



FINAL REPORT | MAY 2014

CITY OF DALLAS SANITATION SERVICES

Consulting Services in Support of Resource Recovery Planning and Implementation

leidos

List of Tables

List of Figures

List of Appendices

Background

In February 2013, the City of Dallas (City) passed its Local Solid Waste Management Plan (LSWMP), which included goals to increase diversion to: 40 percent by 2020, 60 percent by 2030, and 80 percent ("zero waste") by 2040. To accomplish these goals, the City is planning to transition away from traditional, disposal-based waste management practices and increase its focus on recovering valuable resources from the waste stream. Existing, successful resource recovery programs, such as single stream recycling and landfill gas recovery, will continue.

Furthermore, in order to continue providing single stream recycling to residential customers, the City must determine how recyclables will be processed in the future. The existing contract with Waste Management Recycle America (WMRA), including all optional renewal terms, will expire in December 2016. The City must determine where materials will be processed beginning in January 2017, and whether the City would like to have a more active role in a future processing facility (e.g. City-owned facility or public-private partnership).

The City retained Leidos Engineering (Leidos or Project Team) in February 2013 to conduct a Resource Recovery Planning and Implementation Study (study). The Project Team includes staff from Burns and McDonnell, CP&Y, and Alternative Resources, Inc. In the study, the Project Team assisted with planning for future single stream processing services and also evaluated the development of additional resource recovery technologies. This study provides analysis of the following technologies.

- **Single stream recycling:** Sorting of mixed recyclables (from the existing residential recycling program) with minimal contamination and preparation of materials to be sold at market.
- **Mixed waste processing:** Recovery of recyclables from residential or commercial garbage (e.g. mixed waste) and preparation of materials to be sold at market.
- **Gasification:** 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 without burning the waste, and uses the synthesis gas to generate energy.
- **Anaerobic digestion:** Biological process that uses bacteria to decompose biodegradable organic materials (food waste, yard waste, and non-recyclable paper) in the absence of oxygen, producing and using biogas to generate energy and producing a compost product marketed as a fertilizer or soil amendment.

If the City were to develop any of the four above-listed resource recovery technologies, there would be a benefit to co-locating the facility at the McCommas Bluff Landfill (landfill). Developing a facility at the landfill would reduce capital cost, due to not having to purchase land as well as by making use of the existing scale house, basic infrastructure and utilities on the site. In addition to the financial benefits, developing a resource recovery facility at the landfill would bring employment opportunities to Dallas residents and potentially provide an anchor facility for a resource recovery park. The City has identified a 30-acre site at the landfill that could potentially be available for a resource recovery facility. Much of the analysis in this study assumes the City could (but would not be required to) use this site for any future facility development.

Summary of Project Analysis

The following summarizes the analysis included in this study.

Waste Characterization (Section 1)

The Project Team conducted a waste characterization analysis in order to understand the resources that might be able to be recovered from the City's waste stream. The Project Team collected samples from residential and commercial collection vehicles and sorted the samples manually to estimate the composition of the waste stream. The results showed that there is significant opportunity to increase the amount of material recovered through the single stream program. There is also a potential opportunity to recover additional recyclables from residential and commercial mixed waste.

Technology Overview (Section 2)

In this section, the Project Team provided the City with an overview of each of the four technologies, including: description of key operating systems and elements; status of development; potential impacts to current collection, processing and disposal operations; capital, operational, and regulatory requirements; and key advantages and disadvantages.

Screening Analysis (Section 3)

The Project Team conducted a screening analysis to determine which of the four technologies would be evaluated in detail. The process included development of screening criteria, application of the criteria on a comparative basis to the potential technologies, and selection of a short list of technologies for further analysis. The screening criteria included the following: level of diversion, capital and operating cost, status of development, compatibility with current operations, permitting complexity, and project delivery options.

In an interactive and collaborative effort, the Project Team and City staff selected single stream recycling and mixed waste processing for further evaluation (as detailed in Section 4). It was determined that gasification and anaerobic digestion technologies should be monitored, particularly in regard to development activities in North America, and that these technologies could be considered for potential future use by the City. Further explanation for the inclusion and exclusion of each technology is provided below.

- Single stream recycling is comparatively the most favorable technology option. Although it does not provide the highest potential diversion, it is fully consistent with current practices and is expected to have a comparatively lower level of capital and operating cost.

- A mixed waste processing facility would improve upon diversion achieved with single stream recycling, but with potentially higher capital and operating cost and with increased risk and complexity.
- A gasification facility, either with or without mixed waste processing, would offer the highest level of diversion potential. However, gasification is less developed than recycling technologies, posing greater risk and uncertainty regarding cost and performance. Gasification would have substantially higher capital and operating cost when compared to other technologies and would result in the most complex permitting pathway with risk of non-approval.
- Anaerobic digestion of mixed waste has similar comparative limitations as identified for gasification. Also, achieving higher level of diversion requires long-term, beneficial use of the compost, for which markets are uncertain. Anaerobic digestion of source separated organic waste offers comparable or less diversion than could be achieved with mixed waste processing, primarily due to the limitations in the amount of food waste available in the waste stream and assumptions regarding the ability to capture that food waste for processing. This practice is the least compatible with current operations, since it would require separate collection of source-separated food waste.

Detailed Analysis (Section 4)

Based on the screening analysis, the Project Team conducted a detailed analysis of single stream recycling and mixed waste processing. This analysis included an estimate of capital and operating costs for each technology and assessment of potential revenue streams. The results of the detailed analysis are discussed further on page ES-4 of this Executive Summary.

Resource Recovery Park (Section 5)

The Project Team provided an overview of Resource Recovery Parks in Section 5. Resource Recovery Parks or Eco-Industrial Parks are typically a collection of environmentally-minded businesses, industries, and/or governmental agencies that form a synergistic relationship by collaborating to conserve natural resources.

Industry Survey on Procurement and Public Private Partnership Options (Section 6)

The Project Team interviewed nine recycling companies that represent the Dallas and Texas recycling industry in order to gauge interest in various options that the City may consider. In general, there is strong interest from the private sector in providing single stream processing services to the City. Feedback from the private sector was incorporated into the Implementation Plan.

Implementation Plan (Section 7)

Based on the analysis completed for this study, the Project Team developed an implementation plan that identifies the key steps for the City to implement the recommendations provided in the report. The implementation plan is discussed further on page ES-5 of this Executive Summary.

Results of Detailed Analysis of Single stream Recycling and Mixed Waste Processing

In Section 4, the Project Team provided a detailed evaluation of two technologies that were selected by the City for further review: single stream recycling and mixed waste processing. This evaluation included planning-level capital and operating cost estimates and revenue projections for each type of facility.

Following are the Project Team's key findings from analyzing the City's opportunity to develop a single stream recycling facility. For this analysis, the Project Team assumed that the City would develop a facility in partnership with a private operator.

- **A single stream facility is financially and technically feasible for the City, however, the City's current volume alone cannot support a facility**. The Project Team found that a newly constructed single stream facility would need to process 75,000 tons annually in order to be financially viable. The City currently collects close to 55,000 tons of recyclable material annually. Therefore, the City and its private operator would need to obtain additional tonnage, either through increasing material generated through the current City program and/or through processing contracts that a private operator has with other communities and/or commercial entities.
- **Co-locating a facility at the landfill provides significant financial benefit**. The single stream financial analysis would change significantly if a facility were not co-located with the McCommas Bluff Landfill. The additional cost to develop a facility at an undeveloped site would be between $1.5 million and $2.5 million in capital cost and $75,000 to $150,000 in annual operating cost.
- **It is unknown whether a city-developed facility would be a better financial option than the development of a new contract with a private facility.** The City has a processing services agreement (PSA) in place with WMRA that was negotiated in 2007. This agreement and all renewal options will expire in December 2016. The current PSA is financially favorable for the City, with high revenue sharing. However, in recent years, private companies have been requiring municipalities to share more of the risk of single stream recycling via higher processing fees and/or lower revenue sharing. A future PSA negotiated by the City will likely result in lower revenue to the City than under the current PSA. The City needs to conduct a procurement to be able to understand how a City-developed single stream facility and a PSA would directly compare as options (as discussed in the Implementation Plan).

Following are the Project Team's key findings regarding the City's opportunity to develop a mixed waste processing facility. For this analysis, the Project Team assumed the City would obtain a private operator.

- **A mixed waste processing facility is not financially feasible at this time**. The Project Team found that a mixed waste processing facility that processed primarily residential mixed waste, with some commercial waste, would increase operating costs at the landfill by approximately 30 percent.

- **Mixed waste processing carries more technical and business risk than single stream recycling**. Mixed waste processing, while it has been proven on a commercial scale in other parts of the United States, has not been developed for commercial use in the Dallas-Fort Worth Metroplex. Furthermore, since this facility would be considered an integrated part of the landfill, any negative financial performance would negatively impact the landfill's financial performance.
- **Limited, selective mixed waste processing at a single stream facility may be possible.** If the City develops a single stream facility at the landfill, there could be an opportunity to utilize some of the infrastructure to process select, recyclable-rich, dry loads of mixed waste. These loads would likely be generated from commercial sources. As the City develops a procurement for single stream processing, the City should request that vendors state their willingness to use equipment to process select loads of mixed waste and their approach to providing this service.

Implementation Plan (Section 7)

The City has made a substantial investment in curbside single stream recycling, and currently has a processing services agreement (PSA) in place for processing City-collected material at a privately-owned and operated facility. The current PSA will expire at the end of 2016 and is not subject to further extension. Therefore, in order to continue the single stream recycling program, the City must implement new services for processing of this material after the expiration of the current agreement. Future processing could be under a new PSA or at a new single stream processing facility located on City-owned land, at the site identified at the landfill. **Either approach requires that the City conduct a procurement. Furthermore, the City must begin its procurement process as soon as possible to ensure sufficient time for the development of a new facility, if that proves to be the most favorable option.** Specifically, the City should undertake the following steps in developing its procurement.

- **Develop an RFP**. The Project Team recommends the City conduct a procurement using an RFP process focused on a specific approach or a set of approaches. The RFP should allow vendors to propose on multiple options and should provide the City with the opportunity for direct comparison of options. Options recommended for initial consideration include the following.
  - PSA for single stream processing at a new or existing private facility
  - Design-Build-Operate (DBO) of a single stream processing facility at the landfill
- **Integrate stakeholder communication.** Stakeholder communication should be integrated into project procurement and implementation, to provide an open and transparent process that solicits stakeholder input as appropriate. Stakeholders include elected City officials (City Council), environmental and other interest groups, the South East Dallas community, and the wider public community.

Section 1
WASTE CHARACTERIZATION

1.1 Background

The City owns and operates the McCommas Bluff Landfill (landfill) and three transfer stations, Northeast Transfer Station (Fair Oaks), Northwest Transfer Station (Bachman), and Southwest Transfer Station (Westmoreland) (collectively City transfer stations). All materials accepted at the City Transfer stations are transported and disposed of at the landfill. In Fiscal Year 2011/2012, 1.4 million tons of material was disposed at the landfill. Based on the methodology described in Section 1.2, municipal solid waste (MSW) accounted for approximately 803,000 tons, 56.5 percent, of the total tonnage disposed in the landfill from October 1, 2011 through September 20, 2012.

The City retained the Project Team to conduct a municipal solid waste (MSW) characterization study. The objective of the analysis was to provide an understanding of the composition of the MSW waste stream generated within the City and evaluate technologies related to resource recovery of such materials. This section outlines the waste characterization methodology and results.

1.2 Methodology

The Project Team developed the methodology to estimate the amount and composition of MSW generated within the City and disposed at the landfill. This section of discusses the following key elements of the methodology:

- Develop sampling plan;
- Conduct waste characterization field sort event; and
- Analyze collected data.

This section of the report discusses each step of the methodology.

1.2.1 Sampling Plan

Prior to the field sampling event, the Project Team conducted a pre-sort site assessment. The information gathered from the pre-sort site assessment was used to formulate a detailed sampling plan. The sampling plan described the following key components of the field sort event:

- Targeted waste;
- Generators;
- Origin of waste;
- Material categories;
- Load selection;

- Sample selection; and
- Sorting procedures.

A summary of each of the above components of the sampling plan is described below.

Targeted Waste

The sampling approach targeted MSW generated within the City of Dallas. Based on the scale house codes provided by the City, the Project Team selected loads to be sampled from those loads recorded by the scale house as one of the following material codes:

- 310 Garbage, Compacted;
- 320 Garbage, Uncompacted;
- 410 Garbage, Compacted;
- 420 Garbage, Uncompacted;
- 510 Garbage, Compacted;
- 520 Garbage, Uncompacted;
- 210 Garbage, Compacted;
- 220 Garbage, Compacted;
- 2103 Uncompacted Garbage;
- 2104 Uncompacted Garbage;
- 2105 Uncompacted Garbage;
- 2202 CCRC Garbage Uncompacted;
- 2203 BTS Uncompacted Garbage;
- 2204 FO Uncompacted Garbage; and
- 2205 SW Uncompacted Garbage.

Loads designated by the scale house as other material codes, such as construction and demolition (C&D) debris, bulky waste, and yard trimmings, were excluded from the study. In addition, the Project Team excluded homogeneous loads, regardless of the material code, to ensure that the loads would be representative of the "typical" load.

