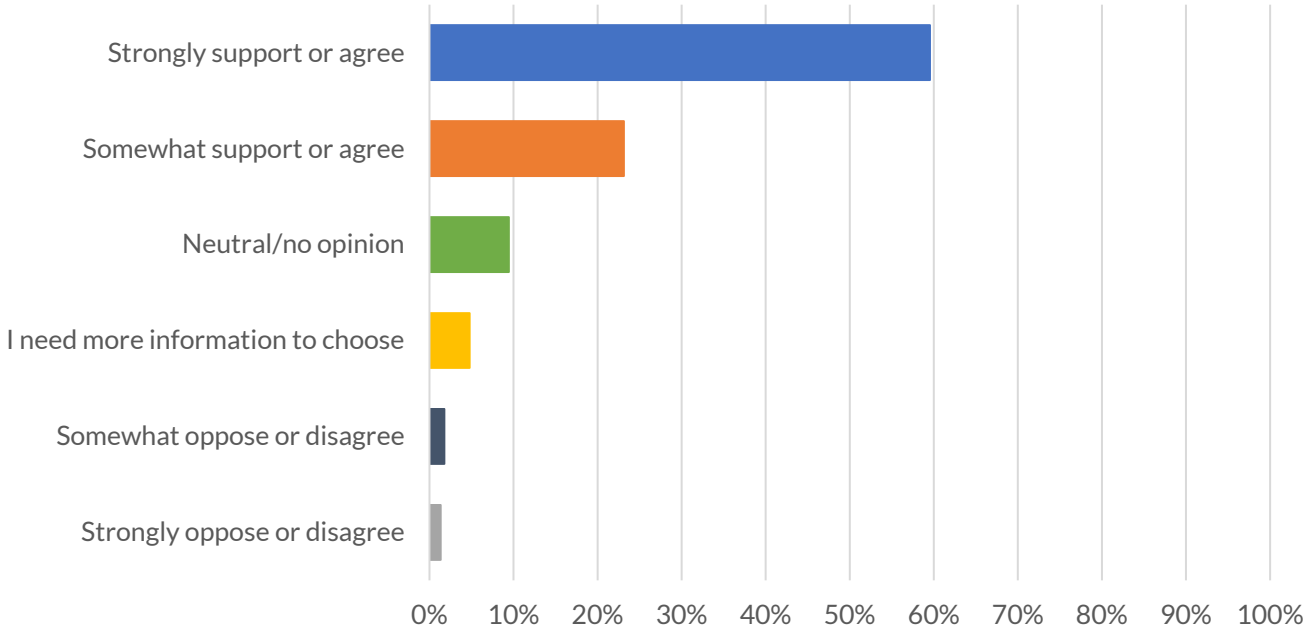
2011 LSWMP Vision & Goals

Q. The City should strive for sustainability by considering the entire life-cycle of products, processes and systems.



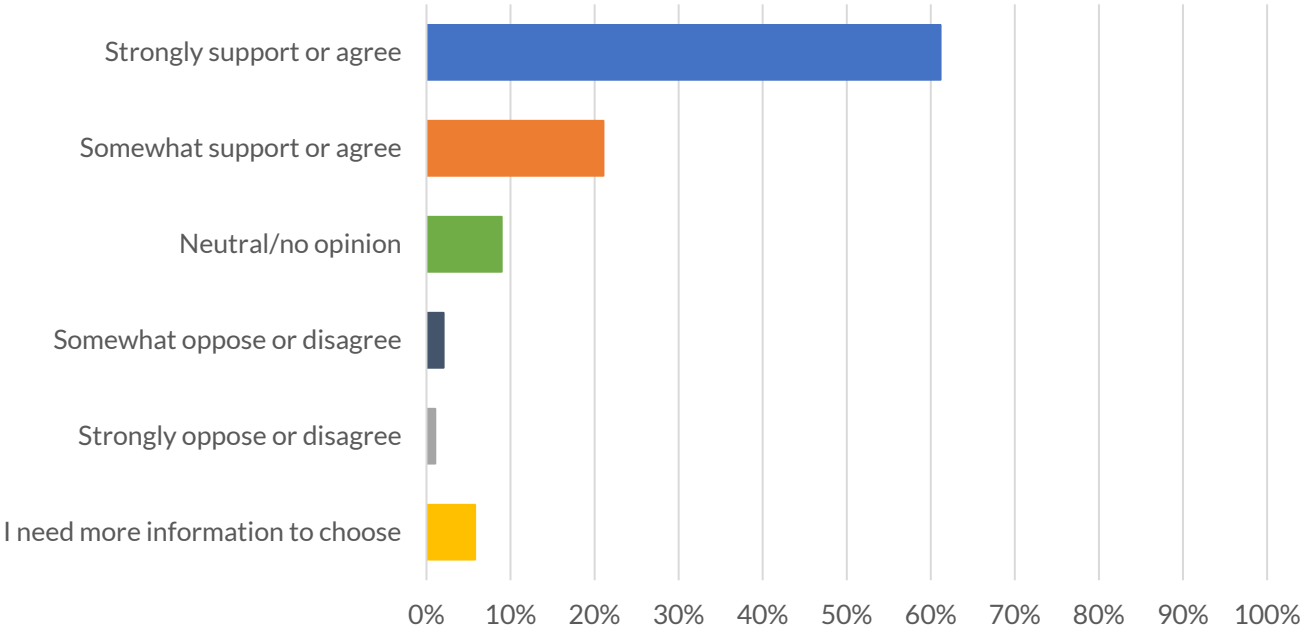
ANSWER CHOICES	RESPONSES	
Strongly support or agree	56.59%	3,102
Somewhat support or agree	23.28%	1,276
Neutral/no opinion	10.23%	561
Somewhat oppose or disagree	1.55%	85
Strongly oppose or disagree	1.15%	63
I need more information to choose	7.21%	395
TOTAL		5,482

Q. The City should demonstrate that the goals of economic growth, environmental stewardship and fiscal responsibility are linked.



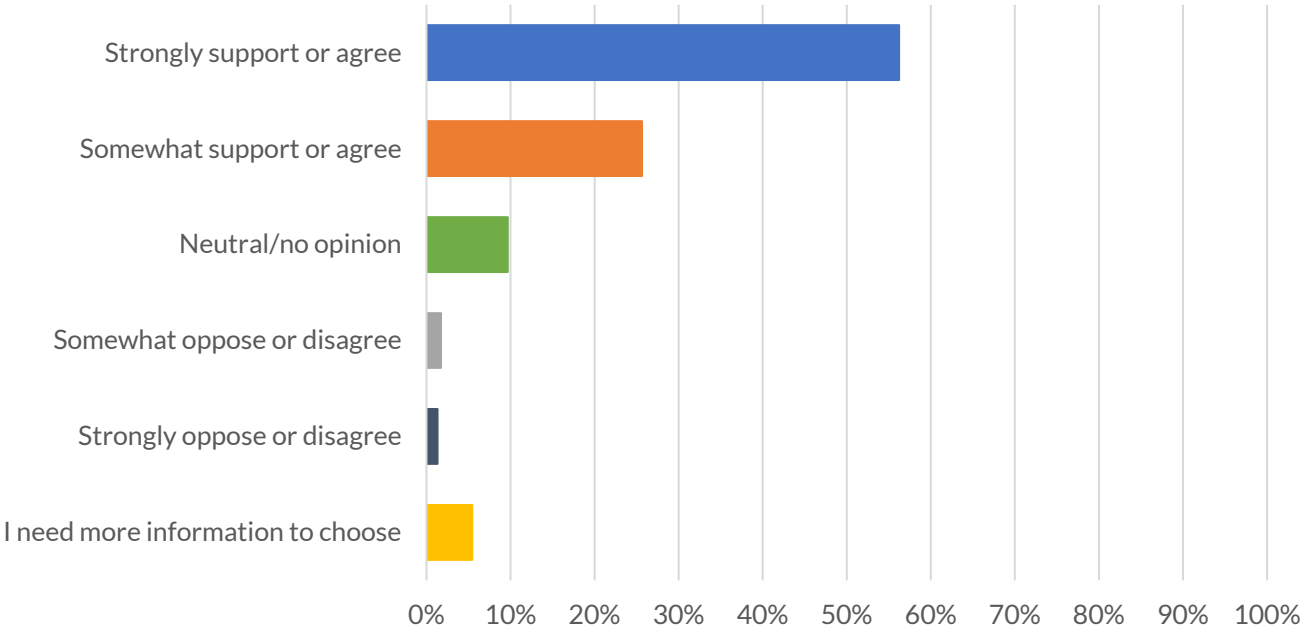
ANSWER CHOICES	RESPONSES	
Strongly support or agree	59.54%	3,261
Somewhat support or agree	23.13%	1,267
Neutral/no opinion	9.44%	517
Somewhat oppose or disagree	1.77%	97
Strongly oppose or disagree	1.33%	73
I need more information to choose	4.78%	262
TOTAL		5,477

Q. The City should reduce the volume of toxicity of discarded materials and maximize diversion from disposal.



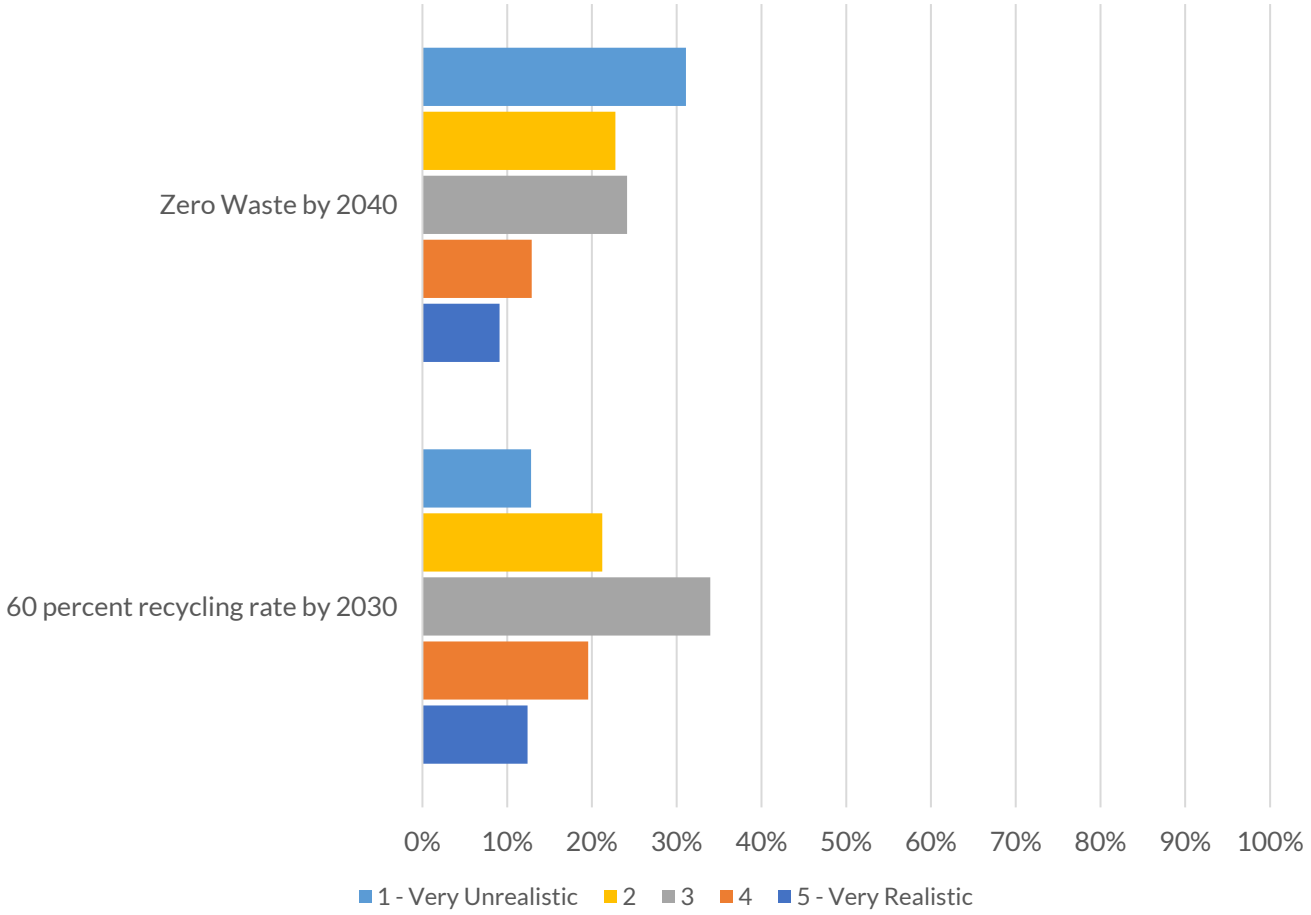
ANSWER CHOICES	RESPONSES	
Strongly support or agree	61.16%	3,346
Somewhat support or agree	21.04%	1,151
Neutral/no opinion	8.94%	489
Somewhat oppose or disagree	2.03%	111
Strongly oppose or disagree	1.04%	57
I need more information to choose	5.79%	317
TOTAL		5,471

Q. The City should spur economic growth by recovering valuable raw materials and clean energy from discarded materials.



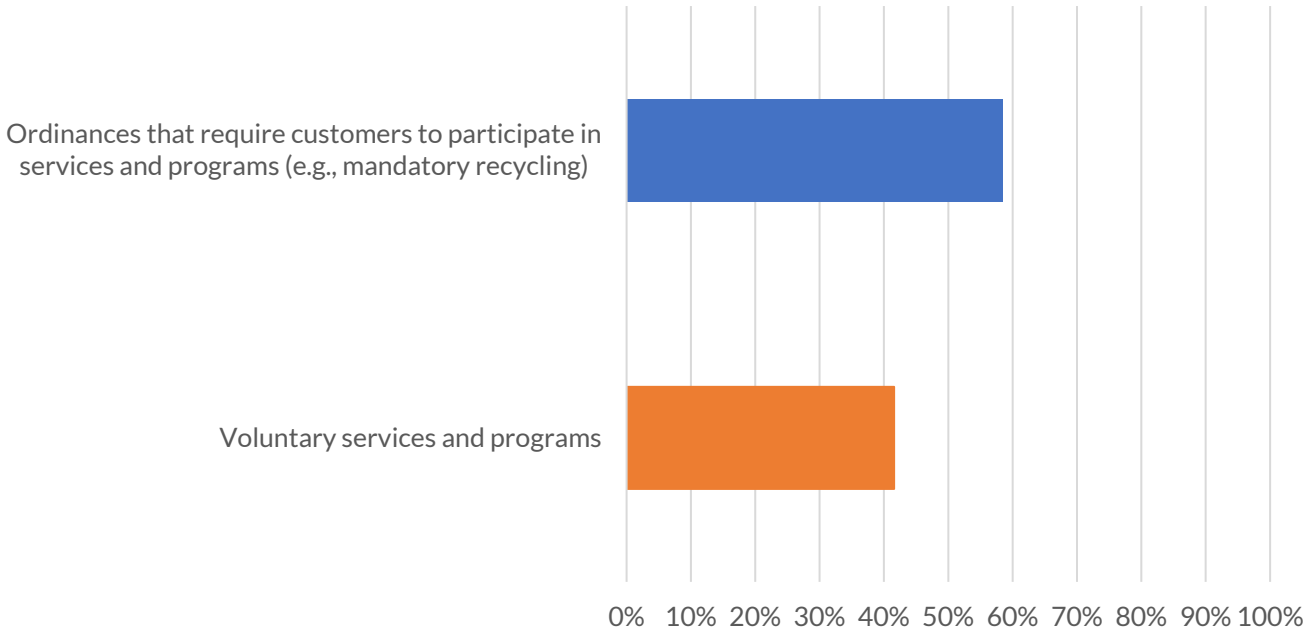
ANSWER CHOICES	RESPONSES	
Strongly support or agree	56.23%	3,081
Somewhat support or agree	25.64%	1,405
Neutral/no opinion	9.66%	529
Somewhat oppose or disagree	1.72%	94
Strongly oppose or disagree	1.31%	72
I need more information to choose	5.44%	298
TOTAL		5,479

Q. As of 2020, the City's recycling rate is approximately 20 percent. On a scale of 1 to 5, with 1 being very unrealistic and 5 being very realistic, how likely do you think it is for the City to achieve:

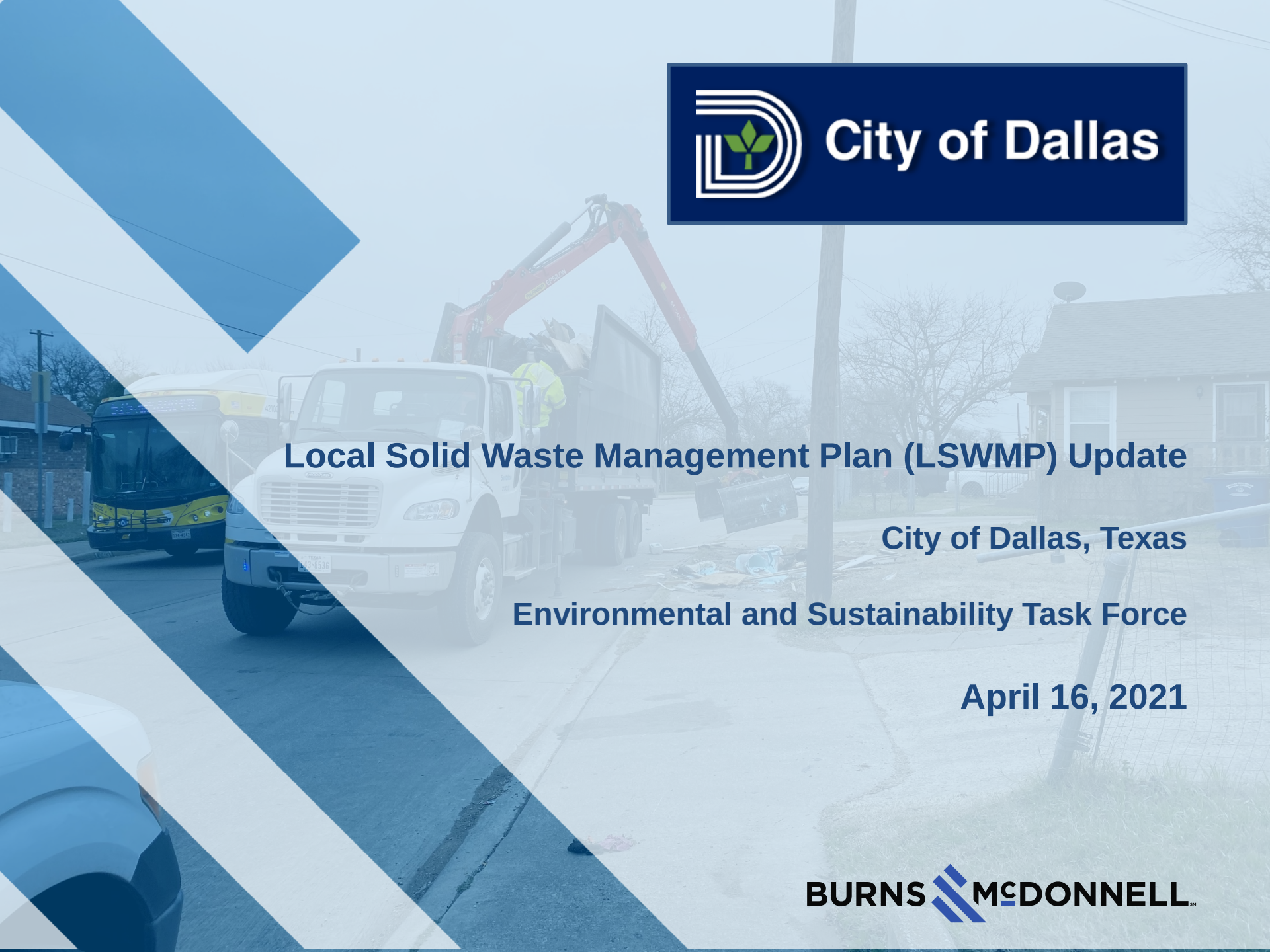


	1 Very Unrealistic		2		3		4		5 Very Realistic		TOTAL
60 percent recycling rate by 2030	12.82%	694	21.23%	1,149	33.97%	1,839	19.56%	1,059	12.41%	672	5,413
Zero Waste by 2040	31.09%	1,643	22.76%	1,203	24.14%	1,276	12.90%	682	9.10%	481	5,285

Q. Which method would you prefer the City use to implement solid waste and recycling programs to accomplish its goals?



ANSWER CHOICES	RESPONSES	
Ordinances that require customers to participate in services and programs (e.g., mandatory recycling)	58.43%	3,170
Voluntary services and programs	41.57%	2,255
TOTAL		5,425



Local Solid Waste Management Plan (LSWMP) Update

City of Dallas, Texas

Environmental and Sustainability Task Force

April 16, 2021

BURNS McDONNELL

Agenda

LSWMP Update Overview

Future Strategic Direction

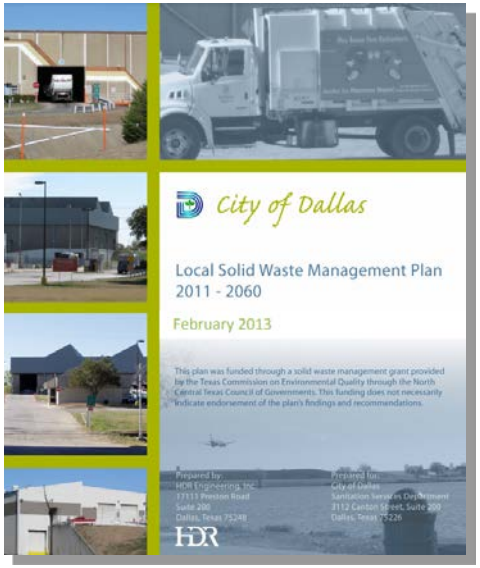
LSWMP Update Planning Process

Supporting CECAP Solid Waste-Related Goals

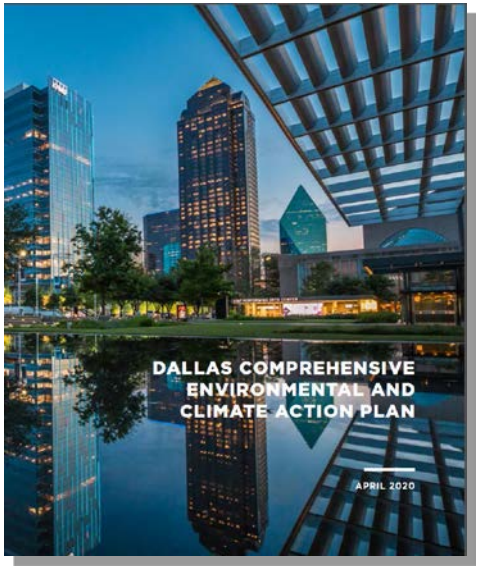
Stakeholder Engagement Options

Upcoming LSWMP Update Tasks

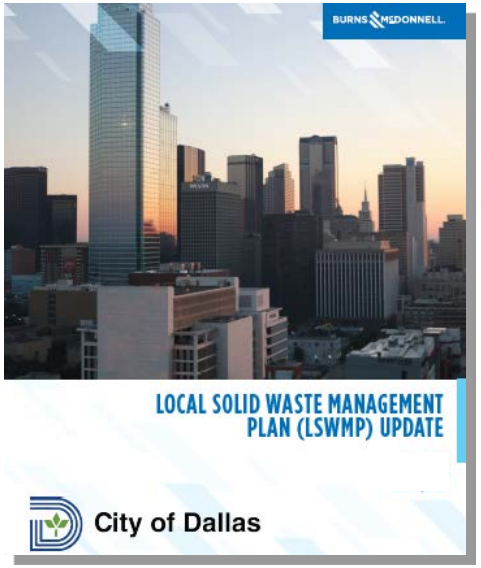
LSWMP Update Overview



- Multiple initiatives focused on increasing diversion
- 50 year planning period



- Nine solid waste-related goals developed as part of CECAP
- LSWMP Update to build on CECAP results and incorporate stakeholder engagement efforts

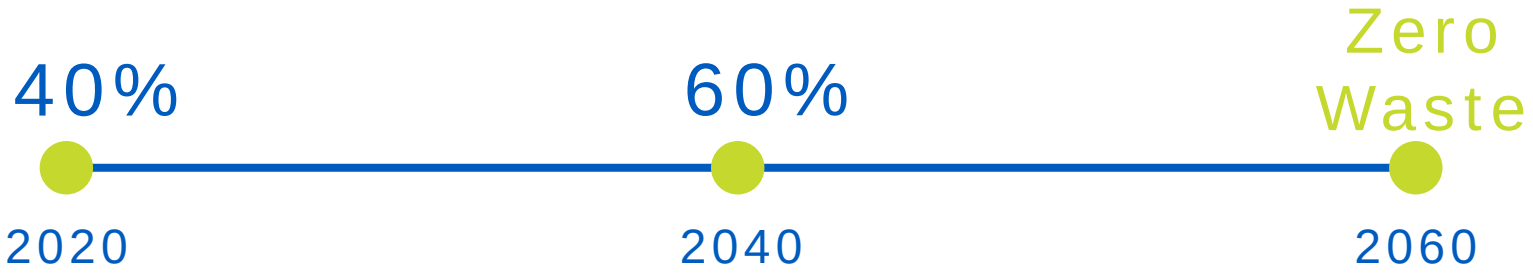


- Evaluate goals from 2011 LSWMP
- Focus on developing near-term strategies while still identifying key long-term issues

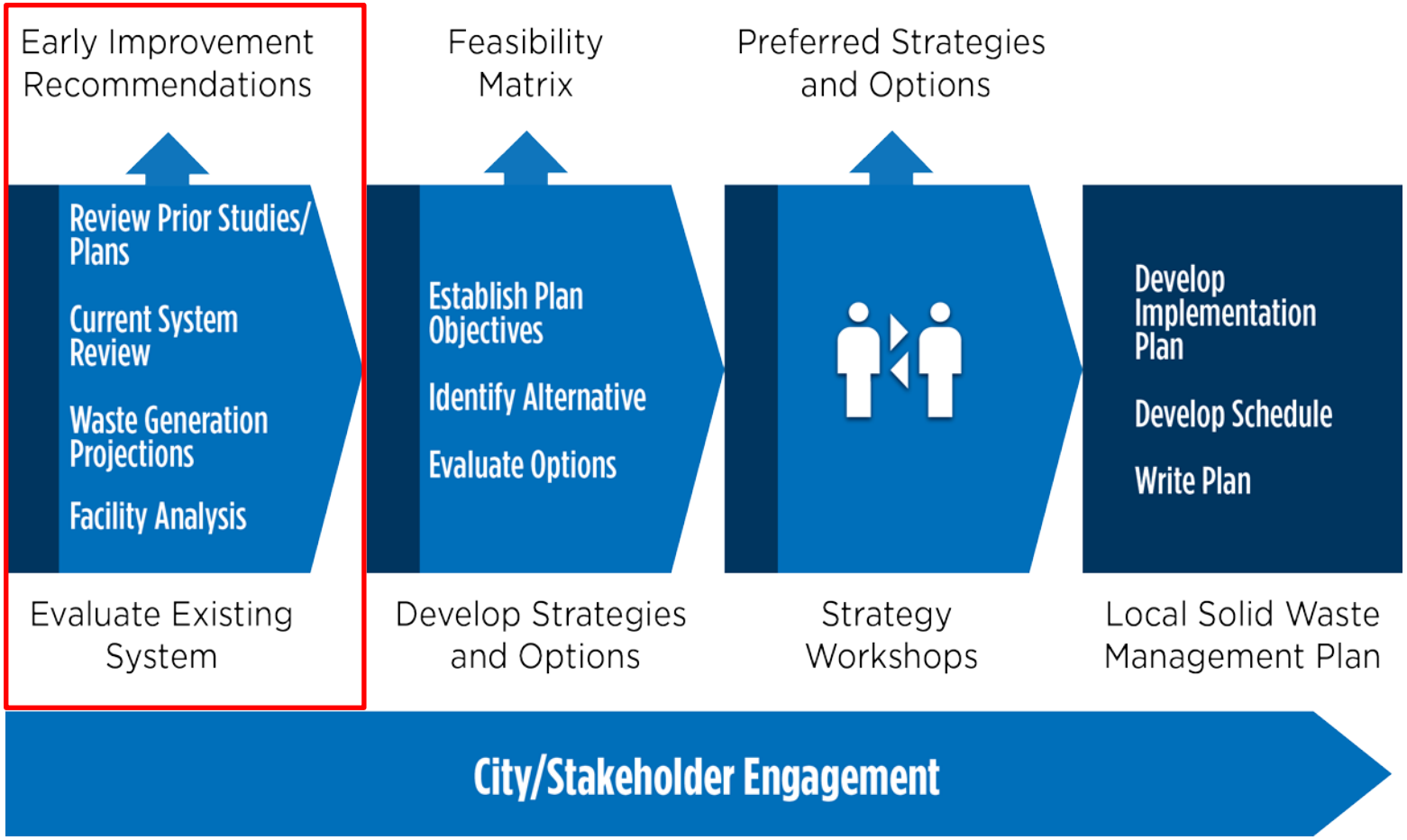
Future Strategic Direction

- Zero Waste is a philosophy and often includes visionary goals.
- Other large cities in Texas face similar challenges to meet or adjust high recycling rate goals.
- Key part of LSWMP Update to provide strategic direction and goals based on past goals and new updates.

2011 LSWMP Recycling Rate Goals



LSWMP Update Planning Process



Supporting CECAP Solid Waste-Related Goals

1. Actively Promote Source Reduction, Recycling and Composting to the Dallas Community
2. Develop a Comprehensive Green Procurement Plan
3. Improve Solid Waste, Recycling and Brush/Bulky Waste Collection Frequency
4. Improve Potential for Electric Waste Collection Vehicles
5. Update and Implement the Zero Waste Management Plan
6. Expand Efforts to Reduce Illegal Dumping by Implementing Recommendations Identified in the Litter and Illegal Dumping Assessment Study
7. Encourage the Development of Material Markets Focusing on Creating New Economic Opportunities
8. Continue to Capture Gas and Expand Capacity from Landfill for Reuse and Evaluate for City Operations
9. Adopt an Ordinance to Implement a City-wide Organics Management Program

Stakeholder Engagement Options

Leveraging the results of CECAP, the City is pursuing the following stakeholder engagement options:

- **Stakeholder Engagement Toolkit**
- **Online Survey**
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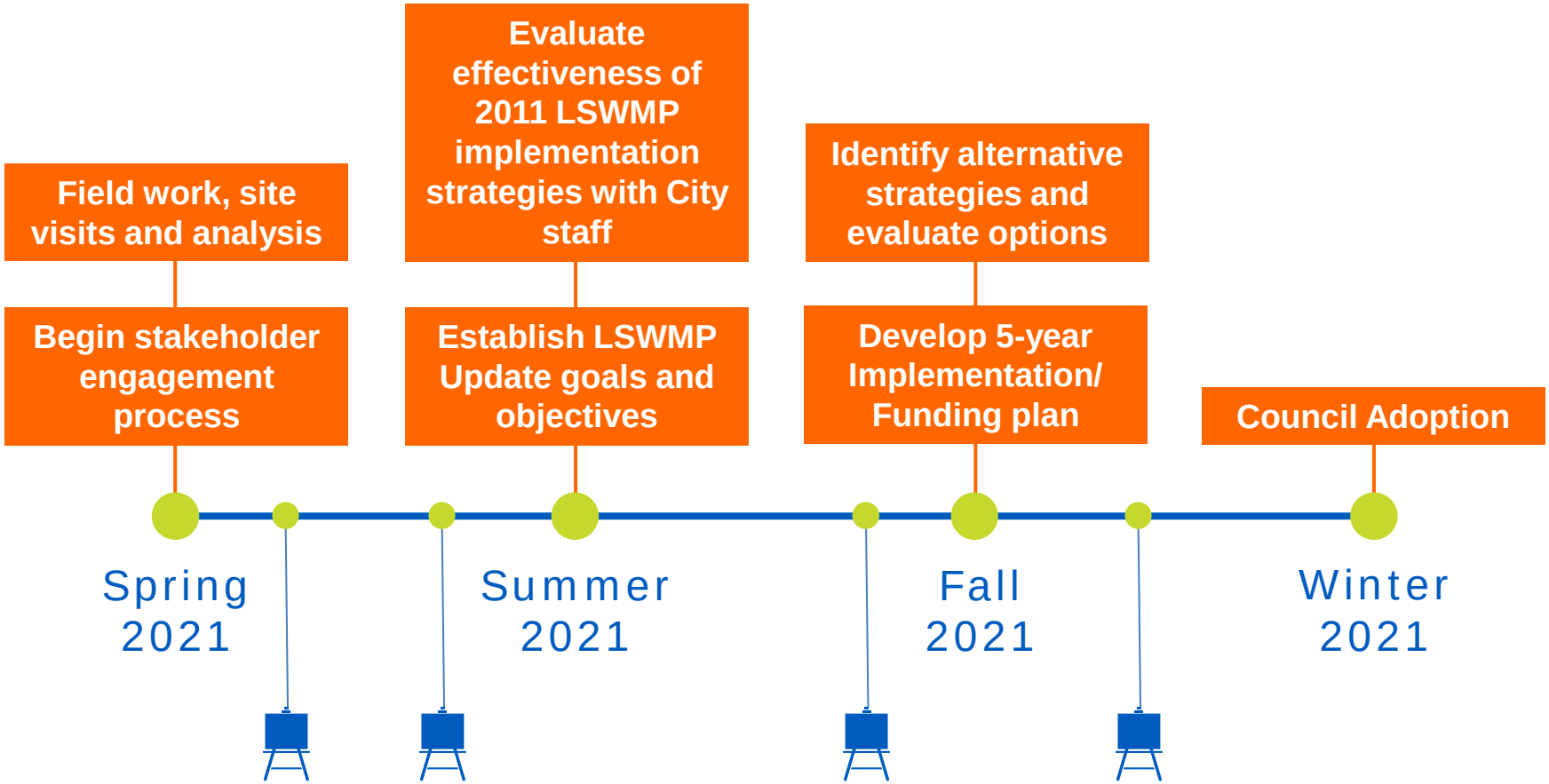
LSWMP Update Key Milestones (Draft)



Indicates City Council Task Force/Subcommittee Presentations

City of Dallas

Local Solid Waste Management Plan (LSWMP) Update

City of Dallas, Texas

Environmental and Sustainability Committee

May 3, 2021

BURNS McDONNELL

Agenda

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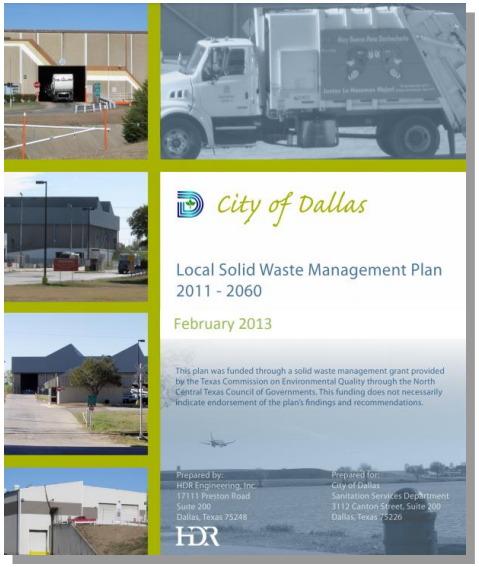

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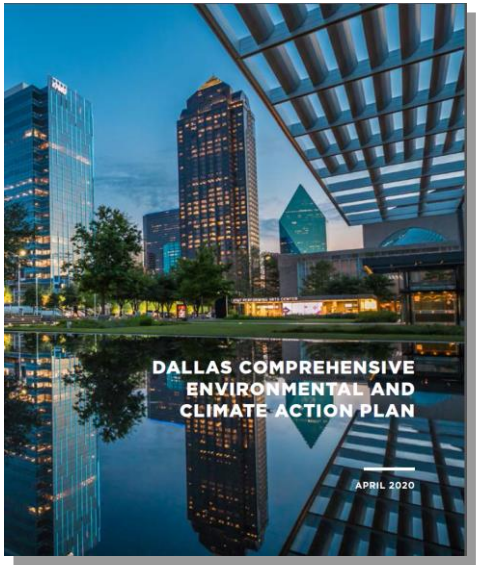

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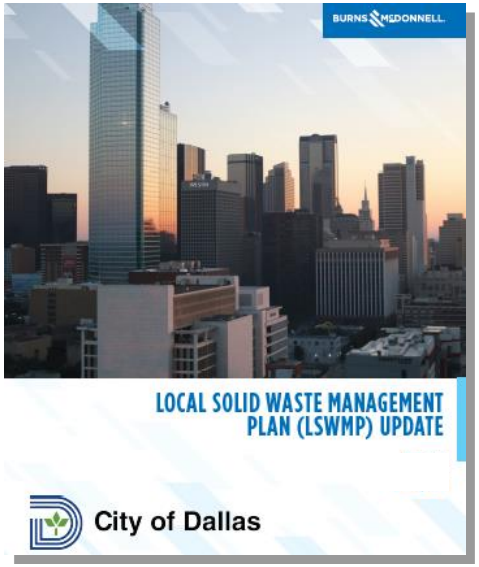

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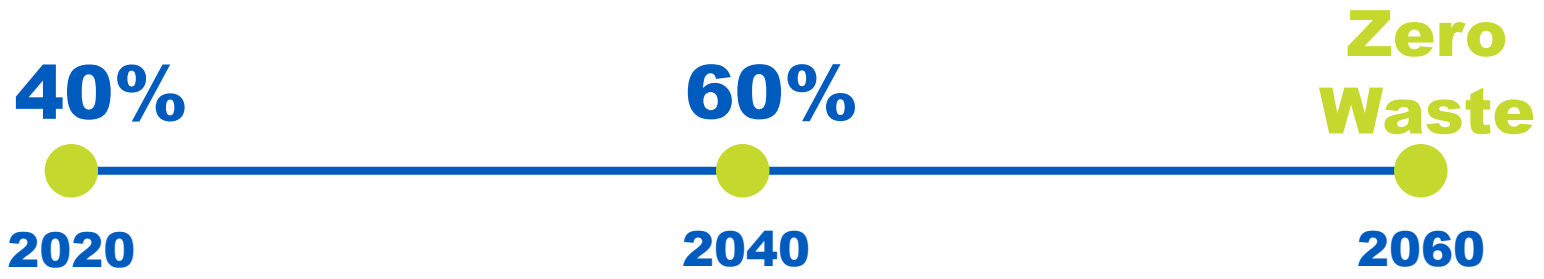
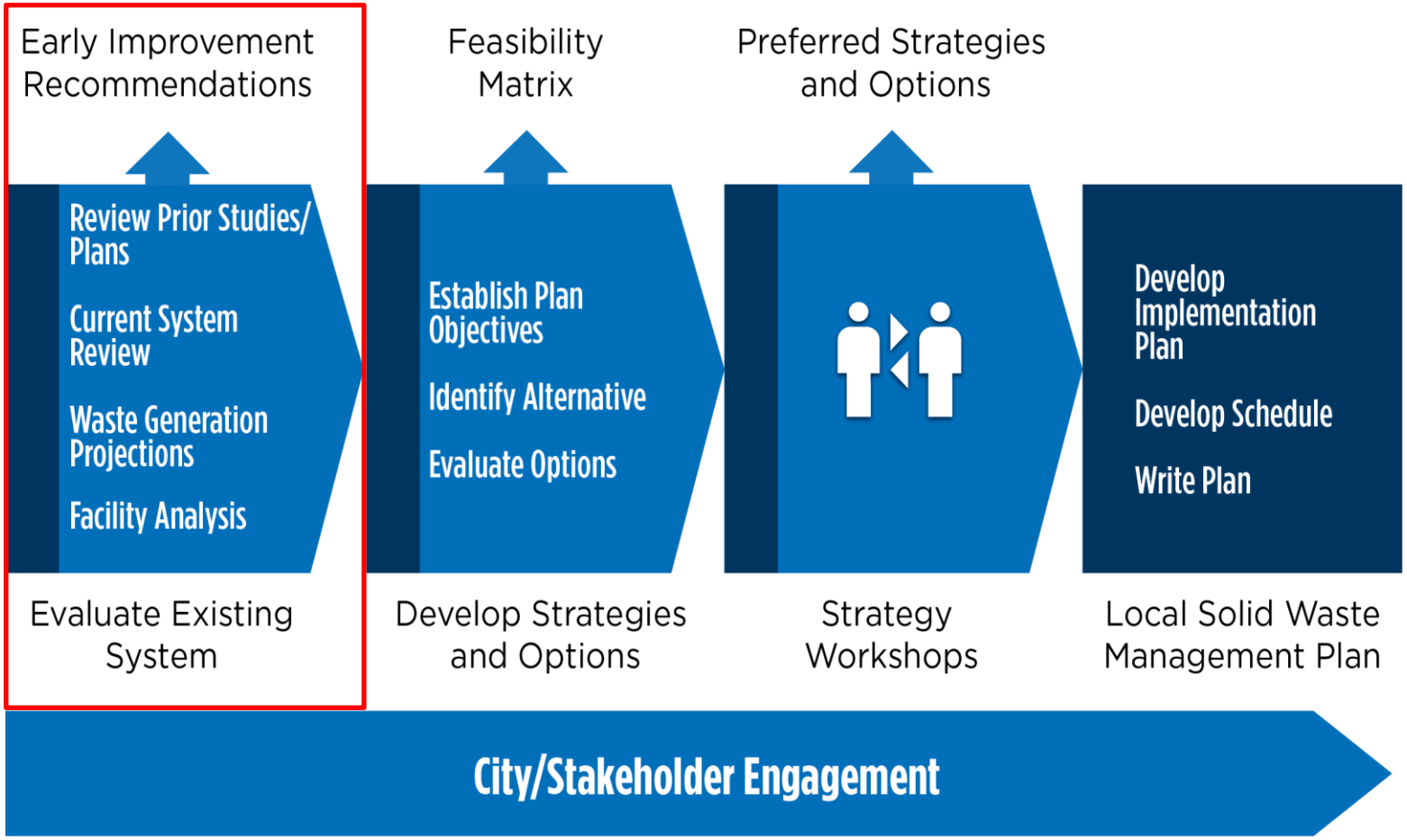


LSWMP Update Planning Process



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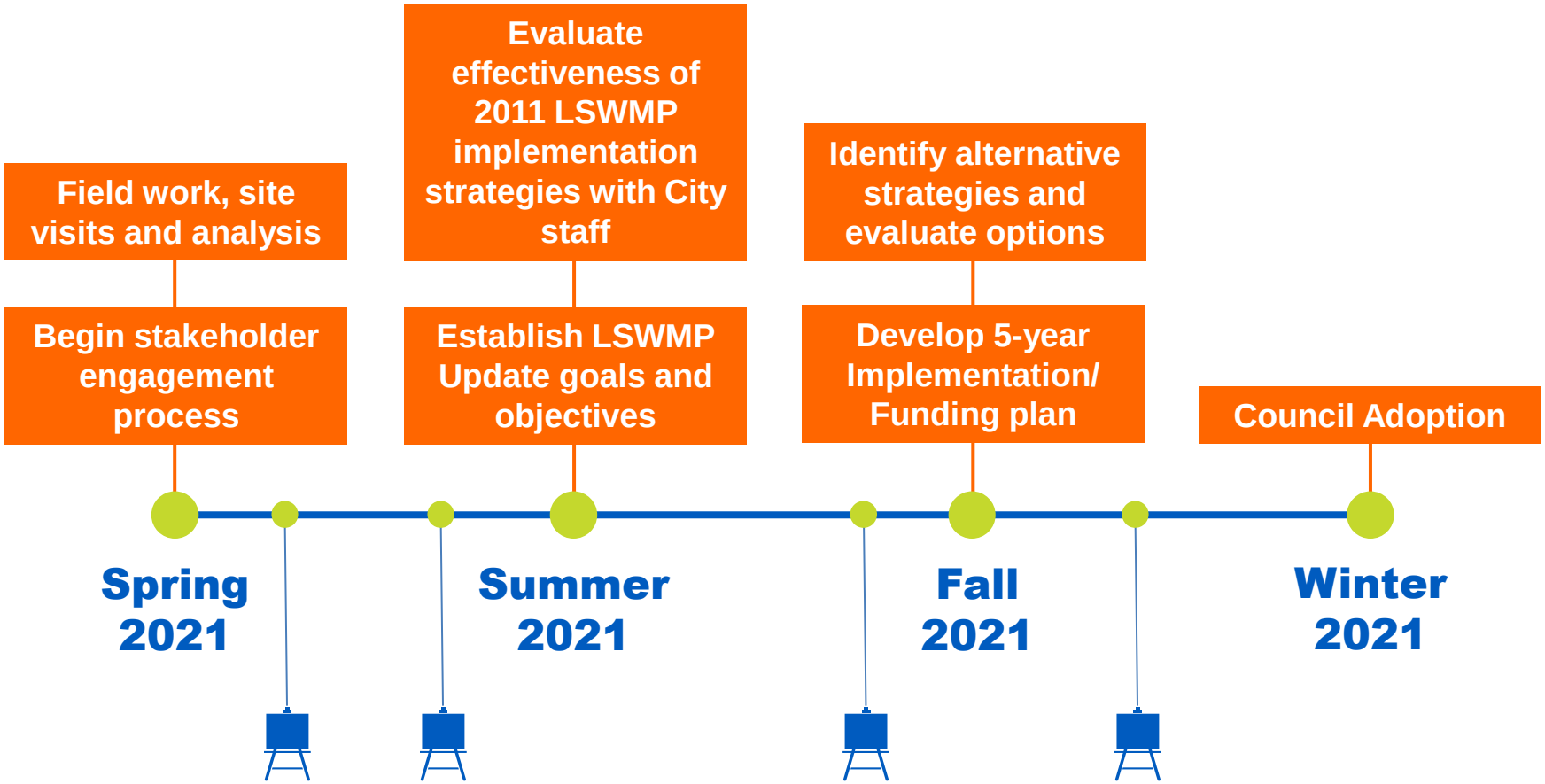