Generators

For MSW loads, the Project Team assigned each load to one of the following generators based on interviews and/or observations:

- Residential: Waste generated in detached single-family residences or multi-family residential buildings and condominiums.
- Commercial: Waste generated from non-residential sources including institutions, businesses and industrial facilities.

Based on discussions with City staff, self-haul (residents and businesses using cars, vans, and non-packer trucks to haul waste), junk haulers, and landscapers were excluded from the waste characterization.

Origin of Waste

The study targeted materials generated in the City and disposed at the landfill. During the waste characterization sorting event, the Project Team staff interviewed the drivers of the pre-selected trucks (see Section 1.2.1 – Load Selection) when they arrived at the scale house. The drivers were asked the origin of the waste (location) and the generator type (commercial or residential, including multi-family). Only loads that originated in the City of Dallas were sampled. Loads generated from outside City limits were not sampled.

Material Categories

The Project Team and the City developed a comprehensive list of material categories. Eight material groups were subdivided into 48 material categories. Table 1-1 presents material groups and material categories developed for the waste characterization.

Table 1-1
List of Material Groups and Categories

Group	Material Categories	
Paper	Newsprint	High Grade Office Paper
	Recyclable Old Corrugated Cardboard (OCC)	Magazine/Glossy
	Non-Recyclable OCC	Polycoated/Aseptic Containers
	Kraft Paper	Mixed (Other Recyclable) Paper
	Paperboard	Other (Non-recyclable) Paper
Plastics	PET Bottles and Jars	Expanded Polystyrene
	HDPE Containers - Natural	Plastic Bags and Film/Wrap
	HDPE Containers - Colored	Other Plastic
	#3 - #7 Bottles, Jars, Containers	
Metal	Aluminum Used Beverage Containers	Other Ferrous Metal
	Ferrous Metal Food Containers	Other Non-Ferrous Metal
Glass	Clear Glass	Amber Glass
	Green Glass	Other Glass
Organics	Yard Waste	Textiles
	Wood (Non-C&D)	Diapers
	Food Waste	Other Organics
C&D	Clean/Unpainted C&D Aggregates	Composition Roofing
	Painted C&D Aggregates	Other Asphalt Roofing (Built-up Roofing)
	Clean/Unpainted C&D Wood	Gypsum Board
	Treated/Painted C&D Wood	Other C&D
Problem Materials	Batteries	Other Electronics/Appliances
	Televisions	Household Hazardous Waste (HHW)
	Computers	Bulky Waste
Other	Tires	Fines
	Other Inorganics	

Detailed definitions for each material category are included in Appendix A.

Load Selection

Table 1-2 presents the targeted samples by generator. The sample distribution by generator was based on the City's request.[1]

[1] Table 1-2 details the number of loads targeted for sampling. During the course of the field sampling, the Project Team sampled two additional commercial loads over the target for a total of 22 loads.

Table 1-2
Sample Distribution by Generator

Generator	Total Targeted Samples
Residential	30
Commercial	20
TOTAL	50

The Project Team distributed the targeted samples by generator (residential and commercial), as described below. For the routes identified for sampling, the Project Team provided the driver with a brightly colored placard and directed the driver to dispose of the load at the sorting area located at the Customer Convenience and Recycling Center (CCRC).

Residential

Residential MSW is collected by City crews. The City provides MSW collection from each of the five residential collection districts (Districts) on Monday, Tuesday, Thursday, and Friday. Residential MSW collected by the City crews is delivered to the landfill or any of the three City Transfer stations. Residential MSW delivered to the City transfer stations is then transported and disposed at the landfill.

Based on Residential MSW delivered to each City facility in Fiscal Year 2011/2012, the Project Team distributed the residential targeted samples proportionately by District and facility. Table 1-3 presents the residential sample distribution by District and facility.

Table 1-3
Residential Sample Distribution by District and Facility

	City Transfer Stations				
Generator Sector	Bachman	Fair Oaks	Westmoreland	McCommas Bluff Landfill	TOTAL
District 1	0	0	0	6	6
District 2	1	0	7	0	8
District 3	3	1	0	0	4
District 4	3	3	0	0	6
District 5	0	3	0	3	6
TOTAL	7	7	7	9	30

Next, the Project Team organized the routes by collection day, District, and facility based on tonnage disposal information for October 2012. For each facility, the Project Team excluded routes disposing of less than 20 tons in October 2012. For the remaining routes, the Project Team utilized computer software to randomly select routes distributed across the collection days to be sampled in accordance with the sample distribution, shown in Table 1-2. For selected residential routes that typically dispose at a transfer station, the City redirected those loads to the landfill for disposal. Table 1-4 presents the routes sampled, by District and collection day.

Table 1-4
Residential Routes Selected for Sampling

Generator Sector	Monday	Tuesday	Thursday	Friday
District 1	11105 11108[1]	12102[1]	14102[1] 14108	15108
District 2	21108 21109[1]	22202[1] 22103	24101 24202[1]	25106 25201[1]
District 3	31106[1]	32105	34106	35104
District 4	41201	42103 42108[1]	44303	45102[1] 45301
District 5	51202 51206[1]	52101	54101[1] 54107	55101[1]

1. Second load was sampled from identified routes. The Project Team sampled from the first load for other routes.

Commercial

Commercial MSW is collected by private haulers. Private haulers may dispose of commercial MSW generated within the City at the landfill or other disposal facilities. Since this study is focused on waste disposed at the City's landfill, commercial refuse that is disposed at other disposal facilities was excluded.

The landfill has two scale houses, the North and the South scale house, that accept commercial MSW. The majority of commercial loads utilize the North scale house. Therefore, the Project Team randomly selected commercial loads from the South scale house Monday and from the North scale house the remainder of the week. A total of 22 commercial loads were sampled.

Sample Selection

At the scale house, the Project Team directed drivers of selected loads to empty the entire load at the CCRC located at the landfill. Once the load was emptied at the CCRC and the collection vehicle had exited the area, the Project Team randomly selected a portion of the load to be sampled and collected approximately 200 pounds of material from the section of the load identified for sampling. The remaining unsampled portion of the load was then handled at the landfill in the normal manner.

A photograph was taken of each selected load and 200-pound sample before it was sorted. Appendix A contains select sample photographs. Photos of all 52 loads were saved to a compact disc and provided to City staff.

Sorting Procedures

Sorting was conducted at the CCRC. The sorting area consisted of a sorting table, containers for each material type, and a digital scale. Prior to sorting the first sample, each of the containers was labeled with the material categories and weighed to obtain the tare weight of the empty container. The materials were then hand sorted by the Project Team into individual containers representing the various 48 material categories. Then, each container was weighed to determine the quantity of materials by material type in each sample. These weights were recorded to the nearest 0.1

pound on individual data sheets to document the sorting process. After each 200-pound sample was sorted and weighed, the sorted waste was placed into the roll-off container provided by the City for disposal at the landfill.

1.2.2 Data Analysis

The data gathered in the field was combined with the historical tonnage information provided by the City. This section provides a description of the analysis performed to estimate the MSW tons disposed by generator and composition of MSW disposed at the landfill.

Estimating MSW Tons Disposed by Generator

The Project Team estimated the tonnage of MSW disposed at the landfill based on tonnage disposed for Fiscal Year 2011/2012. The Project Team assumed loads designated as material codes listed in “Targeted Waste” in Section 1.2.1 (described as compacted or uncompacted garbage) contained MSW. Table 1-5 presents the estimated tonnage of MSW disposed at the landfill.

Table 1-5
MSW Tonnage Disposed at Landfill (FY 2011/2012)

Type of Material	Tonnage	Tonnage Composition (%)
MSW	803,088	56.5%
Other	619,290	43.5%
TOTAL	1,422,378	100.0%

Next, the Project Team assumed MSW delivered from Districts 1 through 5 (customer codes 3511 through 3515), City transfer trucks (customer code 211), City residents (customer code 2), and MSW dropped off at the CCRC (customer code 2202) was residential. In reviewing the remaining customer codes, the Project Team excluded MSW delivered by other City departments (customer codes 220 through 229, 280, 282 through 286 and 301), City brush and recycling services (customer codes 3518 through 3545), and material dropped at the residential self-haul area of the landfill (customer code 2). The Project Team assumed that remaining MSW tonnage accepted at the landfill was commercial. Table 1-6 presents the estimated MSW tonnage by generator.

Table 1-6
Tonnage Allocation for Residential and Commercial MSW

Generator Sector	Tonnage [1]	Tonnage Composition by Generator (%)
Residential	260,019	34.0%
Commercial	510,723	66.0%
Excluded [2]	32,347	NA
TOTAL	803,088	100.0%

1. Minor arithmetic errors are due to rounding.
2. "Excluded" waste is from other City departments, City brush and recycling services, and the residential self-haul area of the landfill.

Estimating Composition of MSW Disposed at Landfill

All of the data from the field event was entered into the Project Team's proprietary waste characterization statistical model (Model). The Model statistically manipulates the data to calculate the mean, 90 percent confidence intervals, and standard deviation for individual material categories by generator sector and aggregate. In addition, the Model is structured to identify where specific samples could be considered statistical outliers.

The mean represents the mathematical average or average percent of a material in the MSW by weight. The confidence interval is an expression of accuracy. It provides the upper and lower limits of the "actual" mean for the MSW disposed at the landfill based upon the sorting and sampling observations. For example, the 90 percent confidence interval represents that there is a 90 percent level of confidence that the true mean falls within the upper and lower bounds of the confidence interval. The 90 percent confidence interval is the generally accepted industry standard for MSW composition studies. In general, the more samples that are sorted, the narrower the range becomes for a given confidence interval. The narrower the intervals, the more precise the data. It is critical when comparing composition results that the confidence intervals are considered along with the mean percentages.

Overall, the outputs of the Model provide multiple measures for evaluating the results.

1.3 Results of MSW Composition Study

The Project Team conducted the one-week field sorting event at the landfill during the week of June 24 through June 28, 2013. A total of 52 samples representing 11,452 pounds of MSW were sampled during the field event. Table 1-7 shows the number of samples characterized by generator. Appendix A provides information regarding each sample selected.

Table 1-7
Sample Distribution by Generator

Generator Sector	Sample Count
Residential	30
Commercial	22
Total	52

This section presents the results of the waste characterization study and identifies opportunities to increase diversion of materials generated in the City.

1.3.1 Aggregate Composition Results

Figure 1-1 presents the aggregate composition of MSW disposed at the landfill based on the composition and weighting by generator. More than half of the MSW disposed was paper and organics.

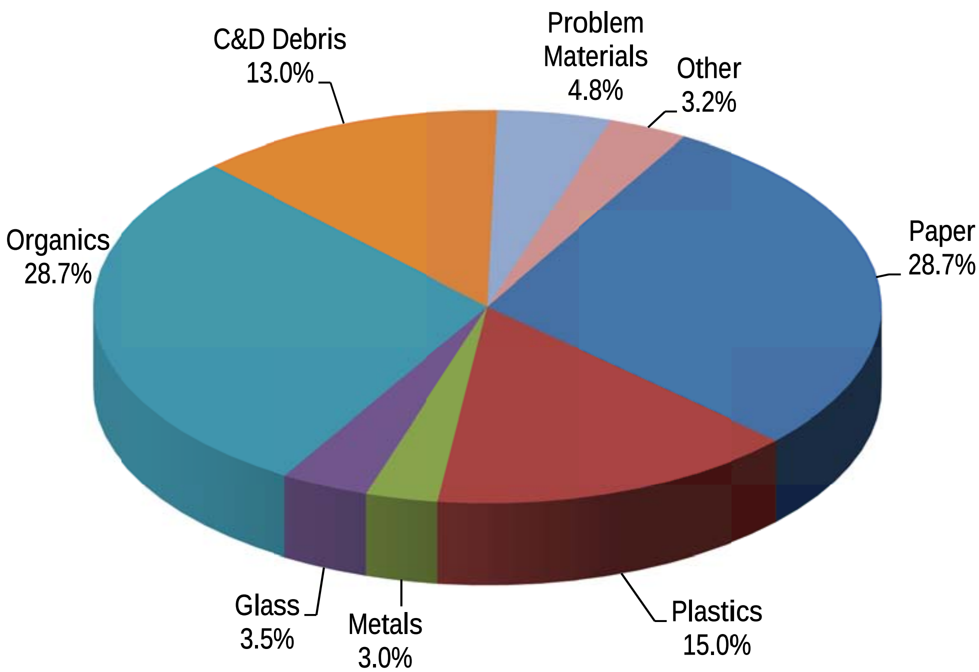


Figure 1-1. Aggregate Composition of MSW Disposed in Landfill

Table 1-8 presents the composition and estimated tonnage of each material category in MSW loads disposed at the landfill.

Table 1-8
Aggregate Composition Results by Material Category

Material Group		Material	Mean (%)	Tonnage	90 % Confidence Interval Lower Bound	90 % Confidence Interval Upper Bound
Paper			28.7%	221,253	25.1%	32.5%
	1	Newsprint	1.4%	11,103	1.1%	1.9%
	2	Recyclable OCC	9.2%	71,053	7.0%	11.7%
	3	Non-Recyclable OCC	1.2%	9,035	0.6%	2.0%
	4	Kraft Paper	1.0%	7,696	0.6%	1.6%
	5	Paperboard	1.8%	14,134	1.5%	2.2%
	6	High Grade Office Paper	1.5%	11,844	1.0%	2.3%
	7	Magazines/Glossy	0.8%	5,957	0.6%	1.1%
	8	Polycoated/Aseptic Containers	0.3%	2,223	0.2%	0.4%
	9	Mixed (Other recyclable) Paper	2.7%	20,722	2.1%	3.4%
	10	Other (Non-recyclable) Paper	8.8%	67,488	7.1%	10.7%
Plastics			15.0%	115,645	13.0%	17.2%
	11	#1 PET Bottles & Jars	1.7%	12,924	1.4%	2.0%
	12	#2 HDPE Containers - Natural	0.3%	2,548	0.2%	0.5%
	13	#2 HDPE Containers - Colored	1.0%	7,413	0.6%	1.5%
	14	#3-#7 Bottles and Jars	1.1%	8,377	0.9%	1.3%
	15	Expanded Polystyrene	0.9%	6,993	0.8%	1.1%
	16	Plastic Bags & Film Wrap	5.2%	40,129	4.4%	6.1%
	17	Other Plastic	4.8%	37,260	3.7%	6.2%
Metals			3.0%	22,834	2.4%	3.7%
	18	Aluminum Used Beverage Containers	0.5%	3,935	0.4%	0.6%
	19	Ferrous Metal Food Containers	0.8%	6,525	0.6%	1.2%
	20	Other Ferrous Metal	0.8%	6,520	0.6%	1.2%
	21	Other Non-Ferrous Metals	0.8%	5,853	0.6%	1.0%
Glass			3.5%	27,238	2.9%	4.3%
	22	Clear Glass	1.4%	10,684	1.1%	1.8%
	23	Green Glass	0.8%	6,169	0.5%	1.1%
	24	Amber Glass	1.1%	8,382	0.8%	1.5%
	25	Other Glass	0.3%	2,003	0.2%	0.4%
Organics			28.7%	221,532	25.1%	32.7%
	26	Yard Waste	4.5%	34,632	3.1%	6.3%
	27	Wood (non C&D)	1.5%	11,297	0.7%	2.7%
	28	Food Waste	15.2%	117,364	12.0%	19.0%
	29	Textiles	4.9%	38,088	3.5%	6.7%
	30	Diapers	1.7%	12,789	1.2%	2.1%
	31	Other Organics	1.0%	7,362	0.7%	1.3%

Material Group		Material	Mean (%)	Tonnage	90 % Confidence Interval Lower Bound	Upper Bound
C&D Debris			13.0%	100,325	8.2%	18.8%
	32	Clean/Unpainted C&D Aggregates	0.0%	87	0.0%	0.0%
	33	Painted C&D Aggregates	0.0%	283	0.0%	0.1%
	34	Clean/Unpainted C&D Wood	6.3%	48,606	3.4%	10.1%
	35	Treated/Painted C&D Wood	2.9%	22,424	1.1%	5.5%
	36	Composition Roofing (3-tab)	0.2%	1,786	0.1%	0.5%
	37	Other Asphalt Roofing (Built-up)	0.0%	0	0.0%	0.0%
	38	Gypsum Board	1.4%	10,892	0.5%	2.9%
	39	Other C&D	2.1%	16,247	0.9%	3.8%
Problem Materials			4.8%	36,989	2.9%	7.0%
	40	Batteries	0.1%	416	0.0%	0.1%
	41	Televisions	0.2%	1,919	0.1%	0.5%
	42	Computers	0.0%	12	0.0%	0.0%
	43	Other Electronics/Appliances	1.2%	9,093	0.7%	1.9%
	44	HHW	0.2%	1,235	0.1%	0.3%
	45	Bulky Waste	3.2%	24,313	1.5%	5.2%
Other			3.2%	24,928	2.3%	4.4%
	46	Tires	1.4%	11,111	0.6%	2.7%
	47	Other Inorganics	0.9%	6,962	0.6%	1.3%
	48	Fines	0.9%	6,854	0.7%	1.1%
TOTAL			100.0%	770,742		

Figure 1-2 shows the top ten most prevalent MSW materials disposed in the landfill. Food waste accounted for nearly double the next largest material disposed.

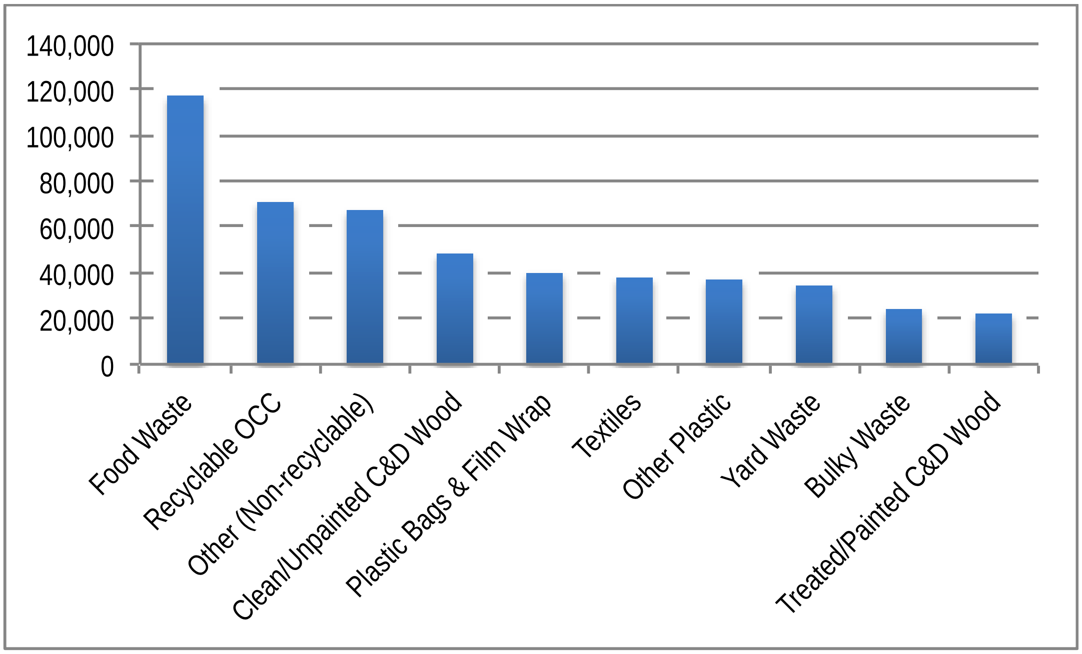


Figure 1-2. Top Ten Material Categories in MSW Disposed in Landfill (Tons)

1.3.2 Composition Results by Generator

The composition of MSW disposed varied based on the generator, residential or commercial. For example, residential loads had a higher percentage of organics while commercial loads resulted in a higher percentage of C&D debris. Table 1-9 presents the mean percentages of each material disposed by generator.

Table 1-9
Composition Results by Generator (Percentages)

Material Group		Material	Residential	Commercial	Aggregate
Paper			24.8%	30.7%	28.7%
	1	Newsprint	2.2%	1.1%	1.4%
	2	Recyclable OCC	2.3%	12.8%	9.2%
	3	Non-Recyclable OCC	0.6%	1.5%	1.2%
	4	Kraft Paper	0.4%	1.3%	1.0%
	5	Paperboard	2.6%	1.4%	1.8%
	6	High Grade Office Paper	0.9%	1.8%	1.5%
	7	Magazines/Glossy	1.3%	0.5%	0.8%
	8	Polycoated/Aseptic Containers	0.3%	0.3%	0.3%
	9	Mixed (Other recyclable) Paper	3.0%	2.5%	2.7%
	10	Other (Non-recyclable) Paper	11.2%	7.5%	8.8%
Plastics			17.7%	13.6%	15.0%
	11	#1 PET Bottles & Jars	2.5%	1.3%	1.7%
	12	#2 HDPE Containers - Natural	0.4%	0.3%	0.3%
	13	#2 HDPE Containers - Colored	0.7%	1.1%	1.0%
	14	#3-#7 Bottles and Jars	1.4%	0.9%	1.1%
	15	Expanded Polystyrene	1.7%	0.5%	0.9%
	16	Plastic Bags & Film Wrap	6.4%	4.6%	5.2%
	17	Other Plastic	4.6%	4.9%	4.8%
Metals			3.8%	2.5%	3.0%
	18	Aluminum Used Beverage Containers	0.8%	0.3%	0.5%
	19	Ferrous Metal Food Containers	1.1%	0.7%	0.8%
	20	Other Ferrous Metal	1.0%	0.8%	0.8%
	21	Other Non-Ferrous Metals	0.8%	0.7%	0.8%
Glass			5.1%	2.7%	3.5%
	22	Clear Glass	2.0%	1.0%	1.4%
	23	Green Glass	0.9%	0.8%	0.8%
	24	Amber Glass	1.8%	0.7%	1.1%
	25	Other Glass	0.4%	0.2%	0.3%
Organics			41.1%	22.4%	28.7%
	26	Yard Waste	9.8%	1.8%	4.5%
	27	Wood (non C&D)	0.9%	1.8%	1.5%
	28	Food Waste	18.5%	13.6%	15.2%
	29	Textiles	7.0%	3.9%	4.9%
	30	Diapers	4.1%	0.4%	1.7%
	31	Other Organics	0.9%	1.0%	1.0%

Material Group		Material	Residential	Commercial	Aggregate
C&D Debris			2.4%	18.4%	13.0%
	32	Clean/Unpainted C&D Aggregates	0.0%	0.0%	0.0%
	33	Painted C&D Aggregates	0.1%	0.0%	0.0%
	34	Clean/Unpainted C&D Wood	1.0%	9.0%	6.3%
	35	Treated/Painted C&D Wood	0.2%	4.3%	2.9%
	36	Composition Roofing (3-tab)	0.7%	0.0%	0.2%
	37	Other Asphalt Roofing (Built-up)	0.0%	0.0%	0.0%
	38	Gypsum Board	0.1%	2.1%	1.4%
	39	Other C&D	0.2%	3.1%	2.1%
Problem Materials			2.0%	6.2%	4.8%
	40	Batteries	0.1%	0.0%	0.1%
	41	Televisions	0.0%	0.4%	0.2%
	42	Computers	0.0%	0.0%	0.0%
	43	Other Electronics/Appliances	1.2%	1.1%	1.2%
	44	HHW	0.4%	0.1%	0.2%
	45	Bulky Waste	0.3%	4.6%	3.2%
Other			3.0%	3.3%	3.2%
	46	Tires	0.1%	2.1%	1.4%
	47	Other Inorganics	1.7%	0.5%	0.9%
	48	Fines	1.2%	0.7%	0.9%
TOTAL			100.0%	100.0%	100.0%

Table 1-10 shows the estimated tons by generator, calculated based on the quantity of MSW disposed by generator as discussed in Section 1.2.2 (Estimating Composition of MSW Disposed at landfill). It is interesting to note that residential and commercial loads accounted for comparable amounts of organics. Commercial loads accounted for a higher percentage of paper (71%) and C&D Debris (94%).

Table 1-10
Composition Results by Generator Sector (Tons)

Material Group		Material	Residential	Commercial	Aggregate
Paper			64,445	156,808	221,253
	1	Newsprint	5,715	5,388	11,103
	2	Recyclable OCC	5,886	65,167	71,053
	3	Non-Recyclable OCC	1,567	7,468	9,035
	4	Kraft Paper	1,120	6,577	7,696
	5	Paperboard	6,845	7,288	14,134
	6	High Grade Office Paper	2,415	9,428	11,844
	7	Magazines/Glossy	3,272	2,684	5,957
	8	Polycoated/Aseptic Containers	650	1,573	2,223
	9	Mixed (Other recyclable) Paper	7,830	12,892	20,722
	10	Other (Non-recyclable) Paper	29,145	38,343	67,488
Plastics			46,091	69,553	115,645
	11	#1 PET Bottles & Jars	6,451	6,473	12,924
	12	#2 HDPE Containers - Natural	960	1,589	2,548
	13	#2 HDPE Containers - Colored	1,770	5,643	7,413
	14	#3-#7 Bottles and Jars	3,562	4,815	8,377
	15	Expanded Polystyrene	4,522	2,472	6,993
	16	Plastic Bags & Film Wrap	16,756	23,373	40,129
	17	Other Plastic	12,071	25,189	37,260
Metals			9,899	12,935	22,834
	18	Aluminum Used Beverage Containers	2,193	1,742	3,935
	19	Ferrous Metal Food Containers	2,926	3,599	6,525
	20	Other Ferrous Metal	2,589	3,931	6,520
	21	Other Non-Ferrous Metals	2,191	3,662	5,853
Glass			13,385	13,853	27,238
	22	Clear Glass	5,323	5,361	10,684
	23	Green Glass	2,238	3,930	6,169
	24	Amber Glass	4,764	3,618	8,382
	25	Other Glass	1,058	945	2,003
Organics			106,989	114,543	221,532
	26	Yard Waste	25,491	9,141	34,632
	27	Wood (non C&D)	2,314	8,983	11,297
	28	Food Waste	48,059	69,305	117,364
	29	Textiles	18,123	19,964	38,088
	30	Diapers	10,732	2,058	12,789
	31	Other Organics	2,270	5,092	7,362

Material Group		Material	Residential	Commercial	Aggregate
C&D Debris			6,112	94,212	100,325
	32	Clean/Unpainted C&D Aggregates	87	0	87
	33	Painted C&D Aggregates	256	27	283
	34	Clean/Unpainted C&D Wood	2,630	45,975	48,606
	35	Treated/Painted C&D Wood	504	21,920	22,424
	36	Composition Roofing (3-tab)	1,786	0	1,786
	37	Other Asphalt Roofing (Built-up)	0	0	0
	38	Gypsum Board	349	10,543	10,892
	39	Other C&D	499	15,747	16,247
Problem Materials			5,271	31,717	36,989
	40	Batteries	235	181	416
	41	Televisions	0	1,919	1,919
	42	Computers	12	0	12
	43	Other Electronics/Appliances	3,247	5,846	9,093
	44	HHW	928	307	1,235
	45	Bulky Waste	849	23,464	24,313
Other			7,827	17,101	24,928
	46	Tires	243	10,869	11,111
	47	Other Inorganics	4,462	2,501	6,962
	48	Fines	3,123	3,731	6,854
TOTAL			260,019	510,723	770,742

Figures 1-3 and 1-4 present the top ten most prevalent MSW materials disposed in the landfill by generator. Five materials, food waste, other (non-recyclable) paper, textiles, plastic bags & film wrap, and other plastics, were in the top ten most prevalent MSW materials disposed for both residential and commercial loads.