Indicates City Council Task Force/Subcommittee Presentations

City of Dallas

Sanitation Services Performance & Initiatives Update

Environment and Sustainability Committee
November 1, 2021

Jay Council, Director
Department of Sanitation Services
City of Dallas

Presentation Overview

- Background
- 2021 Operational & Business Issues
- Performance Update
- Brush and Bulky Item Separation Pilot Update
- Local Solid Waste Management Plan Update
- New Initiatives for 2022
- Next Steps

Background

- Sanitation provides recycling and solid waste collection services to approximately 250,000 customers
  - Approximately 2.4 million collection points each month
    - 1 million garbage collection points
    - 1 million recycling collection points
    - 240,000 brush and bulky waste collection points
  - Monthly residential service fee $34.30/month plus tax as of October 1
- Sanitation operates one of the largest landfills in Texas by volume, and one of largest publicly owned and operated landfills in the United States

Background

- FY 2021-22 operating budget of approximately $140 million
- 594 full-time positions and 215 temporary laborer positions
- Approximately 375 vehicles and heavy equipment units
- Two Major Operational Divisions
  - Recycling & Solid Waste Operations
    - Public-facing component
    - Recycling, garbage, brush and bulky waste collections
  - Post-Collection Operations
    - Final disposal component
    - McCommas Bluff Landfill, Materials Recovery Facility, Transfer Stations
- Support Services: Environmental, Safety, Business Operations, Customer Service, Community Affairs

Presentation Overview

- Background
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2021 Operational & Business Issues

- Brush & Bulky Item Collection Delays Due to Winter Storm
  - Larger than the usual Spring volume of debris set out in March began a cascade of brush collection delays lasting through May
  - 40 contract crews brought in assist with collections
  - Cost of $5.6 million
- Garbage and Recycling Collection Delays Due to Staffing
  - June through August
  - Temporary Laborer Contract
    - Contract on a one-year extension at $12.38/hour living wage
    - Vendor not awarded new contract
    - Two factors resulted in shortage of helpers
  - Sanitation Truck Drivers
    - Pronounced effect of industry-wide shortage of CDL drivers began in May
    - Operational adjustments made, prioritizing garbage collection, extending workdays and work weeks

Presentation Overview

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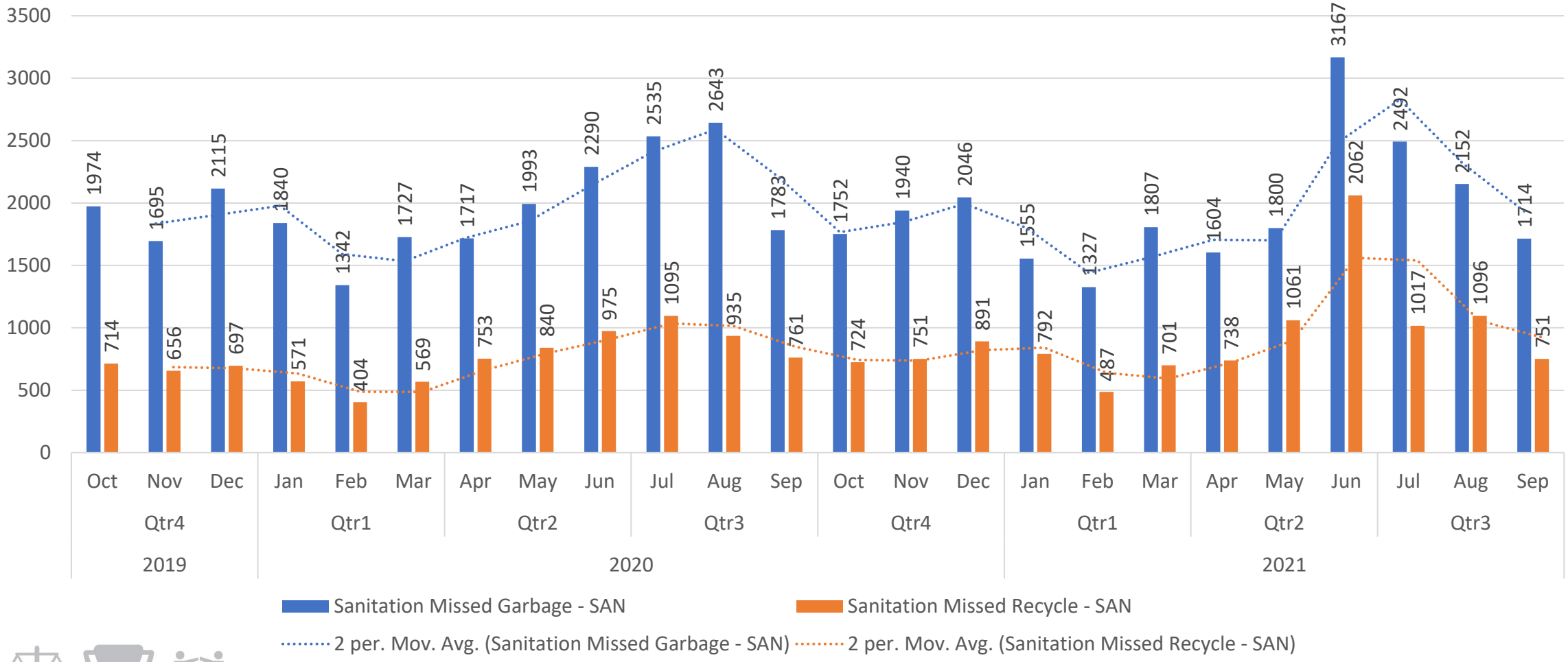
Performance Update

- Reduction in number of missed collection service requests since peak in June
- New Temporary Laborer Contract effective August 16, 2021
  - Provided an average 95% of required laborers daily
- Staffing goal of 240 truck drivers
  - Approximately 200 in mid-August
  - 222 on staff as of October 27, 2021
  - 15 candidates have received offer letters, in on-boarding process

Performance Update

Missed Garbage and Recycling Service Requests
FY 2019-20 and FY 2020-21

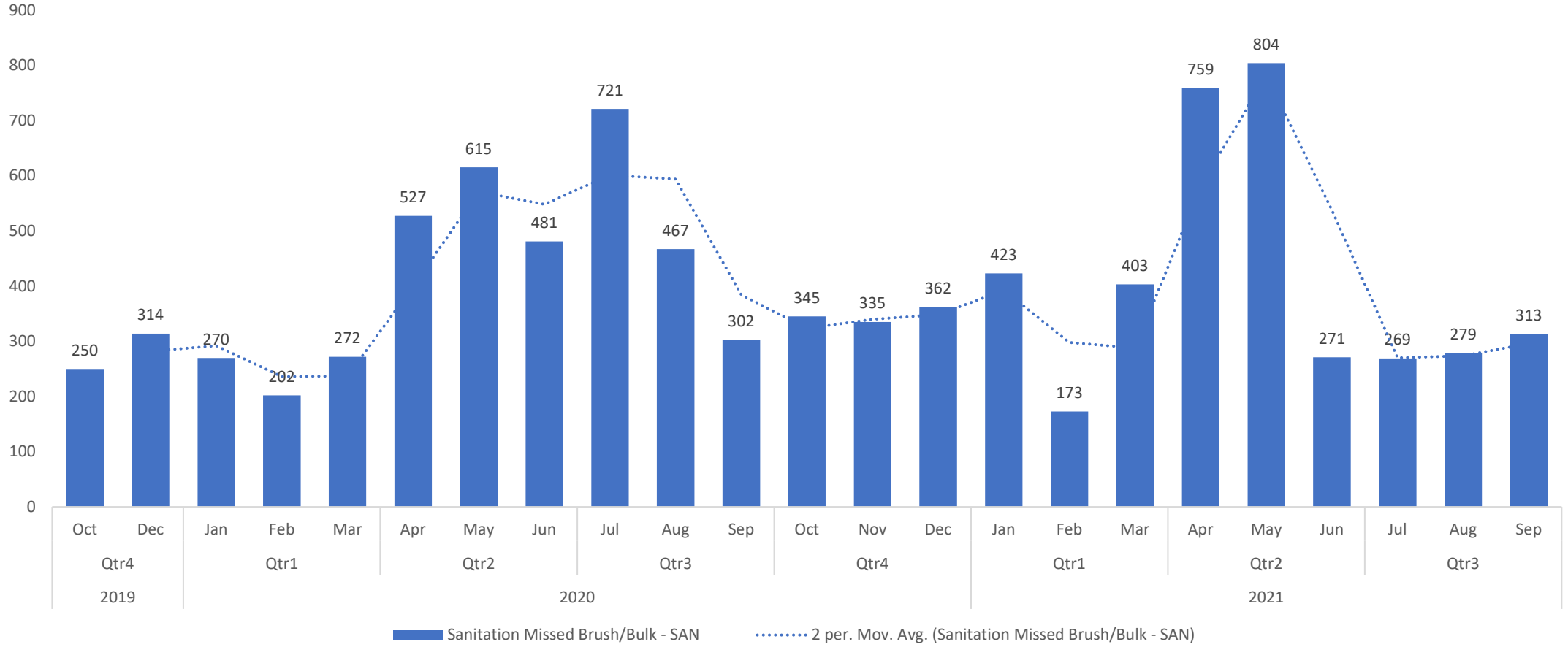


Performance Update

- Brush and bulky waste collections on time since June
  - Supplemental contractor assistance still required
  - Compliance with program guidelines challenging
    - 10 cubic yard limit (once annual 20 cubic yard oversize collection)
    - Prohibited items and placement
- Service provided at a loss over the last several years
  - Increased volumes, labor and equipment costs
  - Cost included in residential fee
- Ongoing discussions with Council on ways to achieve a cost-efficient program aligned with the Comprehensive Environmental and Climate Action Plan (CECAP) goals
  - A 90-day pilot program in 6 neighborhoods began in October

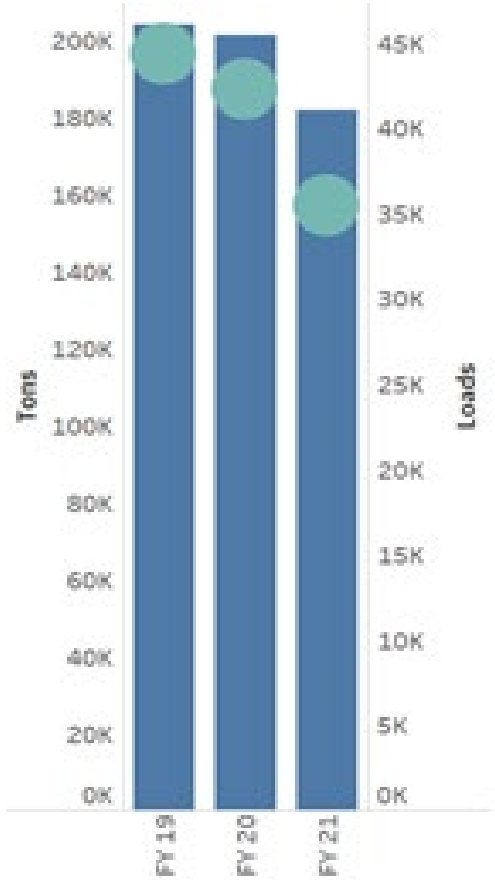
Performance Update

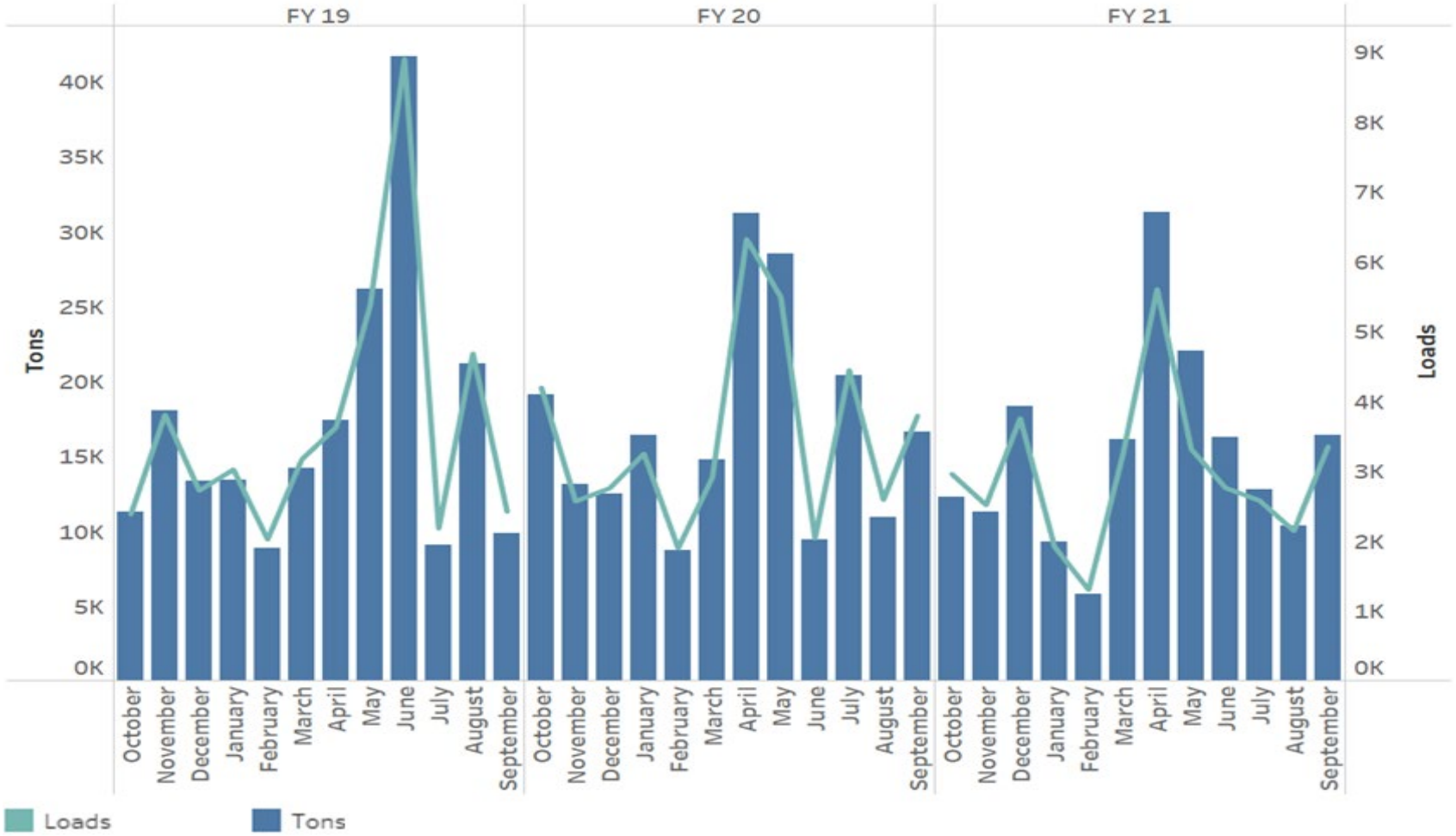
Missed Brush and Bulky Waste Service Requests
FY 2019-20 and FY 2020-21



Performance Update

Missed Brush and Bulky Waste Loads and Tons
FY 2019-20 and FY 2020-21





Presentation Overview

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Brush & Bulky Item Separation Pilot Update

- 6 neighborhoods selected for 90-day pilot from Oct-Dec
- Maintains monthly brush collection
  - Must be free of refuse, construction/demolition debris, and other non-green waste materials
- Bulky item transitions to quarterly service
  - Collected once during pilot program
  - Furniture, appliances, mattresses, other household objects too large to fit in roll cart
  - Bulky items must be placed in a separate pile from brush when both are set out

Brush & Bulky Item Separation Pilot Update

Oak Park North/Twin Oaks

Ledbetter Gardens/Westmoreland Heights

Highland Hills

Pemberton/Trinity Forest

Casa View Oaks

Schreiber Manor/Forestcrest Estates

Guidelines

- Brush continues to be collected monthly
  - Small tree limbs, shrubbery, and yard trimmings
- Bulky item collection will occur once during the 3-month pilot period
  - Furniture, appliances (refrigerants removed, if applicable, doors removed from refrigerators), mattresses, other household objects too large to fit in roll cart.
- When bulky items are placed out for collection, they must be placed in a separate pile from brush materials
- The existing 10 cubic yard limit remains in place for the total volume of set out each month
  - A once annual oversize collection of up to 20 cubic yards may be requested by calling 311 the week in advance of collection

Brush & Bulky Item Separation Pilot Update

- Residents in the pilot neighborhoods were notified in English and Spanish
  - Email to addresses on file for e-billing
  - Paper letters to all homes
  - Door hangers placed at all homes
  - Text messages to all phone numbers associated with billing accounts
  - 6 community meetings held
- Sanitation tagging improper set outs, and making a second pass through the neighborhood 1-2 days later to collect those corrected
  - Residents largely complied with pilot guidelines for October collections

Brush & Bulky Item Separation Pilot Update

- Residents may take materials to transfer stations or landfill at no charge
- Intent is to have brush materials mulched for beneficial reuse
  - Exploring developing composting program
- Regular monthly brush and bulky item collection will resume in January
  - Sanitation will report to City management and City Council on what was learned and make a recommendation on next steps

Presentation Overview

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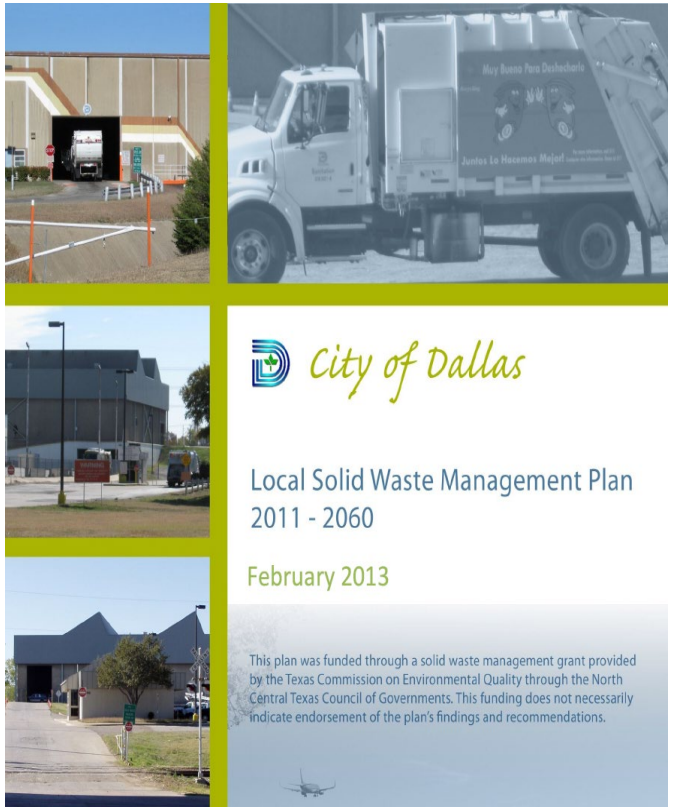
Local Solid Waste Management Plan Update

- The purpose of the plan is to identify policies, programs, and infrastructure that will be needed to manage solid waste and recyclable materials generated in the City over the next 50 years
  - Current plan developed beginning in 2011, adopted by City Council in 2013
- Update needed to re-evaluate goals
  - Current system has advanced since 2011 LSWMP
  - Align with CECAP and other multi-department planning efforts
  - Decennial update process began in Spring 2020
- Last update to ENVS committee in May 2021
  - Updated committee on upcoming system analysis and plan for stakeholder engagement process
- Since last update:
  - Staff interviews, field work and system analysis nearing completion
  - Citywide survey of residents and businesses (English and Spanish) and stakeholder engagement complete
  - In process of evaluating effectiveness of 2011 LSWMP implementation strategies, establishing updated goals, and identifying alternative strategies for evaluation

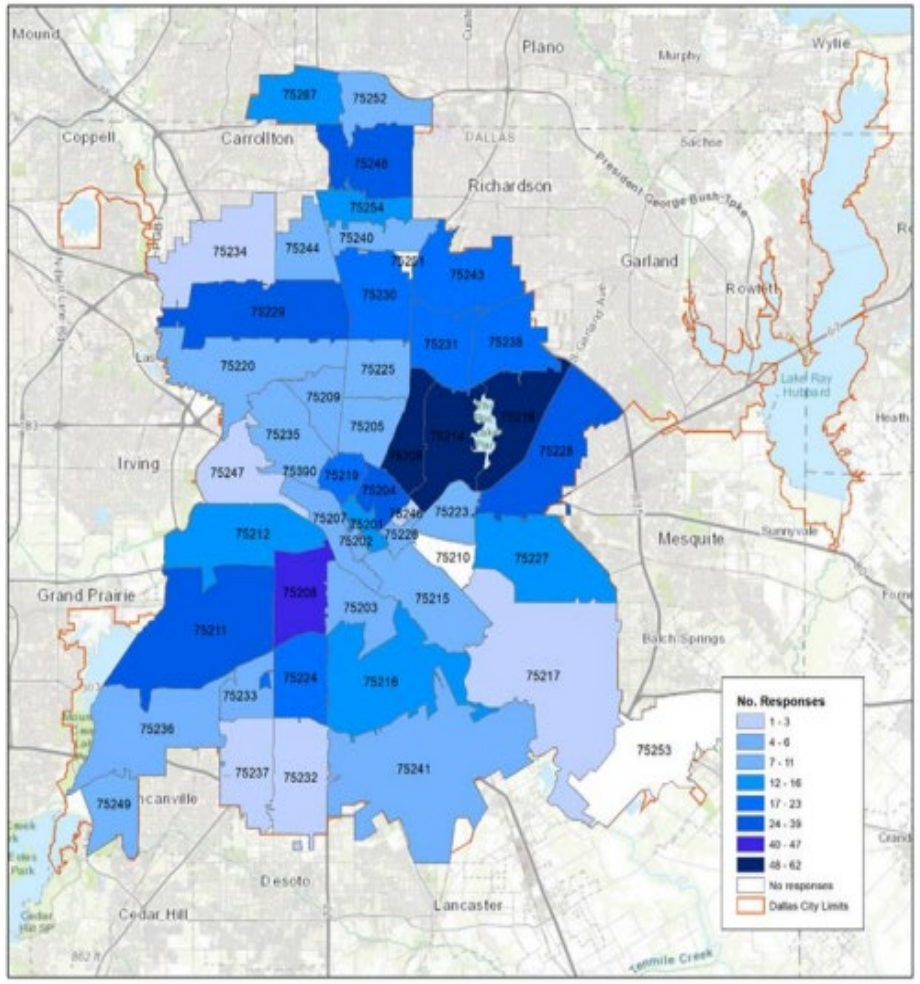


Stakeholder Engagement Results (to date)

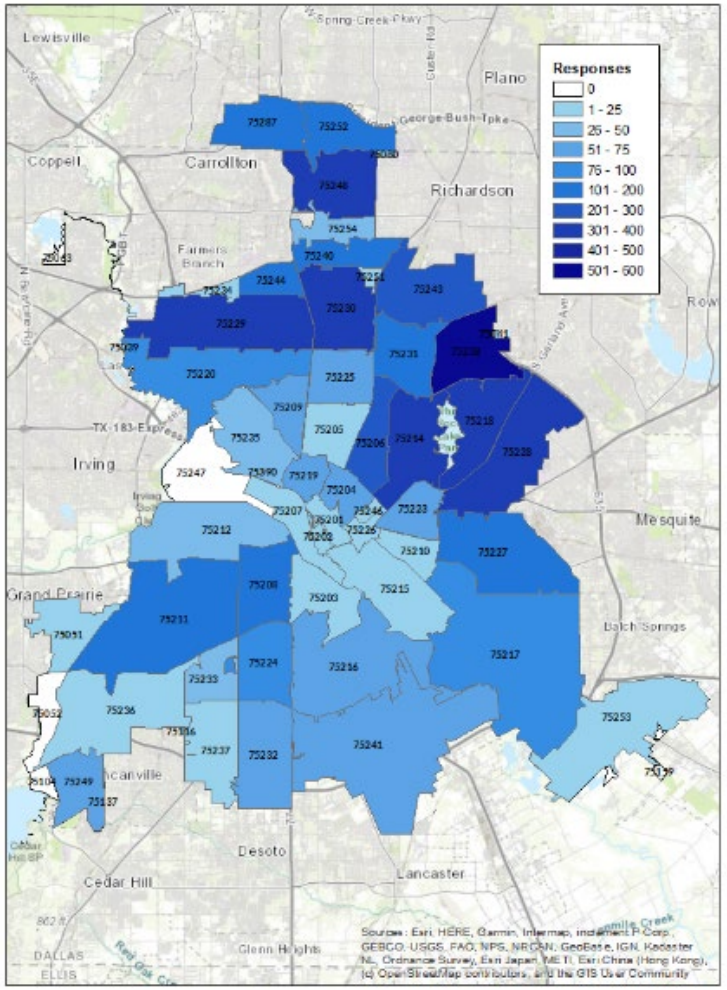
- 5,500+ survey responses (includes single-family, multi-family and commercial respondents)
- Approximately 6,800 visits to LSWMP Update webpage
- Completed seven stakeholder engagement meetings
  - Three neighborhood groups, Dallas Regional Chamber. Texas Restaurant Association (Greater Dallas Chapter), Apartment Association of Greater Dallas, Texas Campaign for the Environment
- Completed interviews with multiple City departments and stakeholders
  - SAN, DWU, OEQS, Economic Development, Dallas County, Development & Sustainability, Code Compliance

Building on CECAP Stakeholder Engagement

DISTRIBUTION OF SURVEY RESPONSES

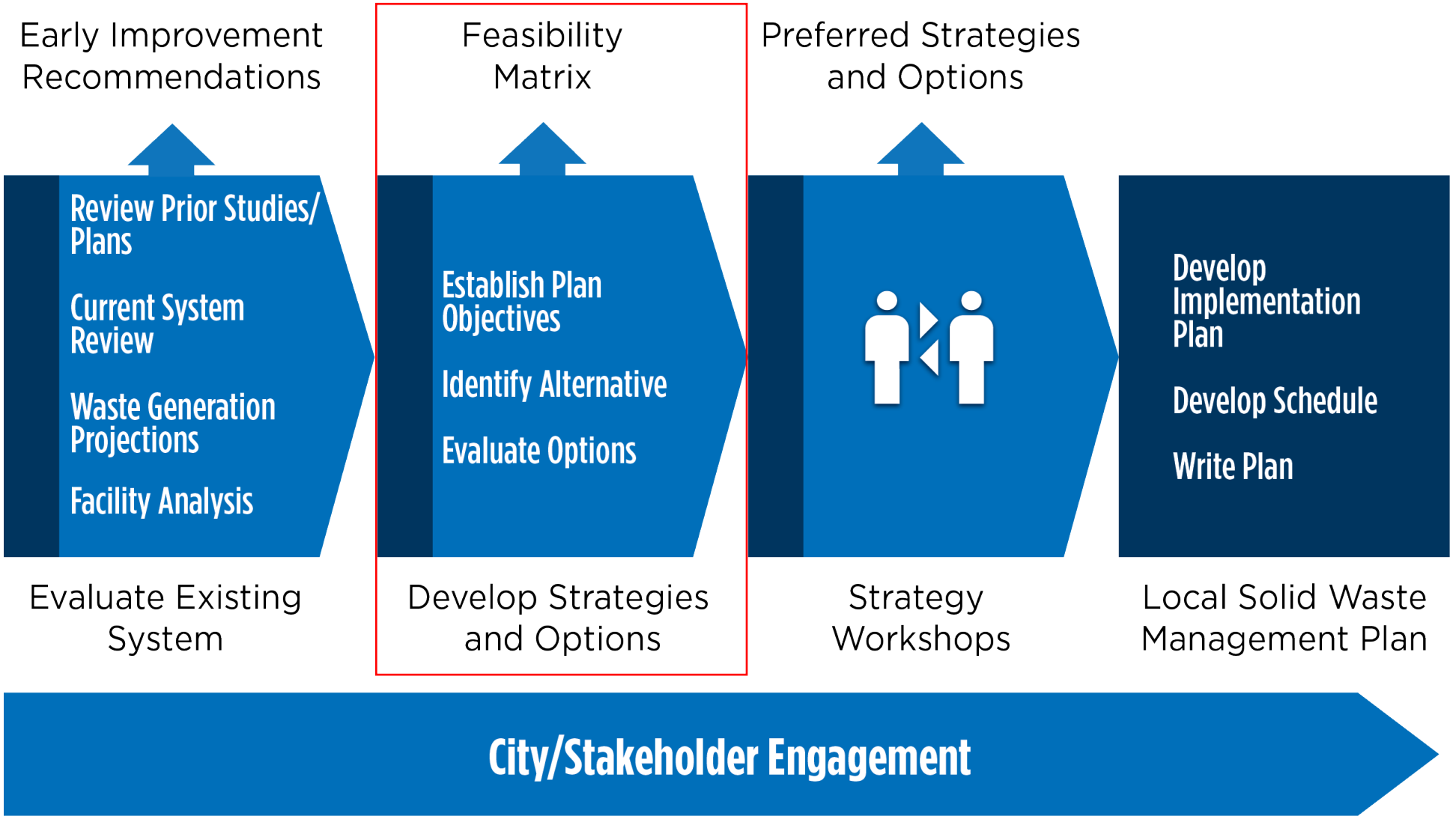


CECAP



LSWMP Update

LSWMP Update Development Progress



Next Steps in LSWMP Update Development

- Finalize results of the current system and facility capacity analysis
- Evaluate effectiveness of 2011 LSWMP implementation, update goals and determine future strategy options
- Continue stakeholder engagement efforts
  - Re-engage community stakeholders in early 2022
  - Identify community meetings and events to share information (with help from ENVS committee/council to identify opportunities)
  - Share results of current system analysis and collect feedback on future strategy options
- Evaluate options for the City's future solid waste management needs
- Develop 5-year implementation/funding plan
- Submit LSWMP Update for council adoption

Presentation Overview

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New Initiatives for 2022

- Implement an organizational reroute that balance all routes and service days
- Change from a 4/10 to a 5/8 work week to improve service delivery, reduce overtime, and reduce the need for contract labor
- Continue to shift from manual to automated collection vehicles, further reducing the need for temporary labor

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Next Steps

- Evaluate the viability of monthly brush and quarterly bulk trash collection for citywide implementation
- Develop the capacity to transfer and process organics citywide
- Develop tiered options for residential collection in rear alley and front of house
- Host meetings with neighborhood associations and community advocates on planned service changes, to ensure awareness, and compliance

Welcome To This Local Solid Waste Management Plan Update Public Workshop

Scan this QR code, or visit PlanMeeting.DSAN.us, to access meeting materials.

Please also let us know you were here by clicking on the "Register Attendance" button on this site.

1

City of Dallas

LSWMP Update Public Workshop

March 31, 2022

Jay Council
Director of Sanitation Services

Cliff Gillespie
Assistant Director of Sanitation Services

2

Public Meeting Housekeeping

- This public meeting is being recorded and is prepared to support in-person and virtual attendance
- The presentation has several break points to engage in brief guided discussion using PollEverywhere service
  - Presenter will switch to webpage where audience responses are displayed live
- This public meeting kicks off the draft LSWMP Update public comment period and Phase 2 survey – more information will be provided at the end of the meeting.

SCAN QR CODE TO ACCESS MEETING MATERIALS

OR VISIT PLANMEETING.DSAN.US

3

3

Public Meeting Agenda

LSWMP Update Background
Information about LSWMP Update process and progress to-date

Draft Objectives and Goals
Draft goals and objectives the City is considering for the updated plan

Single-Family Sector
Services overview and discussion of recommended next steps

Multi-Family Sector
Multi-family Recycling Ordinance (MFRO) overview and discussion of recommended next steps

Commercial Sector
Commercial sector overview and discussion of recommended next steps

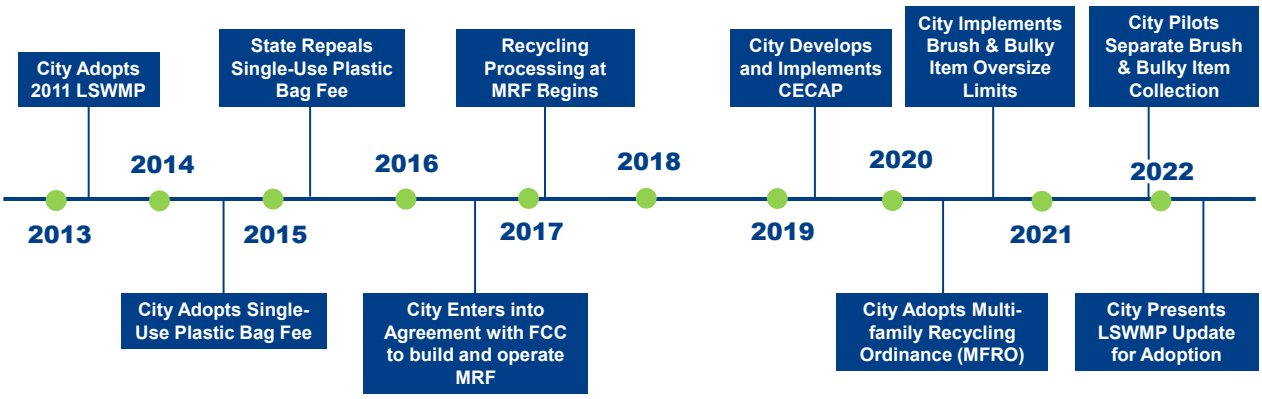
Infrastructure
Review of select materials management infrastructure and discussion of recommended next steps

Next Steps
Upcoming activities to complete the LSWMP Update

4

4

LSWMP Update Background



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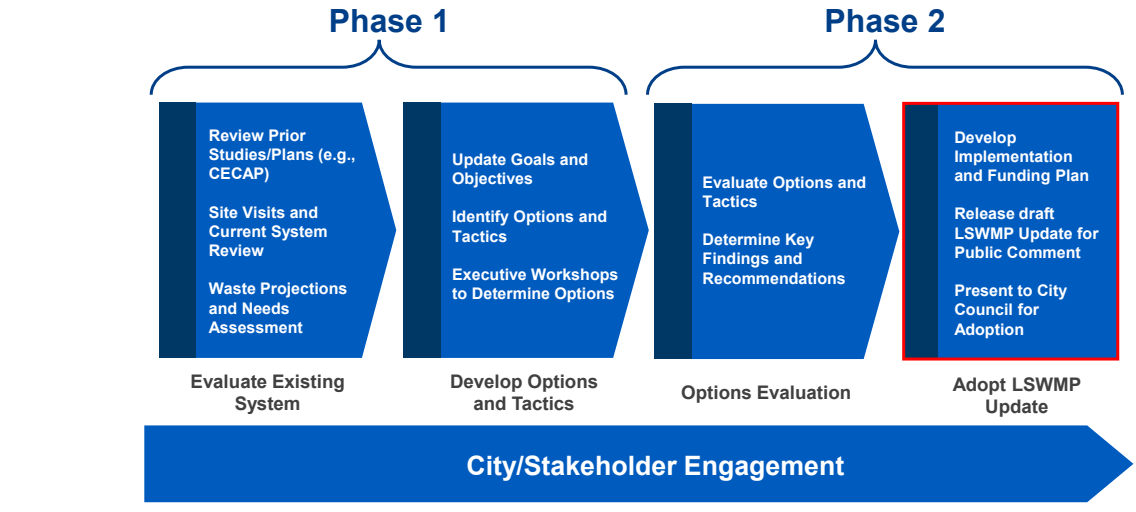
LSWMP Update Process



6

Recommendations Coordinate with Goals

Update Objectives

Identify long-term strategic considerations that will result in successful operations, programs and material management

Update Goals

Establish recycling targets and timing based on updated objectives and current system evaluation

Evaluate Options

Analyze options to achieve goals based on select criteria (e.g., recycling potential, financial impact, environmental impact, etc.)

Develop Recommendations

Develop specific actions aligning with options that provide the foundation for the implementation and funding plan

Coordination with CECAP

LSWMP Update supports the City's Comprehensive Climate and Environmental Action Plan (CECAP) goals related to material management:

- Improve source reduction
- Improve key collection operations
- Incorporate battery-electric garbage trucks to fleet
- Minimize illegal dumping
- Support recycling market development
- Recycle landfill gas for beneficial re-use
- Increase organics recycling

CECAP goals include:

35% and **80%** diversion of organic waste by 2030 and 2050

60% and **90%** of paper waste by 2030 and 2050

35% and **45%** reduction in waste landfilled in 2030 and 2040

LSWMP Update Outline

Overview Sections

1. Objectives, Goals, Stakeholder Engagement
2. Planning Studies, Regulatory, Trends Review
3. Planning Area Characteristics
4. Facilities and Infrastructure

Program, Policies, Infrastructure Evaluation Sections

5. Transfer Station System
6. Refuse and Recycling Collection
7. Brush and Bulky Item Collection
8. Landfill Operation
9. Recycling Processing
10. Organics Management
11. Multi-Family and Commercial Sector
12. Household Hazardous Waste and Electronics
13. Public Education and Outreach

Technical Appendices

A. Stakeholder Engagement Summary
B. Regional Facilities Map
C. Refuse & Recycling Collection Operations Assessment
D. Transfer Station System Operations Assessment
E. Landfill Operations Assessment
F. Implementation Plan

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Public & Stakeholder Engagement

Surveys. 5,500+ survey responses from single-family residents, multi-family tenants and property managers and commercial entities in phase 1 survey. Phase 2 available at www.DallasZeroWaste.com

Dallas Zero Waste Webpage. Location of resources to engage in the planning process including draft plan published for public comment, Frequently Asked Questions, informational 'whiteboard' video.

External Stakeholder Interviews. Interviewed various stakeholder groups including Dallas Regional Chamber Texas Restaurant Association (Greater Dallas Chapter) Apartment Association of Greater Dallas, Texas Campaign for the Environment, multiple neighborhood groups and homeowner associations.

Internal Stakeholder Interviews. Interviewed various City departments involved in supporting recommended policy or program recommendations including Code Compliance, Economic Development, Sustainable Development and Dallas Water Utility (DWU).

Presentation to City Leadership. City Council Environment and Sustainability Commission, City Council Environment and Sustainability Subcommittee.

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Draft Updated Objectives

Approach to updating objectives

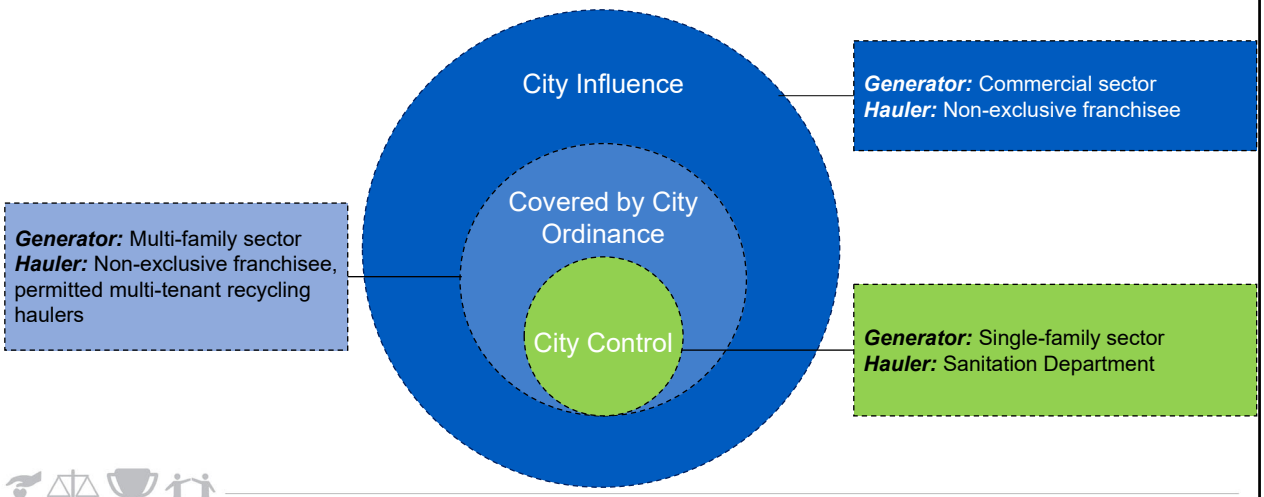
- Recall core ideas from the 2011 LSWMP objectives
- Maintain progress toward the City's long-term Zero Waste goal
- Re-packaged to emphasize near-term goals
- More closely align with goals adopted by CECAP
- Incorporate data collected during stakeholder engagement

Draft updated objectives

- Empower residents and businesses to reduce the amount of discarded material generated through proactive education and outreach.
- Establish and implement innovative operational best practices to provide efficient, cost effective, and environmentally responsible service.
- Provide excellent customer service and support residents and businesses to maximize diversion from landfill.
- Operate a clean, green and efficient waste system that seeks to generate energy from organics.

Control of Material by Sector

You can't manage what you don't measure



Updating Near- and Long-term Goals

Generator Sector	Single-Family	Multi-family	Commercial
Goal Type and Metrics	Recycling rate, capture rate, disposal per capita.	Program participation; reporting compliance	Program participation; reporting compliance
Near-term Goals	• **35%** recycling of organic waste by 2030. • **60%** paper waste by 2030. • **35%** reduction in waste landfilled by 2030.	• **90%** reporting compliance and verification of entities covered under the MFRO for three consecutive years.	• Expand Green Business Certification to **increase** participants year-over-year. • **90%** reporting compliance and verification from non-exclusive franchise haulers for three consecutive years.
Long-term Goals	• **80%** recycling of organic waste by 2050. • **90%** paper waste by 2050. • **45%** reduction in waste landfilled by 2040.	• Analyze data to establish goals consistent with future program in place	• Analyze data to establish goals consistent with future program in place

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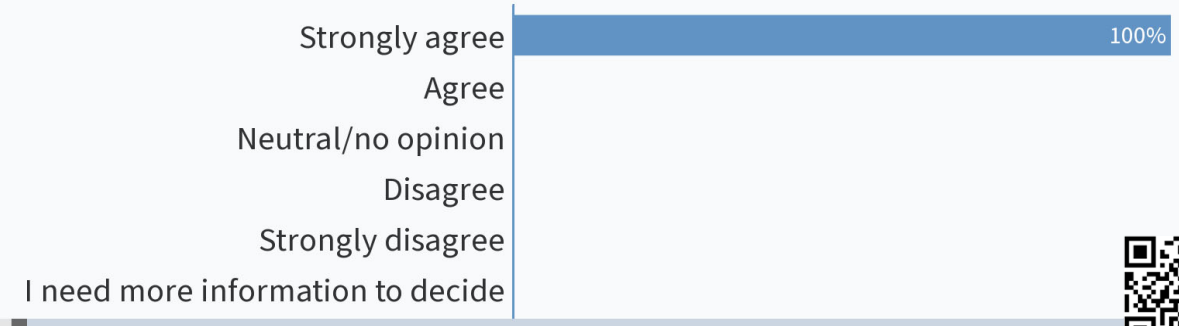
When poll is active, respond at **pollev.com/bmcd**

Text **BMCD** to **22333** once to join

To what extent to you think the updated goals and objectives will move the City in the toward its long-term Zero Waste goals?



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Single-Family Services Overview

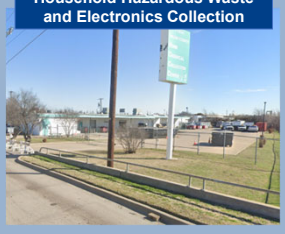
Roll Cart Collection

- Roll cart garbage and recycling collected once per week.
- Automated and semi-automated trucks used to collect roll cart.
- Opportunity to re-route collection fleet to reduce alley collection.

Brush & Bulky Item Collection

- Commingled brush & bulky items collected once per month via grapple trucks.
- 3-month pilot separate brush and bulky item collection completed in December 2021.
- Opportunity to collect and process yard trimmings and brush separately.

Household Hazardous Waste and Electronics Collection



- Household Chemical Collection (HCC) open twice per week operated by Dallas County.
- Battery, Oil, Paint and Antifreeze (BOPA) collection events held by City.
- Inconvenient location and challenges communicating program offering to residents.

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Single-Family Sector Next Steps

The City has **direct control** over material and can increase recycling via existing services

1

Increase capture rate from blue roll-cart program

Focus current and future resources to increased education, outreach and compliance efforts.

Track roll-cart capture rate performance on a year-over-year basis.

2

Separate collection and processing of yard trimmings and brush

Focus current and future resources (e.g., vehicles, staff) to separately collect yard trimmings and brush from bulky items.

Upgrade transfer station system to manage yard trimmings and brush separately.

Develop composting facility through public private partnership.

3

Establish more convenient HHW and electronics collection

Renew interlocal agreement with Dallas County on short-term basis.

Work with County to develop permanent or satellite facility in southern areas of City.

Evaluate feasibility to expand capabilities of BOPA collection program.

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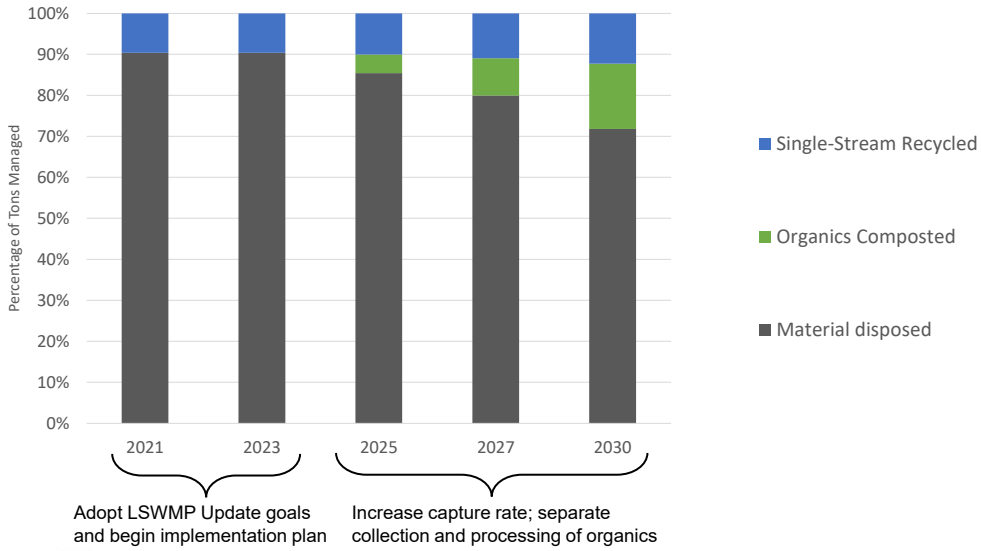
Pathway to 2030 Goals



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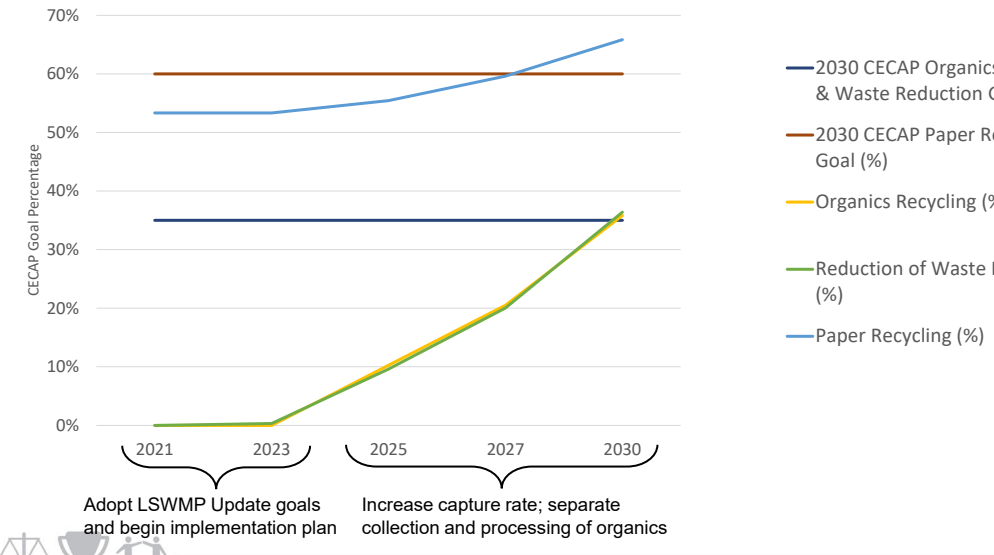
Pathway to 2030 Goals



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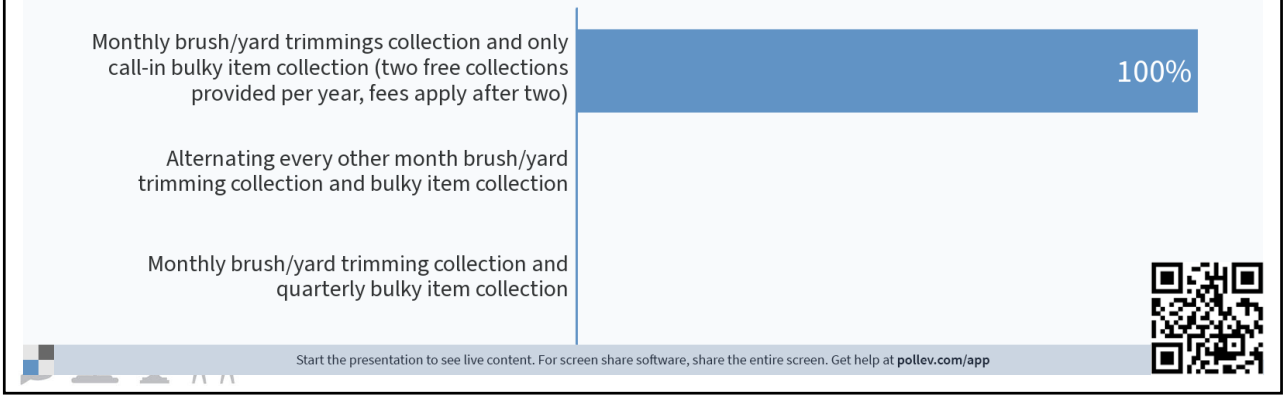
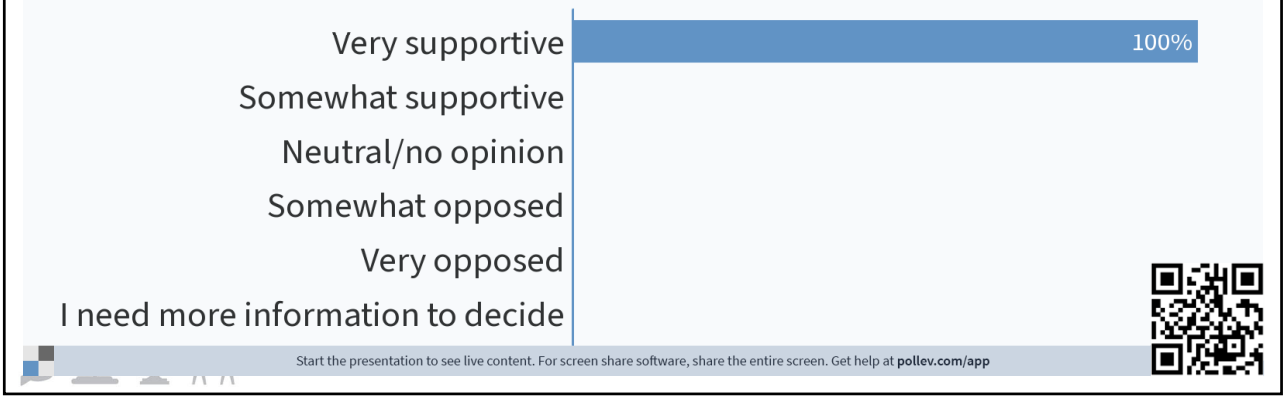
To meet the City's Zero Waste goals, it is critical that yard waste/brush are collected and processed separately from bulky items. Which is your preferred alternative collection frequency for separate brush and bulky items?



19

Alley collection challenges City collection vehicles that are too large to maneuver safely or without risk of property damage. To what extent would you be supportive a transition to curbside collection?



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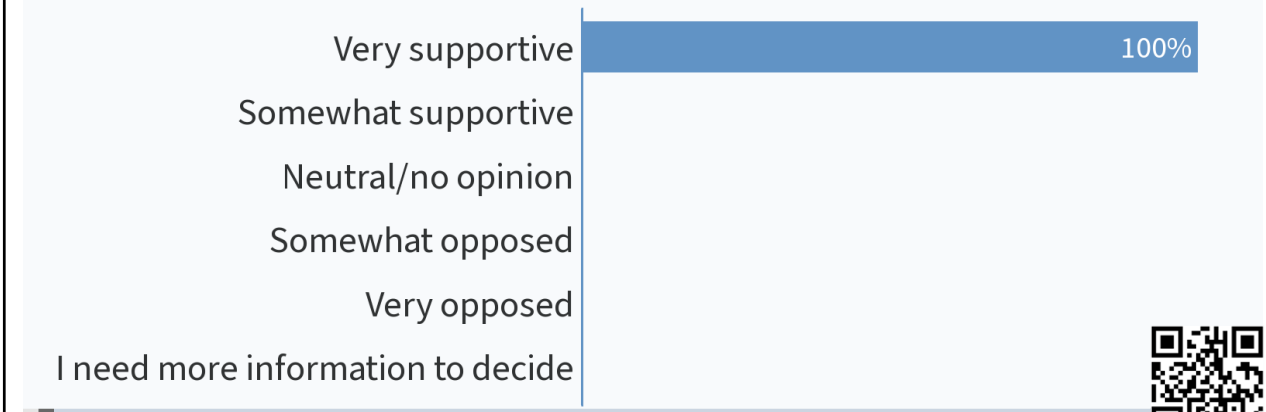
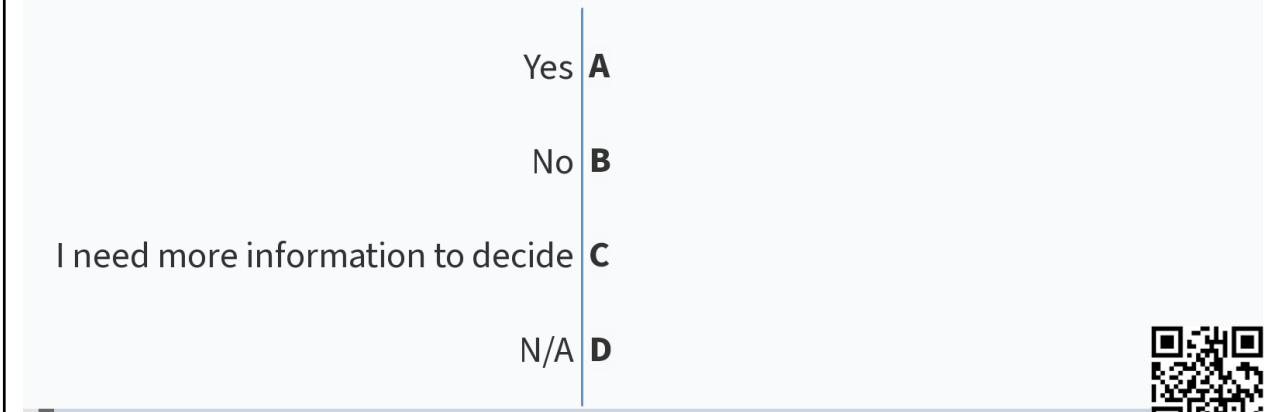
To what extent would you be supportive of roll-cart yard waste collection in addition to your garbage and recycling roll-cart collection?



21

Would a new Household Chemical Collection Center or satellite facility in the southern region of the City be more convenient for you to drop off HHW and electronics?



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Multi-Family Sector Overview

MFRO adopted in 2019

- Reporting and recycling requirements from haulers and apartment complex managers rather than tenants
- Covers multi-family complexes with eight or more units

Initial reporting provided to the City in 2020

- 20 permitted multi-tenant recycling haulers, 60 percent of them combine multi-family and commercial recycling on collection routes
- Haulers reported a total of 10,600 recycling tons collected
- Estimated 7,000 tons from multi-tenant properties only
- Multi-family recycling is hauled to one of 16 facilities spread throughout the City and surrounding areas

Multi-Family Sector Next Steps

The MFRO is an **innovative** policy tool and an excellent platform to build on going forward

1

Increase MFRO compliance from covered entities year-over-year

Continue to implement and increase the compliance from generators and haulers as part of the MFRO.

Monitor new developments that come online and continuing to support affected entities with education and outreach.

2

Adjust reporting requirements to include more comprehensive tonnage reports

Require the submission of more comprehensive data to include refuse, recycling and other divertible tonnages currently collected and the location they are processed and disposed.

3

Sustain education, outreach and compliance efforts

Continue implementation efforts and support haulers and apartment managers to increase compliance year-over-year to meet multi-family sector goals.

The City wants to ensure multi-family residents have convenient access to recycling. Do you find your apartment complex's recycling service hard to use?

Yes

No

I don't know

N/A

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25

Would you take advantage of technical assistance provided by City staff to implement commercial collection as part of the Green Business Certification program?

Yes

No

I need more information to decide

N/A

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Commercial Sector Overview

The commercial sector consists of a variety of properties, facilities and business operations.

- Represents 70 percent of material disposed at Landfill and significant diversion potential
- Unable to gauge how much recycling activity is taking place

Garbage and recycling collected by non-exclusive franchise haulers (currently 109 active haulers)

- Haulers submit a Solid Waste Operator Franchisee Monthly Report on a monthly basis
- Data required does not provide a complete picture of material flows

City recently established Green Business Certification program

- Assists and recognizes entities that incorporate recycling or promote reuse, reduction, and composting in their business operations

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Commercial Sector Next Steps

Commercial sector presents the **biggest** opportunity to reach Zero Waste Goals

1

Expand Green Business Certification Program

Increase the number of certified businesses.

Leverage cross-departmental efforts to provide technical assistance.

2

Adjust Solid Waste Operator reporting requirements

Require submission of more comprehensive and verifiable data.

Include refuse, recycling and other recyclable tonnages currently collected and the location with they are processed and disposed.

3

Adjust non-exclusive franchise ordinance to require haulers offer key services

In the future, require haulers offer recycling services to customers.

Establish compliance mechanisms to ensure that this maintains a level playing field among franchise haulers.

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28

Would you take advantage of technical assistance provided by City staff to implement commercial collection as part of the Green Business Certification program?

Yes

No

I need more information to decide

N/A

Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

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How supportive would you be of an ordinance requiring haulers to offer recycling services to businesses in the City?

Very supportive

Somewhat supportive

Neutral/no opinion

Opposed

Very opposed

I need more information to decide

Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

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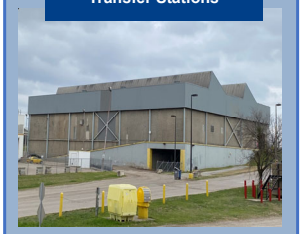
Infrastructure Overview

Transfer Stations



- Material consolidated for more efficient transportation
- Critical part of current and future materials management.
- Aging and unable to manage brush separately for recycling.

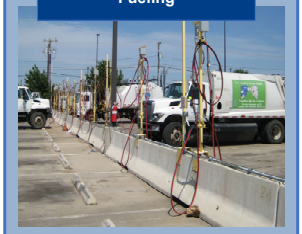
Landfill

- McCommas Bluff Landfill serves the City's long-term disposal needs.
- Conserve valuable airspace by continuing efforts to prolong site life.
- Landfill must meet long-term disposal needs of City and region.

Recycling

- Developed by public-private partnership
- Began operation in 2017
- Facility has sufficient capacity for current and future recycling processing needs

Fueling



- Fueling stations fill the City's fleet.
- Limited fueling infrastructure for Compressed Natural Gas (CNG) or electric collection vehicles.

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Infrastructure Options

Infrastructure improvements are **critical** to achieving near-term and long-term goals.

1

Upgrade transfer station system

Upgrade transfer stations to separately manage organics.

Minimize number of residents or self-haul customers in transfer buildings.

Synchronize scale systems to streamline data analysis.

2

Develop composting facility as part of public-private partnership

The City does not have adequate composting infrastructure to process separately collected yard trimmings and brush.

Develop a composting facility through public-private partnership, similar to the process for installing the recycling facility.

3

Increase CNG/RNG and electric vehicle fueling capacity

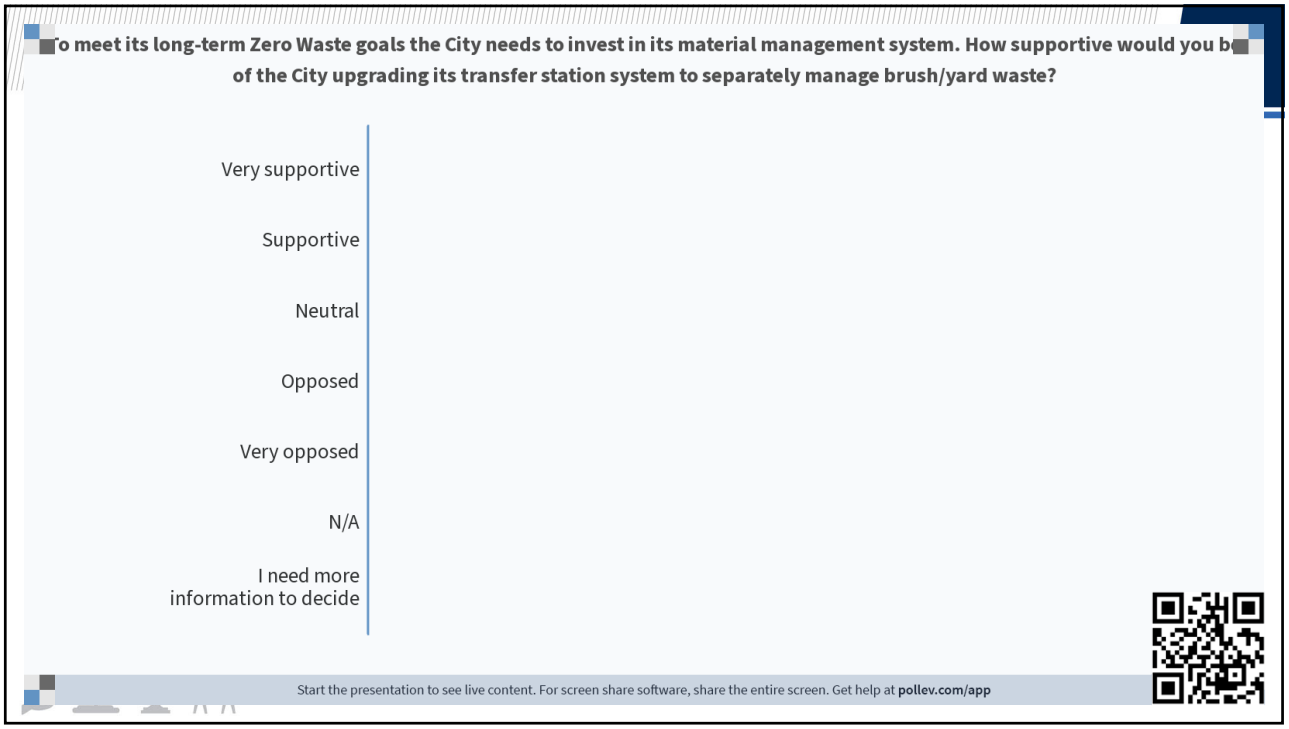
Explore purchase of additional CNG vehicles.

Install additional natural gas fueling stations.

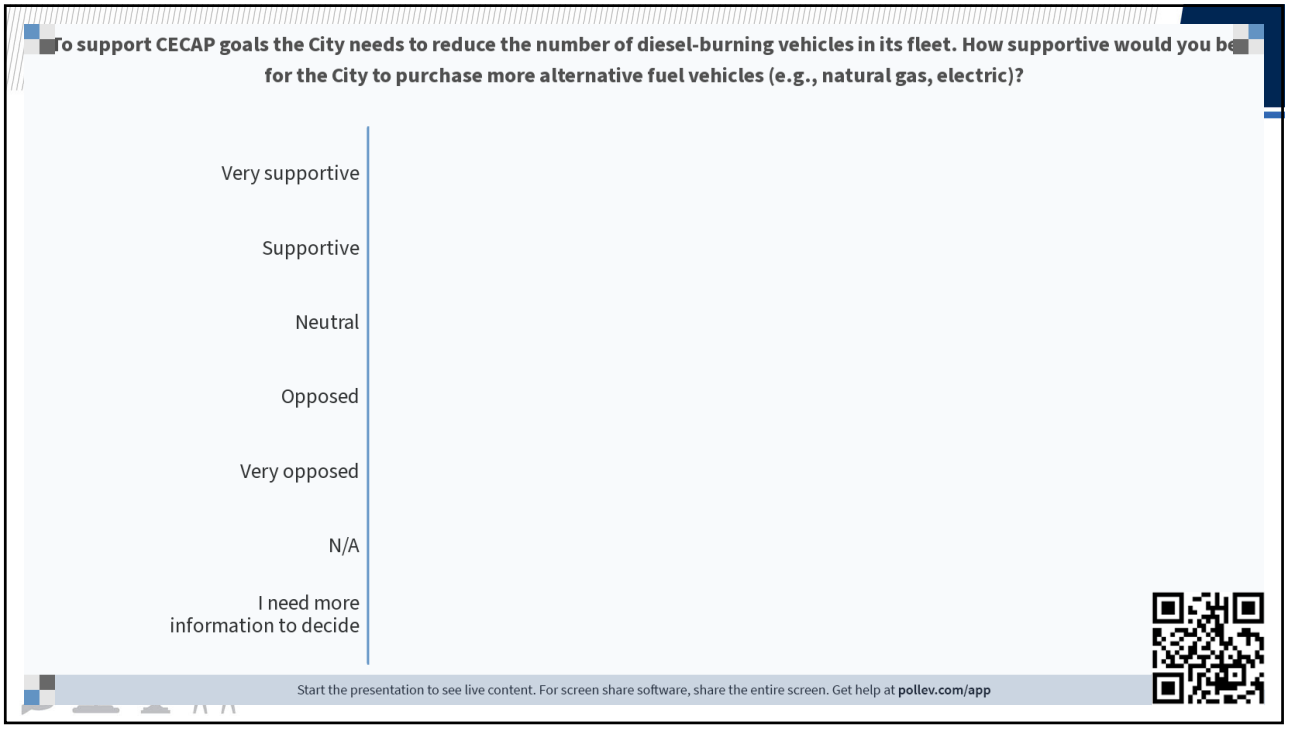
Explore electric solid waste collection vehicle pilot project.

32

32


To meet its long-term Zero Waste goals the City needs to invest in its material management system. How supportive would you be of the City upgrading its transfer station system to separately manage brush/yard waste?
Very supportive
Supportive
Neutral
Opposed
Very opposed
N/A
I need more information to decide
Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app

33


To support CECAP goals the City needs to reduce the number of diesel-burning vehicles in its fleet. How supportive would you be for the City to purchase more alternative fuel vehicles (e.g., natural gas, electric)?
Very supportive
Supportive
Neutral
Opposed
Very opposed
N/A
I need more information to decide
Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app

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Next Steps

1. Evaluate results from public meeting, phase 2 survey and public comment period
2. Incorporate results of survey and public comments to draft LSWMP Update
3. Finalize implementation/funding plan
4. Present LSWMP Update to City Council for adoption in May (tentative)
5. Begin tasks based on implementation/funding plan

35

City of Dallas

Jay Council
Director of Sanitation Services

Cliff Gillespie
Assistant Director of Sanitation Services

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APPENDIX B – REGIONAL FACILITY MAPS

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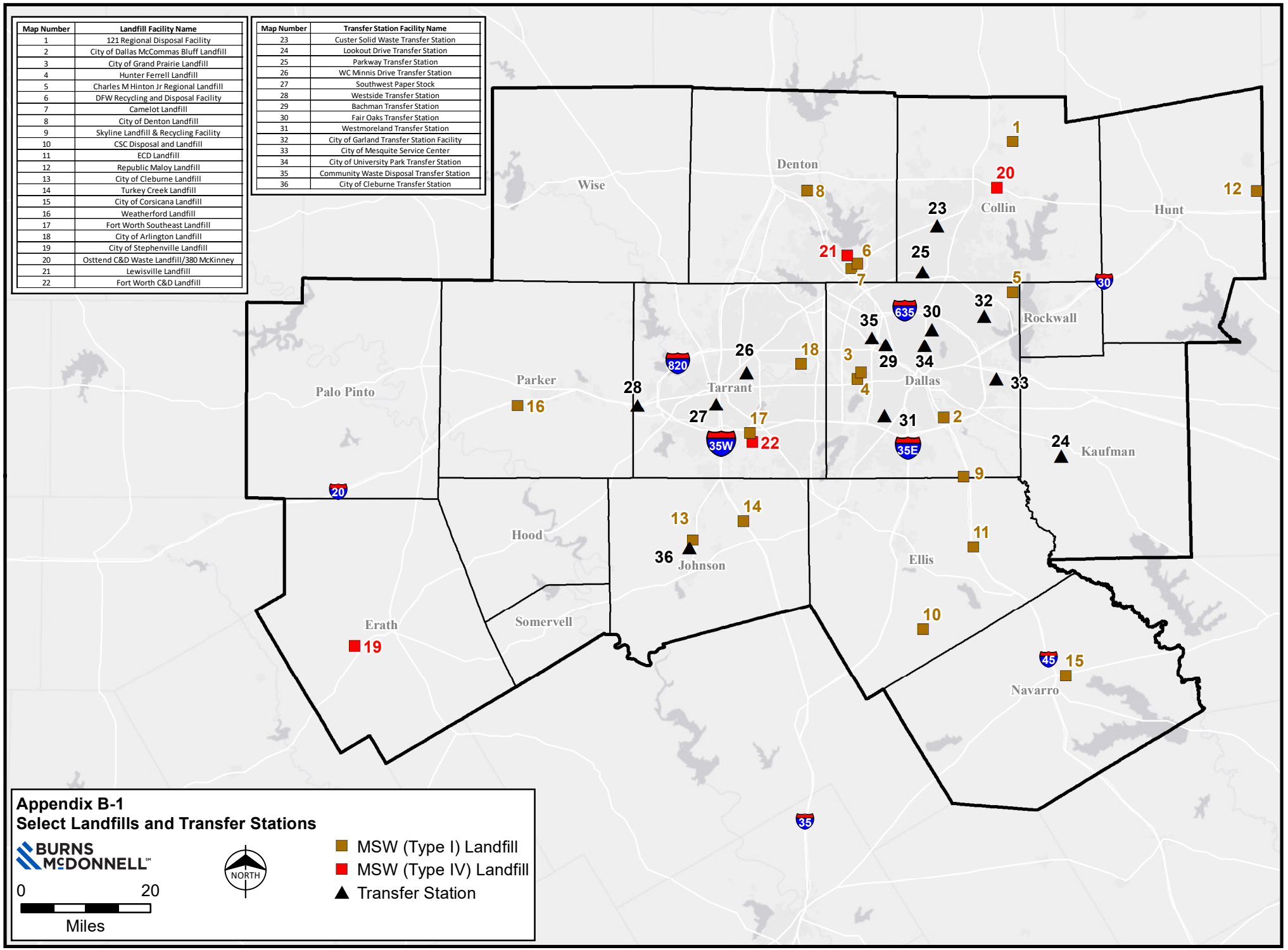
Map Number	Landfill Facility Name
1	121 Regional Disposal Facility
2	City of Dallas McCommas Bluff Landfill
3	City of Grand Prairie Landfill
4	Hunter Ferrell Landfill
5	Charles M Hinton Jr Regional Landfill
6	DFW Recycling and Disposal Facility
7	Camelot Landfill
8	City of Denton Landfill
9	Skyline Landfill & Recycling Facility
10	CSC Disposal and Landfill
11	ECD Landfill
12	Republic Maloy Landfill
13	City of Cleburne Landfill
14	Turkey Creek Landfill
15	City of Corsicana Landfill
16	Weatherford Landfill
17	Fort Worth Southeast Landfill
18	City of Arlington Landfill
19	City of Stephenville Landfill
20	Osttend C&D Waste Landfill/380 McKinney
21	Lewisville Landfill
22	Fort Worth C&D Landfill

Map Number	Transfer Station Facility Name
23	Custer Solid Waste Transfer Station
24	Lookout Drive Transfer Station
25	Parkway Transfer Station
26	WC Minnis Drive Transfer Station
27	Southwest Paper Stock
28	Westside Transfer Station
29	Bachman Transfer Station
30	Fair Oaks Transfer Station
31	Westmoreland Transfer Station
32	City of Garland Transfer Station Facility
33	City of Mesquite Service Center
34	City of University Park Transfer Station
35	Community Waste Disposal Transfer Station
36	City of Cleburne Transfer Station



Appendix B-1
Select Landfills and Transfer Stations

BURNS McDONNELL

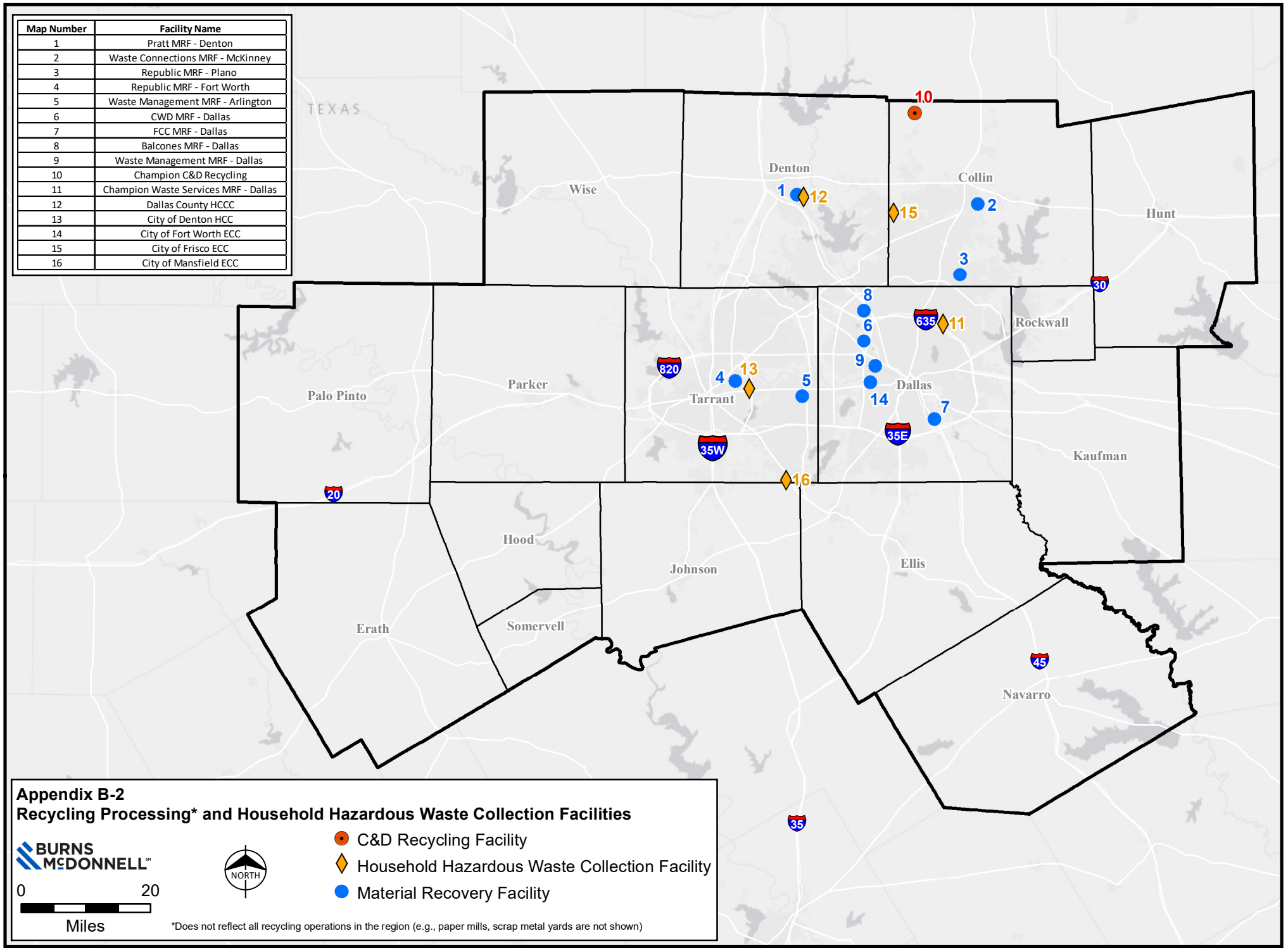
0 20

Miles

NORTH

- MSW (Type I) Landfill
- MSW (Type IV) Landfill
- Transfer Station

Map Number	Facility Name
1	Pratt MRF - Denton
2	Waste Connections MRF - McKinney
3	Republic MRF - Plano
4	Republic MRF - Fort Worth
5	Waste Management MRF - Arlington
6	CWD MRF - Dallas
7	FCC MRF - Dallas
8	Balcones MRF - Dallas
9	Waste Management MRF - Dallas
10	Champion C&D Recycling
11	Champion Waste Services MRF - Dallas
12	Dallas County HCCC
13	City of Denton HCC
14	City of Fort Worth ECC
15	City of Frisco ECC
16	City of Mansfield ECC



Appendix B-2
Recycling Processing* and Household Hazardous Waste Collection Facilities

BURNS McDONNELL℠

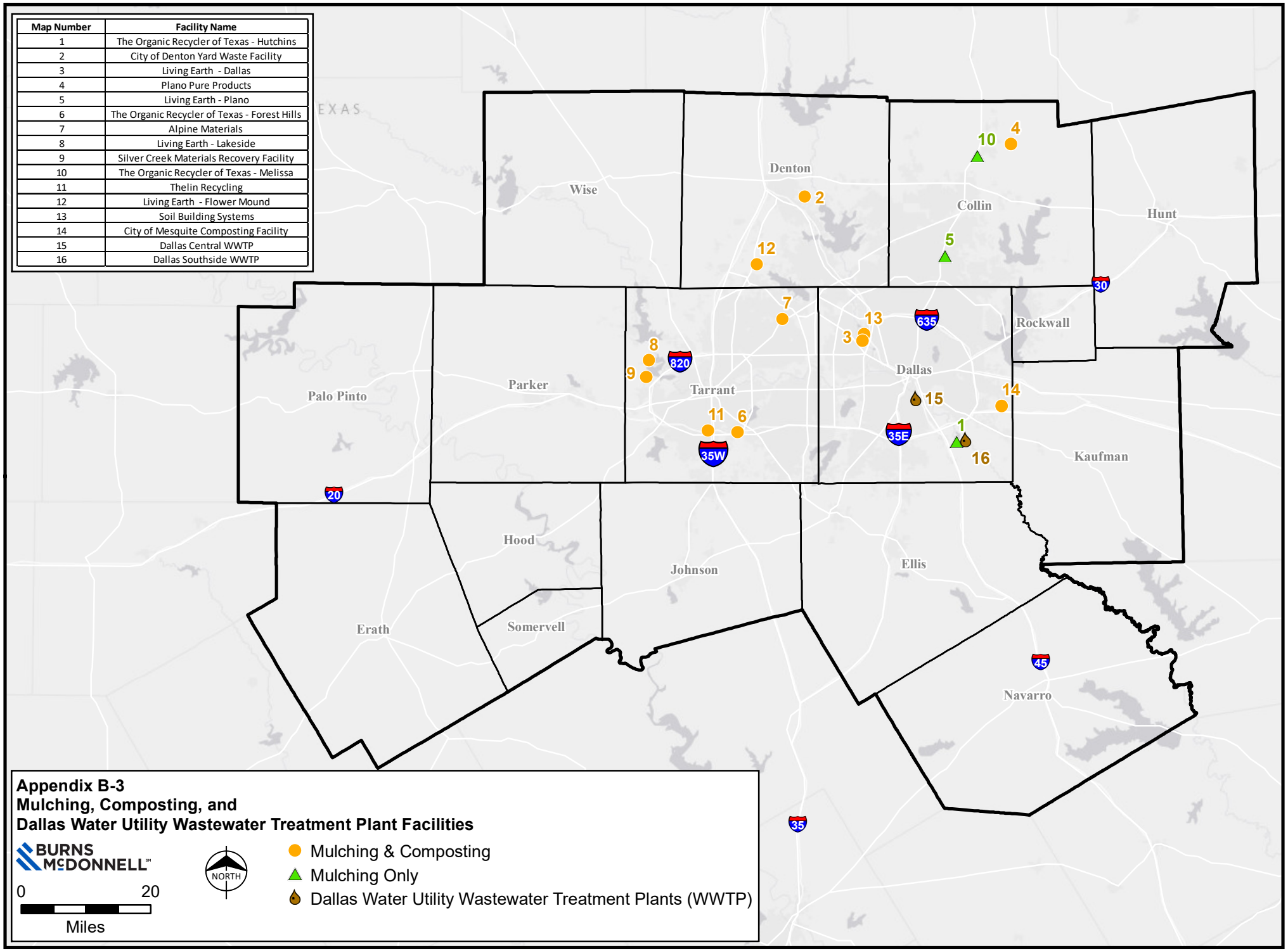
0 20
Miles

NORTH

- C&D Recycling Facility
- Household Hazardous Waste Collection Facility
- Material Recovery Facility

*Does not reflect all recycling operations in the region (e.g., paper mills, scrap metal yards are not shown)

Map Number	Facility Name
1	The Organic Recycler of Texas - Hutchins
2	City of Denton Yard Waste Facility
3	Living Earth - Dallas
4	Plano Pure Products
5	Living Earth - Plano
6	The Organic Recycler of Texas - Forest Hills
7	Alpine Materials
8	Living Earth - Lakeside
9	Silver Creek Materials Recovery Facility
10	The Organic Recycler of Texas - Melissa
11	Thelin Recycling
12	Living Earth - Flower Mound
13	Soil Building Systems
14	City of Mesquite Composting Facility
15	Dallas Central WWTP
16	Dallas Southside WWTP



Appendix B-3
Mulching, Composting, and
Dallas Water Utility Wastewater Treatment Plant Facilities

BURNS McDONNELL℠

0 20

Miles

NORTH

- Mulching & Composting
- Mulching Only
- Dallas Water Utility Wastewater Treatment Plants (WWTP)

APPENDIX C - TRANSFER STATION SYSTEM REVIEW

This technical appendix describes the evaluation methodology, overviews the transfer station system, and identifies system challenges. Further evaluation and presentation of options related to the transfer station system is provided in Section 5.0.

Methodology

As part of the LSWMP Update, Burns & McDonnell observed the transfer station system over the course of three calendar days on February 8, 9 and 10, 2021 (Transfer Station Site Visit). Burns & McDonnell conducted on-site observations of operations at Bachman Transfer Station (Bachman), Fair Oaks Transfer Station (Fair Oaks), Westmoreland Transfer Station (Westmoreland), and the Landfill (to the extent that it impacts transfer station system operations). Operational activities reviewed included, but were not limited to:

- Facility configuration
- Process flow
- Equipment types and maintenance
- Staffing levels
- Transfer operations

Additionally, discussions were held with various members of management and staff to discuss ongoing operations and collect data which is incorporated in this section. Based on the Transfer Station Site Visit and data analysis, the following provides an overview of the transfer station system and describes current challenges to inform the development of options for the City's consideration.

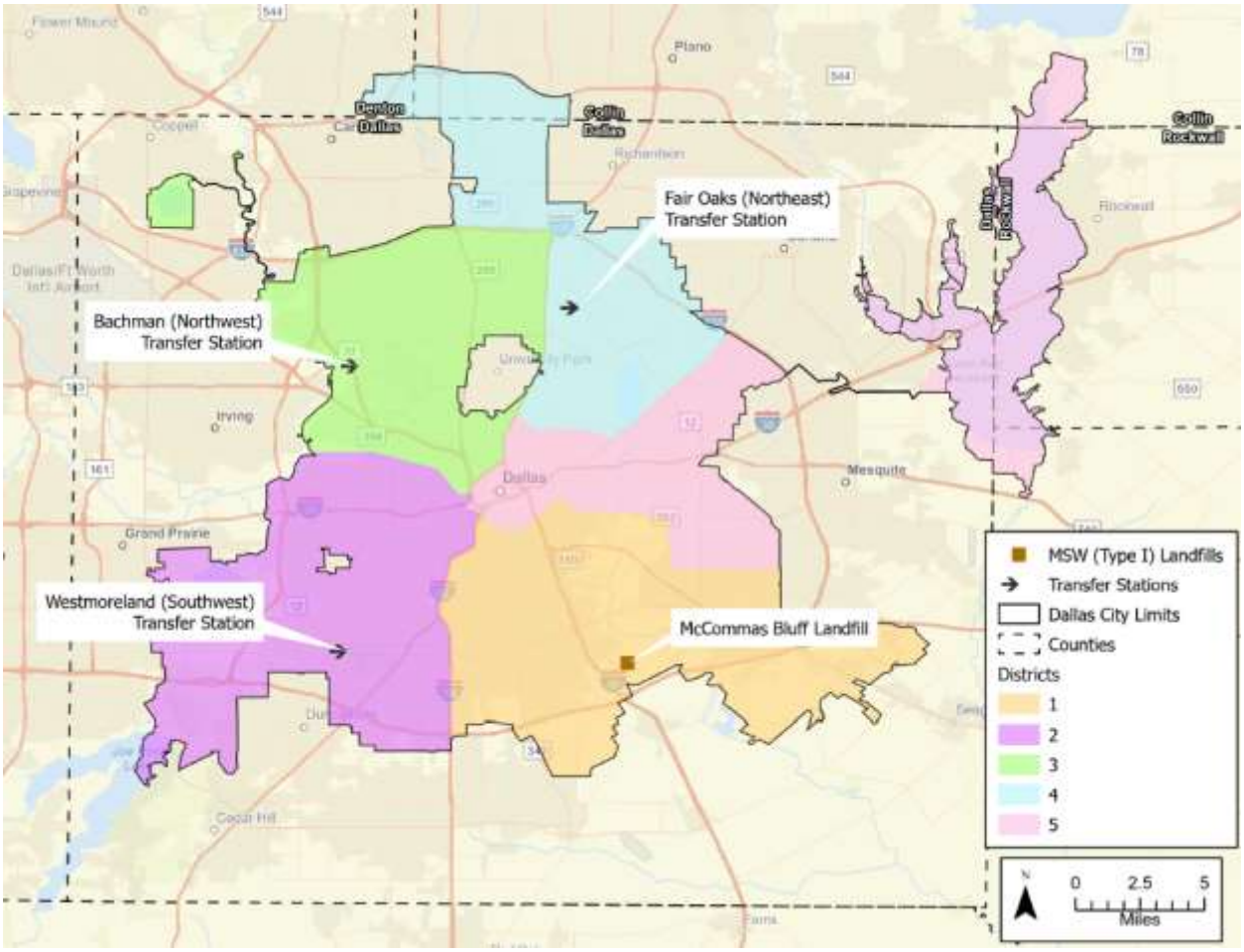
System Overview

The transfer station system consists of the City's three transfer station facilities that collectively shorten haul times for the Sanitation Department's collection system. All material accepted at the transfer stations are hauled to the Landfill for disposal and to the MRF for recycling and are operated via City-owned equipment and City personnel.

The transfer stations are geographically located in the northeast, northwest and southwest areas of the City so the system allows for more efficient transfer and disposal of material. The transfer station system is designed where Bachman is the largest facility and is supported by the smaller Fair Oaks and Westmoreland facilities. Each facility has at least two names (e.g., the Northwest Transfer Station is also called the Fair Oaks Transfer Station). For the purposes of this analysis the facilities in the transfer station system are

called Bachman, Fair Oaks, and Westmoreland based on discussions with City staff during the Transfer Station Site Visit. Figure C-1 shows the locations of the transfer stations in the system overlayed with the Sanitation Department collection districts.