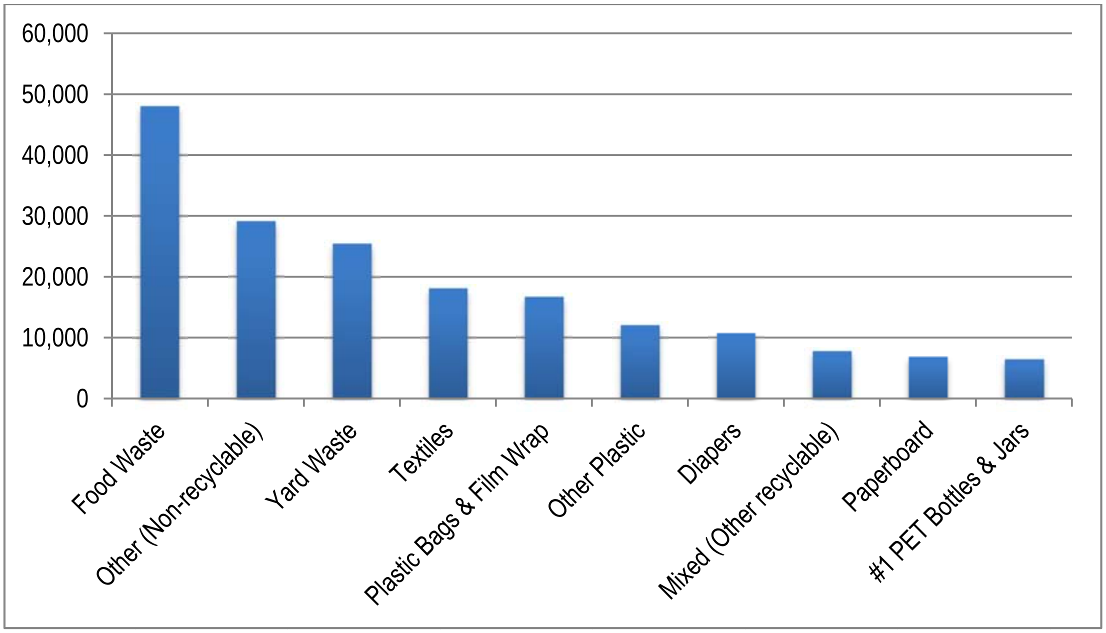


Figure 1-3. Top Ten Material Categories in MSW Disposed in Landfill by Residential Generators (Tons)

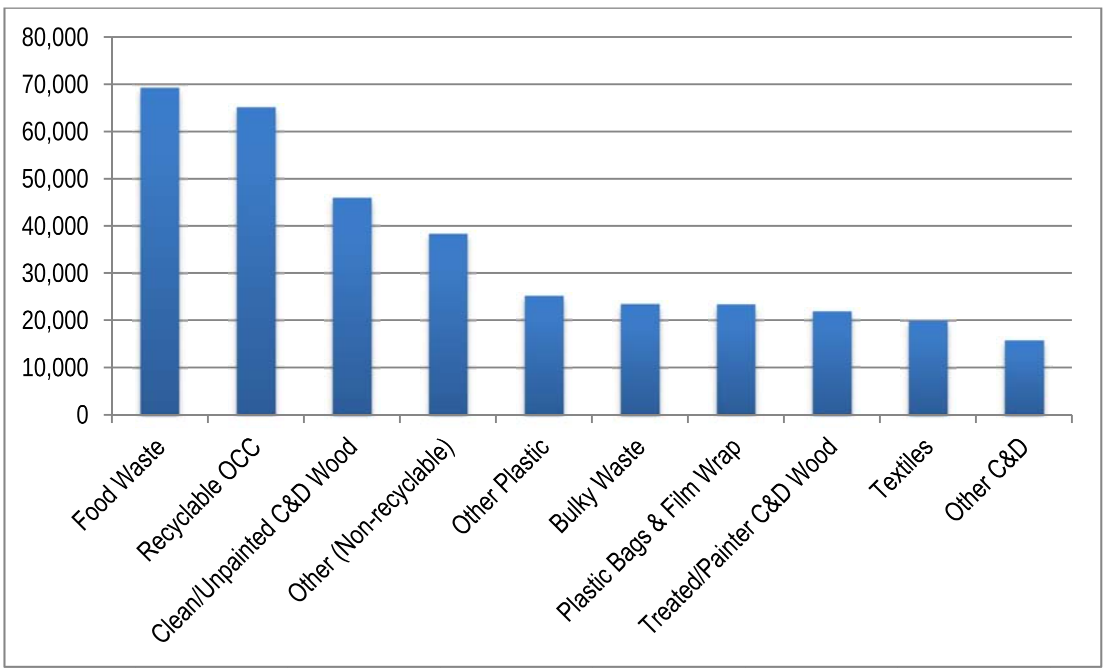


Figure 1-4. Top Ten Material Categories in MSW Disposed in Landfill by Commercial Generators (Tons)

1.3.3 Composition Results by Residential District

Based on residential MSW delivered to each City facility, the Project Team distributed the residential targeted samples proportionately by District based on tonnage disposed in Fiscal Year 2011/2012. Table 1-11 presents the number of samples by District.

Table 1-11
Residential Sample Distribution by District

Generator Sector	Count of Samples
District 1	6
District 2	8
District 3	4
District 4	6
District 5	6
Total	30

Due to the limited number of samples by District, the composition by District is provided for qualitative purposes only. Additional data collection is required to provide statistical results by residential District. Table 1-12 presents the composition of MSW disposed by residential District.

Table 1-12
Composition Results by Residential District (Percentages)

Material Group		Material	Mean (%) by District 1	2	3	4	5
Paper			22.9%	25.8%	30.5%	23.5%	22.8%
	1	Newsprint	2.7%	1.9%	1.7%	2.8%	1.9%
	2	Recyclable OCC	0.8%	2.2%	3.5%	2.0%	3.3%
	3	Non-Recyclable OCC	0.3%	0.7%	0.9%	0.9%	0.2%
	4	Kraft Paper	0.1%	0.4%	1.3%	0.4%	0.3%
	5	Paperboard	2.9%	2.9%	1.8%	2.2%	3.0%
	6	High Grade Office Paper	0.9%	0.8%	0.8%	1.4%	0.8%
	7	Magazines/Glossy	0.6%	0.6%	3.3%	1.4%	1.4%
	8	Polycoated/Aseptic Containers	0.2%	0.2%	0.3%	0.4%	0.1%
	9	Mixed (Other recyclable) Paper	3.2%	3.6%	3.2%	2.7%	2.2%
	10	Other (Non-recyclable) Paper	11.2%	12.5%	13.6%	9.3%	9.8%
Plastics			17.6%	19.4%	14.7%	18.9%	16.5%
	11	#1 PET Bottles & Jars	3.0%	2.8%	1.7%	1.6%	2.8%
	12	#2 HDPE Containers - Natural	0.6%	0.4%	0.2%	0.2%	0.4%
	13	#2 HDPE Containers - Colored	1.0%	0.5%	0.9%	0.6%	0.5%
	14	#3-#7 Bottles and Jars	1.1%	1.3%	1.7%	1.6%	1.3%
	15	Expanded Polystyrene	1.8%	2.5%	1.0%	1.1%	1.8%
	16	Plastic Bags & Film Wrap	7.3%	7.1%	6.4%	5.3%	5.9%
	17	Other Plastic	2.9%	4.9%	2.7%	8.4%	3.7%
Metals			3.6%	4.7%	3.2%	3.4%	3.5%
	18	Aluminum UBC	0.8%	0.8%	0.6%	0.7%	1.3%
	19	Ferrous Metal Food Containers	1.2%	1.6%	0.8%	0.7%	1.1%
	20	Other Ferrous Metal	1.2%	1.4%	0.6%	1.0%	0.5%
	21	Other Non-Ferrous Metals	0.5%	0.9%	1.2%	1.0%	0.6%
Glass			6.1%	5.6%	6.0%	4.1%	4.1%
	22	Clear Glass	2.5%	1.6%	2.5%	2.0%	1.9%
	23	Green Glass	1.1%	0.8%	2.1%	0.5%	0.4%
	24	Amber Glass	2.0%	3.1%	1.0%	1.3%	1.1%
	25	Other Glass	0.5%	0.2%	0.5%	0.3%	0.7%
Organics			38.4%	39.8%	38.2%	39.5%	49.3%
	26	Yard Waste	4.5%	6.0%	7.5%	14.5%	17.1%
	27	Wood (non C&D)	0.0%	0.1%	5.6%	0.1%	0.5%
	28	Food Waste	19.5%	20.3%	18.3%	17.3%	16.3%
	29	Textiles	8.2%	7.8%	2.2%	3.5%	11.2%
	30	Diapers	5.9%	5.3%	3.7%	2.1%	3.1%
	31	Other Organics	0.3%	0.4%	0.9%	1.9%	1.0%

Material Group		Material	Mean (%) by District 1	2	3	4	5
C&D Debris			8.4%	0.9%	0.7%	0.7%	1.0%
	32	Clean/Unpainted C&D Aggregates	0.0%	0.1%	0.0%	0.0%	0.0%
	33	Painted C&D Aggregates	0.0%	0.0%	0.2%	0.0%	0.3%
	34	Clean/Unpainted C&D Wood	4.2%	0.2%	0.1%	0.3%	0.2%
	35	Treated/Painted C&D Wood	0.0%	0.4%	0.4%	0.1%	0.2%
	36	Composition Roofing (3-tab)	3.4%	0.0%	0.0%	0.0%	0.0%
	37	Other Asphalt Roofing (Built-up)	0.0%	0.0%	0.0%	0.0%	0.0%
	38	Gypsum Board	0.0%	0.2%	0.0%	0.0%	0.4%
	39	Other C&D	0.7%	0.0%	0.0%	0.3%	0.0%
Problem Materials			0.9%	2.0%	1.1%	4.3%	1.5%
	40	Batteries	0.1%	0.1%	0.1%	0.1%	0.1%
	41	Televisions	0.0%	0.0%	0.0%	0.0%	0.0%
	42	Computers	0.0%	0.0%	0.0%	0.0%	0.0%
	43	Other Electronics/Appliances	0.4%	0.9%	1.0%	3.5%	0.5%
	44	HHW	0.1%	0.4%	0.0%	0.2%	1.0%
	45	Bulky Waste	0.2%	0.6%	0.0%	0.6%	0.0%
Other			2.2%	1.6%	5.6%	5.6%	1.3%
	46	Tires	0.0%	0.0%	0.7%	0.0%	0.0%
	47	Other Inorganics	1.1%	0.7%	3.5%	4.3%	0.0%
	48	Fines	1.1%	1.0%	1.4%	1.4%	1.3%
TOTAL			100.0%	100.0%	100.0%	100.0%	100.0%

Section 2
REVIEW OF POTENTIAL TECHNOLOGIES

2.1 Introduction

This section provides the City with a broad understanding of the potential resource recovery technologies being evaluated, as listed below:

- Single stream recycling;
- Mixed waste processing; [1]
- Gasification; and
- Anaerobic digestion.

For each technology, the Project Team has included a broad overview of the following:

- Summary of the technology;
- Status of development;
- Potential impacts to current collection, processing and disposal operations;
- Facility capital, operational, and regulatory requirements; and
- Advantages and disadvantages.

For the purposes of this analysis, the Project Team has presented these technologies as discrete options for the City's consideration. However, these technologies are not all mutually exclusive, and a system can be designed to meet the unique needs and objectives of the City of Dallas. For instance, as discussed in this section, single stream recycling can be operated concurrently with mixed waste processing.