Figure C-1: Transfer Station Locations and Sanitation Department Collection Districts



The following sub-sections present information describing the transfer station system and identifying challenges based on the Transfer Station Site Visit and data analysis conducted as part of the LSWMP Update. The system overview is organized as follows, with brief descriptions:

- **Hours of operation**. Defines each customer type accepted transfer facilities and presents the hours material is accepted for each.
- **Process flow and facility configuration.** Describes the flow of vehicles and material through each facility and the transfer station buildings, identifying features that limit capacity of the system.
- **Inbound material.** Presents information on historical inbound loads and tonnages managed by the transfer station system between FY 2016 and FY 2020. Information and analysis are presented by

customer and material type, and analysis is provided describing variations of inbound material flows based on day and time.

- **Outbound material.** Presents information on FY 2020 material transferred from the transfer station system to the Landfill or MRF and describes challenges maintaining optimal operating efficiency.
- **Equipment.** Presents information on the required equipment to operate the transfer station system and indicates if the current equipment inventory and type is sufficient.
- **Staffing.** Presents information on the current staffing required to operate and manage the transfer station system and if the current staffing is sufficient.
- **Capacity.** Describes how the material flow, facility configurations, staffing and equipment impact the capacity of the system.

Hours of Operation

The transfer stations are open to the public from 8:00 am to 5:00 pm, but operations may extend beyond these hours based on the volume of inbound material. The transfer station system is critical in supporting the operations of the City's collection and Landfill operations and may adjust operating hours when required. Table C-1 provides the schedule when the Sanitation Department, residential customers and commercial customers are accepted at each transfer station, followed by brief descriptions of each type of transfer station customer.

Table C-1: Hours of Operation by Facility[1]

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Bachman						
Sanitation Depart.	7AM – 7PM	7AM – 7PM	7AM – 5PM	7AM – 7PM	7AM – 7PM	7AM – 5PM
Residential	7:30AM – 5PM	7:30AM – 5PM	7:30AM – 5PM	7:30AM – 5PM	7:30AM –5PM	7:30AM – PM
Commercial	7:30AM – 5PM	7:30AM – 5PM	7:30AM – 5PM	7:30AM – 5PM	7:30AM –5PM	7:30AM –5PM
Fair Oaks						
Sanitation Depart.	7AM – 6PM	7AM – 6PM		7AM – 6PM	7AM – 6PM	
Residential			7:30AM – 5PM			7:30AM – PM
Commercial						
Westmoreland						
Sanitation Depart.	7AM – 6PM	7AM – 6PM		7AM – 6PM	7AM – 6PM	
Residential			7:30AM – 5PM			7:30AM –5PM
Commercial						

1. Grey cells indicate days customer types are not accepted at each transfer station.

- **Sanitation Department.** City-operated waste collection vehicles, which have tared weights, including automated side-load or rear load compactor trucks that deliver larger loads collected from the City's residential customers and from City department locations.
- **Residential customers.** City of Dallas residents that can drop off materials using light-duty vehicles such as pickup trucks or small trailers that deliver small loads that are self-hauled six days per week at Bachman and on Wednesday and Saturdays at Fair Oaks and Westmoreland.
- **Commercial customers.** Cash and account customers that use residential or light-duty vehicles such as pickup trucks or small trailers that deliver small loads that are self-hauled including roofing, scrap metal or other C&D material. Commercial customers with roll-off or compacting vehicles are accepted at Bachman. City-operated light-duty or pickup vehicles providing material generated from various City department operations (e.g., parks and recreation) are included with commercial customers.

Bachman accepts all three customer types six days per week, providing two extra hours per day for Sanitation Department customers that complete collection routes after 5:00 pm. The Fair Oaks and Westmoreland facilities accept only Sanitation Department collection vehicles Monday, Tuesday, Thursday and Friday and hold dedicated residential customer collection days on Wednesday and Saturday.

Based on discussion with City staff, there are times when the transfer station system becomes inundated with material (e.g., following a storm event). In these cases, the facilities do not remain open to the public and operating hours may be extended from 7:00 am to 8:00 pm to accommodate the increased volumes. In addition, Bachman may operate on Sunday from 7:00 am to 12:00 pm on an as needed basis.

Process Flow and Facility Configurations

During the Transfer Station Site Visit the flow of traffic and waste both into and out of each of the transfer stations were observed and current facility configurations evaluated. The process flow and facility configurations determine the throughput capacity of each transfer station and ultimately dictates the efficiency of the transfer station system as a whole. The facility configuration for each transfer station is critical to the effectiveness of the system, as the location and size of the built features have implications on the throughput capacity of customers and tonnages. All the transfer station facilities in the system were designed with some or all of the following components, with brief descriptions:

- **Scale/Scalehouse.** Designated location where customers enter each facility.
- **Customer entrance/exit.** Designated locations where customers enter and exit each transfer building.

- **Transfer trailer entrance/exit.** Designated locations where transfer trailers pull into, typically below grade from the transfer building tipping area, where trailers are loaded before they transfer material to the Landfill or MRF.
- **Waste storage pit/tipping area.** Designated location where material is deposited and managed by front-end loaders into a load-out hopper.
- **Load-out hopper.** An opening in the tipping floor or waste storage pit through which waste is push by front-loader to transfer trailers positioned below.
- **Direct loading hopper.** A hopper positioned above a transfer trailer vehicle that allows vehicles to back to it and eject material directly into the transfer trailer.
- **Rotobooms.** Stationary equipment positioned behind the hoppers to move and pack material into the transfer trailer and controlled by operators stationed in a control tower or dedicated control cab.

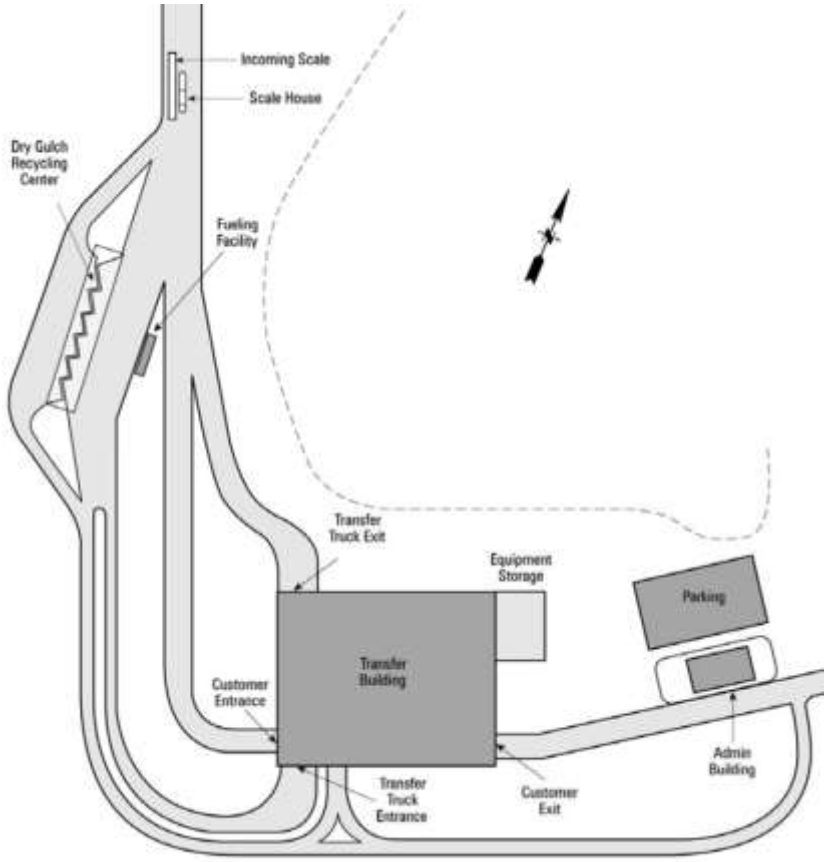
The system was designed to manage refuse material. The addition of recycling, brush and bulky items and increased numbers of residential and commercial customers have decreased the capacity of the transfer station system. This has created challenges leveraging the transfer station system to maximize current and future diversion from Landfill.

The following presents information and analysis related to the process flow and structural configuration of each facility and identifies challenges based on the Transfer Station Site Visit, discussions and data provided by City staff. The diagrams shown of the transfer buildings (reference Figure C-2, Figure C-9 and Figure C-15) indicate the intended function of the space from an engineering design perspective, and may not be reflective of the observed usage during the Transfer Station Site Visit. Section 5.0 provides further discussion and graphic presentation of the current usage of space in the transfer buildings.

Bachman

The Bachman facility is the largest facility in the transfer station system. Figure C-2 shows the Bachman facility layout including the scalehouse, Dry Gulch Recycling Center (Dry Gulch), fueling facility, brush pile, transfer building, equipment storage location, administration building and parking lot.

Figure C-2: Bachman Facility Layout



Sanitation Department, residential and commercial customers are accepted at Bachman and enter through the scalehouse. The scalehouse contains two inbound scales, one for Sanitation Department customers and the other for small residential and commercial customers. The scale system is supported by the City's WasteWORKS software system. Sanitation Department and some commercial customers have tare weights for their vehicles in the system and only need to scale into the facility upon arrival. Cash customers must scale in, deposit their material in the transfer building, and then exit the facility and re-enter to scale out. Based on conversations with City staff, certain residential load weight is estimated based on the type of material and equipment used to self-haul (e.g., a single television). In these cases, they do not have to tare out after disposing of material. The location of the scale at Bachman causes increased queuing at the scalehouse when residential customers exit to run across the scale to weigh out.

Additionally, the hardware and software used to operate the scales (including inbound scales and transfer trailer truck scales) at Bachman are not integrated. This is a challenge among all the scales in the transfer station system and is noted throughout this section.

Upon entering the Bachman facility, customers can immediately take the right hand road to Gulch or bypass it, traveling past a 10,000-gallon capacity diesel fueling facility where transfer equipment and transfer fleet vehicles refuel. Dry Gulch provides a drop-off location for residential self-haul customers that bring loads of cardboard or single stream recyclables, bulky items, tires, and electronics. Figure C-3 shows examples of open top containers and pallets used to collect and manage drop-off material.

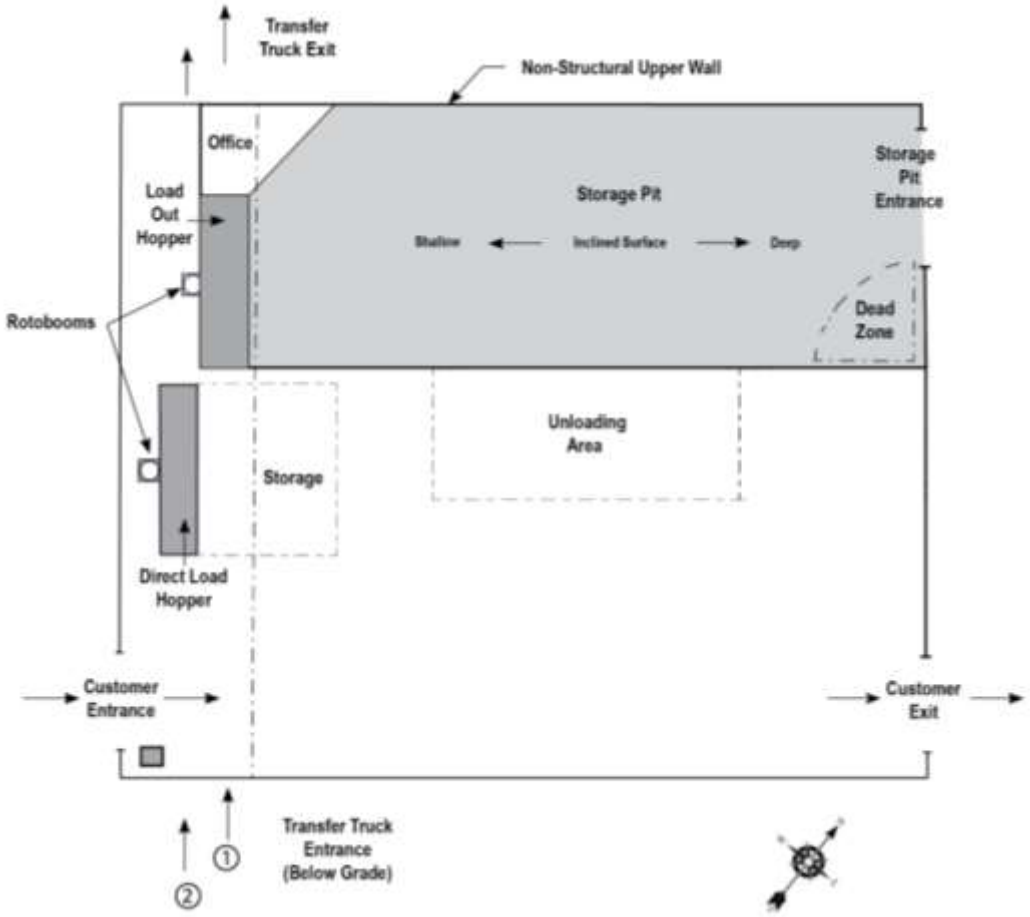
Figure C-3: Dry Gulch Recycling Center Material Collection

Based on discussions with City staff, there is potential to increase the efficiency of managing the material at the Dry Gulch by adding compactors for certain material types; however, there is no three-phase power interconnection at Dry Gulch. The City would need to evaluate the feasibility of upgrading the power available to Dry Gulch.

Customers enter the transfer station building and are directed into the facility by an attendant to back their vehicles to the edge of the waste storage pit to automatically eject or manually unload material. Figure C-4 shows the transfer building configuration of Bachman including customer entrance and exit locations,

transfer trailer entrance and exit locations include the waste storage pit, self-unloading area, manual-unloading area, direct load area, load out hopper, and direct load hopper, and customer tipping areas.

Figure C-4: Bachman Transfer Building Configuration



The storage area shown on the tipping floor is being used as a storage area for recyclables. Figure C-5 shows customers depositing material at the waste storage pit including Sanitation Department brush trucks and customers that are self-unloading.

Figure C-5: Customers Unloading Material at Bachman Facility

This transfer station was designed for automatically ejecting or tipping vehicles to dispose material at the direct loading hopper, but current operations have all vehicles depositing material into the waste storage pit. After depositing material, customers pull forward to exit the transfer station building directly across from where they entered.

The main challenge at Bachman is the increasing occurrences of constrained vehicle traffic. Based on discussions with City staff, when at its busiest Bachman may only have room available to allow one customer to tip material in the pit at a time. When the facility becomes inundated with volume surges, operators are forced to store material in front of the direct load hopper or along the wall near the customer exit. Although the direct load hopper was designed for Sanitation Department vehicles to direct load into the transfer trailer, it is currently used to store and load recyclables. Figure C-6 shows an example of recyclable stored in front of the direct haul hopper.

Figure C-6: Recyclables Stored in Front of Direct Load Hopper at Bachman Facility

When the storage pit capacity is exceeded, material is stockpiled on the tipping floor and the space for customer entrance and egress is reduced. This causes challenges for operators to maneuver heavy equipment within the transfer building. This becomes a safety concern, particularly when high volumes of residential or commercial customers manually unloading create traffic congestion among the larger Sanitation Department vehicles. During the Transfer Station Site Visit, there was one attendant directing inbound traffic, but no attendants available to support customers to back into designated locations along the edge of the waste storage pit.

The storage pit design does not provide optimal capacity because the inclined floor causes challenges with front-end loader traction. Based on discussions with City staff, the front-end loader lines the waste storage pit with material at the beginning of the week to store material and increase traction on the inclined surface during wet conditions.

Figure C-7 shows a front-end loader operating in the storage pit lined with mixed refuse, brush and bulky item material and several areas of the back wall that have been broken through, indicating how high material may be stacked when the facility is at full capacity.

Figure C-7: Waste Storage Pit Wall Structural Damage at Bachman Facility

The interior walls show damage consistent with the draft Facility Conditions Assessment conducted in 2016. The control tower is non-operational, but the rotoboom equipment at Bachman are cab-operated so the non-operational control tower does not directly impact the efficiency of the transfer building, but would vastly improve operations to provide overall management of the transfer building traffic flows and material management.

Based on conversations with City staff, there are other challenges with Bachman that indirectly impact operations including no wireless internet connection, public announcement speakers, fiber-optic interconnections, and limited heating, ventilation and air condition (HVAC) or airflow through the facility. Consistent with the draft Facility Conditions Assessment, it was observed during the Transfer Station Site Visit there was insufficient capacity to properly ventilate the space of dust, odors and heat. Upgrading the data utilities would support transfer station system management to better track data and allow more proactive response to sudden changes in material flow. Additionally, minimizing dust, heat, and noise would improve the working environment, particularly during the summer months when the heat is most intense. The transfer building contains six overhead fans.

All transfer trailer drivers arrive at Bachman to haul material that had been stored in the transfer building and are then dispatched to the Fair Oaks and Westmoreland facilities once customers begin to arrive at these facilities. While this approach works with normal inbound material flows, it creates a challenge ensuring sufficient transfer trailer capacity is available at all the facilities in the transfer station system when one or more facilities experience a surge of material.

Transfer trucks enter the transfer station building by bypassing the customer entrance and enter the transfer trailer tunnel beneath the hoppers. Figure C-8 shows the transfer trailer tunnel location.

Figure C-8: Transfer Trailer Tunnel at Bachman Facility

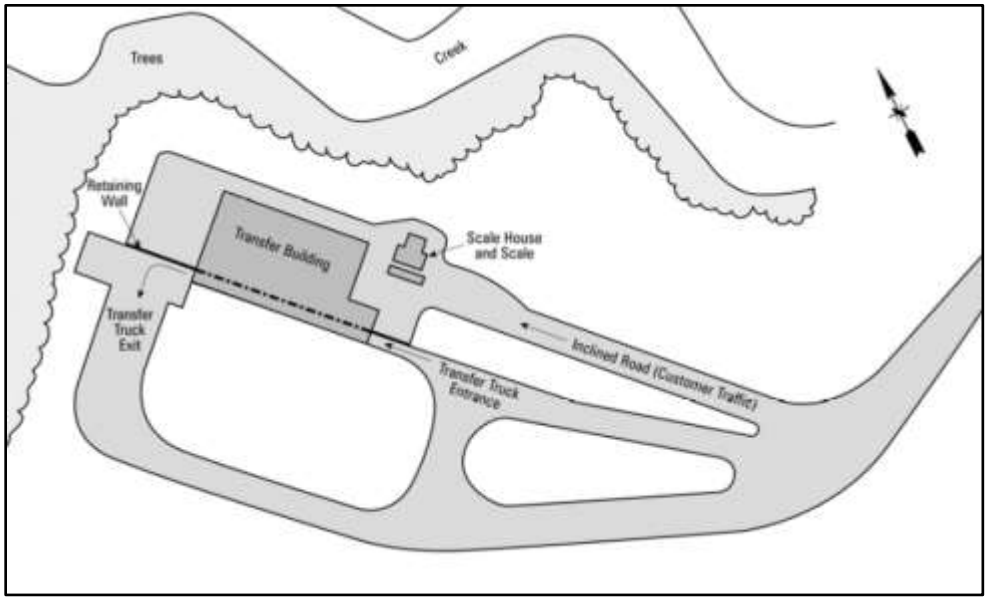
Transfer trucks park below grade, beneath the staggered hoppers in the transfer station building. This location has the capability to position two transfer trucks in a staggered formation, providing flexibility for transfer station operations to fill the trailers with refuse, recycling or brush/bulk material as necessary without the challenge of one transfer truck blocking the egress of the other. However, since the direct load hopper is only used for recycling, only one lane is used to load refuse material.

There are 70-ft in-ground scales installed for use by the transfer trailers that indicate how much material is loaded and packed into the trailers by the rotoboom so truck drivers can ensure they do not exceed the legal Gross Vehicle Weight (GVW) limit of 84,000 pounds when they transfer material to the Landfill or MRF, while also maximizing payload. The scale used to weigh recycling vehicles is a 60-ft mechanical scale. The in-ground transfer scales are not integrated with the inbound scale system, causing challenges for staff to comprehensively analyze vehicle throughput and volume data regularly. Additionally, transfer trailer trucks are required to scale into the Landfill which increases disposal time.

Fair Oaks

The Fair Oaks facility is located adjacent to a creek and has a smaller footprint than the Bachman facility. The facility's location next to the creek has caused challenges with flooding, where the access road to the transfer building has flooded twice in the past four years based on conversations with City staff. Figure C-9 shows the layout of the Fair Oaks facility.

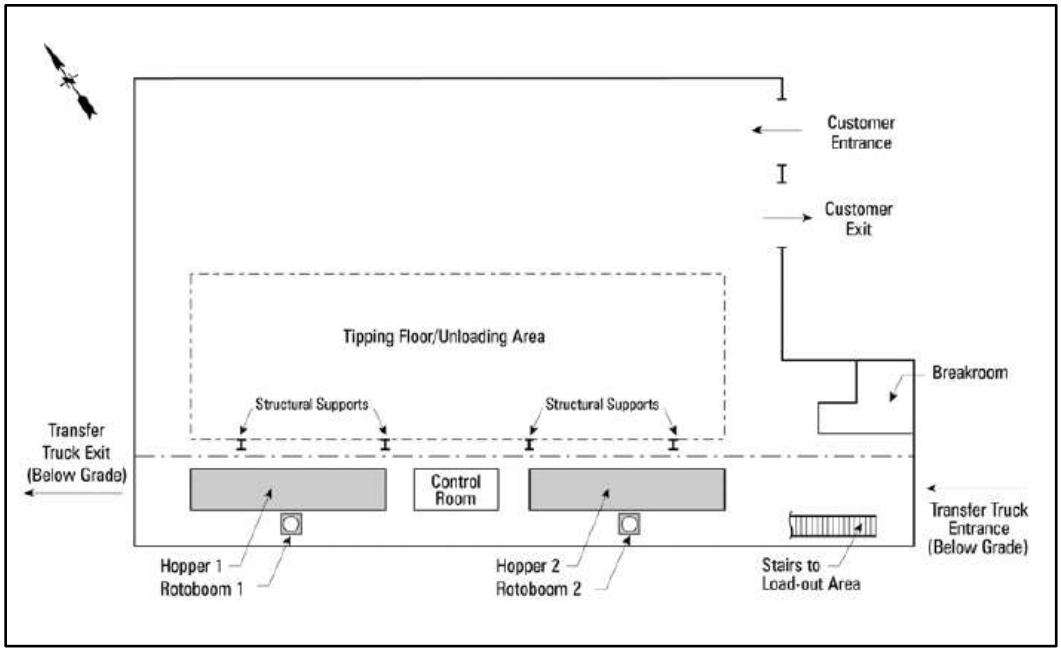
Figure C-9: Fair Oaks Facility Layout



Sanitation Department collection vehicles and residential customers are accepted at the Fair Oaks transfer station and enter by driving up the inclined road and queuing at the scalehouse. Residential customers are only excepted on Wednesday and Saturday. The scalehouse contains one inbound scale supported by the WasteWORKS software system. Sanitation Department collection vehicles have tare weights for their vehicles in the system and only need to scale into the facility upon arrival. Residential customers must enter through the scalehouse, deposit their material in the transfer building and then exit the facility. Tonnage from residential customers is estimated by staff through visual inspection.

Customers enter the transfer building and are directed by staff to back up to the tipping areas in front of one of the two hoppers depending on if they are depositing refuse or recycling. Figure C-10 shows the facility configuration of Fair Oaks, including customer entrance and exit locations, transfer trailer entrance and exit locations, customer tipping areas, load out hoppers, and structural supports.

Figure C-10: Fair Oaks Facility Configuration



The entrance and exit at the Fair Oaks facility are located directly next to each other, which causes challenges maneuvering vehicles and equipment in the transfer station building and potentially blocks egress. Figure C-11 shows the entrance, exit and scalehouse.

Figure C-11: Fair Oaks Entrance, Exit and Scalehouse

Customers enter the facility and are directed by attendants to back into the tipping area and eject or manually unload material. Figure C-12 shows Sanitation Department vehicles unloading refuse and recycling in the designated locations.

Figure C-12: Customers Unloading Material at Fair Oaks Facility

Maneuvering in the transfer station building is challenging when multiple Sanitation Department vehicles are entering, turning, or exiting the building while the front-end loader manages material on the tipping floor. Maneuvering in the transfer station building becomes particularly difficult when surges of Sanitation Department vehicles arrive at the facility, causing the tipping area to become full and only allowing one or two vehicles at a time to enter or exit the facility. In these cases, the operational efficiency of the facility decreases due to limited maneuverability of the front-end loader and fewer customers processed. Additionally, there is increased risk of injury to staff and damage to the transfer station building or equipment.

During the Transfer Station Site Visit, it was observed that recycling material is stored in front of the left hopper and refuse and/or brush and bulky items are stored in front of the right. Figure C-13 shows the tipping area, control room, hoppers and rotobooms at the Fair Oaks facility. At the time of the Transfer Station Site Visit, the left side rotoboom was non-operational, but did not significantly impact operations because the recycling transfer trailer can pull forward to be compacted by the rotoboom that was operational.

Figure C-13: Fair Oaks Facility Tipping Area

Based on discussion with City staff, operating challenges of the transfer building configuration include rotoboom cranes breaking through walls, limited reinforced bunkers that can be used to stack waste, and support beams directly in front of the hoppers increasing the likelihood of equipment or building damage.

The lighting at Fair Oaks is dimmer than Bachman and creates increased challenges maneuvering for both customers and operators. The control tower is aging, but still functional. One operator can control both rotobooms from the control tower, but when one or both are not functional the operating efficiency of the facility decreases.

Once material is deposited and the customer exits the transfer station building, the front-end loader pushes the material into the transfer trailer hopper and the rotoboom packs the material into the trailer.

Transfer trucks enter the transfer station building below the tipping floor, bypassing the customer entrance and parking beneath the hoppers as shown in Figure C-14.

Figure C-14: Fair Oaks Facility Transfer Trailer Truck Pull Through Location

The transfer trailer tunnel provides one lane for trucks and may limit the efficiency of the operation if one vehicle is fully loaded but has to wait for the vehicle ahead to be loaded or if a vehicle arrives and a transfer station is being loaded in the first hopper. There are 70-foot in-ground scales installed for use by the transfer trailer trucks that indicate how much material is loaded and packed into the trailers by the rotobooms so operators can ensure they do not exceed the legal GVW limit, while also maximizing payload.

Based on discussions with City staff, in the case where surges in customers and material arrive in a short time frame and there are no available transfer trailers on site, the ability to move material out of the transfer building becomes significantly impacted.

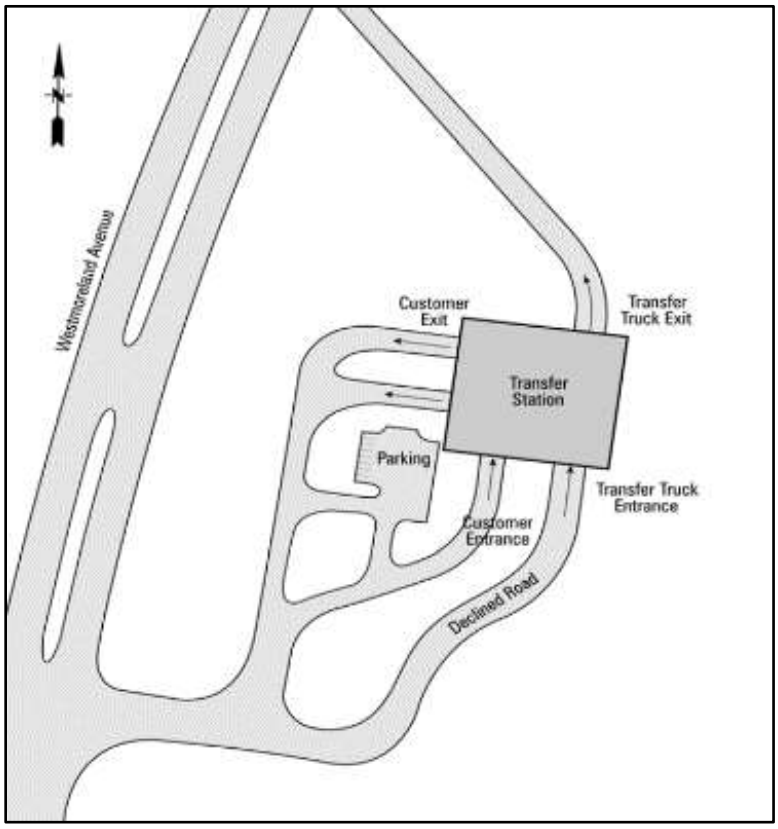
Fair Oaks receives electronics, metals and tires from residential customers and has a dedicated 15 foot trailer unit in the back to store electronics and transfer to Bachman on an as-needed basis. There is a metal

collection bin in back collected by a dedicated vendor and a tire canister under cover in the front of the building that is brought directly to the CCRC at the Landfill.

Westmoreland

The Westmoreland facility is located on Westmoreland Avenue and has a similar sized footprint to the Fair Oaks facility. Figure C-15 shows the layout of the Westmoreland facility.

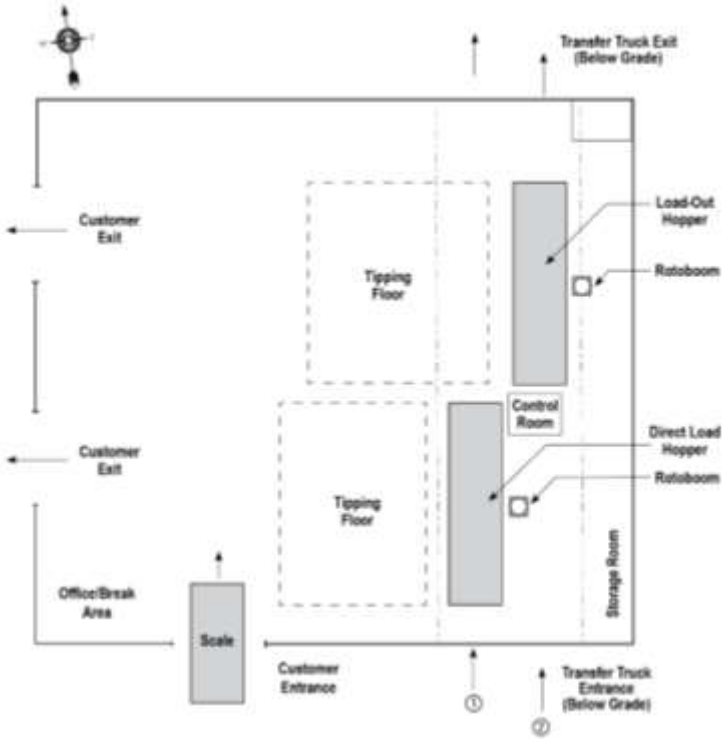
Figure C-15: Westmoreland Facility Layout



Sanitation Department collection vehicles and residential customers are accepted at the Westmoreland transfer station and enter by into the facility at the entrance.

Figure C-16 shows the facility configuration of Westmoreland, including customer entrance and scale, customer exit locations, transfer trailer entrance and exit locations, customer tipping areas, direct unload area, load out hopper and direct load hopper.

Figure C-16: Westmoreland Facility Configuration



The inbound scale at the Westmoreland facility is particularly challenging because it is small has weight limit of 60,000 pounds and is located inside the transfer building. For comparison, the scale at Fair Oaks has a weight limit of 100,000 pounds and the scale at Bachman has a maximum weight limit of 80,000 pounds. Figure C-17 shows the inbound scale at the Westmoreland facility where a driver is communicating the employee, vehicle number and material being hauled so it can be manually entered into the data tracking system.

Figure C-17: Inbound Scale at Westmoreland Facility

When vehicles exceed the weight limits of the inbound scale, they must pull through the transfer station building, exit the facility, weigh in using the transfer trailer truck scales, exit the facility and pull back to queue at the scale, verbally communicate the vehicle weight to the scalehouse attendant and enter the facility to unload material. Since Sanitation Department collection vehicles have tare weights for their vehicles in the system, they do not need to scale out using the transfer trailer truck scales. For this reason, the inbound scale is a significant limitation of the process flow through the Westmoreland facility. The weight of residential customers loads are estimated by staff through visual inspection.

After scaling in, customers enter the transfer building and are directed by staff to back up to the tipping areas in front of one of the two hoppers depending on if they are unloading refuse, recycling or brush/bulk material. Brush and bulky items are only delivered on Wednesdays and Saturdays. There is a direct load hopper and a load out hopper at the Westmoreland facility. The direct load area and load out hopper configuration is designed to allow vehicles to tip directly into the hopper, but this was used as a tipping floor during the Transfer Station Site Visit. The direct load area is adjacent to the transfer building entrance and the observed use as a tipping floor limits space for customers and operators to maneuver in the transfer building. Figure C-18 shows the load out hopper (left) and direct load hopper (right) directly adjacent to the transfer building entrance.

Figure C-18: Westmoreland Facility Hoppers

A key bottleneck of Westmoreland is when refuse and recycling material arrive at the same time, as this blocks the front-end loader from managing material and potentially blocks the entrance and exits for other vehicles in the facility at that time.

The lighting brightness of the facility is significantly less than both Bachman and Fair Oaks transfer stations and causes challenges for customers and operators to safely maneuver in the transfer building.

Transfer trucks enter the transfer station building below grade, bypassing the customer entrance and parking beneath the staggered hoppers as shown in Figure C-19.

Figure C-19: Westmoreland Facility Transfer Trailer Truck Pull Through Location

This location has the capability to position two transfer trucks in a staggered formation, providing flexibility for transfer station operations to fill the trailers with refuse, recycling or brush/bulk material as necessary without the challenge of one transfer truck blocking the egress of the other. There are 60-ft in-ground scales installed for use by the transfer trailer trucks that indicate how much material is loaded and packed into the trailers by the rotobooms so operators can ensure they do not exceed the legal GVW limit, while also maximizing payload. Additionally, these scales are used by vehicles that exceed the weight limits of the inbound scales.

The Westmoreland facility also provides recycling drop off bins for residential customers as shown in Figure C-20.

Figure C-20: Recycling Drop off Bins at Westmoreland Facility

Inbound Material

This section presents analysis of inbound materials, customer types and discusses the impacts of variations by day and time.

The transfer station system was originally designed and constructed to only accept refuse. Since then, the system has begun accepting both recycling and brush/bulk material. Table C-2 indicates the material types accepted at each transfer station.

Table C-2: Material Types Accepted by Facility

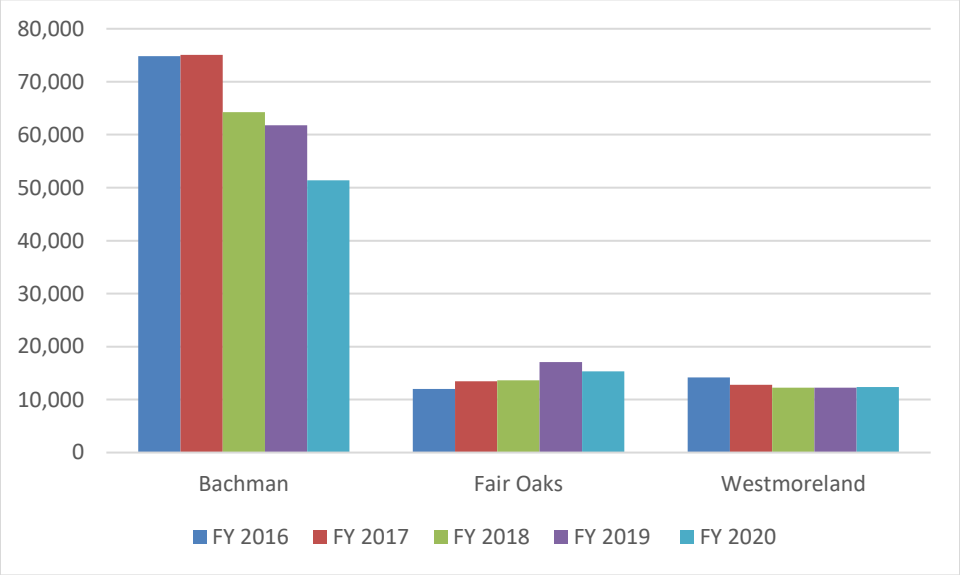
Transfer Station	Refuse	Recycling	Yard Waste	Brush/Bulk	Tires	Electronics
Bachman	✓	✓	✓	✓	✓	✓
Fair Oaks	✓	✓	✓	✓	✓	✓
Westmoreland[1]	✓	✓				

1. Westmoreland has the ability to accept yard waste, brush/bulk, tires and electronics, but these materials are delivered much less frequently than the other transfer stations.

While the transfer station system is able accept all these materials as part of the current operations, the addition of recycling, yard waste, brush and bulky items at the transfer stations has decreased the overall capacity of the system and cause operations to fall behind during significant surges of one or more material types. The inability of Fair Oaks and Westmoreland to accept brush and bulky item material on a regular basis contribute to the challenges managing material during surges.

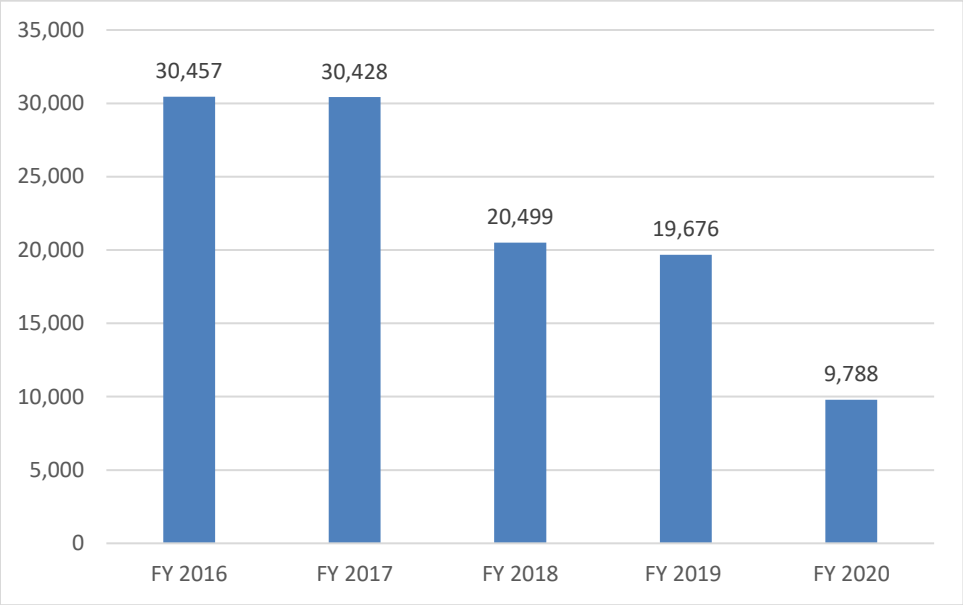
The following provides information and analysis about the volume of transactions and tonnage of inbound customers among the facilities in the transfer station system. Figure C-21 shows the historical transactions from FY 2016 through FY 2020, including transactions from all three customer types.

Figure C-21: Historical Annual Transactions in Transfer System



The total transactions at Bachman have decreased from approximately 74,800 transactions in FY 2016 to approximately 61,700 transactions in FY 2019. FY 2020 is shown but represents an anomaly due to the impact of the COVID-19 pandemic on resident activity that can be explained by a decrease in the number of residential customers that utilized Bachman. Figure C-22 shows the historical annual number of residential customer transactions at Bachman between FY 2016 and FY 2020, which dropped from approximately 19,700 in FY 2019 to 9,800 in FY 2020.

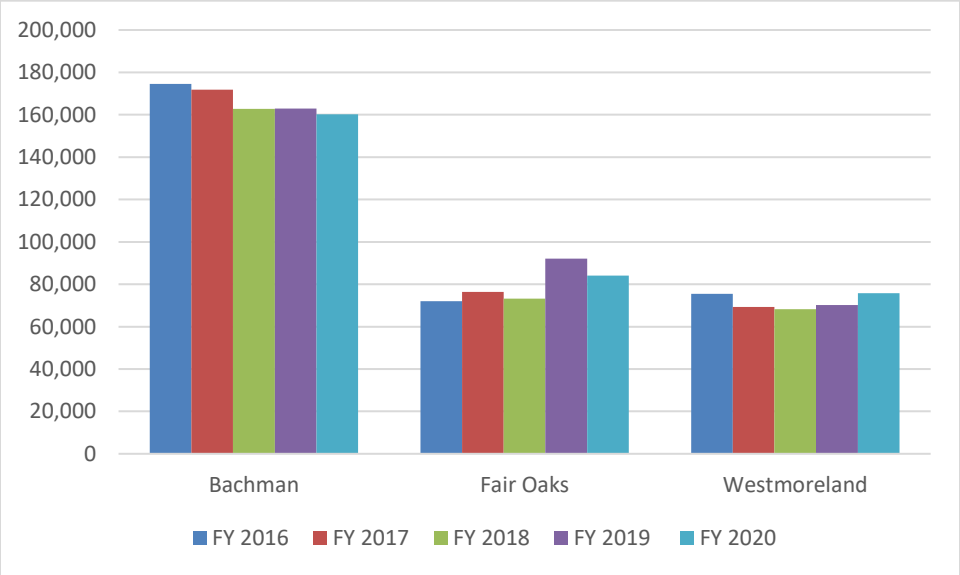
Figure C-22: Historical Annual Number of Residential Customers at Bachman Facility



The number of residential customers that bring material to Fair Oaks and Westmoreland on Wednesdays and Saturdays are not weighed and therefore similar statistics for these facilities are not available[106]. Although there was a noticeable decrease in the number of transactions at Bachman, that did not necessarily impact the amount of tonnage disposed at the transfer station system. Figure C-23 shows the historical annual tonnage disposed in the transfer system.

[106] Residential customer loads at Fair Oaks and Westmoreland are logged but not weight. The FY 2021 average weekly residential customers (Wednesday and Saturday only) utilizing Fair Oaks is 338 and Westmoreland is 865 compared to the weekly average at Bachman of 120 residents over six 6 days. For perspective on the high volume of residential customers at the transfer station, in the first six months of FY 2022 there were 3,225 transactions at Bachman, 9,714 at Fair Oaks and 15,895 at Westmoreland.

Figure C-23: Historical Annual Tonnage Disposed in Transfer System



There is a trend of increasing amount of tonnage at Fair Oaks and Westmoreland facilities, consistent with indications by City staff at the Transfer Station Site Visit of an effort to make more effective use of these facilities.

Table C-3 shows the average historical tons per day (TPD) and tons per load delivered to each facility in the transfer station system between FY 2016 and FY 2020, including the total TPD and tons per load and the TPD on days when Sanitation Department vehicles are operating (Monday, Tuesday, Thursday and Friday).

Table C-3: Historical Average Tons per Day and Tons per Load by Facility

Facility	Total TPD[1]	Total Tons per Load	Collection Day TPD[2]	Collection Days Tons per Load
Bachman	534	2.5	634	2.7
Fair Oaks	255	5.6	363	5.6
Westmoreland	230	5.6	341	5.6
Total	**1,019**	**3.4**	**1,339**	**3.8**

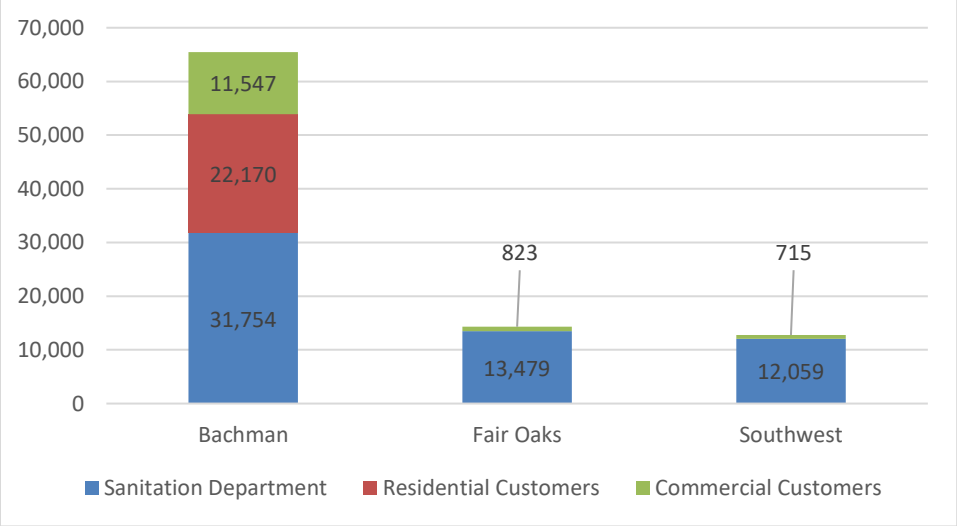
1. Overall TPD represents the average annual tons delivered between FY 2016 and FY 2020 to each facility divided by 52 weeks per year and six working days per week.
2. Collection day TPD represents the average annual tons delivered on Mondays, Tuesdays, Thursdays and Fridays calculated by dividing the average annual tons delivered on these days divided by 52 weeks per year and four working days per week. Although the transfer stations are open more days per week, the collection day TPD (e.g., only considering four working days per week) is not weighted down by the activities on Wednesday and Saturday and more accurately presents the inbound tons by Sanitation Department vehicles.