Appendix B provides additional, clarifying information on issues discussed in this section, such as project delivery methods, potential site for a resource recovery facility and facility permitting.

2.2 Single Stream Recycling

2.2.1 Summary of the Technology

Process Objective

Single stream recycling sorts mixed recyclable materials with minimal contamination and prepares the materials to be sold at market. Single stream facilities typically accept mixed fibers (paper, newspaper and cardboard) and containers (plastic, metal

[1] The mixed waste processing technology review discusses multiple uses for the residual material, including landfill disposal, anaerobic digestion and gasification.

and glass) that are collected from households (residential) and/or businesses (commercial). The following table provides a basic process overview.

Table 2-1
Single Stream Recycling Process Overview

Process Input	Process Output
▪ Mixed recyclable materials ▪ Electrical and hydrocarbon fuel energy ▪ Human energy	▪ Separated recyclables (fibers and containers by type and grade) ▪ Residue (to landfill)

Key Operating Systems and Elements

Typical single stream processing systems consist of a highly integrated system of machine and human elements that can be summarized in the process flow diagram in Figure 2.1.

Figure 2.1. Single Stream Process Flow

2.2.2 Status of Development

Single stream recycling facilities have been in use for more than 20 years in the United States and for even longer in Europe. Over that time, single stream has rapidly replaced dual stream recycling, and, in other instances, has been selected as the technology for a community's first recycling program. There are now over 200 single stream recycling facilities in the United States, and new and expanded facilities are coming on line regularly. These facilities are designed to meet the needs of small and large communities, and can range in size from a low of five tons per hour to very large facilities that process 50 to 60 tons per hour.

A list of major cities, counties and agencies that utilize single stream technology would cover many pages, as this technology has become the mainstay for recyclable material recovery throughout the United States and worldwide.

2.2.3 Potential Impacts to Current Collection, Processing and Disposal Operations

The City implemented weekly collection of single stream recycling for residential households in 2008. Since that time, the City has made a substantial investment in the program via equipment (trucks and carts), staffing, and public education. Since implementing the program, the City has significantly increased the quantity of material recycled. Based on data included in the 2011 "Regional Recycling Rate Update," residents in the City of Dallas recycled 285 pounds of material per single-family household in 2010.[2] In 2011, the amount increased by 40 percent to 400 pounds per household. It is the Project Team's opinion that the City has developed a successful recycling program in a short period of time.

Based on industry experience and the results of the waste characterization study completed for the City (refer to Section 1), the Project Team believes that there is still substantial opportunity to continue increasing the amount of material collected via the single stream program to 600 to 800 pounds per household annually. This program is currently on track to generate approximately 55,000 tons annually, and has the potential to increase to 75,000 to 100,000 tons annually based on the results of the waste characterization study.

Since the City already has a single stream recycling collection program, no changes to the collection system would be required. However, as the program increases the quantity of material collected in the future, there could be a need for incremental increases in the program via additional routes and staff.

Continued efforts to improve single stream recycling will extend the life of the McCommas Bluff Landfill. Due to the level of investment and initial program success with single stream recycling, the Project Team would expect that the City has a strong interest in continuing this program as a key focus of its resource recovery efforts.

The City has a single stream recycling processing contract with Waste Management Recycle America (WMRA). The current contract expires at the end of 2016.

2.2.4 Facility Capital, Operational, and Regulatory Requirements

Typical Capital Requirements

Capital requirements for single stream facilities include the items listed below. Single stream recycling facilities are capital-intensive, but less so than other resource recovery technologies evaluated in this analysis.

[2] This report was developed for the North Central Texas Council of Governments by Leidos Engineering.

- Land
- Building with adequate space for the following: incoming material, sorting equipment, support facilities for staff (such as breakrooms, shower and locker rooms, and administrative offices), and storage for sorted material
- Sorting equipment and other supporting large equipment (forklifts, front loaders, material balers, etc.)
- Equipment service and repair shops and tools
- Utility systems
- Site roadways, vehicle-weighing facilities, and parking

Typical Building Footprint Size and Site Acreage

The size of building required for a single stream facility varies based on the quantity of material being processed, processing system design, and other operational considerations, such as floor space reserved for temporary storage of incoming material, and/or processed material. Building footprints ranging from as small as 30,000 square feet to over 200,000 square feet are common.

The Project Team would expect a building sized for Dallas' needs would at a minimum be between 80,000 and 100,000 square feet. This would be considered an adequate size for a single stream facility processing around 100,000 tons per year assuming a nominal 30 ton-per-hour processing line operating two 8-hour shifts per day five days per week and a 90 percent plant availability (10 percent down time for cleaning and repair). A building this size would have adequate tipping floor space for at least four route trucks to tip simultaneously and for a modest amount of unprocessed material storage on the tipping floor. It would also have a modest amount of inside storage for baled product, perhaps up to a week's worth of production including storage in containers or trailers parked at three to four loading dock doors. However, this size building would not have sufficient space to add a second, duplicate processing line, which would require at least another 20,000 square feet. Considering that the City might want to construct a large enough building to handle future capacity and front and back end storage increases, the initial building size might be increased by 40,000 to 50,000 square feet to between 120,000 to 150,000 square feet overall.

Site size is driven by building size and requirements for large truck queuing and movements. Site sizes ranging from five acres to over 20 acres are common. The Project Team would expect a facility meeting Dallas' needs sited at the McCommas Bluff Landfill would use between 10 to 15 acres, recognizing that some basic infrastructure needed for the facility already exists, such as scale facilities and traffic circulation roadways. In Appendix B, the Project Team has identified a potential site for a resource recovery facility that is located within the permitted boundary of the McCommas Bluff Landfill. To develop a single stream facility at this site, improvements to site access roadways in the vicinity of the facility would be required. Approximately 30 acres of land are available at the identified site.

Typical Operations and Maintenance Requirements

Staffing needs for single stream facilities vary based on the size and throughput of the facility, processing system design, and the number of shifts operated. Some processing systems emphasize the use of human sorting labor while others maximize mechanical sorting and minimize sorting labor. Considering these variables, staff sizes inclusive of supervisory and maintenance staff could range from a low of 20 to 25 for a small facility operating a single shift to a high over 100 for a very large facility operating multiple shifts. The Project Team would expect that a facility serving Dallas' needs would employ between 40 and 60 staff if operated in two, eight-hour shifts five days per week.

Other operating and maintenance requirements include:

- Building and site maintenance;
- Equipment repair and maintenance;
- Fuel for mobile equipment;
- Utilities, including electrical power, water, and sewer; and
- Disposal of residue.

Single stream recycling is considered to have lower operation and maintenance (O&M) requirements than mixed waste processing, anaerobic digestion, and gasification.

Typical Revenue Sources

Single stream facilities generate revenue from the sale of sorted materials. While markets for recycled materials are well established, material pricing can vary significantly based on economic factors. In addition, single stream recycling facilities can generate revenue from processing fees.

Project Delivery Methods

While single stream recycling facilities are technically complex, they are numerous, well understood, and proven from a design and operational perspective. Subject to Texas laws and regulations governing procurement methods, the project delivery options available to the City for providing single stream recycling facility services are broad.[3] The options for project delivery are listed below in order of most to least City involvement.

- Conventional design-bid-build (DBB)
- General contractor/construction manager (GC/CM) or construction manager-at-risk
- Design-build (DB)
- Design-build-operate (DBO)

[3] There have been a number of changes in Texas state law over the last five years that could impact the procurement methods available to the City for capital project and services. The Project Team recommends that the City consult with legal counsel to fully understand its options for project delivery.

- Design-build-own-operate-transfer (DBOOT)
- Contracted services (CS)

These delivery methods are discussed in more detail in Appendix B.

Infrastructure and Utility Requirements

A single stream facility would require roadway access, water and wastewater, natural gas for heating or other uses, and electric power for equipment operation. If the facility is located within the boundaries of the McCommas Bluff Landfill, most of these infrastructure requirements are available for development on or adjacent to the site, and existing infrastructure (scales, scalehouse, roadways) may be used for the facility. Water, wastewater and natural gas utilities, which are available in adequate capacity on or adjacent to the landfill, would be extended to the facility site. Electrical service would be extended to the facility, size dependent on facility load.

Permitting Requirements

A single stream recycling facility would be classified by Texas Commission on Environmental Quality (TCEQ) as a Type V facility. Under certain requirements outlined in 30 TAC 328, a single stream recycling facility may be considered as an Exempt Facility and may require neither a Permit nor Registration. If the requirements for an Exempt Facility are not met, and if the facility is located within the permit boundary of the McCommas Bluff Landfill, the facility could be authorized with a Non-notice Permit Modification of the McCommas Bluff Landfill Permit. The TCEQ has Permitted/Registered/Exempted several single stream recycling facilities in Texas and is familiar with the technologies. Therefore, it is anticipated that a single stream processing facility could be permitted/registered/exempted by TCEQ in a timely manner without major roadblocks, especially if it is located on the site of an existing Permitted MSW Facility. Appendix B provides further detail on facility permitting.

2.2.5 Advantages and Disadvantages

There are a number of advantages and disadvantages of single stream recycling to be considered relative to other technologies discussed in this study.

Advantages

Technological Advantages

- Well established and proven technology with many operating facilities in Texas and the United States.
- Properly planned facilities are adaptable to changes in process and equipment improvements that occur over time.
- Less complex than the other technologies considered in this study.

Diversion Advantages

- As compared to other technologies considered in this analysis, single stream preserves the quality of recovered materials so that they can be processed for their "highest and best use." For example, high-quality paper can be preserved for high-quality use instead of being "down-cycled" to lower-end products like paper board.

- Single stream is the most prevalent recycling method in the United States, and it is consistent with how many other cities in the Dallas-Fort Worth Metroplex are operating their programs.
- More paper grades may be sorted and marketed, including junk mail, phone books and mixed paper with lower contamination than mixed waste processing.

Economic Advantages

- Use of this technology preserves the considerable capital investment the City has already made in its collection system (including fleet, carts, and operator training).
- Markets for recyclable materials resulting from single stream processing are well-established in Texas.
- Several single stream processing facilities are currently operating in the Dallas-Fort Worth Metroplex, demonstrating that the economics are more proven in the region relative to other technologies.
- Lower capital and operating cost than the other technologies evaluated in this study.

Environmental Advantages

- Uses less energy than other technologies evaluated in this study.
- Compared to anaerobic digestion and gasification technologies, valuable commodities can be recycled multiple times thereby reducing reliance on virgin resources.

Other Advantages

- Well understood and accepted by the public as an environmentally sound method for diversion of recyclables.
- Actively continues the established engagement of the public in the recycling system and encourages their "buy in" and support of sustainable resource management practices.

Disadvantages

Technological Disadvantages

- While the technology is well proven, sorting equipment and systems continue to evolve rapidly which may lead to the need for replacing equipment.

Diversion Disadvantages

- Single stream systems are designed to process clean recyclables and rely on the customer to properly sort materials for recycling. Improper sorting by customers can be detrimental to the economics and operation of a single stream system.

- Single stream systems are presently not adaptable to be able to accept organic materials (other than paper), which compose a large portion of the residential and commercial waste stream in the City of Dallas.

Economic Disadvantages

- While the economics of single stream are more proven in the region than other technologies, the economics of single stream can suffer during economic downturns in which the market value of materials decreases.
- Requires continual funding and effort for education of new customers.

2.3 Mixed Waste Processing

2.3.1 Overview of the Technology

Process Objective

Mixed waste processing recovers recyclable materials from mixed waste, or trash, and prepares the recovered materials to be sold at market. Recyclables recovered from mixed waste typically include fibers (paper, newspaper and cardboard) and containers (plastic, metal and glass). The process may also separate organic materials, such as food waste, yard waste, and non-recyclable paper, for use as feedstock for energy recovery in an anaerobic digestion or gasification process. The following table provides a basic process overview.

Table 2-2
Mixed Waste Processing Process Overview

Process Input		Process Output
▪ Mixed residential and commercial mixed waste (trash or garbage) ▪ Electrical and hydrocarbon fuel energy ▪ Human energy	➡	▪ Separated recyclables (fibers and containers by type and grade) ▪ Residue (to landfill, anaerobic digestion or gasification)

Key Operating Systems and Elements

Typical mixed waste processing systems consist of a highly integrated system of machine and human elements that can be summarized in the process flow diagram in Figure 2.2.

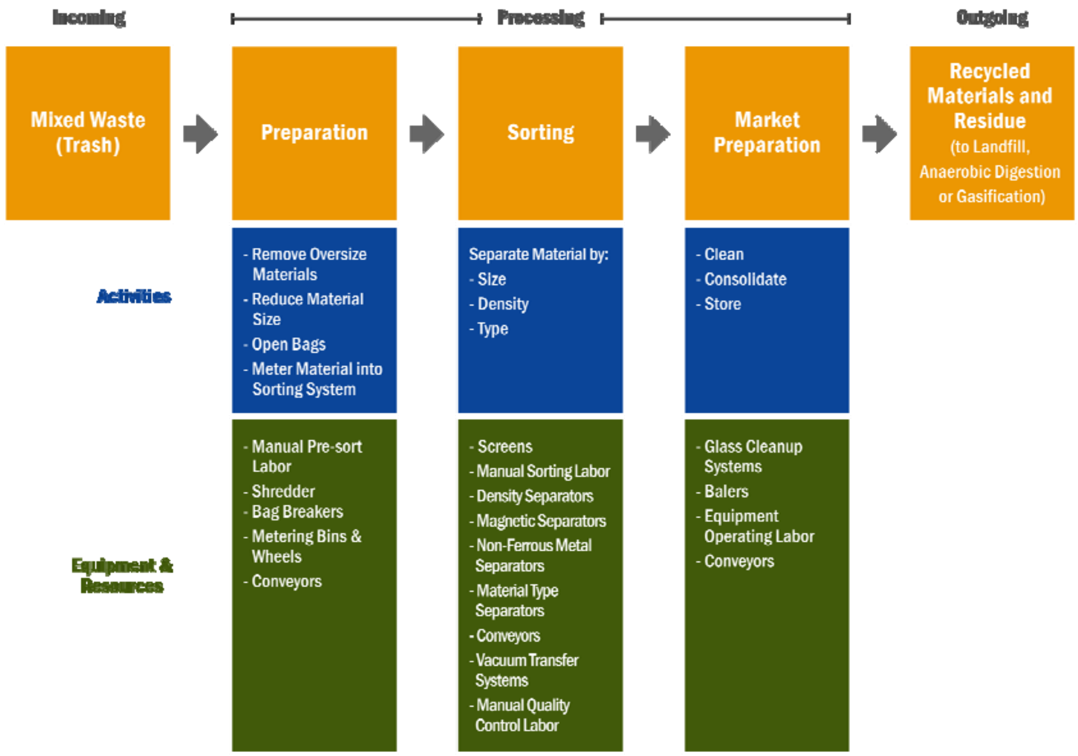


Figure 2.2. Mixed Waste Processing Process Flow

Although mixed waste processing systems include many of the same types of equipment and activities used in single stream recycling, in general the equipment must be larger and more robust, particularly in the front end of the system, as the materials being processed can be much higher in volume and of a more difficult nature to process (e.g. heavy, wet).

2.3.2 Status of Development

Mixed waste processing facilities have been in use since the 1980s in the United States but are not in widespread operation. They are most prevalent in communities in California that must comply with legislated mandates for high waste diversion. Some early attempts to implement these types of facilities fell short of expectations and discontinued operation. This was primarily due to poor equipment performance, high maintenance requirements, and cost competition from the development of large, relatively low-cost regional landfill disposal options. Renewed interest and development of these facilities over the past decade is, in part, directly related to the evolution and improvements in mechanical sorting equipment as well as the increased interest in “zero waste” and high diversion levels.

Mixed waste processing facilities typically range in size from a low of 20 tons per hour to very large facilities that process over 75 tons per hour. If found to be feasible for implementation, a mixed waste processing facility in Dallas would require a facility in the large end of this range. As a point of reference for facility size, consider that a processing facility with an hourly throughput capacity of 75 tons per hour (i.e. large facility) operating two, eight-hour shifts per day, five days per week with 90 percent plant availability would be capable of processing around 280,000 tons of mixed waste per year. The amount of residential and commercial waste being disposed at the McCommas Bluff Landfill is currently over 800,000 tons per year. Therefore, a very large mixed waste processing system would be capable of processing 35 percent of the residential and commercial waste disposed at the landfill.

The following is a representative list of communities in North America where mixed waste processing facilities are located or are being considered for implementation. It should be noted that most of these facilities are privately owned and operated and/or are part of a public-private partnership to achieve diversion objectives.

Table 2-3
Mixed Waste Processing Facilities in North America

▪ San Jose, CA ▪ Western Placer Waste Management Authority, Roseville, CA ▪ San Francisco, CA ▪ San Diego, CA	▪ Sunnyvale, CA ▪ Houston, TX ▪ San Antonio, TX ▪ Tulsa, OK ▪ Montgomery, AL ▪ Portland, OR	▪ Los Angeles County Sanitation Districts, Los Angeles, CA ▪ South Bayside Waste Management Authority, San Carlos, CA ▪ Edmonton, Alberta, Canada ▪ Toronto, Ontario, Canada

Due to their relative proximity to Dallas, the Project Team has provided brief overviews regarding the facilities referenced in Texas and Oklahoma.

- Houston – The City of Houston is requesting proposals from private companies to own and operate a mixed waste processing facility to process the City’s residential refuse.
- San Antonio – Waste Management owns and operates a facility that produces refuse derived fuel from trash. This operation is not associated with the City of San Antonio.
- Tulsa – American Waste Control has owned and operated a mixed waste processing facility for a number of years to process commercial waste. At this facility, relatively dry, recyclable-rich loads of commercial waste are targeted for sorting through the mixed waste processing system. In 2011, American Waste Control started operating a separate single stream processing line at the same facility to process the City of Tulsa’s residential single stream recyclable material.

2.3.3 Potential Impacts to Current Collection, Processing and Disposal Operations

The Project Team understands that the City has made a considerable investment in its single stream program and would like to continue to grow and develop the program. Mixed waste processing does not conflict with the City’s current single stream recycling program. It does have a similar objective of recovering the same types of recyclable materials (primarily fibers, metals, and plastics). The mixed waste processing system duplicates much of the equipment, systems and processes used for single stream recycling. If both single stream and mixed waste processing were used to increase the City’s diversion rate, it would make sense to co-locate and possibly integrate these two systems, as for example is done at the privately operated Newby

Island facility in San Jose, California, and American Waste Control in Tulsa, Oklahoma to take advantage of shared resources and equipment.

From the collection perspective, the development of a mixed waste processing facility means that the City could utilize the same trash and recycling collection system resources (carts, collection trucks and staff) that are currently in place. However, instead of trash collection vehicles disposing at the landfill, they would have the option to take material to the mixed waste processing facility where additional recyclables would be recovered. Depending on the extent of the mixed waste processing system, selected commercial routes could also be directed to the processing facility instead of the landfill.

While it is possible for communities to operate mixed waste processing and single stream programs concurrently, some communities have chosen to collect all material in one container. For instance, the City of Roseville, California takes this “all in one bin” approach. This type of program started in 2014 in Montgomery, Alabama and is under consideration in the City of Houston. In addition, some communities process mixed waste in one “wet” stream (which includes organics, food waste, and food-soiled paper products) and one “dry” stream (which includes recyclable plastics, paper, metal, glass, and all other material). Mixed waste processing facilities can be designed to accommodate any of these preferred collection approaches.

Based on the results of the waste characterization work completed by the Project Team, a mixed waste processing facility designed to handle the City’s commercial waste might be expected to reduce the tonnage of material going to landfill disposal by between 18 and 25 percent of the commercial waste tonnage, or between 31,000 and 44,000 tons. If the facility also included processing of the City collected residential waste, this might further reduce the tonnage of material going to landfill disposal by between 15 and 21 percent of the residential waste tonnage, or between 16,000 and 22,000 tons. However, as the City’s single stream recycling program continues to grow, the quantity of recoverable recyclable materials in the residential waste stream will gradually decrease.

2.3.4 Facility Capital, Operating and Regulatory Requirements

Typical Capital Requirements

Capital requirements for mixed waste processing facilities include the same items that are listed in the capital requirements for single stream processing facilities in Section 2.2.4.

Mixed waste processing facilities are considered to be very capital intensive, much more so than single stream recycling facilities. This is due to the much higher volume of material being processed as well as the more difficult nature of mixed waste compared to single stream recyclables.

Typical Building Footprint Size and Site Acreage

Building size is very dependent on tonnage of material being processed, processing system design and amount of floor space reserved for temporary storage of incoming material and processed material. Mixed waste processing facilities also serve as transfer stations for loads of material that are not suitable for sorting and that are directly transferred to disposal and for a significant amount of residue generated in the sorting process. Building footprints ranging from 50,000 square feet to over 200,000 square feet are common.

The Project Team would expect a building sized for Dallas' needs would at a minimum be between 100,000 and 150,000 square feet. This would be adequate size for the mixed waste processing facility processing around 280,000 tons per year assuming dual processing lines capable of collectively handling 75 tons-per-hour, operating two, eight-hour shifts per day five days per week and a 90 percent plant availability (10 percent down time for cleaning and repair). This amount of throughput capacity would handle around 35 percent of Dallas' total residential and commercial MSW.

A building this size would have adequate tipping floor space for at least four route trucks to tip simultaneously and for a modest amount of unprocessed material storage on the tipping floor. It would also have a modest amount of inside storage for baled product, perhaps up to a week's worth of production including storage in containers or trailers parked at three to four loading dock doors. However, this size building would not have sufficient space for additional processing equipment, which would require at least another 30,000 square feet. Considering that the City might want to construct a large enough building to handle future throughput capacity and front and back end storage increases, the initial building size might be increased by 50,000 to 60,000 square feet to between 150,000 to 210,000 square feet overall.

Site size is driven by building size and requirements for large truck queuing and movements. Site sizes ranging from 10 acres to over 20 acres are common. The Project Team would expect a facility meeting Dallas' needs sited at the McCommas Bluff landfill would use between 10 to 15 acres recognizing that some basic infrastructure needed for the facility, such as scale facilities and traffic circulation roadways, already exist. The storage area requirements for a mixed waste processing facility would be greater than single stream due to the increased quantity of incoming wastes and the increased quantity of residue resulting from the processing. Storage facilities must also be available for the recyclables recovered.

If combined with an additional downstream process such as anaerobic digestion or gasification, the facility and gasification/anaerobic digestion unit could be located on approximately 15 to 25 acres. Additional space would be needed to store feedstock for gasification or anaerobic digestion.

Typical Operations and Maintenance Requirements

Staffing will vary greatly based on the size and throughput of the facility, type of processing system employed, and number of shifts operated. Some processing systems emphasize the use of human sorting labor while others maximize mechanical sorting and minimize sorting labor. Considering these variables, staff sizes inclusive of supervisory and maintenance staff could range from a low of 20 to 25 for a small facility operating a single shift to a high over 100 for a very large facility operating multiple shifts. The Project Team would expect that a facility serving Dallas' needs would employ between 60 to 80 staff if operated in two shifts five days per week.

Other operating and maintenance requirements include:

- Building and site maintenance;
- Equipment repair and maintenance;
- Fuel for mobile equipment;
- Utilities, including electrical power, water, and sewer; and
- Disposal of residue.

Mixed waste processing is considered to have higher O&M requirements than single stream recycling. This is due to the much higher volume of material being processed as well as the more difficult nature of mixed waste compared to single stream recyclables.

Typical Revenue Sources

Mixed waste processing facilities generate revenue from the sale of sorted materials. In addition, when combined with other processes such as gasification and anaerobic digestion, revenue may also be generated from the sale of energy produced. In addition, mixed waste processing facilities can generate revenue from processing fees.

Infrastructure and Utility Requirements

A mixed waste processing facility would have similar infrastructure and utility requirements as a single stream facility, described in Section 2.3.4. However, a mixed waste processing facility would require larger electrical service due to the increased load requirements of larger capacity pieces of equipment.

In addition, a mixed waste processing facility preparing feedstock for a gasification unit would require additional electrical service capacity due to the increased load requirements of larger capacity pieces of equipment, the addition of shredders, and the interconnection equipment for transmitting the generated power to the electrical grid. Electrical infrastructure needs for a mixed waste processing facility preparing feedstock for anaerobic digestion would be similar to those for mixed waste processing with gasification.

Project Delivery Methods

Mixed waste processing facilities are much more technically sophisticated and challenging to operate than single stream recycling facilities. Considering this, a public agency with no experience or expertise in owning and operating a mixed waste processing facility would most likely want to limit its risk exposure by selecting an implementation option that transfers responsibility for the operational risks to other parties. Subject to Texas laws and regulations governing procurement methods, such an approach would suggest limiting the implementation to the following approaches. [4]

[4] There have been a number of changes in Texas state law over the last five years that impact the procurement methods available to the City for capital project and services. The Project Team recommends that the City consult with legal counsel to fully understand its options for project delivery.

- Design-build-operate (DBO)
- Design-build-own-operate-transfer (DBOOT)
- Contracted services (CS)

These and several other delivery methods are discussed in more detail in Appendix B.

Permitting Requirements

A mixed waste processing facility would be classified by TCEQ as a Type V facility, requiring a Registration or potentially a Notice Permit Modification if located at the McCommas Bluff Landfill.[5] The TCEQ has Permitted/Registered a very limited number of these facilities in Texas and as such is not as familiar with this technology as they are with single stream processing. Therefore, it is anticipated that a mixed waste processing facility will require some additional time for Technical Review prior to Permit Modification/Registration approval by TCEQ. However, the Project Team does not anticipate any major roadblocks to approval, especially if it is located on the site of an existing Permitted MSW Facility.

A mixed waste processing facility that prepares a gasification feedstock as a primary by-product may be considered by TCEQ to be an integral part of the Gasification Process, and thus be classified as a Type VI or a Type IX MSW facility. If the mixed waste processing facility is considered separate from the gasification facility it can be Permitted/Registered in the manner described above. However, if the TCEQ classifies the facility as a Type VI or Type IX Facility, it will require a Permit to operate in accordance with 30 TAC 330.7, and the option of the Registration process under 30 TAC 330.9 is not available, regardless of facility location or previous permits.