Comparing the total TPD and loads per day against the collection day TPD and loads per day, the inbound TPD on collection days is 31 percent higher than the total TPD. At Bachman, the total tons per load is 2.5 and collection day tons per load is higher at 2.7 because the Sanitation Department utilize compacting vehicles and the total TPD is skewed by high numbers of residential and commercial customers on Wednesday and Saturday. The total tons per load and collection day tons per load are the same for Fair Oaks and Westmoreland transfer stations due to the fact that residential customers are only permitted to use these facilities on Wednesdays and Saturdays and residential customers are not weighed in because they are able to use these facilities for free during these times. Residential customer tons are recorded by staff by visual inspection in multiples of half-ton.

Customer Type

Among the three customer types accepted at the transfer stations, the Sanitation Department makes up the majority of the transactions at each of the transfer stations. Figure C-24 shows the historical average number of transactions by customer type for each transfer station from FY 2016 through FY 2020[107].

Figure C-24: Average Annual Transactions by Customer Type



Although there are transactions from residential customers at Fair Oaks and Westmoreland transfer stations on Wednesdays and Saturdays, these are not recorded in the scale system because they are provided disposal

[107] FY 2020 was an anomalous year due to the COVID-19 pandemic and caused a decrease in the historical average transactions at Bachman by about five percent and the historical average tonnage by about one percent, largely due to the decrease in residential customer transactions. There was negligible impact on the average historical transactions and tonnage at the Fair Oaks or Westmoreland transfer stations. Therefore, FY 2020 data is included in this evaluation.

for free and are therefore not included in the data provided by the City. Residential customer transactions are recorded at Bachman.

Consistent with the distribution of transactions among the three customer types, the Sanitation Department makes up the majority of tonnage delivered to the transfer station system. Figure C-25 shows the average historical tonnage disposed by customer type for each transfer station from FY 2016 through FY 2020.

Figure C-25: Average Annual Tonnage Disposed by Customer Type

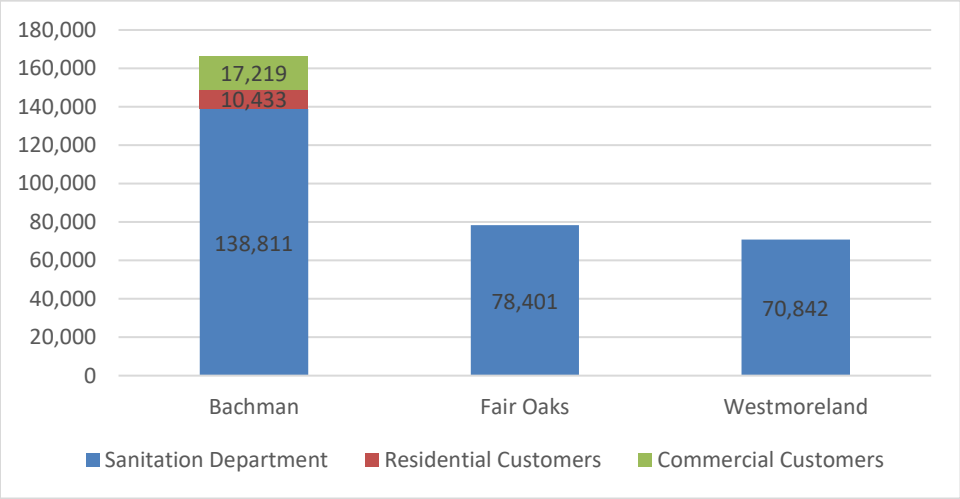
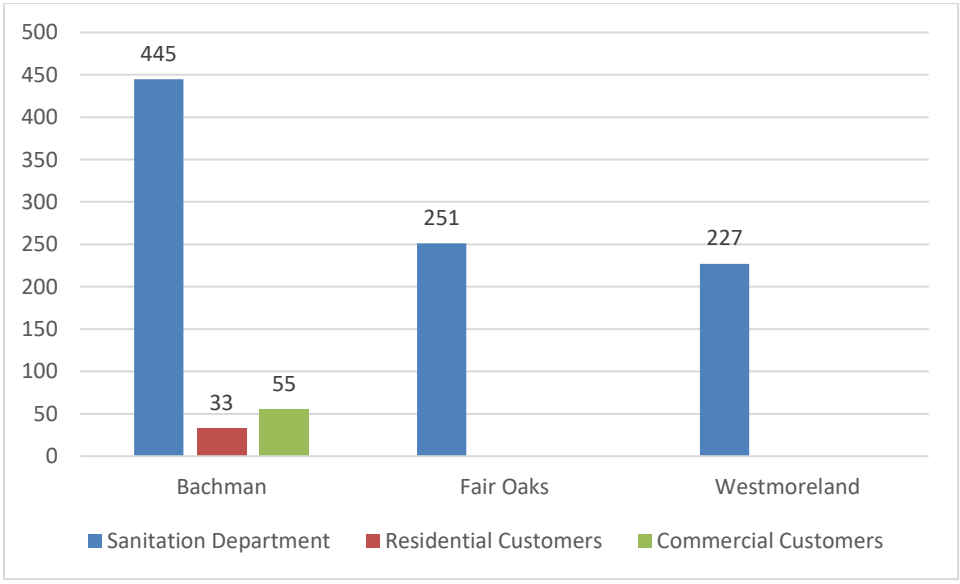


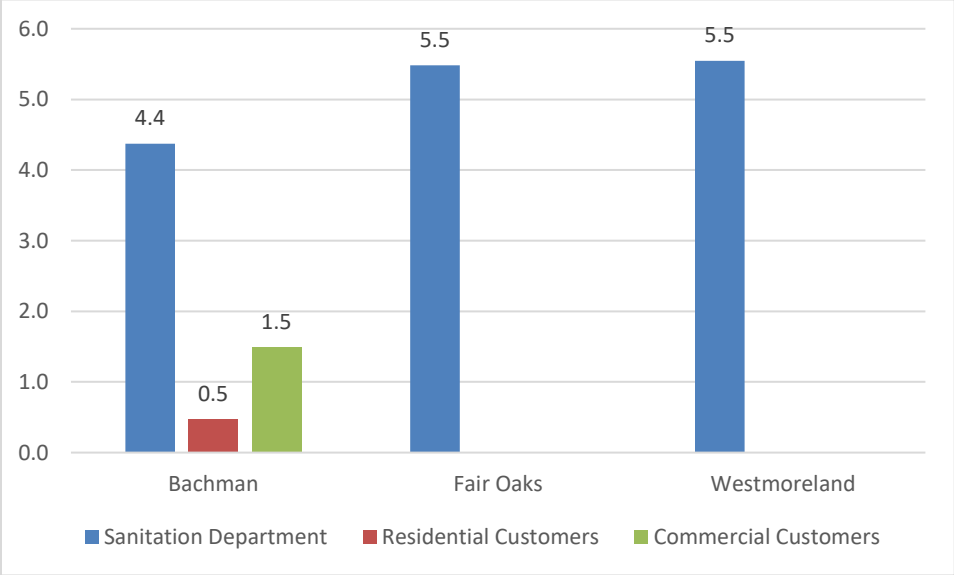
Figure C-26 shows the average tons per day by customer type for each facility between FY 2016 and FY 2020 by dividing the total average annual tonnage received by 52 weeks per year and 6 operating days per week.

Figure C-26: Average Annual Tons per Day by Customer Type



The average inbound TPD are higher on days when the Sanitation Department collections operate as shown in Table C-3. Figure C-27 shows the average tons per load by customer type between FY 2016 and FY 2020.

Figure C-27: Average Tons per Load by Customer Type

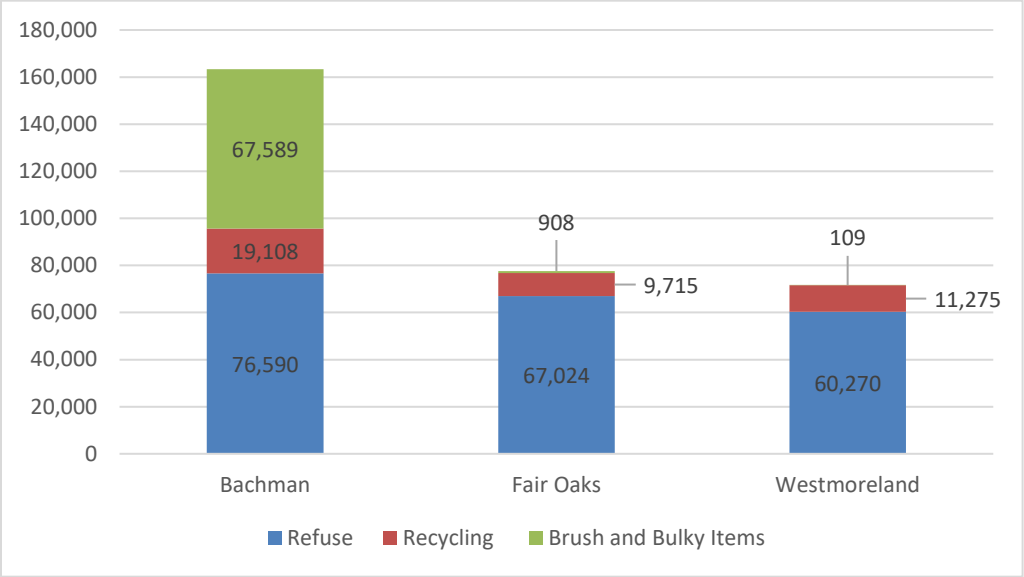


Comparing the average tons per load for Sanitation Department customers, the tons per load is less for vehicles delivering to Bachman compared to Fair Oaks and Westmoreland because Bachman accepts more recycling and brush loads which are not able to compact material as much as refuse loads. For commercial customers, the tons per load is significantly less for at Bachman compared to Fair Oaks and Westmoreland. The average inbound tons per load are higher on days when the Sanitation Department collections operate as shown in Table C-3.

Material Type

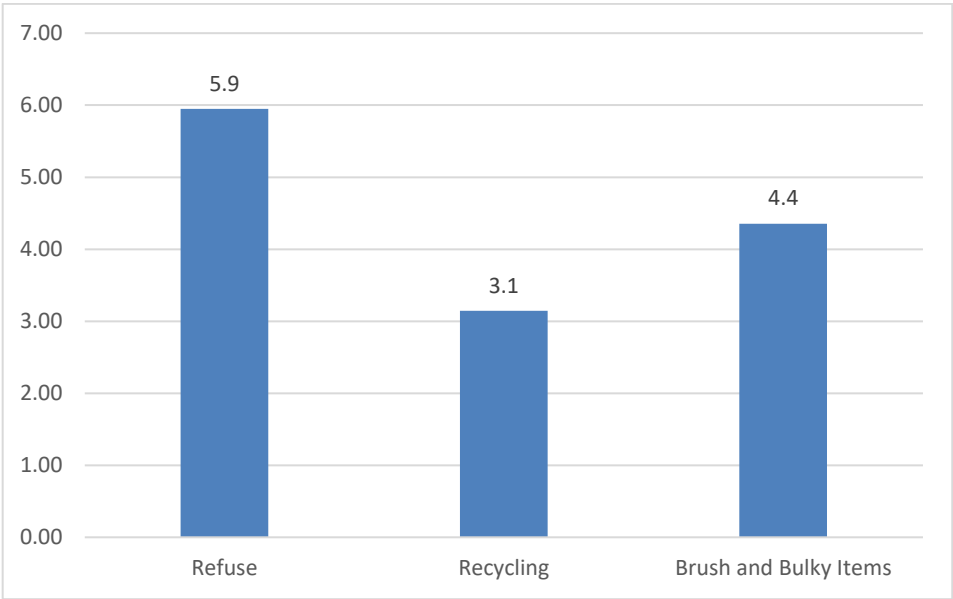
The capacity of the transfer station system depends on the operational efficiency of being able to manage the various material streams that are accepted. One of the key challenges identified by City staff is managing the refuse and brush and bulky item tonnage in addition to the less dense recycling material. Figure C-28 shows the average historical tonnage delivered by material type to each transfer station between FY 2016 and FY 2020, including all customer types.

Figure C-28: Historical Average Annual Tonnage Disposed by Material Type



Bachman accepts more recycling tons and the vast majority of brush and bulky item compared to Fair Oaks and Westmoreland which contributes to the capacity constraints at Bachman. Each of the material types have different physical properties (e.g., density, plasticity) and therefore are delivered to the transfer station system facilities at different rates. Figure C-29 shows the average historical tons per load by material type between FY 2016 and FY 2020 hauled by Sanitation Department customers.

Figure C-29: Average Historical Tons per Load by Material Type Hauled by Sanitation Department Customers



Refuse material is able to achieve the highest average tons per load because it is compacted by Sanitation Department collection vehicles. Typically, compacting refuse collection vehicles can achieve a higher ton per load ranging from six to 10 tons per load, but these figures presented for comparison reflect the total amount of refuse delivered to the facilities (including residential and commercial customers that do not use compacting vehicles at Bachman). Although recycling loads are compacted, the material is much less dense and does not compact as well with the current ejector trailers, resulting in a lower tons per load collection efficiency. Brush and bulky items are between refuse and recycling on a tons per load basis because the material is more dense but is not compacted as part of the City's current collection operations. Further discussion about the City's collection operations for refuse, recycling and brush and bulky items is provided in Sections 6.0 and 7.0.

Variations by Day and Time

The capacity of the transfer station system depends on the operational efficiency of the individual facilities. One of the key challenges identified by City staff is working to anticipate the daily schedule of inbound waste. The volume of customers and tonnage varies based on material type, seasonality, day of the week, week of the month, time of the day and may deviate due to unanticipated interruptions in collection operations (e.g., labor shortage) or weather events (e.g., tornado, flooding, etc.). If one or more facilities become inundated with material without enough staff or equipment to efficiently process the material, the processing efficiency of the transfer station system decreases.

Figure C-30 shows FY 2020 inbound tons and loads by day for all Sanitation Department vehicles including refuse, recycling and brush/bulk material.

Figure C-30: FY 2020 Inbound Tons and Load by Day Delivered by Sanitation Department

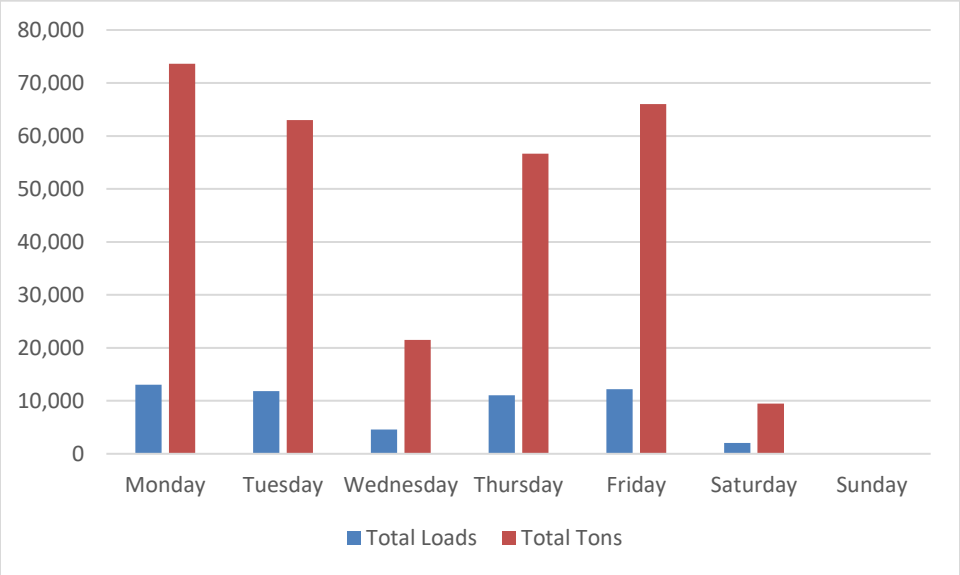


Table C-4 shows the same data for FY 2020 and includes average tons per day, average tons per load and average loads per day.

Table C-4: FY 2020 Average Inbound Tonnage by Day Delivered by Sanitation Department

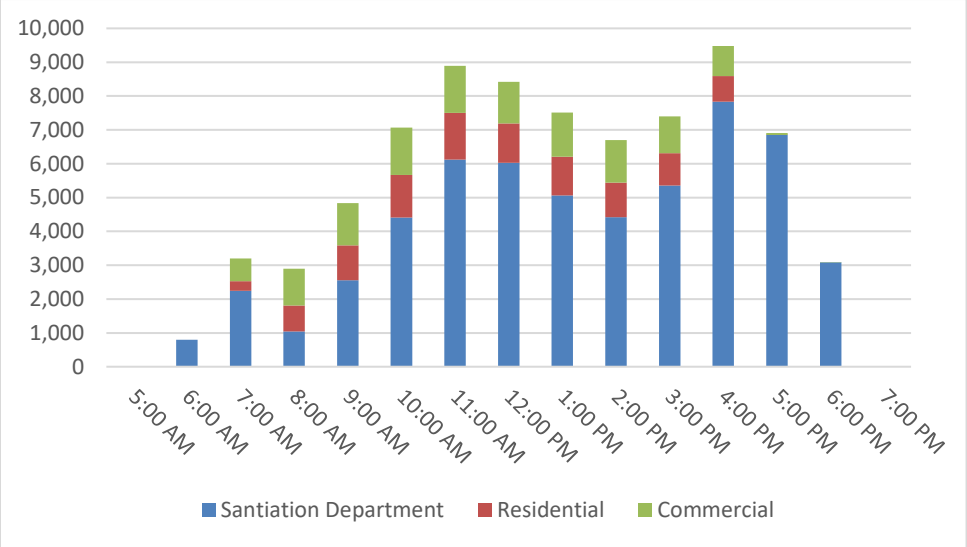
Day	Total Loads	Total Tons	Average Tons per Day[1]	Average Tons per Load	Average Loads per Day[1]
Monday	13,052	73,648	1,416	5.6	251.0
Tuesday	11,849	63,021	1,212	5.3	227.9
Wednesday	4,581	21,475	413	4.7	88.1
Thursday	11,017	56,638	1,089	5.1	211.9
Friday	12,223	66,036	1,270	5.4	235.1
Saturday	2,039	9,476	182	4.6	39.2
Sunday	5	23	0	4.7	0.1

1. Calculated by dividing the total annual loads or tons for that day of the week by 52.

The days with the highest number of loads and highest average tons per load were Monday and Friday. Based on conversations with City staff, material is stored at Bachman on Monday and Tuesday and operators catch up with that material Wednesday through Saturday because they have lower volumes of inbound loads. Wednesday and Saturday tonnage is lower than other days because Sanitation Department collections are not scheduled to operate and there are higher numbers of residential customers utilizing the transfer station system on these days. Further discussion about refuse, recycling and brush and bulky item collection operations is provided in Sections 6.0 and 7.0.

Operations are also impacted by the time that customers arrive at a transfer station. When large numbers of customers arrive at once it can cause traffic congestion in the transfer building or delays related to dispatching transfer trailer trucks. Figure C-31 presents the annual transactions by hour and customer type to demonstrate the typical inbound daily flow of customers in FY 2020.

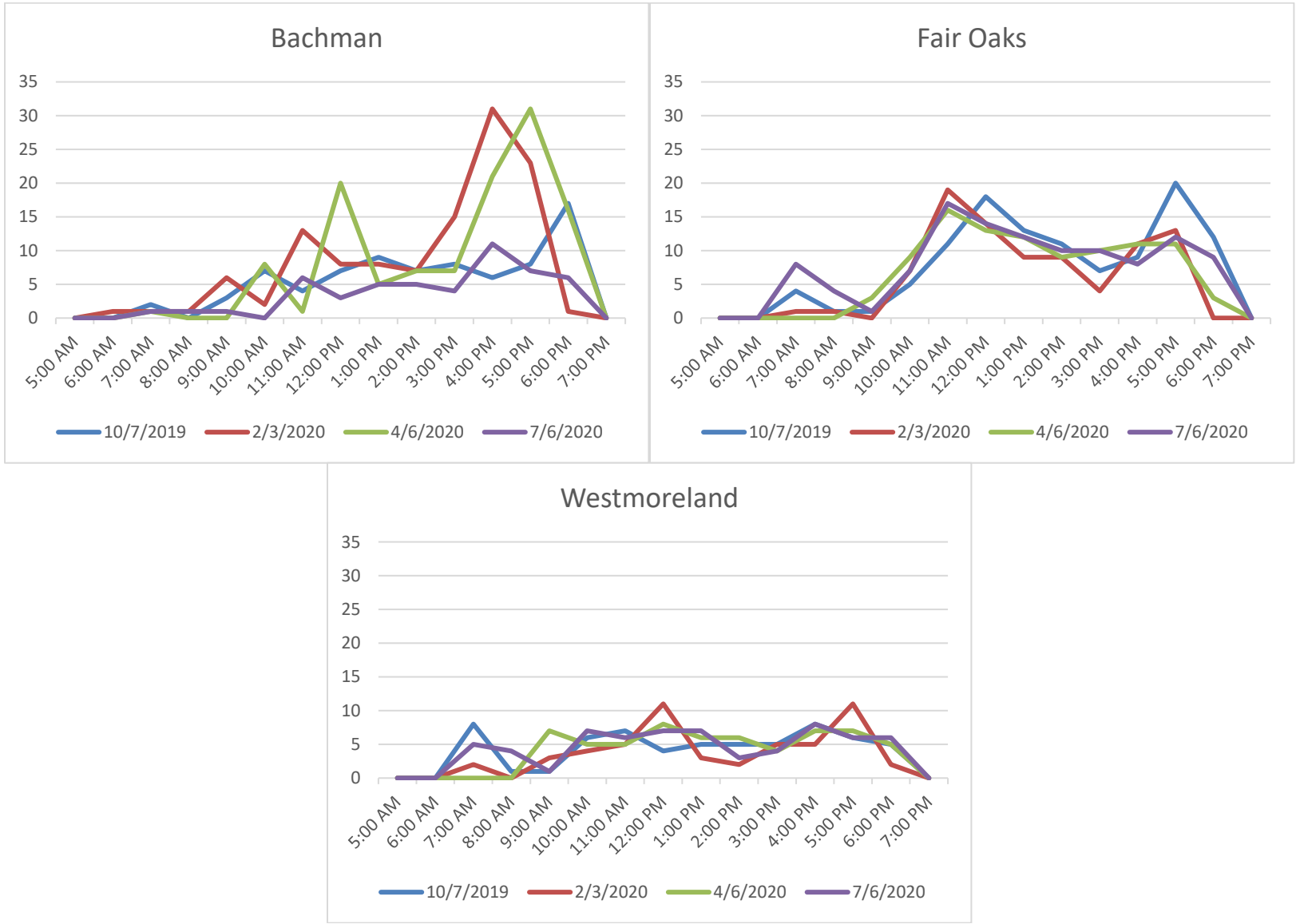
Figure C-31: FY 2020 Annual Inbound Transactions by Hour and Customer Type



The volume of inbound material peaks at 11:00 am and again at 4:00 pm. The daily peaks are generally dependent when Sanitation Department customers complete their routes. The first daily peak includes more residential and commercial customer transactions, and the second peak includes more Sanitation Department customers. When inbound customers taper off toward 6:00 pm, the transfer station operations are able to catch up with material to transfer it out of the facility since front-end loaders are able to focus on loading transfer trailers rather than managing inbound loads.

Figure C-32 shows the daily inbound transactions of Sanitation Department vehicles containing refuse, recycling and brush material for select Mondays in FY 2020 for each transfer station to demonstrate the typical pattern of inbound vehicles and variations of inbound loads due to seasonality and collection operations (e.g., number of loads may vary by week depending on brush and bulky item collection schedule).

Figure C-32: Inbound Transactions by Hour for Select Mondays in FY 2020



Based on the variations by season, number of inbound transactions by Sanitation Department vehicles may vary at Bachman from seven customers on July 6, 2020, between 4:00 pm – 5:00 pm to as many as 31 during the same time period on April 6, 2020. The dead time in the daily schedule results HEOs having no material to process (unless they can take that time to catch up on transferring material that has been stored at the facility) and surges in customers result in bottlenecks in processing material for transfer.

Ultimately, the volatility of the inbound material causes the transfer station system operations to take a reactive, rather than proactive approach to processing material because it is challenging for management to identify which facility will receive material, and when, from different customer types and minimizes the ability to effectively work through bottlenecks in the operation (e.g., deploying sufficient equipment and staffing effectively among the three facilities).

Outbound Material

This section presents analysis of outbound transfers to the Landfill or MRF including annual loads and tons transferred by material and discuss variations in the day and time of transfers. Table C-5 shows the total number of outbound material transfers at each facility in FY 2020.

Table C-5: FY 2020 Outbound Transfer Trailer Average Ton per Load

Facility	Loads	Total Tons	Average Ton per Load
Bachman	9,415	168,560	17.9
Fair Oaks	4,651	80,250	17.3
Westmoreland	4,098	73,519	17.9

The transfer trailer equipment types and efficiency in packing and loading material determine the ability to maximize payload.

Material Type

The average ton per load is also impacted by the type of material that is being hauled. Table C-6 shows the outbound transfer trailer loads by material type from the facilities in the transfer station system for FY 2020.

Table C-6: FY 2020 Outbound Transfer Trailer Average Ton per Load by Material Type

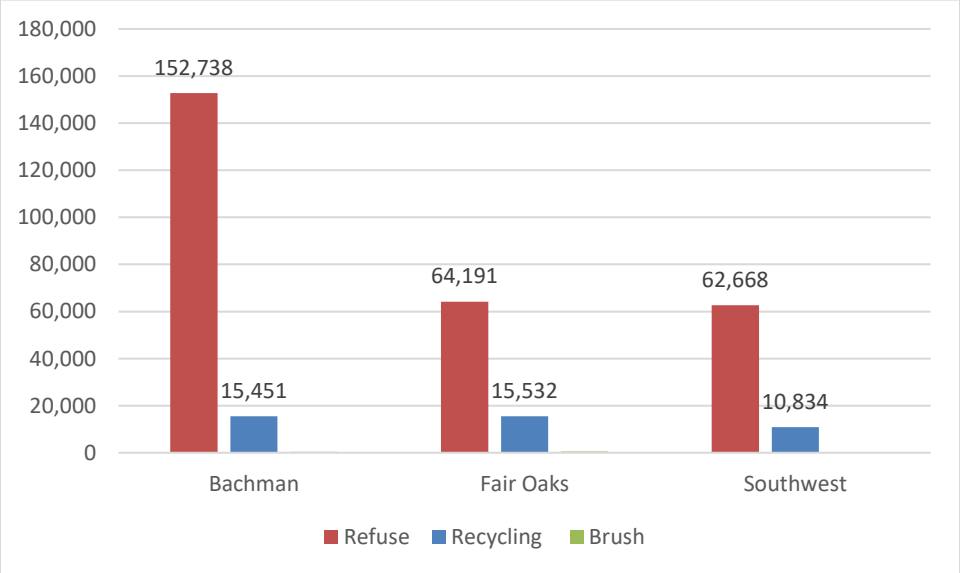
Material Type	Loads	Total Tons	Average Ton per Load
Refuse	14,628	279,597	19.1
Recycling	3,486	41,818	12.0

Brush and Bulky Items	50	914	18.3

Brush and Bulky Item material is loaded into transfer trailer trucks as part of normal operations. The City is able to achieve better efficiency transferring refuse and brush and bulky item loads in the 18 to 19 tons per load range as compared to recycling material at 12 tons per load. This is due to the need for recycling to be transferred in a trailer that can eject the material at the MRF since there is no transfer trailer tipper. The ejection mechanism reduces the volume and weight that can fit in the transfer trailer and contributes to the lower average ton per load. Additionally, recycling material is not able to achieve the same level of compaction as refuse or brush and bulky item material and the ejector trailers used have been retrofitted and are not manufactured to hold loads greater than 15 tons.

Figure C-33 shows the annual tons transferred from each facility by material type for FY 2020.

Figure C-33: FY 2020 Outbound Transfer Trailer Tons by Material Type



Variations by Day and Time

The capacity of the transfer station system is critically dependent on the efficiency of the transfer fleet. The key bottleneck of the operation is the ability to provide transfer trailer trucks and drivers as soon as material is ready for loading. Table C-7 shows the average outbound transfer trailer loads for refuse material by day in FY 2020.

Table C-7: FY 2020 Average Outbound Refuse Transfer Trailer Loads by Day

Refuse	Total Loads	Total Tons	Average Tons per Day	Average Tons per Load	Average Loads per Day
Monday	2,637	50,898	979	19.3	50.7
Tuesday	2,642	51,874	998	19.6	50.8
Wednesday	1,983	35,531	683	17.9	38.1
Thursday	2,465	46,468	894	18.9	47.4
Friday	2,706	53,233	1,024	19.7	52.0
Saturday	1,928	36,333	699	18.8	37.1
Sunday	267	5,261	101	19.7	5.1

The payload of transfer loads on Monday, Tuesday, and Friday are highest for refuse where average tons per load exceed 19 and there are more than 50 loads per day transferred. The payload of the transfer station system drops on Wednesdays, Thursdays, Saturdays and Sundays due to increased numbers of residential customer and less consistent flow of inbound materials. Additionally, these are the days when operations catch up with material stored at Bachman, which may contribute to the lower number of loads per day and payload.

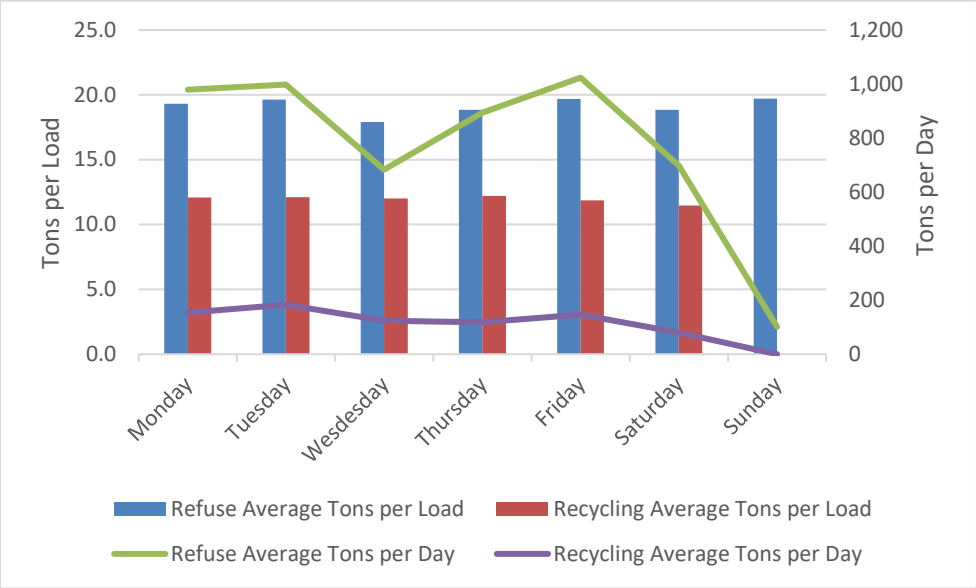
Table C-8 shows the average outbound transfer trailer loads for recycling material by day in FY 2020.

Table C-8: FY 2020 Average Outbound Recycling Transfer Trailer Loads by Day

Recycling	Total Loads	Total Tons	Average Tons per Day	Average Tons per Load	Average Loads per Day
Monday	661	7,990	154	12.1	12.7
Tuesday	787	9,535	183	12.1	15.1
Wednesday	535	6,422	124	12.0	10.3
Thursday	502	6,133	118	12.2	9.7
Friday	640	7,597	146	11.9	12.3
Saturday	361	4,141	80	11.5	6.9
Sunday	0	0	0	0	0

Since there are so many fewer dedicated brush and bulky item transfers (as much of this material is mixed with refuse for transfer and disposal), the outbound load by day figures is not presented. Figure C-34 shows a comparison of refuse and recycling transfer loads and tons for FY 2020.

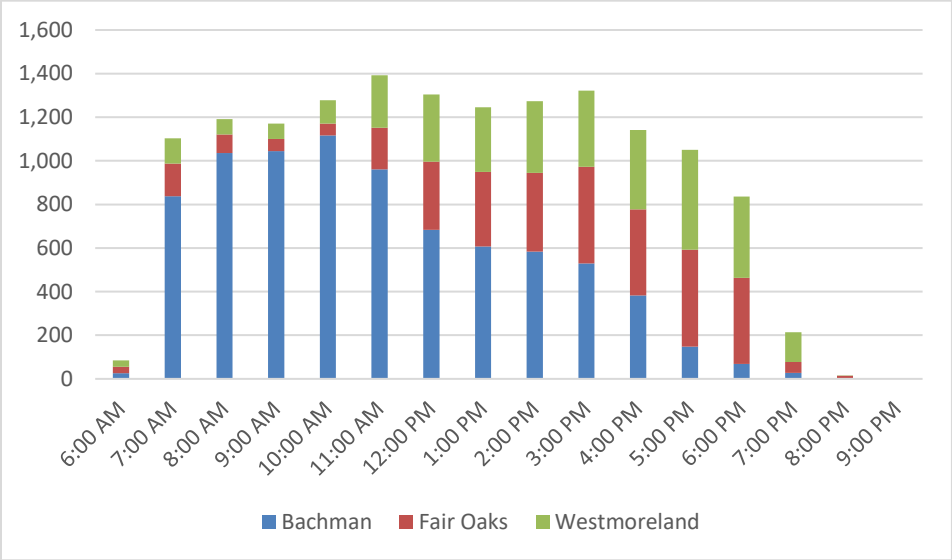
Figure C-34: FY 2020 Comparison of Refuse and Recycling Transfer Loads and Tons



The refuse transfer loads payload allows for between 800 and 1,000 tons to be transferred on Mondays, Tuesdays, Thursdays and Fridays. The average payload is less for recycling transfer loads, and there are fewer inbound tons and available trailers to haul material which contributes to the lower average payload compared to refuse.

Operations are also impacted by the time outbound loads are transferred to the Landfill or MRF. When large numbers of customers arrive at once it can be challenging to ensure that transfer trailer trucks and drivers are available. Figure C-35 presents the annual refuse loads by hour of outbound refuse to demonstrate the typical outbound daily flow of refuse from the transfer station system in FY 2020.

Figure C-35: FY 2020 Annual Refuse Outbound Transactions by Hour and Facility



This shows Bachman has the highest number of transfer loads between 6:00 am and 11:00 am, at which point transfer trailer trucks are shifted to the Fair Oaks and Westmoreland facilities between 11:00 am and 8:00 pm. Given the unpredictability of inbound material volumes and types, there may be instances when this general schedule does not support the demand when surges of material are delivered. For example, on February 2, 2020, there were 31 loads delivered by Sanitation Department between 4:00 pm and 5:00 pm at Bachman (reference Figure C-32). In the case that transfer trailer and staff are servicing the Fair Oaks or Westmoreland facilities at this time or disposing material at the Landfill, operators would not be able to transfer material out of the facility and material would be stored. It is important that transfer trailer trucks be made available to service Fair Oaks and Westmoreland, since they have limited storage capacity and permit conditions do not allow the storage of material overnight; however, if operators are unable to catch up to transfer the material stored during the week, Bachman may need to operate on Sunday to transfer the stored material.

Equipment Requirements

This section provides information on the equipment used among the facilities in the transfer station system, including the equipment for transfer hauling operations. Table C-9 indicates the number and type of equipment utilized in the transfer buildings based on the observations from the Transfer Station Site Visit, followed by brief descriptions.

Table C-9: Transfer Building Operations Equipment

Description	Bachman	Fair Oaks	Westmoreland	Total
Required Front-End Loaders	3	2	2	**7**
Available Front-End Loaders	5	2	2	**9**
Required Rotobooms	2	2	2	**6**
Available Rotobooms	2	2	2	**6**

- **Front-End Loaders.** The City has more front-end loaders than they require for the operation of the transfer station system but based on discussions with City staff not all the equipment is designed for refuse, recycling and brush and bulky item management. Back up loaders are stored at Bachman and are critical for redundancy given the wear and tear incurred managing solid waste materials. At times material impales and damages the equipment that is not outfitted with a waste package that provide extra protection in specific areas of the machinery. In other cases, the equipment is undersized based on the volume of loads tipped. For example, the CAT 644 and CAT 950 are too small to push all the material delivered by a 60 CY brush and bulky item collection truck in a single pass, but the larger 744 John Deere as provided by the manufacturer is not equipped with the waste package and is upgraded in-house[108]. Additionally, during the Transfer Station Site Visit it was observed that the rubber padding under the blade has worn off on some equipment, which causes increased abrasion and damage to the transfer building floors over time. These challenges with front-end loaders in the transfer station system leads to unplanned downtime and increased bottlenecks in processing capacity.
- **Rotobooms.** Rotobooms in the transfer buildings are fixed units and each facility has two. Some of the City's rotobooms are down for maintenance, but there are enough operating to compact and evenly distribute material in the trailers as needed. Although non-operational rotobooms does decrease the ability to transfer maximum payloads, there are currently enough to ensure that refuse and bulky and brush items are spread evenly and compacted and transfer trucks are able to pull up to the functional rotobooms in Fair Oak since there is a single lane for transfer trailers.

The City has a total of 26 transfer trailers and transfer trucks to support the transfer station system's hauling operations, inclusive of frontline and back-up units. The trailers in the City's fleet have two models of trailer, Warren and Innovative. Warren trailers are used to haul recycling because they have the ejection mechanism and Innovative trailers are used to haul refuse or brush and bulky items, which are tipped at the

[108] City staff has worked to "right-size" equipment based on the requirement of each transfer station where Bachman has two 744JD for the pit area and the CAT 966 for the top deck. Fair Oaks is equipped with 2 644JD units due to Monday & Friday peak tonnages and Westmoreland operates two CAT938 which are sufficient to deal with the inbound tonnages and are also small enough to maneuver within the transfer building safety.

Landfill working face. The Warren trailers are heavier due to the ejection mechanism and can fit less material as a result. The Innovative trailers are able to manage more volume of material and weight without exceeding the GVW requirements.

Transfer trailer truck operators report to the Landfill where the transfer trucks and the majority of all active transfer trucks and trailers are stored to begin daily operations**.** Table C-10 presents the round-trip time to load and haul a transfer trailer from each of the facilities in the transfer station system.

Table C-10:Transfer Load Round Trip Time (min)

Task	Bachman	Fair Oaks	Westmoreland
Loading at Facility[1]	40	40	40
Travel Time to Landfill/MRF[2]	32	30	22
Time at Landfill Scalehouse[3]	10	10	10
Time to/from Working Face/MRF[4]	20	20	20
Unloading Time[5]	15	15	15
Post-trip Inspection	15	15	15
Travel Time to Facility	32	30	22
Total (min)	**164**	**160**	**144**

1. Loading time at the facility estimates the time from when the transfer trailer truck pulls under the hopper to when it is driving away from the facility.
2. Travel times are estimated based on the passenger car road miles to travel from Bachman (18.3 miles), Fair Oaks (17.2 miles), and Westmoreland (13.75 miles) to the Landfill.
3. Assumes transfer trailer trucks must wait in line at one of the two Landfill scalehouses or the MRF scales and the time at shown for both is the same.
4. Time to and from the working face or MRF assumes traffic and a wait time before the transfer trailer trucks can begin the process of tipping material at the working face or ejecting material on the MRF tipping floor.
5. Unloading time may be faster at the MRF as compared to the Landfill working face, but for the purposes of this analysis they are assumed to be the same.

Table C-11 presents the estimate round trips that are able to be completed in a 10-hour workday.

Table C-11:Estimated Round Trips per Day by Facility

Description	Bachman	Fair Oaks	Westmoreland
Minutes per Working Day	600	600	600
Travel Time (min)[1]	164	160	144
Round Trips per Day	**3.66**	**3.75**	**4.17**

1. Travel time includes the total round-trip time as presented in Table C-10

Table C-12 calculates the number of required loads per day from each facility based on the average daily inbound tons and average tons per load (reference Table C-3 and Table C-5) and calculates the minimum number of daily transfer trailer trucks required.

Table C-12:Minimum Required Daily Transfer Equipment

Description	Bachman	Fair Oaks	Westmoreland
Peak Daily Inbound Tons[1]	609	484	386
Average Tons per Transfer Load	17.3	18.1	18.3
Required Loads per Day	35.2	26.7	21.1
Minimum Required Transfer Equipment	**9.6**	**7.1**	**5.1**

1. The average inbound tonnage at each transfer station on Monday because this is the day of the week with the highest daily inbound tonnage based on historical data.

Based on this evaluation, the transfer station system requires a total of 21.8 transfer trucks and trailers to service the average historical inbound tonnage. The City has 26 trucks and trailers including both frontline and backup equipment. The City is in the process of purchasing three additional transfer trailers and trucks and three ejector trailers to replace the existing aging ejector trailers. This analysis shows that the City currently has sufficient trailers to operate the transfer system but if equipment is down with prolonged maintenance time, the City may face situations where it does not have enough active trailers. Based on discussion with City staff, the number of trailers meets the minimum requirements, but they still struggle to accommodate surges of inbound tonnage and are generally deploying transfer trailers reactively. If the City were to add trailers and operators, they would be able to effectively maximize the efficiency of the transfer station system by deploying equipment more proactively.

Equipment Maintenance

Transfer station system operating equipment is maintained at the Landfill heavy equipment and maintenance shop. Although there are sufficient levels of equipment to operate the transfer stations and transfer fleet, this equipment is subject to increasing unanticipated downtime as equipment continues to age. Table C-13 presents the average age of front-end loaders, transfer trailers and transfer trucks for informational purposes.

Table C-13:Transfer Station System Equipment List

Equipment Type	Make	Frontline Units	Average Age (years)[1]	Backup Units
Front-end loader[2]	CAT; John Deere	8	7	2
Transfer Trailer[3]	Warren; Innovative	20	5	5
Transfer Trucks[4]	Freightliner	22	3	4

1. Average age as of 2021 includes frontline equipment only.
2. Front-end loader models include CAT 966M, CAT 950K, CAT 938K, John Deere 744, and John Deere 644K.
3. Transfer trailer models include Innovative DSC-50 and Warren WHDT5050-2-A.

Based on the equipment required the City has sufficient equipment to operate the transfer station system, although adding transfer trailers and trucks would allow the City to more proactively deploy equipment as part of the transfer operation.

Staffing Requirements

This section describes the transfer station system staffing and estimates the required staffing levels of Heavy Equipment Operators (HEOs) and transfer truck drivers to identify if current staffing levels are sufficient to maximize the efficiency of the transfer station system. Bachman transfer building operations and the fleet crews operate on two staggard 10-hour shifts (e.g., a morning shift and an afternoon/evening shift). The Fair Oaks and Westmoreland Facilities operate on one daily 10-hour shift. Table C-14 shows the current staffing for each of the transfer stations and fleet operations.

Table C-14:Current Staffing for Transfer Station System Management and Operations

Title/Job Function	FTE Positions Filled	FTE Positions Vacant	Role
Superintendent	1	0	Supervisory position that manages transfer and fleet operations and transfer station business planning.
Supervisor	4	0	Supervisory position that manages transfer and/or fleet operations. Each transfer station has one supervisor. All supervisors are Class A CDL drivers and able to operate as HEOs.
Crew Leader	2	1	Supervisory role managing equipment operators or truck drivers.
Heavy Equipment Operator (HEO)	7	3	Position that operates heavy equipment including front-end loaders and rotobooms to manage material in the transfer buildings. 2 of the 3 vacant are filled by IAPs (interim roles that already have a position in the City but are getting experience to help them get hired as HEO)
Truck Driver	17	5	Position that operates transfer trailer trucks to load trailers and haul for disposal at the Landfill. Truck drivers may serve as HEOs if they have the appropriate qualifications. The City is actively preparing to fill the vacancies and if the candidates are successfully hired will have zero vacancies.
Laborer	11	6	Position that supports transfer station operations including directing vehicle traffic, collecting windblown litter and sweeping material up from the transfer trailer pull through location.
Total Staff	**42**	**15**	

Based on the current number of management and operations positions filled and current vacancies, there is a 26 percent vacancy rate. For the purposes of this evaluation, it is assumed that the number of laborers in the transfer station system are sufficient for operations based on the Transfer Station Site Visit. Table C-15 shows the number of HEOs required to meet the operations of the transfer station system for each facility, by day of the week.

Table C-15: Required HEO Daily Staffing

	Bachman	Fair Oaks	Westmoreland	Total
Monday	5	2	2	**9**
Tuesday	4	2	2	**8**
Wednesday	3	1	1	**5**
Thursday	4	2	2	**8**
Friday	5	2	2	**9**
Saturday	3	1	1	**5**
Sunday	2	0	0	**2**

The currently staffed seven HEOs do not provide enough to cover the nine HEOs required during days with peak inbound tonnage. With the two IAPs available, the City is able to meet the need but if the three available vacancies for HEOs were permanently filled the City would be better prepared to operate the transfer station during times of peak inbound volume.

Table C-16 estimates the number of required transfer loads per day based on the FY 2020 daily inbound tons and the number of required daily transfer trailer truck drivers

Table C-16:Required Transfer Trailer Truck Driver Daily Staffing

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Daily Inbound Tons[1]	1,534	1,310	522	1,176	1,360	253	1
Ton per Load[1]	17.9	17.9	16.7	17.7	18.2	17.7	19.7
Required Loads	86	73	31	66	75	14	0
Number of Trips[2]	3.82	3.82	3.82	3.82	3.82	3.82	3.82
Required Truck Drivers[3]	22.5	19.1	8.2	17.4	19.6	3.7	0.0

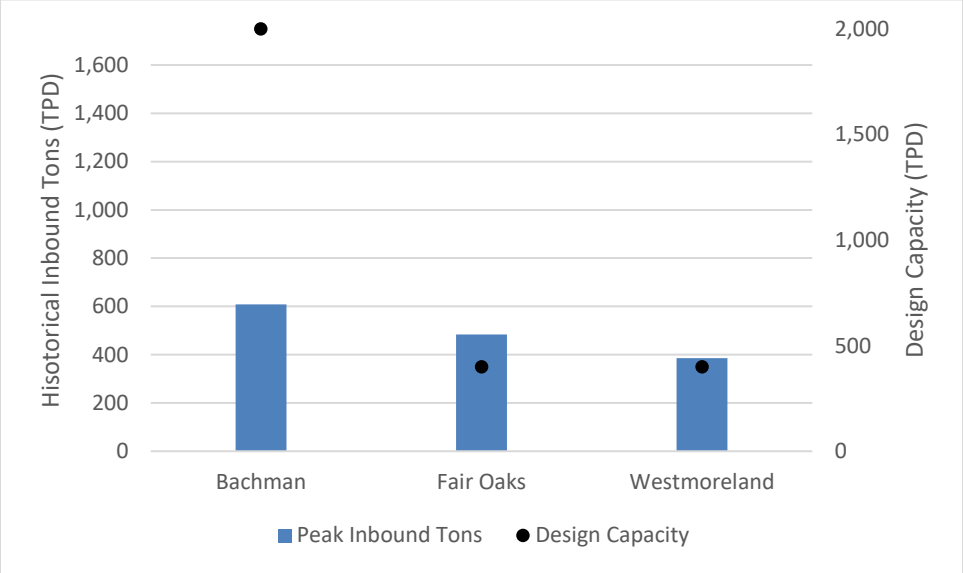
1. Based on FY 2020 data inbound and outbound tonnage data for all material and customer types.
2. Represents the weighted average of the number of trips able to be completed in a 10-hour workday from each facility.
3. Calculated by dividing the required loads by the weighted average number of trips.

The currently staffed 17 transfer truck drivers do not provide enough to cover the calculated 23 required transfer truck drivers on the days with peak inbound. If the three available vacancies for truck drivers were filled, the City would still be able to operate the transfer fleet with maximum efficiency. The number of truck drivers does not take into account PTO or sick leave, indicating that even if the City did fill the current vacancies, they may not be able to operate all the required transfer trailers on the busiest days. This is consistent with the operating practices of storing material at Bachman on Monday and Tuesday and catching up to transfer that material out later in the week.

Capacity

Figure C-36 compares the peak daily historical inbound tonnage (average daily inbound tons on Monday from FY 2016 to FY 2020) to the design capacity of each transfer station.

Figure C-36: Peak Historical Inbound Tonnage vs. Design Capacity.



Based on this comparison the transfer station system is receiving volumes of tonnage that do not exceed Bachman's permitted capacity on a TPD basis but are exceeding the capacity of Fair Oaks and Westmoreland during days with peak inbound tonnage. Even though this will appear as if Bachman has sufficient capacity, managing multiple material streams and the mix of customer types minimizes the available capacity to be much less than is currently available. The City recently increased the maximum Gross Vehicle Weight (GVW) for transfer trucks from 80,000 pounds to 84,000 pounds, allowing for more material to be hauled per trip for disposal or recycling but even with this change the transfer station system is unable to meet the service demand during times of peak inbound tonnage.

APPENDIX D - REFUSE AND RECYCLING COLLECTION

Methodology

As part of the LSWMP Update, select on-route refuse and recycling collection operations were observed on February 8 and 9, 2021 (Collection Operation Observations) including alley and curbside service provided by Automated Side Load (ASL) and Semi-Automated (SA) collection vehicles. Additionally, discussions were held with various members of management and staff to discuss ongoing operations and collect data which is incorporated in this section.

Based on Collection Operation Observations, data analysis and discussions with City staff the following provides an overview of the refuse and recycling collection operation and current challenges to inform the development of options for the City's consideration.

Collection Overview

The City's refuse and recycling collection operation services approximately 250,000 households from among five collection districts. The following refuse and recycling collection services are provided by the Sanitation Department (further discussion of brush and bulky item collection services, including yard trimmings, is provided in Section 7.0):

1. **Refuse.** Once per week collection and disposal of refuse contained in 64 and 96-gallon carts from approximately 250,000 households. All residential customers receive refuse collection from City crews and residents are able to request additional carts for a fee. The City also provides Packout services at an additional charge for collection on private drives.
2. **Recycling.** Once per week collection and processing of recyclables contained in 96-gallon carts from approximately 250,000 households. Recycling collection is voluntary, and residential customers may elect not to receive this service resulting in fewer recycling households serviced.
3. **Commercial.** Collection is provided to a limited number of commercial customers via roll carts. Multi-family and commercial properties may receive service for up to 10 refuse and 10 recycling roll carts. The City collects a small number of larger solid waste dumpsters.

Chapter 18 of the City's Code of Ordinances establishes that collection services, including collection, removal, disposal and processing of refuse and recycling must be provided by the Sanitation Department for all residences and duplexes. Collection service may not be performed by other entities. Chapter 18-4 defines the collection of refuse and recycling from residences and duplexes by any other entities besides the Sanitation Department as an offense unless they are:

- The owner or occupant of the residence.
- Employed under contract with the City to provide services.
- A charitable organization that gathers clothes, salvageable newspapers or other recyclable material.
- Hauling away brush and bulky items incidental to maintenance, delivery, lawn or home improvement service.
- Providing recycling services to the premises for source separated (e.g., dual stream) paper, metal and glass.

The City is organized into five collection districts that operate autonomously, where each district has a manager of operations. Figure D-1 shows the collection areas of the City by day, the Sanitation Department collection districts, and the location of the transfer stations and Landfill.

Figure D-1: Sanitation Department Collection Districts and Collection Day Boundaries

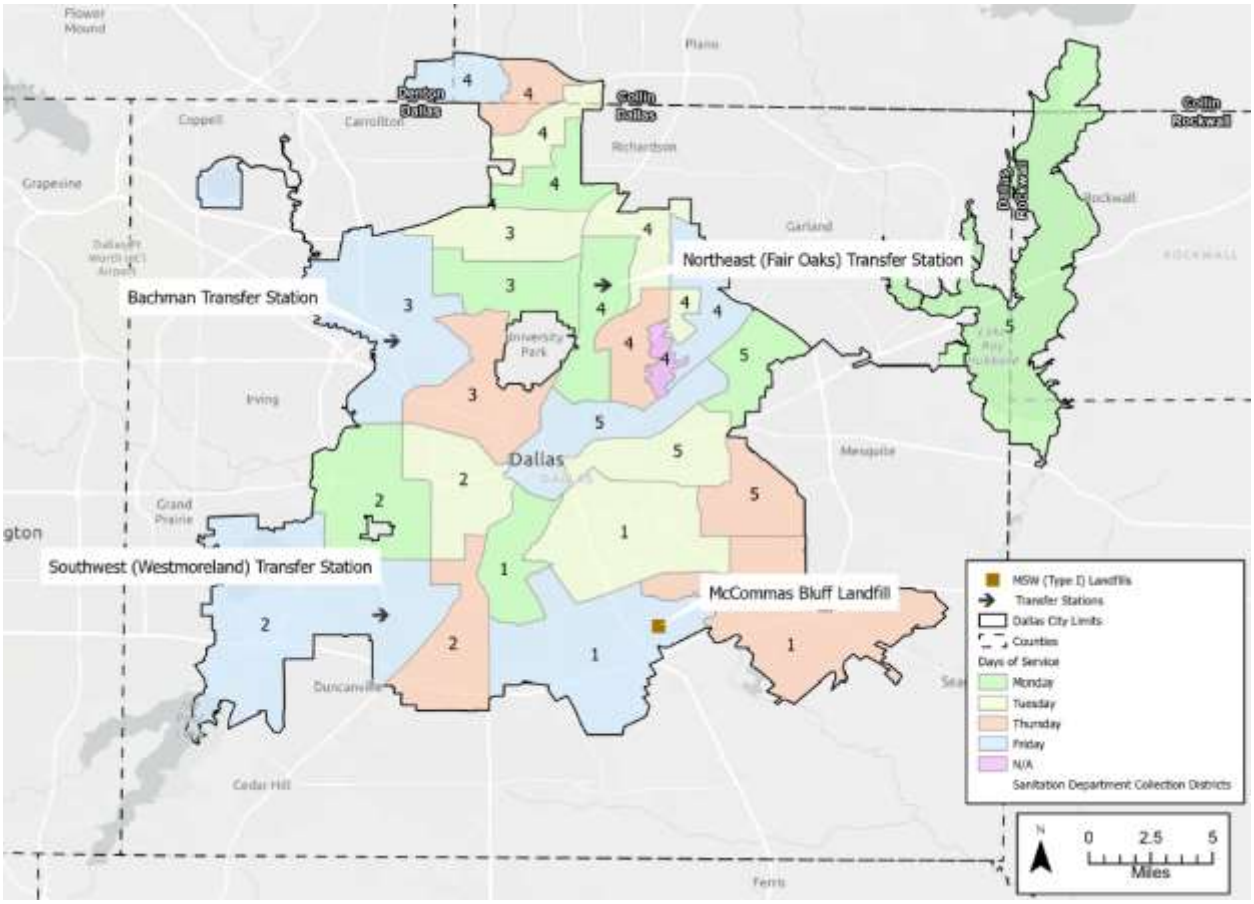


Table D-1 shows the number of residential customers broken out by material type and district in FY 2020.

Table D-1: Residential Collection Customers by District and Material Type[1]

District	Refuse	Percentage	Recycling	Percentage
1	47,668	19.1%	47,306	19.0%
2	54,402	21.8%	54,349	21.8%
3	38,812	15.5%	38,876	15.6%
4	60,872	24.4%	60,508	24.3%
5	47,885	19.2%	47,884	19.2%
Total	**249,639**	**100.0%**	**248,923**	**100.0%**

1. Collection customer counts by district represent most recent data as of November 4, 2021, does not represent average annual figures and is subject to change based on typical monthly collection customer count changes.

The number of customers is not evenly distributed based on the existing Sanitation Department collection districts where District 2 and District 4 contain about 45 percent of the City's refuse and recycling customers and District 1, District 3 and District 5 contain about 55 percent of the City's customers. The City primarily uses ASL and SA collection vehicles for refuse and recycling collection. Smaller Alley Cat (AC) collection vehicles are used in alleys where larger vehicles cannot operate. The City also collects refuse and recycling from small commercial or commercial-like establishments (condominiums, churches, and mobile homes) that manage material in carts. Table D-2 shows the number of commercial customers by roll cart size and frequency of service.

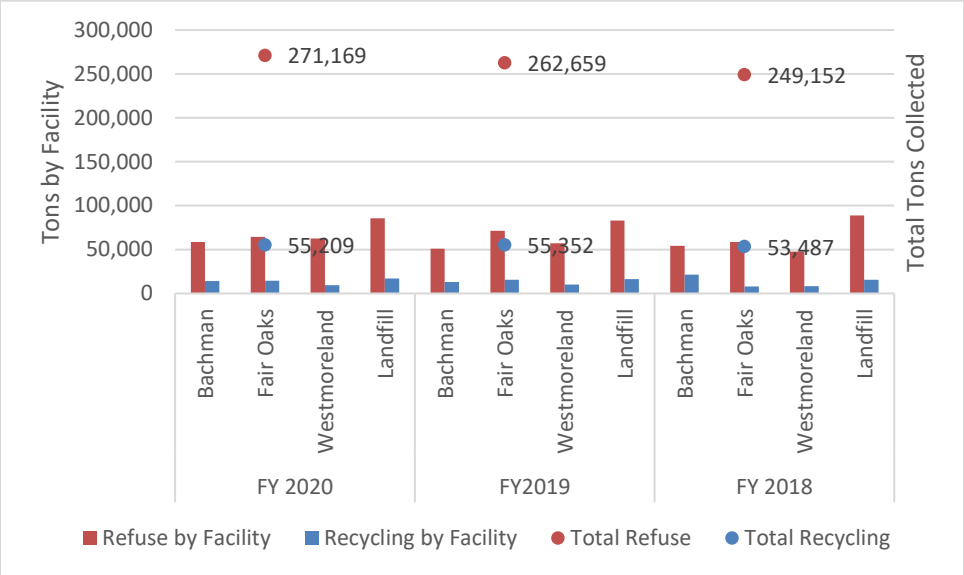
Table D-2: Commercial Roll Cart Collection Customers[1]

Services per Week	1	2	3	4	5	6	7	Total
64 Gallon	0	3	0	0	0	0	0	3
96 Gallon	0	1,149	10	3	8	8	4	1,182

1. Commercial roll cart collection customers counts represent data as of July 17, 2020, does not represent average annual figures and is subject to change based on typical customer fluctuations

The tonnage of material collected by the Sanitation Department fluctuates seasonally and is impacted by unanticipated events (e.g., tornado, pandemic) that cause surges in material generation. All material collected is taken to one of the City's transfer stations or directly to the Landfill for disposal or MRF for processing. The transfer station system is critically important to the City's ability to manage material cost-effectively while minimizing emissions and roadway damage. Figure D-2 shows the annual historical inbound refuse and recycling tonnage processed through the City's transfer station system and delivered directly to the Landfill and MRF from FY 2018 to FY 2020.

Figure D-2: Annual Inbound Sanitation Department Collected Refuse and Recycling by Facility[1]



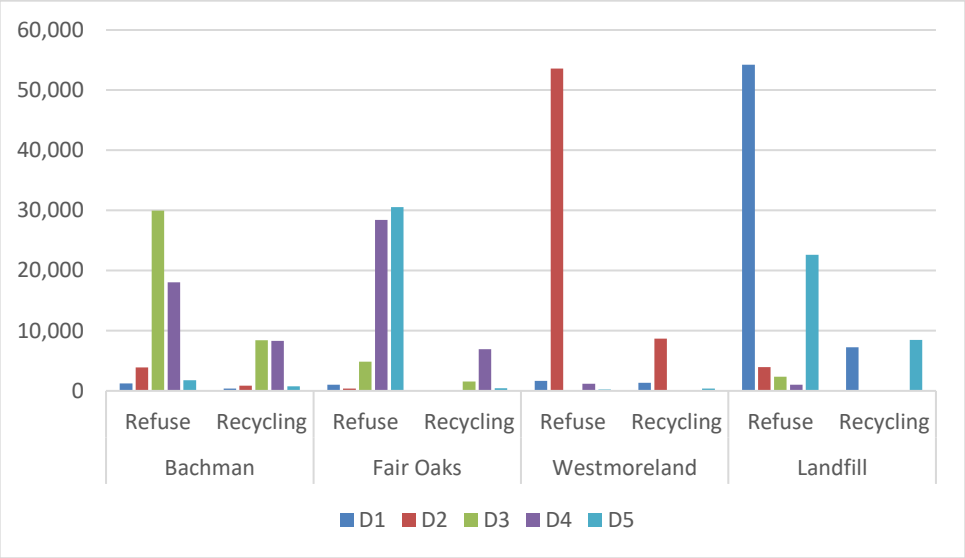
1. Recycling by facility tons reflect the tonnage reported by WasteWORKS of recycling material transferred to the MRF and the tonnage direct-hauled to the MRF reported by FCC. There is a slight discrepancy in the amount of material transferred because of reporting from two different scale systems.

Refuse and recycling material collected annually remains fairly consistent between FY 2016 and FY 2019 where the Landfill received the largest volume of refuse and Bachman received the largest volume of recycling. Even with fluctuations in typical residential generation due to the COVID-19 pandemic (e.g., mandatory stay-at-home orders) and staffing challenges and labor shortages following the initial outbreak[109], the recycling tonnage collected and processed at the transfer stations in FY 2020 remained consistent to previous years.

Figure D-3 shows the average annual tons of refuse and recycling delivered to each transfer station and directly to the Landfill for disposal from FY 2016 through FY 2020.

[109] D Magazine. "Labor Shortage Hits Dallas Trash Collection, City Says." June 20, 2021. Website hyperlink: https://www.dmagazine.com/frontburner/2021/06/labor-shortage-hits-dallas-trash-collection-city-says/

Figure D-3: Average Annual Sanitation Department Refuse and Recycling by Collection District[1]



2. Recycling direct hauled to the MRF represents the average tons delivered reported by FCC from FY 2017 – FY 2020.

Bachman supports District 3 and District 4; Fair Oaks supports District 4 and District 5 and Westmoreland supports District 2. District 1 and District 5 deliver directly to the Landfill, and do not rely on the transfer station system as heavily as the other collection districts.

The following sub-sections provide an overview of the refuse and recycling collection operation and is organized as follows, with brief descriptions:

- **Schedule**. Describes the schedule of collection for residential roll cart-based refuse and recycling including information about tonnage collected and number of households serviced by days of the week.
- **Routes.** Presents information related to route efficiency, the number of daily routes deployed by district and day.
- **Alley collection.** Presents information on the number of curbside and alley collection points, number of mixed alley and curbside routes, and discusses the impact of alley service on the collection operation.
- **Equipment.** Describes the equipment used for refuse and recycling collection, inventory of collection vehicles including frontline and backup, evaluates required amount of equipment to operate the current number of routes, discusses equipment fueling and maintenance needs, and provides an overview of cart maintenance.

- **Staffing requirements.** Presents information on the current staffing positions by district and evaluates staffing requirements to operate the residential cart-based refuse and recycling collection system.
- **Customer service.** Describes the current customer service system and data related to the number of customer service inquiries related to refuse and recycling collection.

Collection Schedule

The City currently services customers four days per week operating on a 10-hour per day schedule. Refuse and recycling collection operations occurs year-round, with the exception of City-designated holidays. Collection operations begin at 6:00 am (collection staff may arrive at this time, although vehicles may not reach households until later) and target completion of routes by 4:00 pm. However, routes may finish later during times of heavy set out or staffing shortages. Residents are asked to set out their roll carts no earlier than 6:00 pm the night before collection and no later than 7:00 am the day of collection.

The current four day per week operating schedule allows district managers to deploy refuse and recycling collection staff across the operation to support brush and bulky item collection operations on Wednesdays and Saturdays, which results in overtime pay for refuse and recycling staff. Based on discussions with City staff during the Collection Operations Observations, the refuse and recycling collection program is typically able to complete daily routes; however, with tonnage surges in residential refuse and recycling due to COVID-19 in combination with anticipated seasonal or holiday-based surges, collection operations have fallen behind at certain times. When there are surges in refuse and recycling material or challenges maintaining staffing levels, the overall collection operation becomes strained.

Although the current collection districts and schedule support the City's existing needs, adjusting the collection districts and/or transitioning to a five days per week, eight hour per day schedule may provide refuse and recycling collection more flexibility to adjust routes to meet seasonal and holiday surges, unanticipated surges (e.g., storm events) and overall growing volumes due to increasing residential customers. However, with a five-day work schedule, there would be less ability to shift refuse and recycling staff to support brush and bulky item collection or other aspects of the operation when needed.

Table D-3 and Table D-4 show the number of households that are provided refuse and recycling service by district and day.

Table D-3: Refuse Customers Serviced by District and Day[1]

District	Monday	Tuesday	Thursday	Friday
1	11,637	11,671	12,751	11,609
2	14,063	13,403	12,446	14,490
3	9,723	9,723	9,435	9,931
4	16,531	15,245	15,040	14,056
5	11,405	11,747	12,749	11,984
Total	**63,359**	**61,789**	**62,421**	**62,070**
Percentage	**25.4%**	**24.8%**	**25.0%**	**24.9%**

1. Household counts by district represent most recent data as of November 4, 2021, does not represent average annual figures and is subject to change based on typical customer fluctuations.

Table D-4: Recycling Customers Serviced by District and Day[1]

District	Monday	Tuesday	Thursday	Friday
1	11,533	11,544	12,672	11,557
2	14,056	13,370	12,445	14,478
3	9,982	9,705	9,358	9,831
4	16,358	15,197	14,960	13,993
5	11,559	11,582	12,758	11,985
Total	**63,488**	**61,398**	**62,193**	**61,844**
Percentage	**25.5%**	**24.7%**	**25.0%**	**24.8%**

1. Household counts by district represent most recent data as of November 4, 2021, does not represent average annual figures and is subject to change based on typical customer fluctuations.

The number of customers serviced is evenly distributed between the collection days at about 25 percent of total customers serviced each day. Although the number of customers serviced are fairly balanced between the collection days, the City struggles to complete routes during surges of material or labor shortage in certain areas of the City because collections in the alley are not distributed among the districts consistently.

Routes

The City currently operates daily refuse and recycling routes to meet the needs of the all the residential customers. Route efficiency is based on, but is not limited to, the following:

- **Collection efficiency.** Collection efficiency is the rate that collection vehicles can service customers and is determined by the time it takes for vehicles to drive from the prior set out to the next set out, service the cart, and place the cart back at the set out location. Collection or

management of material requiring the vehicle operator to exit the vehicle (e.g., bags set outside or on top of cart) reduces collection efficiency.

- **Set out rate.** The set out rate represents the total expected cart set outs on a given week. Lower participation causes collection efficiency to decrease when collection vehicles' time spent on routes result in fewer households serviced; however, there are fewer carts requiring service per and therefore a need for fewer routes. Refuse carts typically have a higher set out rate compared to recycling. Set out rate is a key metric related to collection efficiency and is an indicator of customer behavior related to the volume of recycling generated and the level of contamination present.
- **Non-collection time.** Non-collection time includes the time it takes to prepare for route such as pre-trip inspection, morning meetings, and travel time to route, as well as travel time to/from the disposal or processing facility, lunch breaks, post trip inspection and fueling. Non-collection time effects how long vehicles can be on-route throughout the day.
- **Vehicle type and operating personnel.** There are multiple configurations of vehicle types and personnel operating that service refuse and recycling routes and various collection environments. ASL collection vehicles have one driver and operator, where SA vehicles have one driver and typically two laborers.
- **Collection environment.** The collection environment on routes including traffic conditions, construction, physical constraints (e.g., overhanging limbs, power lines, alley ruts/ditches, sunken curbs), inaccessible set outs (e.g., parked cars), and weather conditions impact route efficiency. Challenging collection environments such as dead ends, cul-de-sacs, and narrow alleyways as well as congested traffic patterns cause vehicle operators to spend more time servicing set outs and ultimately decreases route efficiency.

Table D-5 and Table D-6 show the number of daily refuse and recycling routes deployed by district and day.

Table D-5: Daily Refuse Routes by District and Day

District	Monday	Tuesday	Thursday	Friday	Total
1	14	14	15	14	**57**
2	16	15	16	17	**64**
3	15	14	12	13	**54**
4	19	19	19	19	**76**
5	16	17	17	15	**65**
Total	**80**	**79**	**79**	**78**	**316**
Percentage	**25.3%**	**25.0%**	**25.0%**	**24.7%**	

1. Daily route counts by district represent most recent data as of November 4, 2021, include routes of all vehicle types and are subject to change based on pending re-routing and daily operational needs.

Table D-6: Daily Recycling Routes by District and Day

District	Monday	Tuesday	Thursday	Friday	Total
1	6	7	8	6	**27**
2	8	8	8	8	**32**
3	11	11	10	11	**43**
4	16	16	16	14	**62**
5	9	8	8	11	**36**
Total	**50**	**50**	**50**	**50**	**200**
Percentage	**25.0%**	**25.0%**	**25.0%**	**25.0%**	

- Daily route counts by district represent most recent data as of November 4, 2021, include routes of all vehicle types and are subject to change based on pending re-routing and daily operational needs.

The number of routes run is evenly distributed between the collection days at approximately 25 percent of total routes run each day. Although the number of routes is fairly balanced between the collection days, there are 116 fewer recycling routes than refuse routes because the recycling program is voluntary, the set out rate is less than refuse, and less material is generated so there are fewer required trips to the transfer station and/or MRF.

As of the writing of the LSWMP Update, the City is in the process of re-routing refuse and recycling collection routes to minimize the number of mixed alley and curbside routes and increase the efficiency of the program. Additionally, the City is implementing on-board technology that would allow for vehicles to be re-routed mid route on an as needed basis. This should provide the flexibility to pull certain equipment on or off routes to support other routes that encounter challenges (e.g., vehicle breakdowns, physical constraints, etc.).

Alley Collection

Collecting a high percentage of households in the alley decreases refuse and recycling collection efficiency and accelerates wear and tear on both vehicles and alleys. Figure D-4 provides examples of cart collection in alleys from an ASL collection vehicle (left) and a SA collection vehicle (right).

Figure D-4: ASL and SA Alley Collection

Table D-7 show the number of residential customers by Sanitation Department district, including the percentage of customers collected in alleys.

Table D-7: Alley and Curbside Refuse Customers by District

District	Alley Customers	Percent Alley	Curbside Customers	Percent Curbside	Total
1	4,269	8.9%	43,747	91.1%	48,016
2	14,802	27.2%	39,671	72.8%	54,473
3	24,890	64.9%	13,460	35.1%	38,350
4	39,018	64.1%	21,808	35.9%	60,826
5	17,440	36.4%	30,534	63.6%	47,974
Total	**100,419**	**40.2%**	**149,220**	**59.8%**	**249,639**

1. Alley and curbside refuse customer counts by district represent most recent data as of November 4, 2021, does not represent average annual figures and is subject to change based on pending re-routing and daily operational needs

District 1 has the least amount of alley collection customers and delivers the majority of material collected directly to the Landfill. Based on discussions with City staff, the City is in the process of adjusting routes so that District 1 only contains curbside only routes. District 3 and District 4 have the highest number of alley customers and deliver material primarily to Bachman and Fair Oaks transfer stations. While these transfer stations have the capacity to process materials collected from District 3 and District 4, the high number of alley set outs make it challenging to anticipate when vehicles will complete routes and arrive at transfer stations, particularly during surges in material generation. Clear and frequent communication between collection operations and transfer station operations is critically important to optimize the capacity of the transfer stations.

The following provides brief descriptions of the key impacts that collecting carts in alleys has on collection efficiency.

- **Size of vehicle.** In order to collect in the City's narrow alleys, the vehicles are smaller with less hauling capacity. The City primarily operates 20 or 22 CY capacity ASL collection vehicles to service alley set outs since the larger 28 CY capacity collection vehicles are too large to travel down some of the City's alleys. Routes that contain alleys require smaller vehicles and are not able to collect as much material before traveling to the transfer station, Landfill or MRF to tip material, reducing the route efficiency.
- **Size of alleys.** The size of the City's alleys widely varies depending on surface conditions, vegetation, and powerlines. In narrower alleys with protruding trees and vegetation, collection can take considerably longer than on the street, especially in those alleys where the surface conditions are also poor. Low hanging power and cable lines may obstruct trucks from passing through an alley and also present a safety concern to drivers. Damage to the alleys or collection vehicles causes the City's maintenance costs to rise.
- **Less space for carts.** For ASL collection vehicles, carts should be placed at least three to five feet apart to allow adequate clearance for the collection arm. The City directs residents to place roll carts facing the point of collection with three feet of space on all sides. In many alleys, the space constraints often result in little or no space between the carts. The driver needs to either get out of the vehicle to maneuver the carts or spend additional time guiding the arm to collect the carts. Additionally, fences, utilities lines, gas meters, etc. often interfere with the collection arm on ASL collection vehicles.
- **Checking carts.** For households collected in the street, residents must place their cart at the curb for their collection day and retrieve it afterward. Therefore, it is easy for a driver to determine which carts need to be collected. In areas where the recycling participation is lower, there are few recycling carts on the street and therefore the driver can focus on those carts that have been set at the curb for collection. In the alleys, most customers store carts in the same place where they are collected. Consequently, ASL collection vehicles must service every cart, even though many may be empty, and semi-automated rear-load crews have to manually check every cart before collection, decreasing collection efficiency.
- **Equipment type.** ASL collection vehicles collecting material in the alleys can only collect one side of the alley at a time, and there is less space for carts making ASL collection vehicles less efficient in the alleys.

The inefficiencies associated with servicing high numbers of customers in the alleys causes challenges for collection crews to complete routes in certain districts or days of the week. When this occurs, routes may not be completed until the following day causing the collection operation to fall behind schedule. These challenges are compounded when the demand of brush and bulky item collection requires refuse and recycling collection staff to help across the operation. Additionally, when refuse and recycling collections fall behind it becomes harder to predict when vehicles will complete routes and when inbound tonnage to the transfer stations will arrive at the transfer stations.

One of the key challenges of the refuse and recycling collection operation is that some routes service both alley and curbside set outs where other routes are only curbside. When ASL collection vehicles are required to collect both curbside and alley set outs on a single route, the City must use smaller collection vehicles that cannot haul as much and will have to stop collecting to dispose material at a transfer station, Landfill or MRF sooner than a larger vehicle would; however, larger vehicles may not be able to collect portions of the route with alleys due to physical constraints and challenging collection environments.

Although the City has previously evaluated the positive impact of minimizing the number of routes mixed between curbside and alley collection and should continue to minimize the number of mixed routes, service at the curb presents its own set of challenges for certain housing types. Street parking and challenging collection environments are physical constraints that minimize efficiency and safety, while increasing the risk of property damage in some areas of the City.

Equipment

Refuse and recycling collection operations utilize the following vehicles provided with technical descriptions:

- **Automated Side Load (ASL).** ASL collection vehicles operate an automated arm to tip material into the body of the truck for compaction. A one-man crew is able to operate the vehicle and collection arm. The City owns ASLs with 20, 22, 26 and 30 CY of capacity that can collect between six to eight tons of refuse before disposing. The 26 and 30 CY ASL collection vehicles were recently added to the vehicle fleet. The smaller 20 and 22 CY models are able to navigate certain collection environments that 26 and 30 CY models cannot; however, smaller body models cannot hold as much material and are required to leave routes to dispose of collected material sooner than the larger body models. The larger 30 CY model is primarily used for curbside collection and the 20 CY model is used for both curbside and alley collection of both refuse and recycling. Figure D-5 shows an ASL collecting a residential refuse cart.

Figure D-5: Automated Side Load Collection Vehicle

Semi-Automated Rear Load (SA). SA collection vehicles have a cart-tipper located at the rear of the vehicle that is operated by laborers. The laborers must roll carts to the back of the vehicle and initiate the tipper to load material in the truck for compaction. The City owns 20 CY SA collection vehicles that can collect between eight to ten tons of refuse before disposing. Historically, the City deployed SA collection vehicles for recycling routes so laborers could visually inspect carts for high levels of contamination and result in hauling less tonnage of material on average. SA collection vehicles have the advantage of laborers to roll carts to the vehicle to collect material that an ASLs grapple arm would not be able to access. Additionally, SA vehicles are able to collect material from alleys in one pass since laborers can roll carts from both sides to the vehicle. Conversely, a large portion of the City's SA collection vehicles (and a few ASL collection vehicles) are CNG vehicles and may contain fuel tanks that cause challenges maneuvering in confined spaces. Figure D-6 shows a SA vehicle being loaded by laborers.

Figure D-6: Semi-Automated Rear Load Collection Vehicle

Alley Cat (AC). AC are semi-automated rear loading compaction vehicles with 11 CY of capacity. The smaller design allows these vehicles to collect in tighter spaces and provide service in areas that may be

inaccessible to larger vehicles. Similar to the 20 CY ASL model, ACs cannot hold as much material and are required to leave routes to dispose of collected material sooner than larger collection equipment. Figure D-7 shows an AC vehicle for example purposes only, and the vehicle shown is not owned by the City.

Figure D-7: Alley Cat Collection Vehicle

PUP. PUP vehicles are modified pickup trucks with a small collection body that can be used for missed collection and collecting from private residences with long driveways. The City provides Packout service where customers can provide a signed agreement to allow the Sanitation Department to enter private property that is not immediately adjacent to a location accessible to the standard collection vehicle and collect refuse and/or recycling materials. Figure D-8 shows a PUP collection vehicle.

Figure D-8: PUP Collection Vehicle

Table D-8 presents the City's inventory of collection vehicles including the number of front line, backup, and backup ratio.

Table D-8: Frontline and Backup Collection Vehicles

Vehicle Type	Collection Vehicles[1]	Front Line[2]	Backup	Backup Ratio[3]
ASL	84	51	33	39.3%
SA	91	67	24	26.4%
AC	14	12	2	14.3%
PUP	2	1	1	50.0%
Total	**191**	**131**	**60**	**31.4%**

1. Total collection vehicles by type represents vehicle inventory data as of November 16, 2021.
2. Frontline vehicles include all vehicle types and sizes used to service the total daily refuse and recycling routes as of December 10, 2021. Number of daily routes frontline vehicles, and total collection vehicles are subject to change based on pending re-routing and equipment availability.
3. Backup ratio is calculated by dividing the number of backup vehicles by the total collection vehicles.

The backup ratio of vehicles ranges between 26.4 percent and 39.3 percent for ASL, SA and AC vehicles. The backup ratio for SA vehicles is within the typical recommended industry average range of 20 to 25 percent; however, the backup ratio for ASL collection vehicles is higher than the recommended industry average range. Table D-9 shows the breakdown of required collection equipment based on the average utilization of each vehicle type to service the current number of daily refuse and recycling routes.

Table D-9: Required Daily Collection Equipment by Vehicle Type

Vehicle Type	% Refuse Routes[1]	Required Refuse Vehicles[2]	% Recycling Routes[3]	Required Recycling Vehicles[4]	Total
ASL	60.8%	48.0	13.0%	6.5	54.5
SA	34.2%	27.0	79.0%	39.5	66.5
AC	4.7%	3.7	7.5%	3.75	7.5
PUP	0.3%	0.2	0.5%	0.25	0.5
Total	**100.0%**	**79.0**	**100.0%**	**50.0**	129.0

1. Percent refuse routes indicates the percentage of daily refuse routes serviced by each vehicle type as of November 4, 2021.
2. Required refuse vehicles is calculated by multiplying the percent refuse routes by the average daily refuse routes (reference Table D-5)
3. Percent recycling routes indicates the percentage of daily refuse routes serviced by each vehicle type as of November 4, 2021.
4. Required recycling vehicles is calculated by multiplying the percent refuse routes by the average daily refuse routes (reference Table D-6)

Based on the number of current frontline vehicles and required number of each vehicle type to service the current route configuration, the City has sufficient number of frontline equipment to support current

services and has a backup ratio within or exceeding the industry standard range of 20 to 25 percent for each vehicle type.

Equipment Fueling

The City's collection vehicles run on both diesel and CNG. Table D-10 shows the number of vehicles by fuel type.

Table D-10: Collection Vehicles by Fuel Type

Vehicle Type	Diesel	CNG	Total
ASL	82	2	84
SA	48	43	91
AC	14	0	14
PUP	2	0	2
Total	**146**	**45**	**191**

Based on discussions with City staff, the tank size on the older vehicles has limited the distance they can travel; however, newer trucks have larger tanks that eliminate this limitation. The older SA CNG vehicles were conversions and have increased maintenance requirements as compared to the newer CNG vehicles, which were built for CNG fuels versus conversions from diesel. Newer CNG vehicles have improved technology and reliability and do not have the same challenges as the older vehicles with CNG retrofits.

Collection vehicles are stored at truck yards at the sanitation district operations centers among the City. Each sanitation district has a dedicated operations center that contains a diesel fueling station. District 3 and District 4 operations centers are co-located and contains the City's CNG fueling station. Table D-11 shows the number of collection vehicles stored at each sanitation district operation center.

Table D-11: Collection Vehicle Storage Locations[1]

Vehicle Type	District 1	District 2	District 3/4[1]	District 5	Total
ASL	24	20	25	15	84
SA	9	16	44	22	91
AC	0	0	13	1	14
PUP	0	0	2	0	2
Total	**33**	**36**	**84**	**38**	**191**
Percentage	**17%**	**19%**	**44%**	**20%**	**100%**

1. Collection vehicles by storage location represents data as of November 16, 2021.
2. District 3 and District 4 are shown on a combined basis because they are co-located.

9.1.1.2 Equipment Maintenance

The majority of collection equipment is maintained by the City's Equipment and Fleet Maintenance (EFM) department. Outside of personnel costs, vehicle maintenance represents the largest operating expenses for the Sanitation Department's collection operations. Table D-12 presents the average age and cost by equipment type for front line collection vehicles.

Table D-12: Average Age and Cost by Vehicle Type

Vehicle Type	Average Age[1]
ASL	4.4
SA	4.8
AC	2.5
PUP	5.0

1. Represents average age of all collection vehicles in City inventory as of November 16, 2021

The average age of frontline ASL, SA and AC vehicles range between 2.5 and 4.8 years depending on the vehicle type. The average age of all ASL, SA, and AC vehicles (including frontline and backup) ranges between 4.4 and 4.8 years. This age range is within the expected five to seven year useful life of these vehicles. This indicates vehicles are being replaced in a timely fashion; however, based on conversations with City staff, equipment maintenance is behind on the life cycle repairs for equipment and the City is considering transitioning to a five-year replacement cycle on ASL vehicles. Collection vehicles operating in the alleys require more maintenance and sustain more damage than other vehicles in the City's fleet.

There are sufficient backup vehicles to support collection operations, but there are challenges coordinating with EFM to maintain vehicle availability and the backup ratio is shown to be higher than industry average. A high backup ratio indicates that the City may need to adjust the purchasing frequency of certain types of vehicles to minimize the ownership of unused equipment that requires storing. To proactively minimize the need for maintenance and ensure that repairs are completed in a timely manner, collection operations must ensure that the correct equipment is deployed based on the route's collection environment (e.g., alley, curbside) and collection vehicle operators are not required to "overpack" trucks in an attempt to complete routes using smaller capacity vehicles. When there are delays in vehicle maintenance and repair that limit availability of specific types of vehicles, it creates challenges optimizing the collection operation, particularly during times when volumes are surging.

Cart Management

This section provides a description of the City's cart management including the resources deployed to provide this service. City staff provides cart maintenance, repair, collection, delivery and inventory management for refuse and recycling carts. Approximately 80 percent of carts are managed and stored at the special services building and the additional 20 percent of cart inventory is stored at Bachman.

Cart management is a critical part of providing refuse and recycling collection service and consists of cart collection/delivery, assembly, repair, maintenance, cleaning, and inventorying. The capability to provide this service in-house allows the City to be responsive to customer service requests as it relates to requesting or removing carts, since they do not have to work with a third party to respond to these requests.

If the City has challenges maintaining staff or equipment related to cart management, hiring a third party could be considered to allow for increased responsiveness to cart management requests, but would come at a cost of paying the third party for service. Some other cities in the region outsource the management of carts to a third-party vendors either by contracting directly with the cart vendor or hiring an outside group to provide maintenance, repair, collection and delivery only.

Staffing Requirements

This section describes the refuse and recycling collection system staffing and estimates the required staffing levels of supervisors and collection operators to identify if the current staffing levels are sufficient to maximize the efficiency of the refuse and recycling collection system. Table D-13 shows the current staffing for the refuse and recycling collection operation.

Table D-13: Current Collection Operations Staffing[1]

Title/Job Function	FTE Positions Filled	FTE Positions Vacant	Role
Manager	5	0	Supervisory position that manages collection operations and business planning.
Supervisor	16	0	Supervisory position that manages collection operations both district-wide and on a route-by-route basis.
Truck Driver	154	11	Position that operates collection vehicles including ASLs, SA, AC or PUP trucks.
Contract Laborer[1]	164	0	Contract labor that supports collection operations including operating SA collection vehicles.
Total Staff	**339**	**11**	

1. FTE Managers, Supervisors and Truck Drivers are based on organizational charts provided as of August 8, 2020.
2. FTE contract laborers calculated based on FY 2020 contract labor costs for refuse and recycling service.

The refuse and recycling collection operation is split among the five collection districts, which operate independently. Table D-14 shows the total number of FTEs among each of the collection districts

Table D-14: Current Collection Operations Staffing by District[1]

Title/Job Function	District 1	District 2	District 3	District 4	District 5	Total
Manager	1	1	1	1	1	5
Supervisor	3	3	3	4	3	16
Truck Driver	27	28	30	39	30	154
Total	**31**	**32**	**34**	**44**	**34**	**175**

1. Contract laborers not shown by district because they may shift among districts on an as-needed basis

To effectively operate the collection system, there needs to be a sufficient number of district and route supervisors. Table D-15 shows the number of supervisor staffing demand based on the average daily number of refuse and recycling routes run.

Table D-15: Supervisor Staffing

Material Type	Average Daily Routes[1]	Supervisor Demand[1]	FTE Supervisors
Refuse	79.0	7.9	10
Recycling	50.0	5.0	6
Total	**129.0**	**12.9**	**16**

1. Reference Table D-5 and Table D-6.
2. Industry standard suggests one route supervisors per ten routes is sufficient to support operations.

Based on the current number of average daily routes, the number of current FTE supervisors is sufficient to manage the collection system.

Table D-16 shows the total number of crew members required by each vehicle type to operate the various types of collection vehicles in the City's fleet.

Table D-16: Crew Structure by Collection Vehicle Type

Crew Structure	ASL	SA	AC
Driver	1	1	1
Contract Labor	0	2	2
Total	**1**	**3**	**3**

Table D-17 present the required collection staff to operate the current number of refuse and recycling collection routes multiplying the number of each type of personnel required to operate each equipment type by the minimum number of equipment required to service the current routes.

Table D-17: Required Equipment Operating Staff by Vehicle Type

Description	ASL	SA	AC
Daily Routes[1]	55	67	7
Drivers	55	67	7
Contract Labor	0	133	15
Subtotal	**55**	**200**	**22**
Backup[2]	20%	20%	20%
Total	**65**	**239**	**27**

1. Required equipment by vehicle type presented in Table D-9.
2. 20 percent backup is included to account for PTO, sick leave and unexpected absences.

Based on the required staffing, there is sufficient number of FTEs to provide refuse and recycling collection service. However, based on discussions with staff collection operators work a high number of overtime hours because staff are asked to support other parts of the operations (e.g., brush and bulky item collection on Wednesdays and Saturdays). Even with a sufficient number of FTEs, there is still a strain on staffing

across the collection system due to this need, particularly when there are surges in material or challenges securing contract labor.

Customer Service

The City provides customer service through the 3-1-1 program. Table D-18 shows the number of complaints related to refuse and recycling were addressed in FY 2020.

Table D-18: FY 2020 Total Service Resolutions by Sanitation District[1]

District	Refuse	Recycling
1	10,039	2,606
2	16,008	5,584
3	7,708	5,660
4	7,806	3,647
5	5,319	2,508
Total	**46,880**	**20,005**

Although it may seem that the combined total of about 67,000 annual customer service is high, it represents a relatively high service success rate provided to customers on an annual basis. Table D-19 shows the services success rate in FY 2020.

Table D-19: FY 2020 Service Resolutions per Service Opportunity

Description	Refuse	Recycling
Customers	249,639	248,923
Services Opportunities per year[1]	12,981,228	12,943,996
Service Resolutions	46,880	20,005
Service Success Rate[2]	99.6%	99.8%

1. Calculated by multiplying the number of customers by 52 weeks per year since residents receive once a week collection.
2. Service success rate represents the percentage of customers serviced annually that do not require any ticket resolutions calculated by dividing the service resolutions by the service opportunities and subtracting from 100%.

When put into this context, the City's service success rate indicates that refuse and recycling collection operations successfully service 99.6 percent of refuse customers and 99.8 of recycling customers without need for service resolutions.

APPENDIX E - LANDFILL OPERATION EVALUATION

This section describes the evaluation methodology, overviews the Landfill facility operation and identifies operational challenges.

Methodology

As part of the LSWMP Update, a full working day of operations were observed at the Landfill on April 27 and 28, 2021 (Landfill Site Visit). Operational activities reviewed included, but were not limited to:

- General operations and procedures
- Facility opening and closing
- Waste flow and traffic control
- Staffing levels
- Equipment types and maintenance
- Site development progress
- Leachate collection systems
- Gas collection and control system (GCCS)
- Stormwater management

Additionally, discussions were held with various members of management and staff to discuss ongoing operations and collect data which is incorporated in this section. Based on the Landfill Site Visit and data analysis, the following provides a detailed overview of the Landfill operations and describes current challenges to inform the development of options for the City's consideration.