The Permitting/Registration process for the mixed waste processing with anaerobic digestion alternative would be identical to that discussed for the mixed waste processing with gasification alternative.

To date the TCEQ has not issued a MSW Permit for a gasification facility or anaerobic digestion facility and may not be technically comfortable with the technology. Therefore it is anticipated that both the Technical Review and the Public Hearing processes will be time consuming, and, in fact, may not lead to Permit Approval. Appendix B provides further detail on facility permitting.

2.3.5 Advantages and Disadvantages

There are a number of advantages and disadvantages of mixed waste processing relative to other resource recovery technologies discussed in this study.

[5] TCEQ may choose to require a separate Registration for mixed waste processing rather than incorporate it into the Landfill Permit as a Permit Modification due to having less experience with these types of facilities.

Advantages

Technological Advantages

- Technology continues to improve over time, making mixed waste processing more efficient and resulting materials more marketable.
- Uses the same types of equipment employed in single stream recycling which makes it possible to integrate both single stream recycling and mixed waste processing into a single processing facility with some elements of the sorting system shared as part of an enhanced diversion system (examples include Newby Island and Greenwaste MRF's in San Jose, California).

Diversion Advantages

- Allows communities the opportunity to increase their diversion rate for recyclable material as compared to single stream recycling by capturing materials that are not source separated by the generators.
- Provides the opportunity to increase diversion of commercial material.
- Unlike single stream recycling, mixed waste processing can be combined with other downstream processes such as gasification and anaerobic digestion which recover significant quantity of energy in addition to recyclable material.

Economic Advantages

- Uses existing collection resources (carts, collection trucks and staff).
- Cost of diversion is at least partially offset by value of recovered material and energy, if coupled with gasification or anaerobic digestion.
- Due to the more complex nature of the facility, creates more jobs in the community compared to single stream recycling.

Environmental Advantages

- Compared to anaerobic digestion and gasification technologies, valuable commodities can be recycled multiple times thereby reducing reliance on virgin resources.

Other Advantages

- If retention of single stream recycling is desired, the mixed waste processing facility can be designed to incorporate both processes and take advantage of shared use of certain elements in the process as well as support facilities.

Disadvantages

Technological Disadvantages

- Mixed waste processing is technically complex with higher operating and maintenance costs and risk for operational problems than for single stream recycling. If combined with gasification or anaerobic digestion, the technical complexity, cost, and risks increase.

- While mixed waste processing has been technologically proven in a small number of communities in the United States, sorting equipment continues to evolve rapidly which may lead to the need for equipment replacement.

Diversion Disadvantages

- Because mixed waste processing involves removing recyclables from commingled waste, there is a higher risk that materials would not be used for their “highest and best use.” Materials may be “down-cycled,” referring to the use of high-value commodities for low-end uses because of the presence of contaminants such as glass, food, and liquids.
- It is difficult to achieve high diversion rates with mixed waste processing alone, but some communities have combined mixed waste processing with energy recovery technologies, such as incineration, gasification, or anaerobic digestion.

Economic Disadvantages

- Requires significantly higher initial capital and operating cost than single stream recycling.
- Compared to single stream recycling, mixed waste processing has a higher potential for low revenue for recovered materials due to contamination of paper/fibers from food waste, liquids, broken glass, and other contaminants many of which are not present in single stream mixed materials.
- The economics of mixed waste processing are unproven in the region, and the cost of diversion may not be offset by the value of recovered material and energy.
- Similar to single stream recycling, commodity market pricing is highly volatile resulting in both “good” and “bad” times with regard to system economics.
- A mixed waste processing system would rely on large quantities of incoming waste from the commercial sector to be economically viable. If commercial users began to divert their waste to another disposal facility, it could significantly affect the economic viability of the system.

Customer Disadvantages

- If coupled with single stream recycling, can lead to customer confusion about what should be done with different materials.
- If coupled with single stream recycling, particularly if facilities are separate, can lead to customer complaints about high cost of services due to parallel, competing systems that are duplicative.

Other Disadvantages

- Robust and ongoing public communication would be required to educate customers about the system and address potential public concerns.
- Potential for diminished public confidence in materials management system if recyclables are diverted to disposal due to contamination or reduced marketability.

The advantages and disadvantages of mixed waste processing combined with either anaerobic digestion or gasification are similar but must be expanded to include the advantages and disadvantages of the downstream process. These additional advantages and disadvantages are discussed in Sections 2.4 and 2.5.

2.3.6 Mixed Waste Processing Variations

The preceding discussion of mixed waste processing is directed primarily toward systems that are focused on maximizing the recovery of recyclable material with the residue going to landfill disposal. Mixed waste processing systems can also be developed with other objectives in mind, including downstream processing of residue using anaerobic digestion or gasification. A more detailed discussion of gasification and anaerobic digestion as stand-alone technologies can be found in Sections 2.4 and 2.5, respectively.

For both gasification and anaerobic digestion, production of feedstock for the downstream system requires a similar, but technically less sophisticated, sorting system, with much less sorting labor than a mixed waste system focused solely on recovery of recyclable materials. However, the overall system of mixed waste coupled with gasification or anaerobic digestion is technically much more complex, much higher in capital cost and higher in operating and maintenance cost than the mixed waste processing system that is focused only on recyclable material recovery.

Since energy recovery and conversion to electrical power or to a liquid or gaseous fuel is an important aspect of both gasification and anaerobic digestion, the economics of the facility is tied directly to the cost of energy in the region where the plant is located.

2.4 Gasification

2.4.1 Summary of the Technology

Process Objective

Gasification is 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 (syngas) without burning the waste. Syngas consists of energy-rich hydrogen and carbon monoxide. After the conversion process, the syngas is then cleaned and conditioned as needed and used to generate electricity, fuels, or chemicals. Inert material in the mixed waste (including glass, sand, and metals) can potentially be recovered for recycling or beneficial use, particularly if the process converts the inert material to a vitrified slag or aggregate material. The process can result in some residue requiring landfill disposal, including oversized or inert material that may be removed during pre-processing as well as residual inerts remaining after gasification and not otherwise vitrified (commonly called ash).

There are many variations of gasification technology, including those that use controlled amounts of air or oxygen (and sometimes steam) to promote the chemical reaction that converts the waste to syngas, those that operate without any air or oxygen (pyrolysis), and those that use plasma technology as a high-temperature heating device (plasma gasification). Different types of gasification technologies operate at different temperature profiles. Pyrolysis technologies have the lowest operating temperatures, commonly on the order of 1200°F. Plasma gasification technologies have the highest operating temperatures, commonly on the order of 3000°F in the gasification zone and much higher at the plasma torch. Aside from these extremes, many gasification technologies operate in the range of 1500°F to 2000°F. Individual gasification technologies are usually proprietary, with patented features for reactor design and related components. These individual gasification technologies may require different inputs to help support the process, such as limestone, coke and natural gas, and may incorporate various other systems to complete the process. These variations of the technology are referred to herein as simply "gasification", since they have the same overall process objective.

Gasification facilities can accept residential and commercial mixed waste and are commonly paired with front-end pre-processing systems to recover recyclables from the mixed waste and prepare the feedstock for efficient processing (such as size reduction and drying). Although pre-processing is not a requirement of all gasification technologies, most gasification technologies use some type of pre-processing. For others where pre-processing is not a technical requirement, it may be still be beneficially incorporated for economic, environmental, and/or policy purposes. Gasification facilities can also accept residue from mixed waste processing facilities as a feedstock (as discussed in Section 2.3.6), likely with a reduced amount of front-end pre-processing. In addition, gasification facilities can accept other specific waste streams, such as non-recyclable plastic. The following table provides a basic process overview for gasification.

Table 2-4
Gasification Process Overview

Process Input	Process Output
▪ Mixed waste and/or residue from mixed waste processing ▪ Controlled amounts of air or oxygen ▪ Electrical and sometimes hydrocarbon fuel energy ▪ Other technology-specific inputs, such as steam, limestone, coke, and chemicals for syngas cleaning and air emission control	▪ Separated recyclables ▪ Syngas (subsequently converted to electricity, fuels or chemicals) ▪ Technology-specific commodity products (sulfur, salts) ▪ Byproducts from the inert constituents in the feedstock (vitrified slag, char) ▪ Pre-processing residue and ash (to landfill)

Key Operating Systems and Elements

Typical gasification systems consist of complex and integrated processes. Manual labor may be used for feedstock handling and management, the front-end recovery of recyclables, and byproduct handling and management, but otherwise gasification systems are typically highly automated processes. Experienced staff is needed for operational oversight, repair and maintenance, product marketing, and regulatory functions.

The key operating systems and elements of gasification technology include feedstock management, gasification, and syngas use. These systems are broadly summarized in the process flow diagram in Figure 2.3.

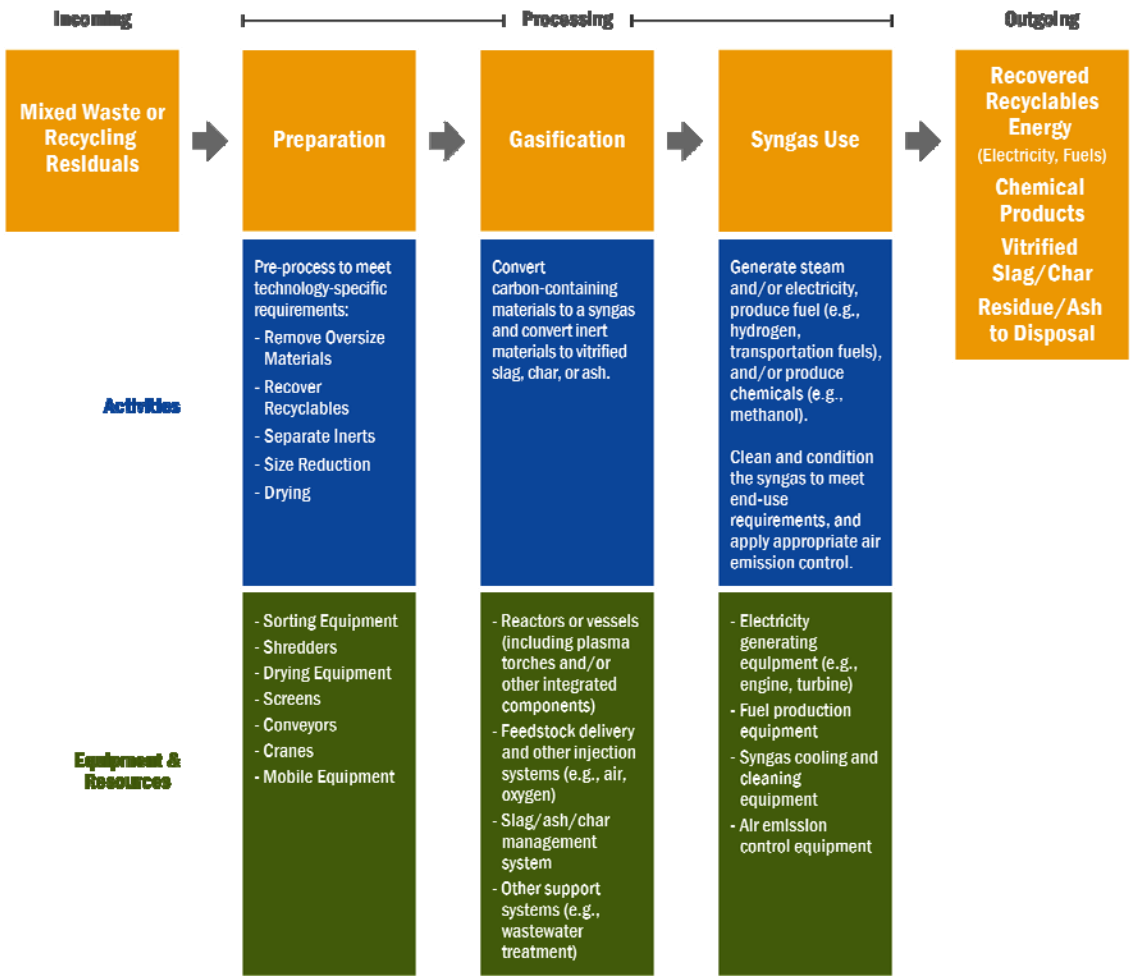


Figure 2.3. Gasification Process Flow

2.4.2 Status of Development

Gasification of municipal solid waste is not yet commercially established in North America. However, there has been steady progress on development of gasification projects in various locations in the United States and Canada. While some of the focus has been on site-specific feasibility studies and procurement activities, several projects are at advanced development stages. Based on publically available information, examples include the following.

- Covanta Energy is operating its CLEERGAS gasification technology on a demonstration basis at its resource recovery facility in Tulsa, Oklahoma (operating two municipal waste combustors and one gasification unit at the facility, with each unit having a capacity of about 110,000 tons per year).