Landfill Operation Overview

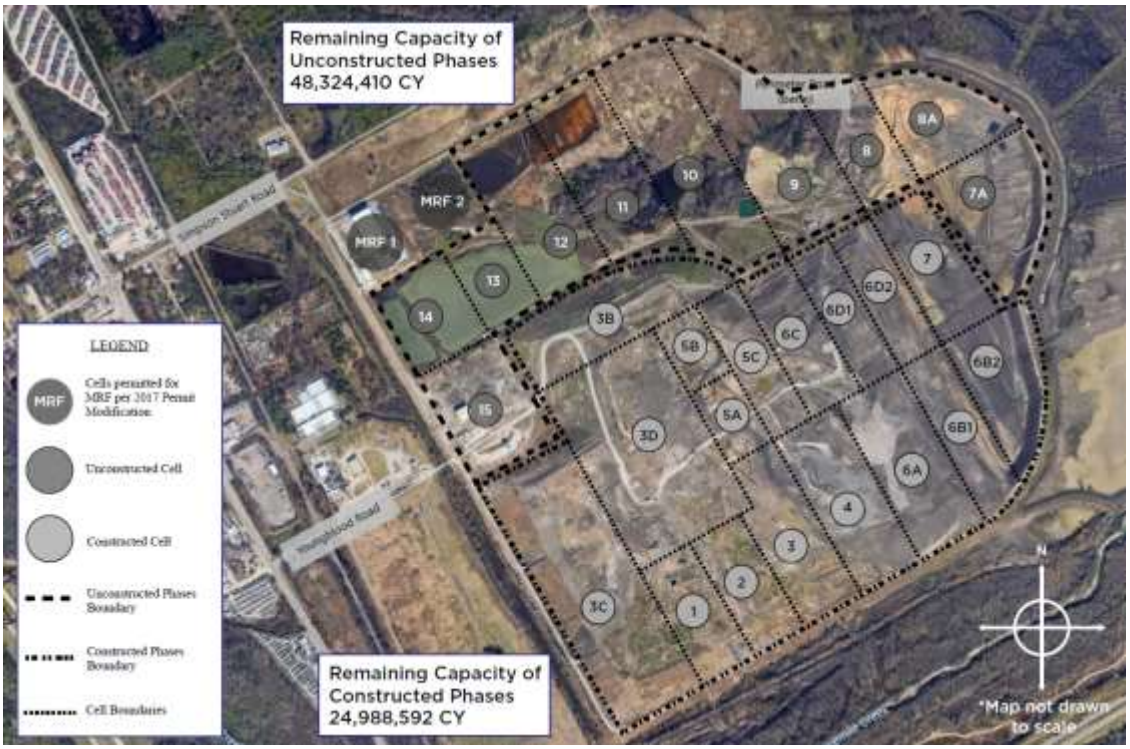
The Landfill manages high tonnage and volume of daily customers. The City owns and operates the Landfill, located at 5100 Youngblood Road just north of the intersection of Interstates 45 and 20. The Landfill is open to customers from 5:00 am to 8:00 pm Monday through Friday and 6:00 am to 4:00 pm on Saturday; however, the facility is permitted to operate 24 hours per day. Table E-1 provides the permits and registrations that have been issued by the TCEQ or are currently pending.

Table E-1: Regulatory Operating Licenses Issued by TCEQ

Number	Type	Description
62	Permit	Type I MSW Disposal
6200461	Registration	Tires Registration
TXR05DF34	Permit	Stormwater
74705	Permit	Title V Air Operating Permit
165313 (Pending)	Registration	Air New Source Registration
4327 (Pending)	Permit	Air Operating Permit

The Landfill has a permitted boundary of 965 acres with a waste disposal footprint of 877 acres. There is approximately 70,713,556 cubic yards remaining of the originally designed capacity 155,901,455CY including both constructed and unconstructed areas of the Landfill (excluding final cover) based on the most recent airspace analysis conducted October 2021. Constructed and open cells are identified on Figure E-1 and constructed cells contain intermediate cover. For future cells 7A through 15 (also identified on Figure E-1), there is an additional approximately 48,324,410 CY of available airspace (excluding final cover).

Figure E-1: Currently Constructed and Planned Landfill Cells



At the time of the Landfill Site Visit, waste filling was occurring in cell 6B2 along the southeast border of the waste disposal footprint and based on discussion with City staff will continue north as part of the fill plan. The areas identified as MRF 1 and MRF 2 indicate the location of the existing MRF land designated for future expansion. These parcels were initially part of the Landfill footprint and were adjusted as part of a permit modification. The equivalent amount of airspace was added to the current permit capacity in an airspace swap, so there was no effective change to the permitted airspace.

The Landfill accepts and processes an average of 6,400 tons of waste per day during a six-day work week and processes a range of 1,400 to 1,600 loads per day, many of which come from small haulers who need to manually unload. Table E-2 shows the reported tonnage accepted and disposed at the Landfill between fiscal years (FY) 2010 and 2020 (beginning October 1 and ending September 30), the annual airspace consumed, airspace utilization factor (AUF), and the annual remaining airspace. In addition, the 2011 LSWMP disposal projections are provided as a comparison to projected and actual tons received at the Landfill.

Table E-2: Historical Annual Disposal Tons, Airspace Consumed and Remaining Airspace

Fiscal Year	2011 LSWMP Disposal Projections (Tons)[1]	Reported Disposal (Tons)[2]	Airspace Consumed (CY)[3]	AUF (lbs/CY)[4]	Remaining Airspace (CY)[5]
2010	1,362,422	1,362,266	1,970,242	1,383	99,810,182
2011	1,373,629	1,355,411	1,658,908	1,634	98,151,274
2012	1,384,836	1,419,508	1,284,718	2,210	96,866,556
2013	1,396,043	1,461,947	2,097,483	1,394	94,769,073
2014	1,407,250	1,872,789	2,647,052	1,415	92,122,021
2015	1,418,457	1,707,183	2,071,824	1,648	90,050,197
2016	1,429,671	2,138,532	2,595,306	1,648	87,454,891
2017[6]	1,440,974	1,887,251	6,758,328	558	80,696,563
2018	1,452,366	1,797,349	1,587,236	2,265	79,109,327
2019	1,463,848	1,782,700	2,139,568	1,666	76,969,759
2020	1,475,421	1,617,121	2,105,291	1,600	74,864,468
2021		1,618,387	3,504,571	1,469	71,359,897

1. The 2011 LSWMP Waste Quantity Projections Technical Memo estimates the Landfill reaching capacity in the year 2053 assuming all the waste currently going to the Landfill will continue based on only the current users of the facility. The basis for the tonnage growth projections in the 2011 LSWMP is population growth.
2. Tons disposed are based on annual reports submitted to TCEQ.
3. Annual airspace consumed is calculated based on the reported airspace utilization factor reported annually to TCEQ.
4. AUF is calculated by dividing the reported disposal by the consumed airspace annually.
5. Remaining airspace is based on annual reports submitted to TCEQ

Pricing has a big impact on the volume of tonnage that is disposed at the Landfill. The City began raising prices for disposal to be more in line with other facilities in the region in 2018. Table E-3 shows this historical gate rate for the Landfill between 2015 and 2021.

Table E-3: Historical Landfill Gate Rate

Fiscal Year	Gate Rate	Dollar Change	Percent Change
2015	$21.50	$0.00	0.0%
2016	$21.50	$0.00	0.0%
2017	$25.00	$3.50	16.3%
2018	$25.00	$0.00	0.0%
2019	$26.25	$1.25	5.0%
2020	$28.50	$2.25	8.6%
2021	$34.20	$5.70	20.0%
2022	$34.88	$0.68	2.0%

The City allows higher volume customers to receive a discount relative to the gate rate (currently $34.88 per ton) based on the guaranteed annual tons and the length of commitment. Once the discounted rate is established, it increases each year of the contract based on a Consumer Price Index (CPI) adjustment. Table E-4 presents the Landfill discount matrix.

Table E-4: Landfill Discount Matrix

Guaranteed Annual Tons		Discount from Gate Rate		
From	To	1 or 2 Year Contract Term	3 or 4 Year Contract Term	5 Year Contract Term
5,000	9,999	12.28%	13.60%	14.88%
10,000	49,999	17.81%	19.72%	21.58%
50,000	74,999	20.65%	23.55%	29.23%
75,000	99,999	21.58%	25.46%	33.06%
100,000	124,999	22.62%	27.32%	36.83%
125,000	149,999	22.85%	27.78%	37.87%
150,000	199,999	22.97%	28.13%	38.45%
200,000	No maximum	23.20%	28.65%	39.38%

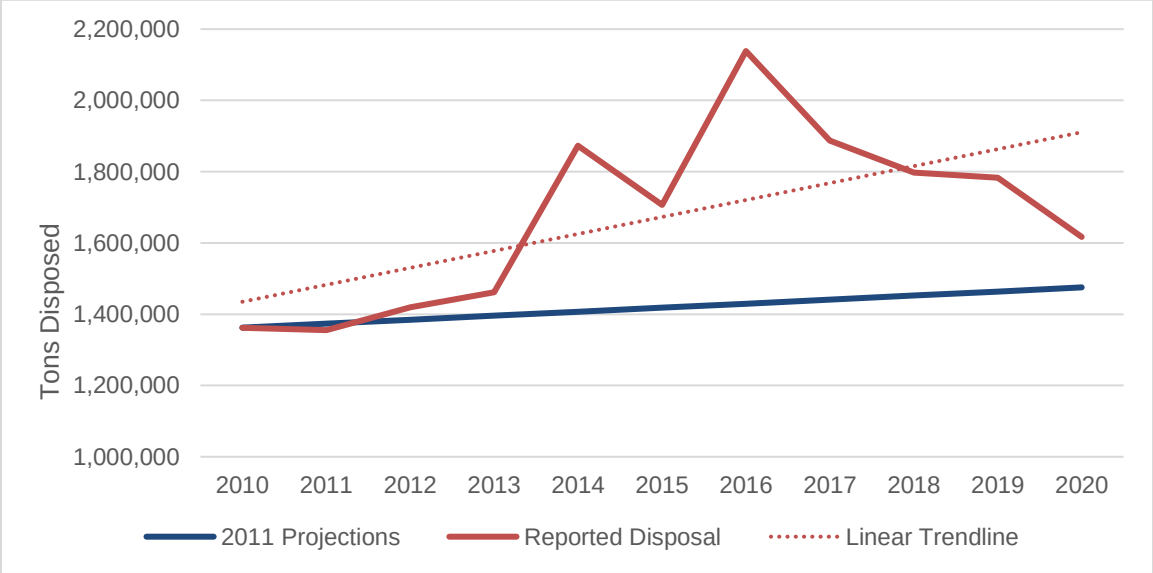
The closure and post-closure care of the Landfill is subject to the requirements of Subtitle D of the Resource Conservation and Recovery Act (P.L. 94-580) and Sections 330.250-256 of Title 30 of the Texas

Administrative Code administered by the TCEQ. These regulations require the City to place a final cover on each cell of the Landfill when it ceases to accept waste and perform certain maintenance and monitoring functions for thirty years after the closure of each cell. Because final contours have not been achieved, the City has not yet initiated closure of any of this landfill or incurred closure expenses. Based on the City's 2020 Comprehensive Annual Financial Report (CAFR), the total long-term liability is estimated at $42.8 million for closure/post-closure care.

Comparison of 2011 LSWMP to Actual Disposal Rates

Between FY 2010 and 2020 about 2.8 million tons were disposed above the projections provided as part of the 2011 LSWMP (15.6 million projected tons versus 18.4 million reported disposal tons). Figure E-2 shows the annual disposal projections from the 2011 LSWMP, historical tonnage disposed at the Landfill over the past ten years, and the linear trendline demonstrating the year-over-year actual growth of 1.73 percent.

Figure E-2: Historical Landfill Disposal Tons



The 2011 LSWMP projected there would be 79,459,156 CY of remaining airspace in 2020; however, the actual available airspace of the Landfill in 2020 is 74,864,468 CY, about 4.5 million CY less than projected. Additionally, the 2011 LSWMP estimated that the Landfill would reach capacity in 2053[110]. Based on the most recent annual report submitted to TCEQ, the Landfill is currently projected to reach capacity in 2055.

[110] The 2011 LSWMP Waste Quantity Projections Technical Memo estimates the Landfill reaching capacity in the year 2053 assuming all the waste currently going to the Landfill will continue based on only the current users of the facility.

Airspace Utilization Factor

The Landfill's AUF is key to understanding how well waste disposal is being managed to conserve airspace and is a critical component of projecting remaining Landfill life and planning for future cell constructions and closures. The AUF is a measure of the total airspace consumed by the tonnage of waste disposed. To calculate the AUF, the following information is required:

- Tonnage of the waste disposed in the Landfill during a period of time
- Airspace utilized in cubic yards during the same period of time

The AUF is calculated by the following equation:

$$AUF\ \left(\frac{pounds}{CY}\right) = \frac{Waste\ Disposed\ (tons) \times 2{,}000\frac{pounds}{ton}}{Total\ Airspace\ Consumed\ (CY)}$$

The average historic annual AUF based on the data reported to TCEQ between 2010 and 2020 is about 1,600 pounds per cubic yard (lbs/CY). Based on industry experience, an AUF of greater than 1,400 lbs/CY is achievable if the staffing and equipment is deployed strategically. The City is currently exceeding this based on calculations. Cover soil is excavated from the levee surrounding the east side of the Landfill adjacent to the Trinity River as part of an ongoing floodplain project. Although operations are able to achieve economies of scale to minimize the amount of soil used for cover, staff indicated during the Landfill Site Visit that soil usage ranges between 15 and 30 percent of the disposed material, including 18 inches of intermediate cover. Using soil at a rate of 15 to 20 percent of material disposed is more typical for a facility of this size; however, the City is able to mitigate litter, erosion and fugitive emissions with the application of 18 inches of intermediate cover.

Staffing

This section describes the Landfill required staffing levels, vacancies, training, and safety considerations. Staff operate two shifts from (1) 3:30 am to 3:00 pm and (2) 10:30 am to close on a four days per week 10 hours per day schedule. Table E-5 shows the current staffing for the Landfill management and operations staff involved in the direct operations of the Landfill (e.g., environmental coordinators, hazardous waste inspectors, and office assistance are not included).

Table E-5: Current Staffing for Landfill Management and Operations

Title/Job Function	FTE Positions Filled	FTE Positions Vacant	Role
Manager	2	0	Supervisory position that manages Landfill operations, scalehouse operations, and Landfill business planning.
Supervisor	3	0	Supervisory position that manages Landfill operations, scalehouse operations, and Landfill business planning.
Crew Leader	3	0	Supervisory role managing equipment operators.
Equipment Operator	33	14	Position that executes working face operations (spreading, compacting and covering waste), hauling of daily cover soils, erosion control, and road maintenance.
Laborer	17	3	Position that supports Landfill operations including directing vehicle traffic and collecting windblown litter.
Customer Service Representative (CSR)	8	4	Position that executes operations at the scalehouses.
Total Landfill Staff	**66**	**21**	

Based on the current number of management and operations positions filled and current vacancies, there is a 24 percent vacancy rate. During the Landfill Site Visit supervisors indicated that they often fill in or support equipment operations when operations are short staffed. Overtime costs are estimated to be about 20-30 percent of annual operating costs and may be attributed to the high vacancy rate.

Table E-6 estimates the number of equipment operators required to meet the observed operations at the Landfill.

Table E-6: Required Equipment Operator Daily Staff Hours

Working Day	Receiving Hours[1]	Operators During Receiving Hours[2]	Non-Receiving Hours[3]	Operators During Non-Receiving Hours[4]	Daily Staffing Hours
Monday	14	13	3	3	191
Tuesday	14	13	3	3	191
Wednesday	14	13	3	3	191
Thursday	14	13	3	3	191
Friday	14	13	3	3	191
Saturday	9	13	3	3	126
Total	**79**		**18**		**1,081**

1. Receiving hours are based on the time that the Landfill is open to receiving waste from customers between 5:00 am and 8:00 pm Monday through Friday and 6:00 am to 4:00 pm on Saturday, less an hour for lunch break, for a total of 79 hours per week.
2. The number of operators required during receiving hours is based on the minimum requirements per the Site Operating Plan of running three compactors, three dozers, three dump trucks, two scrapers, motor grader, and excavator, assuming that no additional personnel is required to operate the tipper or motor grader.
3. Non-receiving hours are based on staff arriving to the Landfill 1.5 hours before the facility begins receiving waste and 1.5 hours after closing.
4. The number of operators required during non-receiving hours is based on the minimum requirement of running two dozers and the hydro seeder.

Table E-7 calculates the required equipment operator staffing based on the total daily staff hours required to operate the Landfill.

Table E-7: Required Equipment Operator Staffing

Description	Person-Hours Required per Week
Staff Hours[1]	1,081
Back-up[2]	216
Total Required Staff Hours	1,297
Required Equipment Operators[3]	32.43
Additional Staff Required	**-0.57**

1. Required weekly staff hours for equipment operators is calculated in Table E-6.
2. Twenty percent of total time required for all activities was used to account for FTE staff back-up, which includes time for training, vacations, sick time, and other unforeseen circumstances.
3. Required equipment operators is calculated by dividing the total required staff hours by 40 hours per week.

The currently staffed 33 equipment operators working 40 hours per week provide enough to cover the calculated 32.43 required equipment operators. If the City were able to fill the 14 available vacancies for

equipment operators, they would be able to operate at full capacity with redundancy and minimize need for overtime and challenges approving PTO.

The City's 24 percent vacancy rate and overtime expenditures ranging between 20-30 percent of the operating budget. Typical overtime expenditures for overtime at landfills are between zero and five percent and usage of overtime is meant to provide the flexibility to increase staff on an as-needed basis, rather than as a consistent management practice.

Table E-8 estimates the number of laborers required meet the observed operations at the Landfill.

Table E-8: Required Laborer Daily Staff Hours

Working Day	Receiving Hours[1]	FTE Laborers[2]	FTE Laborers Hours	Temporary Laborers	Temporary Laborers Hours	Total Daily Staffing Hours
Monday	14	4	56	2	28	84
Tuesday	14	4	56	2	28	84
Wednesday	14	4	56	2	28	84
Thursday	14	4	56	2	28	84
Friday	14	4	56	2	28	84
Saturday	9	4	36	2	18	54
Total	**79**		**316**		**158**	**474**

1. Receiving hours are based on the time that the Landfill is open to receiving waste from customers between 5:00 am and 8:00 pm Monday through Friday and 6:00 am to 4:00 pm on Saturday, less an hour for lunch break, for a total of 79 hours per week.
2. The number of laborers required during receiving hours is based on discussions with City staff indicating that four FTE laborers and two temporary laborers are required to manage traffic at the working face and to collect windblown material around the Landfill.

Table E-9 calculates the required laborer staffing based on the total daily staff hours required to operate the Landfill.

Table E-9: Required Laborer Staffing

Description	Person-Hours Required per Week
Weekly FTE Laborers Staff Hours[1]	316
Weekly Temporary Laborers Staff Hours	158
Back-up[2]	63
Total Required Staff Hours	379
Required Laborers[3]	9.48
Additional Staff Required	-3.52

1. Required weekly staff hours for laborers is calculated in Table E-8.
2. Twenty percent of total time required for all activities was used to account for FTE staff (temporary laborers not included) back-up, which includes time for training, vacations, sick time, and other unforeseen circumstances.
3. Required equipment operators is calculated by dividing the total required staff hours by 40 hours per week.

The currently staffed 17 laborers operating 40 hours per week sufficiently cover the staffing demand.

Table E-10 estimates number of CSRs required meet the observed operations at the Landfill.

Table E-10: Required CSR Daily Staff Hours

Working Day	Receiving Hours[1]	CSRs During Receiving Hours[2]	Non-Receiving Hours[3]	CSRs During Non-Receiving Hours[4]	Daily Staffing Hours
Monday	14	5	1	2	71
Tuesday	14	5	1	2	71
Wednesday	14	5	1	2	71
Thursday	14	5	1	2	71
Friday	14	5	1	2	71
Saturday	9	5	1	2	46
Total	**79**				**401**

1. Receiving hours are based on the time that the Landfill is open to receiving waste from customers between 5:00 am and 8:00 pm Monday through Friday and 6:00 am to 4:00 pm on Saturday, less an hour for lunch break, for a total of 79 hours per week.
2. The number of CSRs required during receiving hours is based on five CSRs in the Youngblood Scalehouse and none at the Stuart Simpson Scalehouse.
3. Non-receiving hours are based on CSRs arriving to the Landfill 30 minutes before the facility begins receiving waste and 30 minutes after closing.
4. The number of CSRs required during non-receiving hours is based on one CSR opening and closing each scalehouse after the Landfill closes.

Table E-11 calculates the required CSR staffing based on the total daily staff hours required to operate the Landfill.

Table E-11: Required CSR Staffing

Description	Person-Hours Required per Week
Staff Hours[1]	401
Back-up[2]	80
Total Required Staff Hours	481
Required CSRs[3]	12.03
Additional Staff Required	**4.03**

1. Required weekly staff hours for CSRs is calculated in Table E-10.
2. Twenty percent of total time required for all activities was used to account for FTE staff back-up, which includes time for training, vacations, sick time, and other unforeseen circumstances.
3. Required equipment operators is calculated by dividing the total required staff hours by 40 hours per week.

The currently staffed eight CSRs operating 40 hours per week do not provide enough to cover the calculated 12.03 required CSRs, indicating a need for 4.03 additional FTE CSRs. If the City were able to fill the four available vacancies for CSRs, they would be able to operate at full capacity and minimize transaction time at the Landfill's scalehouses and overtime demand. Additionally, operational changes at the scalehouses may decrease the requirements for additional CSRs such as minimizing manual data entry or installing upgraded transaction technology.

Based on discussion with City staff, challenges maintaining a full staffing roster may be due to lower salaries offered by the City compared to other equipment operator positions at facilities in the region and a lack of performance incentive programs such as performance-based annual bonuses. The City currently offers $23.00 per hour for equipment operators.

Job hiring is open and transparent but there is a lack of career ladder and succession planning. Managers note that the City's hiring panel is broad and may not have landfill operations background. Based on this hiring approach, there is potential for a current employee that is best fit for the job to not be offered the position.

Training and Safety

Landfill operation has been identified as one of the most dangerous industries according to the Occupational Safety and Health Administration (OSHA). Landfill staff are trained in accordance with the SOP by persons trained in waste management procedures in accordance with 30 TAC 335.586 (a) and (c) in the following topics:

- Customer notification and load inspection procedures
- Identification of hazardous wastes, PCB wastes, and other prohibited wastes

- Waste handling procedures (acceptable and prohibited wastes)
- Segregation of construction and demolition waste
- Health and safety issues
- Fire safety
- Emergency response procedures
- Landfill fire prevention and response
- Record keeping

Documentation of introductory and continued training is provided to all equipment operators, load inspectors and other personnel at departmental safety meetings and training sessions including TCEQ-sponsored courses, or other approved training courses.

Equipment

This section describes the equipment that is used to operate the Landfill including the frontline and backup equipment and description of the vehicle storage, fueling and maintenance provided at the Landfill. Table E-12 shows the equipment type, make, model, number of frontline equipment, backup equipment, and average age of frontline equipment.

Table E-12: Landfill Equipment List

Equipment Type	Make	Frontline Units	Average Age (years)[1]	Backup Units
Compactor[3]	CAT	3	4.3	2
Dozer[4]	CAT	8	7.3	4
Articulating Dump Truck (ADT)[5]	CAT	3	5.7	3
Excavator[6]	CAT	3	4.0	1
Trailer Tipper[7]	Phelps	1	16.0	1
Grader[8]	CAT	2	15.5	0

1. Average age as of 2021 includes frontline equipment only.
2. Backup ratio calculated by dividing the total backup units by the total available units.
3. Compactor models include CAT 836H and CAT 836K. Frontline units include equipment numbers 179108, 179109, and 199110.
4. Dozer models include D7, D8, D9, and CAT 973 Track Loader. Frontline units include equipment numbers 179225, 189227, 199229, 209230, 109217, 189226, 189228, and 209401. The City has approved purchase of additional D6XEs to replace the existing D8Ts which have maintenance challenges related to overheating during heavy use.
5. ADT models include CAT 740 and 740B. Frontline units include equipment numbers 139328, 159346, and 199347.
6. Excavator models include Komatsu PC400LC, CAT 336EL, CAT 349FL; and CAT 336. Frontline units include equipment numbers 139527, 189528, and 209530.
7. Frontline trailer tipper unit is equipment number 59705.
8. Grader models include 14G and 140M. Frontline units include equipment numbers 279173 and 189008.

Based on the equipment roster provided the City has sufficient equipment to operate the Landfill, assuming all equipment are available, consistent with the observations during the Landfill Site Visit.

Equipment Maintenance

Heavy equipment maintenance is performed in an on-site shop under as part of Landfill operations. Outside vendors are used for maintenance tasks that are beyond the scope of the shop such as drive train components. Figure E-3 shows the heavy equipment and maintenance shop.

Figure E-3: Heavy Equipment Maintenance Shop

The maintenance shop appears to be functional and provides the support required by operations for Landfill equipment availability, but struggles to manage transfer station trailer and truck equipment in addition to the other Landfill equipment. Maintenance staff provides the following services and shifts:

- Fueling 4:30 am to 1:00 pm Monday to Friday
- Day repair shift 6:30 am to 3:00 pm Monday to Friday
- Fueling and minor maintenance 12:30 pm to 9:00 pm Monday to Friday
- Fueling and minor maintenance 6:30 am to 3:00 pm Saturday and Sunday

The City maintains good preventative maintenance practices to minimize repair costs for equipment. Table E-13 shows the maintenance targets for compactors, dozers, and ADTs, comparing the average usage of frontline and backup equipment to the target replacement usage.

Table E-13: Equipment Replacement

Equipment Type	Target Replacement Usage (hours)	Average Frontline Usage to Date	Average Backup Usage to Date
Compactor	25,000	5,781	31,545
Bulldozer	25,000	12,487	18,180
Articulating Dump Truck	20,000	8,574	20,011

The PM practices in place include doing a certified powertrain (CPT) rebuild between 10,000 – 13,000 hours of run time and CAT performs undercarriage maintenance. The City experiences challenges meeting equipment maintenance demand. Based on discussions with City staff, the heavy equipment and maintenance shop is "worn out" and undersized and suffers from a lack of electrical infrastructure that was diverted for other uses around the Landfill (e.g., unattended scale and wheel wash facility). Additionally, manual forms and information tracking are utilized, which decreases operational capacity. This could be addressed by implementing information technology upgrades for data entry and analysis.

In addition to the Landfill equipment, the heavy equipment and maintenance shop is also responsible for maintaining the transfer station fleet. The rest of collection equipment is maintained by the Equipment and Fleet Maintenance (EFM) department which causes challenges related to managing parts inventory and storage, since collection vehicle parts would be stored to two different locations. Based on discussions with City staff, more fleet equipment has been transferred over to the heavy equipment and maintenance shop over time which has caused the facility to become too small for the equipment maintenance demand.

This section does not provide a dedicated analysis on maintenance staffing; however, during the Landfill Site Visit City staff communicated there was a high turnover in maintenance staff and challenges filling vacancies, have a limited inventory of parts. The maintenance shop has 15 mechanics and five vacancies. Falling behind on equipment maintenance causes challenges with Landfill operations when there is unplanned downtime for compactors, dozers, ADTs or other equipment. When the number of required units are not available for these equipment types, Landfill operators may not be able to manage material as efficiently from the tipping deck to the working face, achieve intended compaction rates, or haul material (e.g., cover soil) around the site.

Waste Acceptance and Traffic Control

This section discusses the scalehouse operations, inbound vehicles, customer types, and the traffic control measures implemented to manage vehicles traveling within the facility and to the working face.

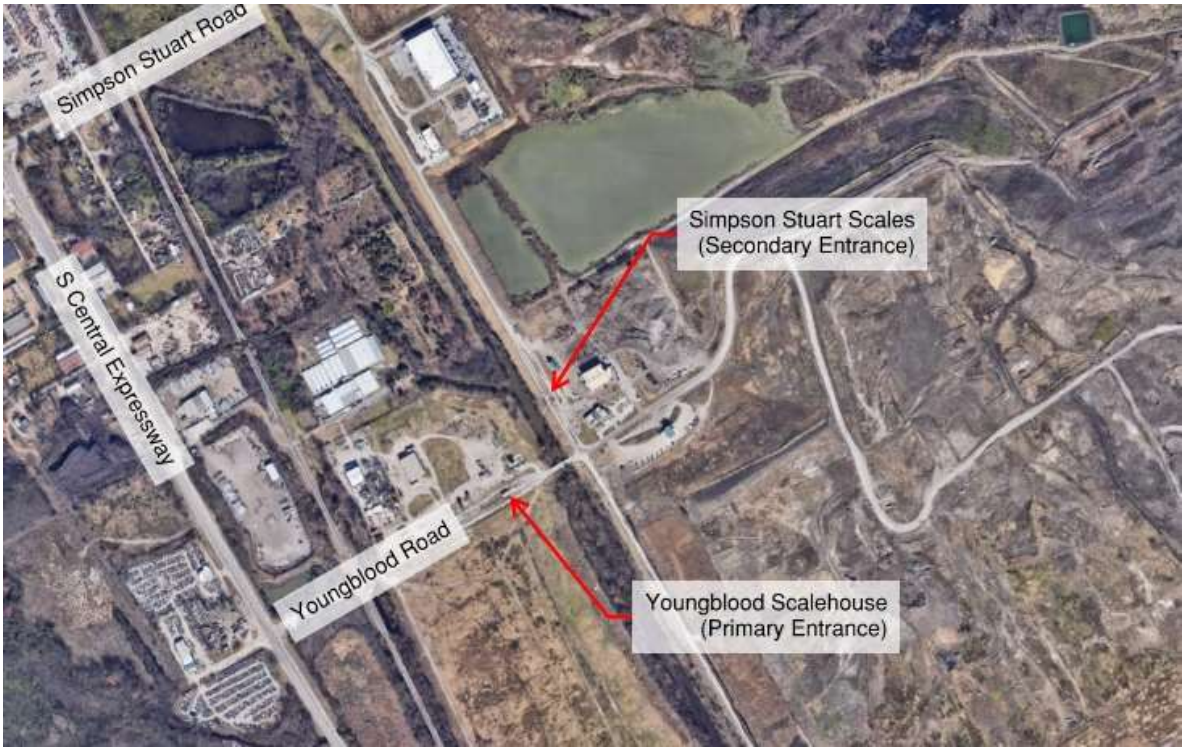
Scalehouse

The Landfill scalehouses are located at the primary entrance to the Facility at Youngblood Road and at the secondary entrance and Stuart Simpson Road. The Landfill has two scale systems: the Youngblood Scalehouse and Simpson Stuart scales that collect data using the WasteWORKS software. The Youngblood Scalehouse is the primary entrance to the site and predominantly serves the small haulers and City residents and contains two inbound scales and one outbound scale with a bypass lane on each side as shown in Figure E-4.

Figure E-4: Youngblood Scalehouse

The Simpson Stuart scales are unattended and act as a secondary site entrance and are primarily used by the Sanitation Department and other large commercial customers and contains two inbound scales and one outbound scale, with a bypass lane on each side. Figure E-5 shows the Landfill scales and scalehouse locations.

Figure E-5: Landfill Scales and Scalehouse Locations



Weight data from the scales is collected using WasteWORKS software and payments are processed at the Youngblood Scalehouse. As part of the draft Scalehouse Feasibility Study prepared by Burns & McDonnell, the transaction data from FY 2019 was evaluated to develop recommendations regarding potential upgrades to the existing scalehouses or the development of a new future facility.

Increases in the number of customers over the past several years have strained the processing capacity of the Landfill's scale system and customers frequently experience longer than expected wait times to enter the Landfill. At the Youngblood Scalehouse, despite a scalehouse design of two inbound scales (Scale 1 and Scale 2) and one outbound scale (Scale 3), data provided by the City indicates consistent use of all three scales for incoming traffic throughout operating hours. The aerial photo in Figure E-6 shows these queuing challenges remain even when all three scales at the Youngblood Scalehouse are used for incoming customers.

Figure E-6: Overhead Snapshot of Traffic at Youngblood Scalehouse

When all three scales are used for inbound vehicles, any customers that need to scale out must wait in line to weigh their empty vehicle so the tonnage of material disposed can be assessed.

Customer Types and Inbound Vehicles

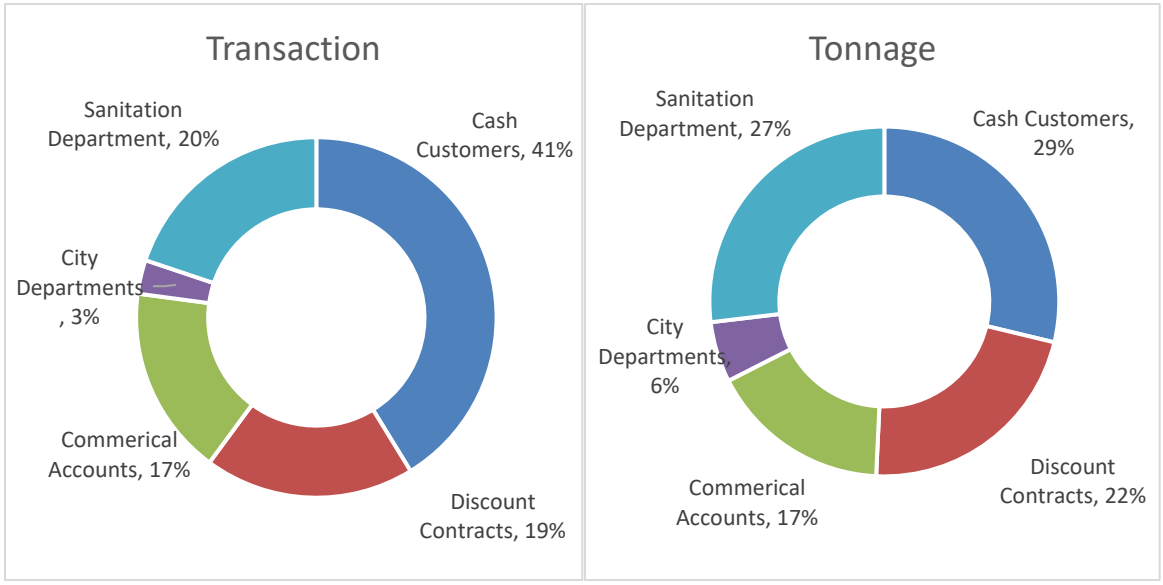
The types of customers serviced by the Landfill are provided below, with brief descriptions:

- **Cash customers.** Point-of-sale customers paying by cash, credit card, or check. Cash customers use residential or light-duty vehicles such as pickup trucks or small trailers that deliver small loads that are self-hauled, including by customers of the City's residential collection program. Cash customers must exit their vehicles at the Youngblood Scalehouse scale to interact with the transaction kiosk and communicate with the scalehouse attendants and must scale out after they have completed disposing their load at the working face.
- **Sanitation Department.** City-operated conventional waste collection vehicles, which have tared weights, including automated side-load or rear load compactor trucks, transfer trailers, or roll-offs that deliver larger loads collected from City customers. Sanitation Department vehicles are able to scale into the Landfill through the Simpson Stuart scales, so they do not need to scale out after they have completed disposing their load at the working face.

- **Commercial and discount accounts.** Commercial customers, who have tared weights, typically deliver material in automated side load, rear load, or roll-offs. Commercial customers that have long-term contracts may receive a discounted disposal fee because they can guarantee annual tonnage volumes that will be disposed at the Landfill. The nine commercial and discount accounts are able to scale into the Simpson Stuart scales, unless their vehicle is not tared. If they are not tared, they would need to scale in and out at the Youngblood Scalehouse.
- **City departments.** City-operated vehicles providing material generated from various City department operations (e.g., parks and recreation). City departments are able to scale into the Landfill and provide their vehicle number to the scalehouse attendant, so they do not need to scale out after they have completed disposing their load at the working face.

Figure E-7 compares the number of annual transactions against the total inbound tonnage by customer type for FY 2020.

Figure E-7: Annual Customer Summary by Total Transactions and Tons, FY 2019



While cash customers comprise the highest number of transactions, these customers' loads are often smaller than those of sanitation services. As a result, the incoming tonnage is more evenly distributed between the three largest customer types: cash customers (29 percent of tonnage), Sanitation Department (27 percent), and discount contracts (22 percent).

One key operational difference between the Youngblood Scalehouse and Simpson Stuart scales is the type of customer transactions processed at each. Cash customers without an existing account must use the Youngblood Scalehouse for processing and payment. Although City residents do not need to pay a tip fee,

they must enter through the Youngblood Scalehouse with proof of residency. The entrance off Simpson Stuart Road is accessible to certain commercial and account customers, such as collection vehicles and transfer trailers from the Sanitation Department as well as other commercial haulers.

Based on an analysis of transactions received from the City, the day with the highest number of transactions was on June 13, 2019, Table E-14 compares summary statistics for the Youngblood Scalehouse and Simpson Stuart scales for June 13, 2019, including number of customers, inbound tons, operating hours, and average customers per hour[111].

Table E-14: Youngblood Scalehouse and Simpson Stuart Scalehouse Single-day Inbound Traffic Comparison (June 13, 2019)

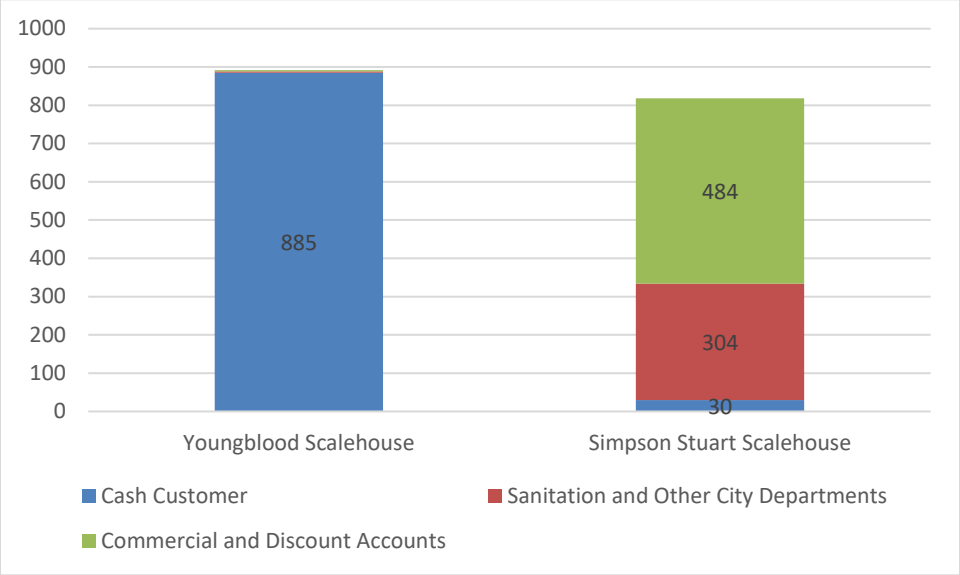
	Youngblood Scalehouse	Simpson Stuart Scalehouse
Daily Number of Customers	892	818
Daily Tons Received	3,163	4,998
Daily Active Operational Hours	15.75	14.5
Average Customers per Hour	57	56
Average Tons per Customer	3.5	6.1
Average Customers per Hour per Scale	19	28

While the daily average traffic for Youngblood Scalehouse and Simpson Stuart scales were similar (57 customers per hour and 56 customers per hour, respectively), Simpson Stuart scales received roughly 1.5 times the incoming tonnage due to customer loads being larger on average (6.1 tons per customer for Simpson Stuart scales compared to 3.5 tons per customer for Youngblood Scalehouse). In total, more customers used the Youngblood Scalehouse likely due to having longer active operating hours (15 hours, 45 minutes for Youngblood compared to 14 hours, 30 minutes for Simpson Stuart scales) and because cash customers must use this scalehouse.

Figure E-8 presents a single-day comparison of the inbound customer types at the Youngblood Scalehouse and Simpson Stuart Scalehouse on June 13, 2019 where Sanitation and other City Departments figures have been combined and commercial and discount customer figures have been combined.

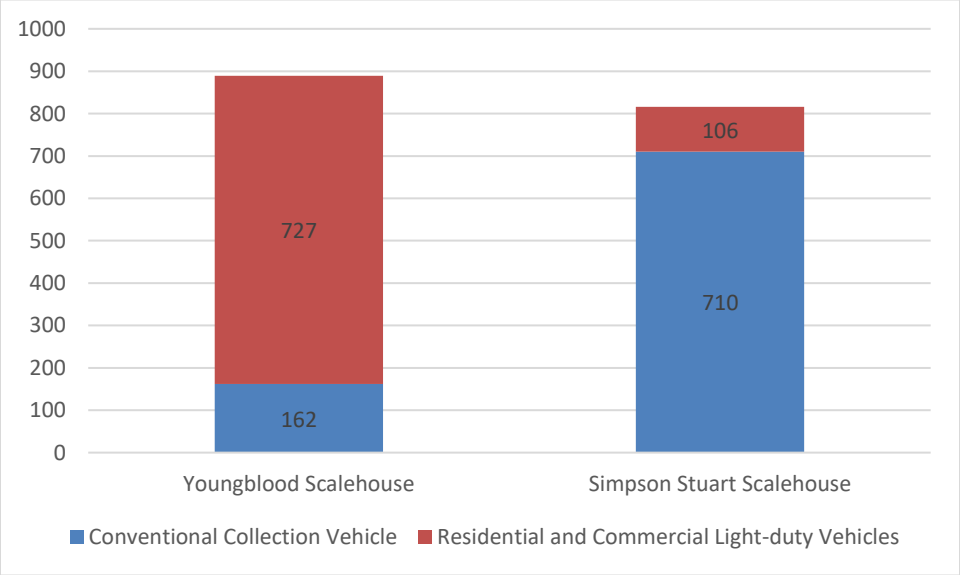
[111] There was a large storm that occurred on June 9, 2019 which may have caused increased Landfill activity.

Figure E-8: Youngblood Scalehouse and Simpson Stuart Scalehouse Single-day Customer Type Comparison (June 13, 2019)



Due to the differences in customer types entering through the Youngblood Scalehouse and Simpson Stuart scales, there are also differences in the vehicle types using each entrance. Figure E-9 presents a single-day comparison of the inbound vehicles at the Youngblood Scalehouse and Simpson Stuart scales comparing the number of conventional collection vehicles and residential and commercial light-duty vehicles at each scalehouse. Only tared vehicles are able to use the Simpson Stuart scales.

Figure E-9: Youngblood Scalehouse and Simpson Stuart Scales Single-Day Vehicle Type Comparison (June 13, 2019)[1]

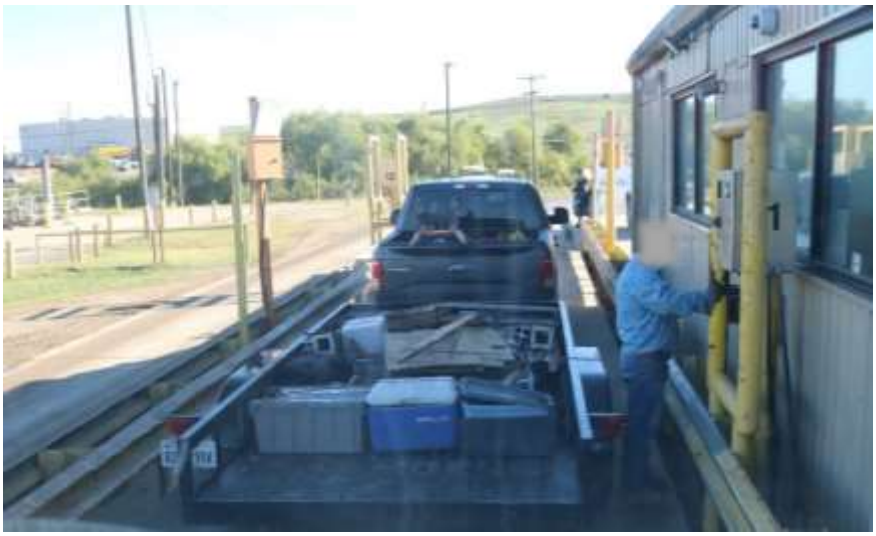


1. Total number of vehicles entering each scalehouse does not sum exactly to the number of total inbound vehicles presented in Table E-14 because they were not categorized by vehicle type and therefore omitted from Figure E-9.

Conventional collection vehicles (e.g., compactor trucks, transfer trailers, roll-offs) primarily enter at Simpson Stuart. Residential and commercial light-duty vehicles (e.g., commercial pickups, small trailers) enter at Youngblood, as well as most large truck/trailer commercial vehicles (unless they have tared vehicles).

Besides the generally high volume of customers that utilize the Landfill, the transaction time at the scalehouses are prolonged by the transaction process and technology employed such as when customers are required to exit their vehicles to conduct the transaction as shown in Table E-10

Figure E-10: Self-Haul Customer Transaction at Youngblood Scalehouse



To increase efficiency of the scalehouses, the City should look to streamline transaction data collection resulting in time saving and improved customer experience. Additionally, updating WasteWORKS software and refreshing the database of customers and transactions would decrease computer software processing time. If the City would be able to maintain card-on-file accounts to reduce point of sale transactions, fewer customers would require manual data entry and reduce transaction time and minimize the potential for mistakes.

Traffic Control

Efficient traffic control at the Landfill is critical to the meeting the long-term operational goals and providing high-quality customer service. Traffic at the Youngblood and Simpson Stuart scalehouses vary on an hourly basis and may depend on the when vehicles on collection routes become full, the workflow of development projects, or when residents are able to self-haul material to the Landfill among work schedules. Figure E-11 shows a single day of the number of hourly customers by vehicle type at the Youngblood Scalehouse and Figure E-12 shows the total hourly customers at the Simpson Stuart scales.

Figure E-11: Single-Day Hourly Scalehouse Customers by Vehicle Type at Youngblood Scalehouse (June 13, 2019)

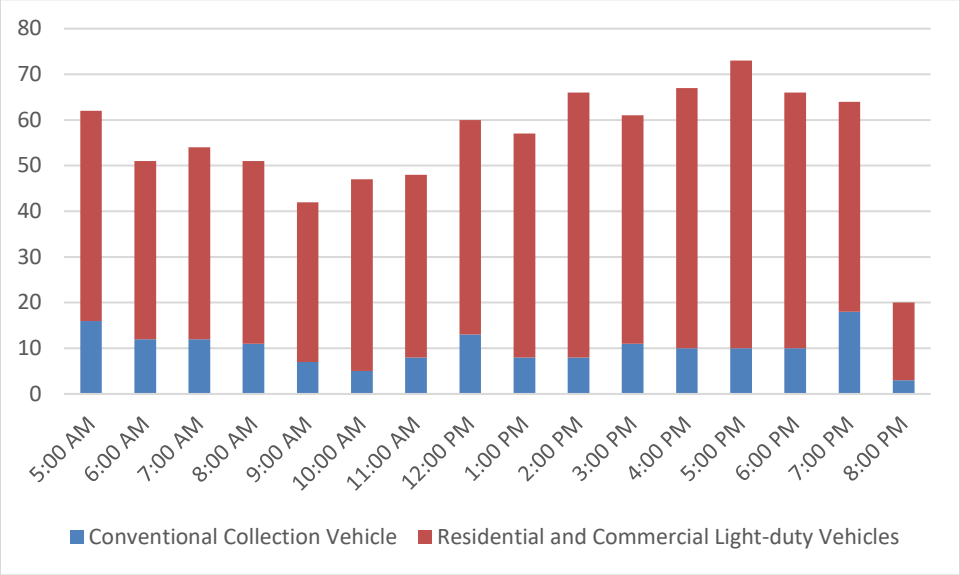
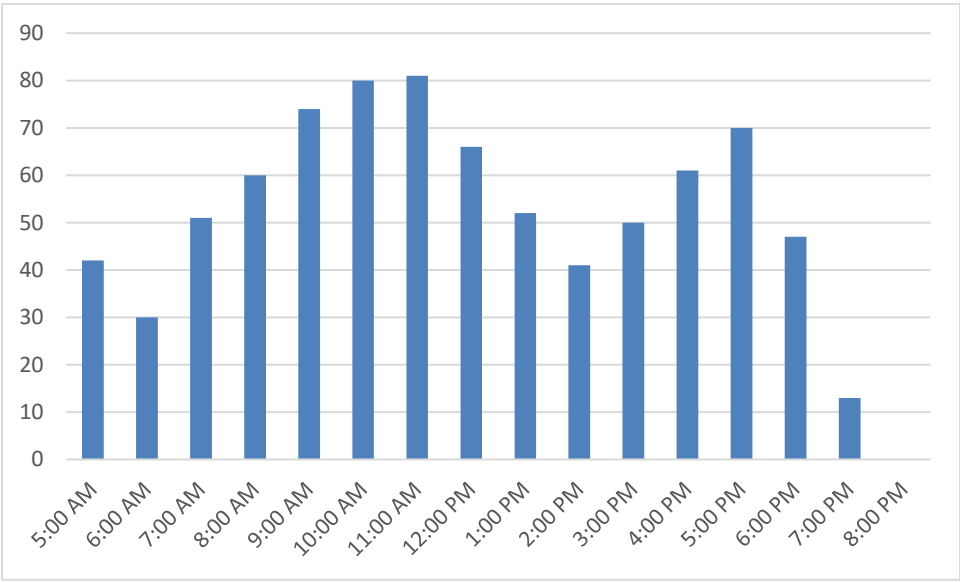


Figure E-12: Single-Day Hourly Scalehouse Customers at Simpson Stuart scales (June 13, 2019)



The customers that enter the Landfill at the start of the day or at the end of the day may be due to commercial customers that finish operations at the end of the day and arrive close to closing or arrive early in the morning hauling material generate the day before.

After scaling into the Landfill, customers from both the Youngblood Scalehouse and Simpson Stuart scales pass through a four-way intersection that is staffed by traffic control personnel to manage the traffic flow through the facility and minimize vehicle collisions.

Customers then travel to the working face of the Landfill and wait in one or more queues to tip material for disposal. The working face is staffed by spotters to organize the customers waiting in line and instruct them when and where to unload their vehicles safely and efficiently on the tipping deck.

Figure E-13: Conventional Collection Vehicle Ejecting Material on Tipping Deck

After disposing material at the on the tipping deck, customers exit the Landfill. Customers with vehicles that are not tared must re-enter the line at the Youngblood Scalehouse to weigh their empty vehicle before exiting the facility.

The time it takes for customers to scale into the Landfill, dispose material at the working face, and exit is referred to as the turnaround time and is a critical factor of customer satisfaction and Landfill operating efficiency. The CCC is available to self-haul customers but is not required for use. Many customers travel to the working face to dispose material instead of using the CCC. These self-haul customers that travel to the working face cause challenges related to traffic congestion and present safety concerns, particularly in adverse weather/operating conditions

Disposal Operations

The following sub-sections describe key aspects of the Landfill's disposal operations including the working face and daily opening and closing procedures.

Working Face

At the time of the Landfill Site Visit, customers traveled to the working face of the Landfill via two internal gravel all-weather roads either (1) over the filled Cells 3D, 5A, 5B 5C and 6C or (2) around the southwest

perimeter of the Landfill to arrive at the working face located at the south end of Cell 6B2. Much of the perimeter is hard surface, providing good vehicle access. The access roads internal to the Landfill, including the roads to the working face, were observed to be in good condition based on the application of ground wood, mulch, and shingles to increase road stability, even during wet conditions. Figure E-14 shows an overhead view of the working face including the vehicle queue.

Figure E-14: Landfill Working Face and Vehicle Queue

The location of the working face changes as Landfill filling progresses. Based on observations the current operations are able to receive 100-105 customers per hour at the tipping deck and working face, but become overwhelmed if the number rises to 120 and above. The major challenge is to minimize self-haul customers (e.g., contractors, roofers, small business operators) at the working face or to separate them more effectively from the automatic unloading vehicles. The current operations do a good job of keeping the queued customers away from the tipping deck for increased safety.

Two to three bulldozers (typically, Caterpillar D6, D7, D8, and D9) are used to push material from customer lanes to the working face and two compactors (currently CAT 836s) pass across the working face to compact material. The bulldozers used during operations depend on the volume each vehicle deposits on the tipping deck. For example, D7 bulldozers are the most efficient for pushing 20-ton loads deposited by transfer trailers, but D6 are best for smaller manually unloaded material or collection vehicles with capacity ranging from four to 10 tons.

Waste lifts are typically 20 feet thick, which provide sufficient levels of compaction and take between two to three days to complete with the current 300 foot by 100 foot working face configuration. The City has submitted a revised SOP to the TCEQ to increase the active area to two acres. Material is compacted to be

flat or with a slope of 5:1 to maintain drainage. The City uses Geographic Positioning System (GPS) on bulldozers and compactors to track their location and the number of passes they make while processing material.

A dedicated tarping/untarping and cleanout area has been designated for customers before/after they tip material; however, some customers do not utilize this space.

The current working face is approximately 300 feet by 100 feet in dimension. Based on the volume of customers and tonnage being disposed at the Landfill, this represents a constrained working face that presents challenges separating customers by vehicle type (e.g., self-unloading vehicles at a different tipping deck than automatically ejecting vehicles). Self-unloading vehicles present a significant challenge because of the increased time it takes to manually unload material. As part of the Landfill Site Visit, it was observed that the number of spotters and tower to direct traffic has improved safety conditions at the working face.

The constrained working face presents challenges with the type of dozers that are most effective for managing material between the tipping deck and working face. The D6 model is able to maneuver more effectively, but the D7 is the most efficient for pushing larger loads (e.g., 20 tons tipped from the transfer trailer. Ultimately a mix of D6 and D7 dozers should be utilized to maximize the efficiency of operations with the currently constrained working face.

Based on discussions with City staff, there is currently a permit modification under development that would allow the City to expand its working face to improve safety by allowing more tipping space for customers and more space for equipment operators. It would also allow the City to achieve higher operating efficiency by running up to four compactors at the working face and further separate large load customers from small load customers.

Daily Opening and Closing Procedures

The daily opening and closing procedures were observed during the Landfill Site Visit including removing the tarps from the working face to begin operations and applying tarps and Alternative Daily Cover (ADC) to close operations. Figure E-15 shows the tarp covering the working face during Landfill closing operations.

Figure E-15: Alternative Daily Cover Tarp

Staff arrived at the Landfill starting at 3:30 am and had about 10 customers in line at the Stuart Simpson scales. Landfill staff began operations by removing tarps, prepping the working face, and shuttling staff to and from various posts around the Landfill. The Landfill began accepting materials from customers at about 4:30 am, a half hour before the Landfill was scheduled to open.

The last customer accepted at the working face was at about 8:00 pm when staff began placing daily cover over the working face. Clearing both tipping decks using three bulldozers took about an hour. The CAT 836 compactors continued packing the working face until staff began unrolling tarps using two dozers per tarp. After the cover tarps were fully unrolled, the whole process taking about an hour, staff applied ADC spray to the areas that were not covered by the tarps using a 1200-gallon hydroseeder units that had to be filled twice to cover the rest of the working face. Figure E-16 shows the ADC spray material that is used as part of the Landfill daily cover operations.

Figure E-16: ADC Spray Pellets and Hydroseeder

The current hours of operation at the Landfill extend a total of three hours before and after the facility opens to customers based on the time requirements of opening and closing the facility. Based on observations, the time requirements to open and close the facility as well as the current level of vacant positions cause increased overtime requirements, which can potentially lead to fatigue-related safety concerns such as less capability to identify hot loads (e.g., vehicles tipping material that is actively burning). Additionally, being understaffed may cause challenges efficiently opening and closing daily operations.

Landfill operators should be able to complete all daily opening activities no more than an hour before the facility begins accepting customers and complete all daily closing activities no more than an hour after the facility finishes processing material. Applying the tarp and spray ADC is time consuming During the Landfill Site Visit, filling was occurring in the south corner of cell 6B2, which is a difficult area to cover. Typical operations that are not in a corner may be able to complete closing activities in less time.

Leachate

All water that comes into contact with waste, leachate, or contaminated soils is collected within the Landfill disposal area and treated as leachate. Leachate ultimately reaches the leachate collection system within each cell, is consolidated within the sump, and pumped out of the cell via a pump located in the side slope riser

pipe. Landfill staff monitor the depth of leachate on the liner using a pressure transducer located on each submersible pump.

Previously the City had recirculated condensate and leachate, which provided operational benefits including:

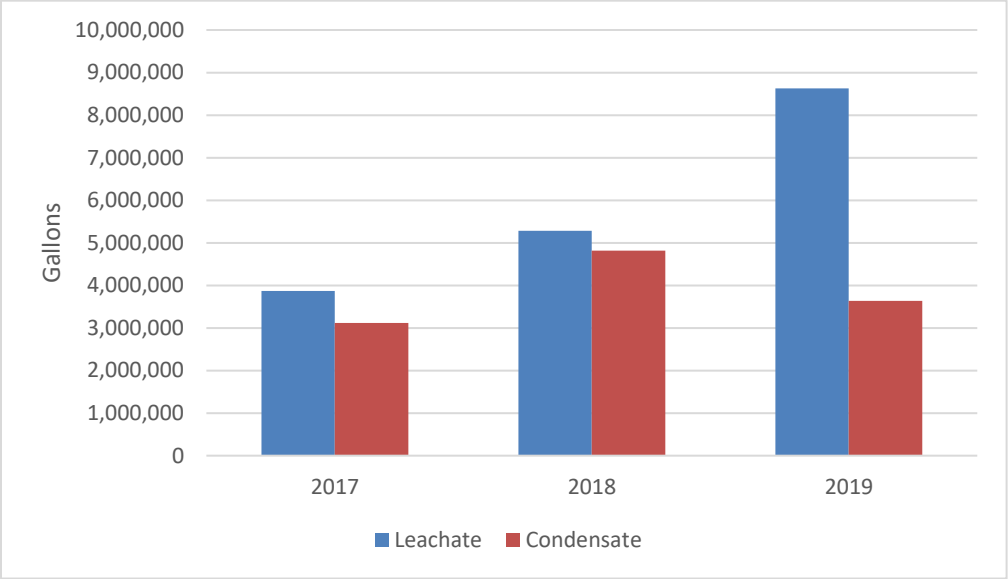
- Improving the initial compaction of the waste
- Accelerating settlement of waste improving the airspace utilization.
- Providing alternate mean of leachate management.
- Minimizing windblown litter by applying leachate application at the working face.

Although there are benefits to Enhanced Leachate Recirculation (ELR), the City experienced operational challenges related to over-recirculation of leachate and landfill gas condensate in the past, causing increased occurrence of seeps. Additionally, the landfill gas wells become watered causing costly redrills. The City is currently able to recirculate leachate as part of its existing permit, but currently pumps the material to a storage tank equipped with a pressure transducer to monitor remaining capacity and is then piped to the Southside Wastewater Treatment Plant. Based on the most recently available data provided by the City, about 8.6 million gallons of leachate was collected in 2019 from the Landfill and conveyed to the Southside WWTP. DWU tests the leachate quality and there have been no challenges accepting this material.

Condensate is handled separately from leachate and in 2019 about 3.6 million gallons of condensate was pumped from the Landfill Gas-to-Energy Plant, held in two vertical above ground tanks and discharged in lined areas of the Landfill. The City recirculates this material by excavating holes in strategic locations in the Landfill, discharging condensate, and then subsequently covering the holes up with soil material. DCEMB will become responsible for condensate management in 2025. The City is unable to send condensate to the Southside WWTP due to high total petroleum hydrocarbon (TPH) concentrations. The City and Plant are investigating methods to reduce the TPH concentrations.

Figure E-17 shows the historical generation of leachate and condensate in gallons between 2017 and 2019.

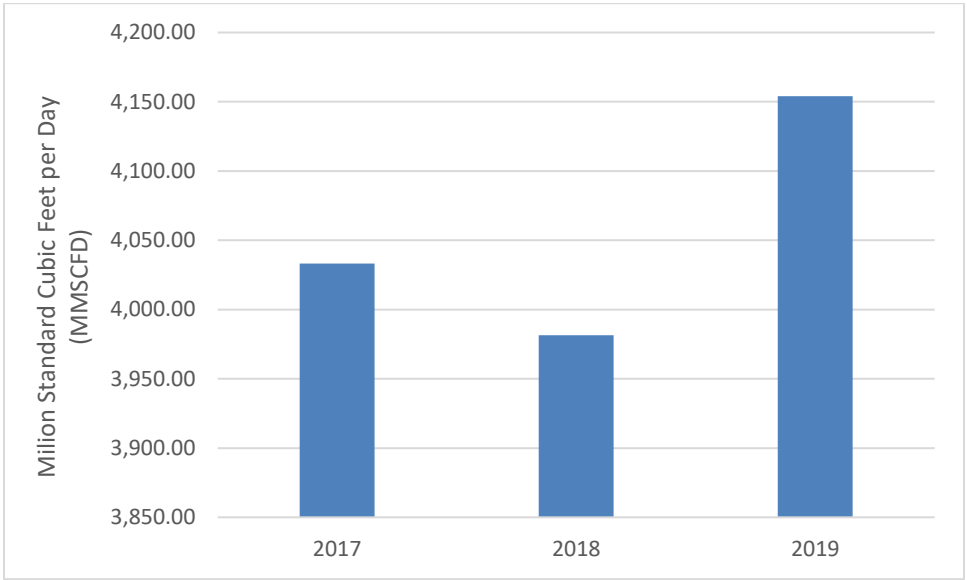
Figure E-17: Historical Leachate and Condensate Managed at Landfill



Gas Collection and Control System

Dallas Clean Energy McCommas Bluff, LLC (DCEMB) currently operates the landfill gas collection and control system (GCCS) consisting of over 500 of interconnected vertical wells and horizontal pipes in trenches that currently produce approximately 9,800 cubic feet per minute of landfill gas. Figure E-18 shows the historical gas generation at the Landfill.

Figure E-18: Historical Gas Generation at Landfill



A landfill of this size should be collecting above 10,000 cubic feet per minute of landfill gas and indicates that there may be opportunity for DCEMB to increase to efficiency of its GCCS system.

This system is designed to balance well flow to meet DCEMB quality while maintaining New Source Performance Standards (NSPS) compliance. The contract between the City and its third-party operator terminates on December 31, 2034, if all available extensions are exercised. At this point, the City will need to take over operations or procure another contractor to manage the facility. The City received $50,000 for the first year of the lease agreement, receives $1,000 each subsequent year of the lease, and receives 12.5 percent of the revenue stream from landfill gas and constituent product sales, less the supplemental fuel costs. Revenues include the sale of greenhouse gas credits, Renewable Identification Number (RIN) credits, or other carbon standards from gas sale or energy production.

DCEMB is managed by Energy Power Partners and owns and operates the pipeline injection plant at the Landfill. Figure E-19 shows the Landfill gas to energy plant including the flare, gas processing equipment, and pipeline injection plant.

Figure E-19: Landfill Gas-to-Energy Plant

DCEMB has an exclusive agreement with the City to lease and develop landfill gas. The City's current contract with DCEMB is a 20-year extension (through 2034), under which DCEMB is responsible for the expansion and operation of the GCCS and the operation and maintenance of the high-BTU landfill gas processing plant. The contract is structured such that the City receives a site lease payment ($15,000 for the first year, $1,000 per year thereafter) and 12.5 percent of the gross revenue stream from landfill gas and constituent product gas sales and all related environmental credits.

Currently, Loci Controls (Loci) in partnership with DCEMB provides automated well tuning utilizing remote wellfield control through a cloud-based software application to maximize gas collection. Although

Loci's system is automated, the wells are still required by the air permit to be tuned in person on a monthly basis. Based on discussion with City staff, the 210 wells managed by Loci are the highest producing wells covering 75 to 80 percent of the total gas flow generated.

Stormwater Management

Providing effective stormwater management to minimize seeps and erosion allows the Landfill operations to better capture airspace, minimize leachate generation, more effectively construct cells to meet final grade and improve landfill gas generation and capture.

The Landfill operation has challenges managing stormwater since slopes are not constructed to convey water to downchutes and final cover is not applied to the existing cells when they are complete, potentially causing increased volumes of stormwater to become leachate. Without applying final cover or constructing diversion berms, the resulting erosion has become a secondary challenge for operations. At the time of the Landfill Site Visit, instead of filling the working face with waste, covering with intermediate cover, and draining the stormwater off the footprint, Landfill staff constructed a temporary hold to collect stormwater that was then pumped over the perimeter road to a perimeter ditch. This approach was intended to minimize erosion deposition on the roadway. Although staff indicated this procedure was temporary, it is not preferable because it increases contact water and leachate generation. Although minimizing erosion is important to maintain adequate working conditions at the Landfill, increased leachate generation requires that the Landfill manage increased volumes of leachate and are not proactively minimizing operational impacts of high levels of leachate (e.g., seeps)

Based on discussions with City staff, after filling cell 6B2, operations would approach stormwater management by working to fill cells so the slope is closer 4:1 per the permit design and then cover with intermediate cover to minimize contact water and leachate generation.

Ancillary Site Infrastructure

Ancillary site infrastructure (e.g., existing buildings and operations other than the working face) were observed during the Landfill Site Visit for current functionality and condition. The following summarizes ancillary buildings and other active operations at the Landfill:

Citizen's Convenience and Recycling Center (CCRC). The CCRC is located in permanent open air steel structure where large recyclable items are collected and removed from the site. Items collected include white goods (household appliances), air condition units, metal tanks, large metal pieces, and automobile parts. The City removes freon from white goods, contracts with third parties to collect appliances or electronic waste and waste tires are collected for offsite disposal by a private tire processing company or

ground for use on the site. The CCRC was observed to be in good working condition during the Landfill Site Visit. Figure E-20 shows the CCRC permanent open air steel structure located adjacent to the Landfill Gas-to-Energy Plant.

Figure E-20: CCRC Permanent Pole-Barn Structure

Citizen Convenience Center (CCC). The CCC is a permanent drop-off facility for self-unloading vehicles that leverages grade separation to allow customers to back up to a ledge and drop material into a trailer. When full, the trailer is hauled for disposal at the working face by the City. The CCC was observed to be in good working condition during the Landfill Site Visit and as part of discussion with management customers are not required to use this facility. Figure E-21 shows the CCC. The CCC is located within the permitted limits of waste (in future Cell 15).

Figure E-21: CCC Transfer Trailer and Metal Recycling Roll-Off Containers

Administration Building. The administration building is located in the cell 15 of the Landfill's permanent airspace (reference Figure E-1) and provides parking, locker rooms, break rooms, training rooms, offices, and restroom facilities. The administration building is used by Landfill management, staff and temporary laborers and was observed to be in good working condition during the Landfill Site Visit. Figure E-22

shows the administration building and parking lot. The CCC is located within the permitted limits of waste (in future Cell 15).

Figure E-22: Administration Building

Yard Waste Processing. The City has entered into a master agreement to have clean yard waste ground for volume reduction. Clean yard waste material is delivered by commercial customers and the ground material is used to support internal road management during storm events. Figure E-23 shows the yard waste grinding operation located on a closed cell at the Landfill.

Figure E-23: Yard Waste Grinding Operation

Further discussion about organics management and diversion of this material is provided in Section 10.

Mobile litter control fences. Mobile litter control fences and secondary litter control fences are used around the site to prevent material from blowing away from the working face and minimize the demand for laborers to collect windblown material from around the site. Mobile fences are shifted as the working face

location moves and secondary fences are semi-permanent. Figure E-24 shows the mobile litter control fences in the background and a secondary letter fence in the foreground.

Figure E-24: Mobile Litter Control and Secondary Litter Control Fences

Site signage. There is limited signage at the Landfill to support wayfinding for customers that are not familiar with the site. The City has recently lowered the speed limit from 20 to 15 miles per hour to minimize risk of vehicle collisions. The City does have temporary laborers that help with traffic control but having multiple scalehouse facilities and multiple routes to the working face may cause confusion for customers.

APPENDIX F – IMPLEMENTATION & FUNDING PLAN

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LSWMP Update Reference	Recommendation	CECAP Goal	Priority	Recycling Potential	Difficulty of Implementation	Financial Impact	Funding Source	Implementation Timing	Responsible Party	Notes
5-1	**Implement key operational adjustments and capital upgrades to maximize existing capacity among the transfer station system.**									
	Increase transfer trucks and drivers required to meet needs of a separated brush and bulky item collection program.	3	High	High	Low	Medium	SAN Enterprise Fund	Near-term	SAN	
	Increase capacity of Dry Gulch to divert haul and manual unload customers from the transfer building at Bachman.	3	High	High	High	High	SAN Enterprise Fund	Mid-term	SAN	Consider providing enhanced residential customer drop-off at each transfer station.
	Upgrade transfer buildings including repairing building shells, upgrading/integrating scaling hardware and software, and reconfiguring internal roadways as needed.	N/A	High	N/A	High	High	SAN Enterprise Fund	Mid-term	SAN	Ongoing effort to repair Southwest transfer station.
	Increase communication protocols and leverage on-board vehicle technology to support operating capacity (e.g., anticipate when surges of material are heading to one or more transfer stations).	3	High	N/A	Medium	Low	SAN Enterprise Fund	Near-term	SAN	
5-2	**Transfer brush and yard trimming loads through Bachman on a pilot basis.**									
	Separately receive and manage separately collected brush and yard trimmings at Bachman using the existing equipment and staffing.	3, 7	High	High	High	High	SAN Enterprise Fund	Mid-term	SAN	Contingent on upgrading Dry Gulch and adjusting schedule consistent with any changes to refuse/recycling and brush/bulky item collection service to make this operationally feasible.
	Process separated brush/yard trimmings material through Bachman on a regular basis for transfer to the Landfill's existing brush grinding operation until an available composting facility is identified.	3, 7	High	High	High	High	SAN Enterprise Fund	Mid-term	SAN	Concurrently with implementation of key operational and/or capital upgrades.
5-3	**Develop engineering design study and preliminary construction phasing plan for major expansion or rebuild of Bachman.**									
	Develop and evaluate a series of options to expand services while maintaining continuity of service through strategic construction phasing, including configurations required to manage separately collected brush/yard trimmings and potentially separately collected food waste in the future.	N/A	High	High	N/A	High	SAN Enterprise Fund	Near-term	SAN	Options evaluation should include tasks to study the feasibility of leveraging existing organics processing in the region that support the transfer station system upgrades.
6-1	**Evaluate efficiencies that could be achieved by adjusting collection schedule to five days per week, eight hours per day as part of the ongoing re-route.**									
	Evaluate the impact of the reducing the number of households per route required for a five day collection week, identifying efficiencies in the re-routed system that could position the City to implement increased service levels in the future (e.g., every other week recycling, weekly collection of yard trimmings).	3, 8	High	Medium	Medium	Low	N/A	Near-term	SAN, OEQS, Code Compliance	
6-2	**Develop an education, outreach, and compliance plan for adjustments to the City's collection schedule.**									
	Communicate service changes including how the City would leverage on-board technology to support compliance efforts, required adjustments to other City programs (e.g., brush and bulky item collection, transfer station operation), and phasing plan regarding the implementation of the re-route.	3	High	Medium	Medium	Medium	SAN Enterprise Fund; OEQS Budget; Code Compliance Budget; NCTCOG Grant	Near-term	SAN, OEQS, Code Compliance	
6-3	**Utilize on-board vehicle technology to collect key performance metrics and support compliance efforts.**									
	Track key performance metrics such as daily time on-route and off-route, number of trips to disposal/processing facilities per route, and tonnage collected per route and per household.	3	High	Medium	Medium	Low	N/A	Near-term	SAN, OEQS, Code Compliance	Current 3rd Eye on-board technology allows City to run reports about total vehicle run time for trucks before re-route and after to determine reduction of time on street to provide more proactive preventative maintenance.
6-4	**Exit the alleys and minimize combined alley and curbside routes as part of the ongoing re-route.**									
	Adjust the collection routes and/or sanitation districts to transition residents from alley to curbside collection, as able.	3	High	High	High	Low	N/A	Near-term	SAN, OEQS, Code Compliance	The City may consider a tiered rate schedule to more equitably charge residential customers (e.g., curbside collection rate-payers are currently subsidizing the alley collection which is more costly to operate.
6-5	**Ensure the Sanitation Department is involved in permit pre-approval review process conducted by the Sustainable Development Department.**									
	Regularly review permit applications for mixed use developments or multi-tenant complexes would require developers to consider solid waste collection and recycling capabilities as part of the development process to minimize challenging collection environments.	N/A	High	Medium	Medium	Low	N/A	Near-term	SAN, Sustainable Development	Requires ordinance update to clarify definition of single-family attached/detached properties, evaluation existing of form-based code, and multi-family property recycling infrastructure (e.g., trash and recycling chutes/storage rooms).
6-6	**Increase number of CNG and/or RNG vehicles in collection fleet and expand fueling infrastructure.**									
	Increase number of CNG and/or RNG vehicles in collection fleet.	8	Medium	Medium	Medium	Medium	SAN Enterprise Fund	Mid-term	SAN, EFM	Utilizing RNG considered as part of recycling potential.
	Install additional CNG/RNG fueling station.	8	Medium	Medium	High	High	SAN Enterprise Fund	Mid-term	SAN, EFM	Utilizing RNG considered as part of recycling potential.
	Apply for regional or national grants or other available funding support to subsidize the purchase, infrastructure upgrade, or maintenance needs to successfully increase number of CNG/RNG collection vehicle in fleet.	8	Medium	N/A	Low	N/A	NCTCOG Grant	Near-term	SAN, EFM	
6-7	**Track ongoing efforts to implement BEVs and explore the feasibility of a BEV pilot project based on the results from peer cities.**									
	Track ongoing efforts of Battery Electric Vehicles (BEVs) used for solid waste collection around the country.	4	High	N/A	N/A	Low	N/A	Near-term	SAN, OEQS, EFM	Include evaluation of running vehicles, maintenance and charging infrastructure.
	Explore the feasibility of running a BEV pilot upon identification of successful implementation on a long-term basis (e.g., through a full replacement cycle) in peer cities.	4	Medium	N/A	N/A	Low	N/A	Long-term	SAN, EFM	
	Apply for regional or national grants or other available funding support to subsidize the purchase, infrastructure upgrade, or maintenance needs to successfully implement a pilot project.	4	Medium	N/A	Low	Low	NCTCOG Grant	Mid-term	SAN, EFM	
6-8	**Explore opportunities to procure carts leveraging cooperative purchasing arrangement with peer cities.**									
	Release an RFP in conjunction with peer cities.	N/A	Medium	N/A	Low	Low	N/A	Near-term	SAN	Explore the ability to leverage collective purchasing power with peer cities to realize cost savings on cart purchase and/or cart management and support services.

LSWMP Update Reference	Recommendation	CECAP Goal	Priority	Recycling Potential	Difficulty of Implementation	Financial Impact	Funding Source	Implementation Timing	Responsible Party	Notes
7-1	**Maintain 10 CY set out limits**									
	Continue implementation of 10 CY limit and fee assessment.	3	High	High	N/A	Low	N/A	Near-term	SAN, OEQS, Code Compliance	
	Decrease set out limit to eight CY.	3	Low	High	Low	Low	N/A	Long-term	SAN, OEQS, Code Compliance	
7-2	**Deploy brush and bulky item collection crews based on set out patterns.**									
	Deploy rotocombo vehicles to areas of the City that have the largest set outs, and the rotoboom crews to those with smaller items given the strengths of each particular equipment type.	3	High	High	Low	Low	N/A	Near-term	SAN	
	Pilot two-person crew for rotocombo equipment	3	Medium	High	Low	Low	N/A	Near-term	SAN	
7-3	**Increase capacity for managing brush and bulky items separately at Bachman and the Landfill.**									
	Expand Bachman to allow for processing and transfer of separately collected brush and bulky items.	3	High	High	High	High	SAN Enterprise Fund	Near-term	SAN	
	Identify location at Landfill for storage and processing of organics.	3	Medium	High	Low	Low	N/A	Near-term	SAN	
7-4	**Implement separate brush and bulky item collection scenario City-wide using phased approach**									
	Transition to weekly cart-based separate yard trimmings with appointment-based brush and/or bulky item collection.	3	High	High	High	High	SAN Enterprise Fund	Near-term	SAN, OEQS, Code Compliance, EFM	Requires ordinance update for definition of brush, yard trimmings and bulky items. "Sunset" Cost-Plus program and establish call-in bulky item collecting program on routed basis (e.g., requests determine routes, generated on a weekly basis). Customers would be provided appointment-based services four times per year for brush and/or bulky items (cannot be both).
	Streamline compliance tools to support transition to appointment-based brush and bulky item collection.	3	High	High	High	High	SAN Enterprise Fund	Near-term	SAN, Code Compliance	
8-1	**Maximize site life and maintain sufficient revenues.**									
	Conduct periodic market assessment to determine ongoing and future pricing increases.	5	Medium	N/A	N/A	Medium	N/A	Mid-term	SAN, Finance	
	Implement environmental fee (or similar) to fund long-term management of the Landfill equitably.	5	High	N/A	High	Low	N/A	Mid-term	SAN, Finance	Ensure rising tip fees to not drive tonnage away to the point it impacts Landfill revenues.
	Implement recycling incentive for third-party haulers.	5	Medium	High	Medium	Low	N/A	Mid-term	SAN, Finance	
	Implement hardware and software tools for continued increases in operational efficiency.	5, 8	Medium	Medium	Low	Medium	SAN Enterprise Fund	Mid-term	SAN	Considers recycling of landfill gas.
8-2	**Increase usage of Customer Convenience Center (CCC).**									
	Track usage and hauls from CCC on daily or weekly basis.	5	High	N/A	Low	Low	N/A	Near-term	SAN	Either manually or run transfer trailers over unmanned scales.
	Incentivize use of CCC by offering discount/flat fee for manual unload customers.	5	High	N/A	Medium	Low	SAN Enterprise Fund	Near-term	SAN	Create charge rate for manual unload vehicles to minimize need to scale in/out. Will account for tonnages by weighing transfer trailers.
8-3	**Increase organics processing capacity.**									
	Identify location outside the permitted limits of waste disposal at Landfill to process separately collected brush/yard trimmings.	5	High	High	High	Low	SAN Enterprise Fund	Near-term	SAN	In coordination with potential RFCSP for organics processing vendor.
8-4	**Evaluate long-term operations and development approaches.**									
	Develop facility master plan to address long-term site development phasing, Capital Improvement Plan (CIP), and infrastructure needs (e.g., stormwater, electrical).	5	Medium	N/A	N/A	Medium	SAN Enterprise Fund	Near-term	SAN, Third Party	Third party may be engineering consulting firm.
	Explore modifications to final grading plan and permitted elevation to address current or anticipated operational challenges and provide additional airspace.	5	Medium	N/A	Medium	Medium	SAN Enterprise Fund	Long-term	SAN	May require preparation and submission of Landfill permit modifications.
	Plan adjustments to ancillary facilities at the site to ensure they are outside the permitted limits of waste.	5	Medium	N/A	High	High	SAN Enterprise Fund	Long-term	SAN, Third Party	Third party may be engineering consulting firm.

LSWMP Update Reference	Recommendation	CECAP Goal	Priority	Recycling Potential	Difficulty of Implementation	Financial Impact	Funding Source	Implementation Timing	Responsible Party	Notes
9-1	**Maintain current terms and conditions of the agreement and hold the contractor accountable to maintain them.**									
	Administer the terms of the agreement and hold the contractor to them, including requesting confirmation of agreements with alternative facilities in the case of unplanned downtime.	5	High	N/A	Low	Low	N/A	Near-term	SAN, OEQS	
9-2	**Re-evaluate recycling processing agreement four years before conclusion of initial term.**									
	Determine if financial terms are still favorable (e.g., processing fee and revenue sharing provision), if the contractor has maintained compliance (e.g., regularly scheduling MRF audits, meeting reporting requirements, storing materials inside the processing building) and the state of the processing equipment.	5	Low	N/A	Low	Low	N/A	Long-term	SAN, Finance	Based on this evaluation, the City would determine to execute an extension of the agreement or solicit proposals for other options.
9-3	**Work with FCC to expand facility as needed in the future.**									
	Work with FCC to identify the timing and needs of any future facility expansion.	5	Low	Medium	Low	High	N/A	Long-term	SAN	
10-1	**Emphasize backyard composting, food donation and source reduction programs as part of future data collection and the development of education and outreach programs.**									
	Focus education, outreach and program development to expand backyard composting and food donation.	1	High	N/A	Low	Low	N/A	Near-term	SAN, OEQS	Maximizes existing City resources without requiring hiring more personnel or purchasing more equipment.
10-2	**Pilot windrow composting project outside the permitted disposal areas of the Landfill for yard trimmings and brush only**									
	Identify areas that could be used to pilot a windrow composting operation to gauge the feasibility of transitioning the existing organic material processing operation at the Landfill to compost rather than just grind brush and yard trimmings for use by other City departments or Landfill customers.	7, 9	High	High	High	Medium	SAN Enterprise Fund	Near-term	SAN	As part of the ongoing considerations to adjust the location of key infrastructure at the Landfill
10-3	**Engage with private-sector processors in the area to identify the feasibility of developing a public-private partnership.**									
	Reach out to composting operators in the region to identify parties that would be interested in accepting separately collected brush material, developing a new composting facility in the area or operating a composting facility at the Landfill.	7, 9	High	High	Medium	Low	SAN Enterprise Fund	Near-term	SAN	
	If there is interest, develop and release an Request for Competitive Sealed Proposals (RFCSP) to evaluate opportunities and identify the best value proposal to determine how the City should move forward to establish processing capacity for separately collected brush and yard trimming materials.	7, 9	High	High	Medium	Low	SAN Enterprise Fund	Near-term	SAN, Procurement	Focusing on processing of dry brush/yard trimmings in the near-term, with room for expansion to include putrescibles as part of composting or upgraded processing technology (e.g., anaerobic digestion, mixed waste processing, etc.).
10-4	**Evaluate the capital cost requirements at the SS WWTP to be able to accept organic materials.**									
	Develop a feasibility study that evaluates the traffic and tonnage flows if the Southside Wastewater Treatment Plant (SS WWTP) were to accept material delivered by either vacuum trucks or solid waste collection vehicles.	7, 8, 9	High	N/A	N/A	Medium	SAN Enterprise Fund, DWU Budget	Near-term	SAN, DWU	The feasibility study should assess the capital and infrastructure upgrades required to effectively receive and manage third-party organic materials.
	Pilot organics processing program at the SS WWTP coordinating with NCTCOG on regional efforts to increase organics recycling.	7, 8, 9	High	High	High	Medium	SAN Enterprise Fund, DWU Budget	Near-term	SAN, DWU	
11-1	**Maintain the MFRO and continue to increase the percentage of covered entities in compliance year-over-year.**									
	Continue to implement and increase the compliance from generators and haulers as part of the Multi-family Recycling Ordinance (MFRO).	1	High	High	Low	Low	N/A	Near-term	SAN, OEQS	
	Monitor new developments that come online and continuing to support affected entities with education and outreach.	1	High	High	Low	Low	N/A	Mid-term	SAN, OEQS, Development Services	
11-2	**Adjust franchise and permitted recycling hauler reporting requirements to include more comprehensive tonnage data reports.**									
	Require submission of more comprehensive data to include refuse, recycling and other recyclable tonnages collected including the location with materials are processed and disposed.	5	High	N/A	Low	Low	N/A	Near-term	SAN, Finance	Implement by making adjustments when non-exclusive franchise ordinance come up for renewal rather than scraping them all. Could also consider increasing franchise fees over time as part of this process.
11-3	**Require franchise haulers offer recycling and organics diversion services.**									
	After the requirements of franchise hauler reporting has been implemented and analyzed, determine the requirements for haulers to offer recycling services to customers.	5, 7	Medium	High	Medium	Low	N/A	Mid-term	SAN, Finance	Including both single-stream and organics depending on customer type.
	Establish compliance mechanisms to ensure that requirements maintain a level playing field among franchise haulers.	5, 7	Medium	High	Medium	Medium	SAN Enterprise Fund	Mid-term	SAN, Finance	Requires that City have sufficient staffing for data collection/verification.
11-4	**Expand the Green Business Certification to provide technical assistance leveraging cross-departmental synergies.**									
	Expand program to increase the number of certified businesses year over year.	5	High	High	Low	Low	OEQS Budget	Near-term	SAN, OEQS, Code Compliance	
	Increase the capability of the program to provide technical assistance to increase recycling from the commercial sector, leveraging cross-department collaboration to capture efficiencies by spreading the demand on staff time across multiple departments and streamlining efforts.	5	Medium	High	Medium	Medium	SAN Enterprise Fund, OEQS Budget, Code Compliance Budget	Mid-term	SAN, OEQS, Development Services, Code Compliance	
11-5	**Implement targeted commercial diversion requirements on a phased basis.**									
	Determine the threshold of material generation quantity, facility size (square footage) or business size (number of employees) that would make the most impact on the City's recycling rate as part of a phased approach, where more generators are included over time and are required to contract with franchise haulers to recycle material.	9	High	High	High	Low	N/A	Long-term	SAN, OEQS, Code Compliance	After adjusting the franchise and permitted recycling hauler requirements and ensuring that the available processing capacity for recycling and organics diversion,
11-6	**Consider exclusive or zoned franchise system to support targeted commercial diversion requirements.**									
	Develop an exclusive or zoned franchise system that establishes geographic areas where service is provided to commercial generators and infrastructure exists to support the implementation of targeted commercial diversion requirements.	9	Low	High	High	Low	N/A	Long-term	SAN	Implementation efforts of targeted commercial diversion requirements may receive pushback from the hauler community indicating that requirements minimize their ability to achieve efficiencies related to route density and significantly increase their cost to provide service while prohibiting them from increasing rates for certain services.

LSWMP Update Reference	Recommendation	CECAP Goal	Priority	Recycling Potential	Difficulty of Implementation	Financial Impact	Funding Source	Implementation Timing	Responsible Party	Notes
12-1	**Enter new contract with the County**									
	Extend the current agreement in a similar structure to the existing ILA on a one-year basis with three, 1-yr extensions.	5	High	N/A	Low	High	N/A	Near-term	SAN, OEQS, Code Compliance	Enter new one year agreement with strategic operational adjustments to ensure the short-term needs of the City are met with flexibility to explore other options to minimize future costs as the City continues to grow.
12-2	**Explore the ability for the County to extend operating hours and automate data tracking and analysis.**									
	Support County to justify extending operating hours and automating data tracking would streamline operations at the existing facility but may require capital upgrades including installation of wireless internet and a covered area to receive customers.	5	Medium	N/A	Low	Medium	N/A	Mid-term	SAN, OEQS	
12-3	**Work with the County to increase materials that can be cost-effectively recycled to minimize disposal costs.**									
	Work with the County to proactively establish recycling outlets for materials that are currently disposed to minimizing disposal costs passed through as part of the ILA.	6, 7	Medium	High	Medium	Low	N/A	Mid-term	SAN, OEQS	This is challenging with the existing space constraints at the HCCC, but may be more feasible at a new HCCC or satellite facility.
12-4	**Collaborate with the County to identify locations where new HCCC or satellite facility could be located in the southern part of the County.**									
	Develop a new HCCC and/or satellite facility to increase accessibility for City residents, working closely with the County and its stakeholders to establish the needs (e.g., challenges managing service demand, rising operating costs, changing material types and recycling outlets) and benefits (e.g., more convenient access for residents, managing costs over time).	6	High	High	High	High	OEQS Budget, Code Compliance Budget	Mid-term	SAN, OEQS, County	A key consideration is to ensure current participating members support the approach and understand the benefits to their residential customers.
12-5	**Coordinate with the County to support increasing frequency and materials accepted at HHW and BOPA events.**									
	Increase frequency and material types accepted at HHW and BOPA collection events to be consistent with materials accepted at HCCC.	6	High	High	Medium	High	OEQS Budget, Code Compliance Budget	Mid-term	SAN, OEQS, Code Compliance	The key challenges to increasing the frequency of events is the additional cost of equipment and staff time, including an on-site chemist and additional staff training.
	Coordinate with the County to identify opportunities where the County could support needs (e.g., providing use of its full-time chemist at some or all mobile collection events) to allow City to increase the number of collection events without incurring the full cost burden of the program expansion.	6	Low	High	Medium	Low	N/A	Mid-term	SAN, OEQS, Code Compliance	
13-1	**Enter new contract with the County**									
	Extend the current agreement in a similar structure to the existing ILA on a one-year basis with three, 1-yr extensions.	5	High	N/A	Low	High	N/A	Near-term	SAN, OEQS, Code Compliance	Enter new one year agreement with strategic operational adjustments to ensure the short-term needs of the City are met with flexibility to explore other options to minimize future costs as the City continues to grow.
13-2	**Explore the ability for the County to extend operating hours and automate data tracking and analysis.**									
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13-3	**Work with the County to increase materials that can be cost-effectively recycled to minimize disposal costs.**									
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	Coordinate with the County to identify opportunities where the County could support needs (e.g., providing use of its full-time chemist at some or all mobile collection events) to allow City to increase the number of collection events without incurring the full cost burden of the program expansion.	6	Low	High	Medium	Low	N/A	Mid-term	SAN, OEQS, Code Compliance	