- IneosBio operates a facility in Vero Beach, Florida, that processes wood waste (including some yard trimmings) but not yet mixed waste.
- Enerkem is nearing completion of a facility in Canada that will process municipal solid waste from the City of Edmonton (110,000 tons per year) to produce methanol and ethanol; commissioning has begun and operations are anticipated later in 2014.
- Air Products is constructing a plasma gasifier in Tees Valley, UK (385,000 tons per year) using the AlterNRG Westinghouse plasma gasification technology, which will be the largest facility of its kind. Startup is planned for late 2014 with operations commencing in 2015.
- Fulcrum BioEnergy is developing a facility near Reno, Nevada; permitting is completed and feedstock agreements have been executed for municipal solid waste, with operations anticipated in 2017.
- Entech-REM has completed environmental screening for a mixed waste gasification facility in Port Hope, Ontario (Canada), significantly advancing its project development efforts. The planned facility will process up to approximately 180,000 tons per year of waste from municipal, commercial, industrial and institutional sources.

There have been numerous pilot facilities in the United States and Canada that have operated intermittently on a demonstration basis, processing a variety of feedstocks including mixed waste. Some of these pilot facilities are still operational and serve a valuable purpose of demonstrating the gasification process and furthering technology and system development (such as the AlterNRG/Westinghouse Plasma Center in Madison, Pennsylvania, and the Plasco Trail Road facility in Ottawa, Canada). However, most of the pilot facilities have been small-scale, typically less than commercial-scale for the technology, and many have commonly consisted of the gasification process without the integrated system components required for commercial operation or full demonstration (such as pre-processing, automated feedstock handling, and syngas cleanup and use).

Reasonable facility capacities for initial gasification projects in the United States depend on several factors. Facility capacities demonstrated overseas range from less than 30,000 tons per year to about 200,000 tons per year. These facilities are constructed with one or more units, with individual unit capacities up to about 100,000 tons per year. Covanta has been operating its CLEERGAS gasification technology on a demonstration basis in Tulsa, Oklahoma at a unit capacity of about 110,000 tons per year. And, although not yet operational, the gasification facility being constructed in Tees Valley UK will have a unit capacity of 385,000 tons per year. Accounting for demonstrated capacity, scale-up of unit size, and modularity of design (the ability to achieve larger facility capacity by adding more units), the City could reasonably consider a large-scale facility of approximately 365,000 tons per year. While larger facility capacities may be suitable for some gasification technologies for project-specific applications, and such larger facility capacities could improve economic feasibility, a limited number of technologies would be able to viably develop a project at larger capacities due to concerns such as scalability.

2.4.3 Potential Impacts to Current Collection, Processing and Disposal Operations

Gasification is compatible with current collection, processing and disposal operations, including the City's current single stream recycling program. The removal of metals and glass from the mixed waste is beneficial to the gasification process. Paper, plastic, and other materials in mixed waste that cannot be economically recycled are suitable feedstock for gasification, and can be converted to energy rather than being disposed at the landfill. Based on our industry experience and the results of the waste composition study completed for the City (refer to Section 1), the Project Team believes that even if the City capitalizes on opportunities to increase recycling, gasification could be incorporated into an integrated system to further extend the life of the McCommas Bluff Landfill. Because gasification can accept mixed waste or residue from mixed waste processing as a feedstock, it would remain compatible with future potential practices, such as mixed waste processing, and would offer the potential to be phased-in at a future date.

2.4.4 Facility Capital, Operational, and Regulatory Requirements

Typical Capital Requirements

Gasification facilities are typically capital-intensive, particularly compared to the other technologies evaluated in this analysis, and include the items listed below.

- Land
- Building with adequate space for at least the following: receipt and storage of feedstock, pre-processing equipment, gasification reactors, equipment to handle and store process residue and ash (and/or other byproducts such as vitrified slag or char), process control equipment and other monitoring and support systems, and facilities for staff (such as breakrooms, shower and locker rooms, and administrative offices)
- If not included in a building, dedicated space for: water and wastewater treatment systems; syngas cleaning equipment; power generation, fuel production or chemical production systems, and air emission control equipment
- Equipment service and repair shops and tools, including spare parts storage
- Utility systems
- Site roadways, vehicle-weighing facilities, parking, stormwater control, and buffer/green (landscaped) areas

Typical Building Footprint Size and Site Acreage

The size of building required for a gasification facility varies significantly based on the quantity and type of material being processed, the extent of pre-processing required, design elements of the gasification system and support processes, and the ability to locate certain equipment and structures outside of the building. For a large-scale facility (about 365,000 tons per year), a building footprint of approximately

200,000 square feet or even larger could be expected. The total area required for buildings and other equipment and structures (located outside the buildings) could be about 300,000 to 400,000 square feet.

Site size is driven by building size and layout requirements for equipment and structures, roadways and requirements for large truck queuing and movements, stormwater control, and landscaping and green buffer zones. For a large-scale facility (about 365,000 tons per year), a site size of 15 to 25 acres, or even more, would be common. The larger site size (25 acres or more) would provide for the most optimum facility layout, including allowing for greater amounts of landscaping and green buffer areas, and would meet the space requirements of the majority of gasification technologies. The smaller site size (15 acres) may present layout challenges for some gasification technologies, particularly if there is extensive pre-processing or space-intensive systems to clean and use the syngas.

Typical Operations and Maintenance Requirements

Staffing needs for gasification facilities vary based on the size and throughput of the facility, the type of material being processed, the amount of pre-processing required, design elements of the gasification system, and the design of integrated system components that use the syngas to generate electricity, fuels or chemicals. Gasification facilities are typically operated on a continuous basis (24 hours per day, seven days per week), requiring continuous staffing. Considering these variables, staff sizes inclusive of supervisory and maintenance staff for a large-scale facility (about 365,000 tons per year) would typically range from 50 to 75 staff, and perhaps more if there is pre-processing inclusive of high levels of manual labor. Labor costs are commonly the largest component of gasification facility operating costs.

Other operating and maintenance requirements include:

- Building and site maintenance;
- Equipment repair and replacement;
- Utilities, including electrical power, natural gas, water, and sewer;
- Chemicals and other expendables for process operations; and
- Disposal of residue.

Gasification is considered to have higher O&M requirements than single stream recycling, mixed waste processing, and anaerobic digestion.

Typical Revenue Sources

Aside from tipping fees, gasification facilities generate revenue primarily from the sale of electricity, fuels, or chemicals. Markets for these products are established; however, pricing can vary significantly based on various regulatory policies and economic factors. For fuel products, such as ethanol, it can often be difficult to secure long-term contracts with economically viable floor prices.

In addition to energy sales, gasification facilities can also generate revenue from recyclables that are recovered during pre-processing as well as metals that may be recovered post-processing. Gasification technologies that produce a vitrified slag from the inert materials in the feedstock can potentially generate revenue selling this material as an aggregate. If no revenue is generated, landfill disposal cost is avoided through the beneficial use of this material. Similarly, gasification facilities that produce a carbon char instead of a vitrified slag also have the potential to beneficially use this material. However, the absence of commercial gasification facilities in the United States presents uncertainty in the ability to market these materials, including the ability to obtain the necessary regulatory approval. Gasification systems can produce various other byproducts that have value as commodity products (such as sulfur and salts), but these commodities would not typically generate significant revenue.

Project Delivery Methods

Gasification facilities processing mixed waste are technically complex and not commercially established in the United States. In general, gasification technology has been proven from a design and operational perspective through overseas operations, but it can often be difficult to obtain the necessary operations and performance data from overseas facilities, creating technology transfer challenges. As a result, regulators, public entities, and the public in general can find it difficult to understand gasification technology. In addition, most individual gasification technologies have unique design elements, usually of a proprietary nature, which require specific consideration for design, construction and operation. In consideration of these factors, and subject to Texas laws and regulations governing procurement methods, the project delivery options available to the City for providing gasification facility services are limited.[6] The most likely options for project delivery are listed below.

- Design-build-operate (DBO)
- Design-build-own-operate-transfer (DBOOT)
- Contracted services (CS)

These delivery methods are discussed in more detail in Appendix B.

Infrastructure and Utility Requirements

A gasification facility would require connection to the power network to receive electricity for startup (and for operations, if not producing electricity) and to export electricity (as applicable) when the facility is in operation. It would also require water (with largest usage requirements for facilities that use wet cooling towers), wastewater from sanitary uses and potentially for process discharges (unless the facility is designed for zero process discharge), and natural gas for start-up and in some cases to support operations. If the facility is located within the boundaries of the McCommas Bluff Landfill, most of these infrastructure requirements are available for development on or adjacent to the site, and existing infrastructure (scales, scalehouse, roadways) may be used for the facility. Water, wastewater and natural gas utilities, which are available in adequate capacity on or adjacent to the landfill, would be extended to the

[6] There have been a number of changes in Texas state law over the last five years that could impact the procurement methods available to the City for capital project and services. The Project Team recommends that the City consult with legal counsel to fully understand its options for project delivery.

facility site. Electrical service would be extended to the facility to meet facility load and to provide for sale of electricity to the grid, as applicable.

Permitting Requirements

As discussed in Section 2.3.4, a gasification facility would be classified as a Type VI or a Type IX MSW facility and would require a Permit to operate in accordance with 30 TAC 330.7. To date the TCEQ has not issued a MSW Permit for a gasification facility and may not be technically comfortable with the technology. Therefore it is anticipated that both the Technical Review and the Public Hearing processes will be time consuming, and, in fact, may not lead to Permit Approval. Appendix B provides further detail on facility permitting.

2.4.5 Advantages and Disadvantages

There are a number of advantages and disadvantages of gasification technology to be considered relative to other technologies evaluated in this study.

Advantages

Technological Advantages

- Gasification is generally suitable for a wide range of feedstock, including mixed waste and residue from mixed waste processing. This feedstock flexibility makes gasification compatible with different waste collection and processing practices, including both single stream recycling and mixed waste processing. It also makes gasification potentially suitable for implementation in the future as a phased-in supplement to other processing systems.
- Facility design is adaptable to various operational objectives. For example, gasification facilities can be designed to achieve higher diversion rates by processing inert materials with the mixed waste and converting such materials to products (vitrified slag). Conversely, facilities can be designed to remove inert materials with pre-processing to optimize the gasification process.
- Gasification produces an energy-rich syngas that provides broad options for energy generation, including fuel production, chemical production, and the application of highly-efficient power generation technology.

Diversion Advantages

- As compared to other technologies considered in this analysis, gasification offers the highest diversion potential by converting feedstock to energy and other products. Most gasification technologies processing mixed waste can achieve greater than 80 percent diversion from landfill disposal. Some gasification technologies may approach or achieve 100 percent diversion, subject to the ability to market (or beneficially use) the non-energy byproducts, such as vitrified slag.
- Gasification is compatible with recycling and with the integration of pre-processing can supplement and enhance recycling programs by recovering additional recyclable materials.

Economic Advantages

- Syngas from gasification can be used to produce electricity, fuels or chemicals, which provides flexibility for optimizing project economics.
- Gasification facilities require a large labor force including many skilled positions, which can have a positive impact on the local economy.

Environmental Advantages

- Gasification achieves high rates of landfill diversion, preserving valuable landfill capacity and reducing landfill gas emissions and leachate generation.
- While energy needs for gasification facilities would be higher than for other technologies considered in this analysis, gasification is a net producer of energy and has the ability to meet most of its own energy needs.
- As a net energy producer, gasification results in greenhouse gas reductions, particularly through the generation of energy that would otherwise have been generated with fossil fuels.
- Gasification facilities can be configured to cost-effectively clean the syngas prior to use, and are amendable to economic application of certain highly efficient technologies for air emissions control.

Other Advantages

- Gasification has garnered a high level of interest from local, state and federal officials across the United States, due to its potential as a viable processing technology.
- Due to its feedstock flexibility, including continued technology development for unique and specific feedstocks (such as recovered but non-recyclable plastics), gasification presents opportunity for future phase-in as part of an overall, integrated solid waste management system.

Disadvantages

Technological Disadvantages

- Gasification of mixed waste is commercially established overseas, but it is not yet operational in the United States. Gasification equipment and related systems continue to evolve rapidly, which may lead to long start-up periods, early obsolescence, and the need for expensive replacement of installed equipment.
- Developing a facility that would be large enough to meet the needs of the City would require an annual capacity of 365,000 tons per year or more, which would make it one of the largest gasification facilities in the world. Therefore, there is significantly more risk associated with this technology than with some of the other technologies being considered in this analysis, specifically single stream recycling and mixed waste processing.

Diversion Disadvantages

- The highest rates of diversion that are potentially achievable by gasification require sale or beneficial use of the non-energy by-products, such as the vitrified slag. The ability to achieve regulatory approval for beneficial use and to consistently identify markets is uncertain. Diversion rates would be reduced if this material required landfill disposal, but would still be higher than the diversion potential for single stream recycling, mixed waste processing, and anaerobic digestion.

Economic Disadvantages

- Requires significant initial capital cost for processing facility and other up front facility development costs.
- Requires significant operating costs, including high costs for labor (for a comparatively large, skilled labor force) and a high cost for routine capital repair and replacement.
- Requires funding and effort for public education during project development and continuing through operation.
- The City has invested in a sophisticated landfill gas collection system, and the diversion of organic waste from the landfill to a gasification process would reduce the generation of landfill gas and may impact the effectiveness of this system.
- A gasification system would rely on large quantities of incoming waste from the commercial sector to be economically viable. If commercial users began to divert their waste to another disposal facility, it could significantly affect the economic viability of the system.

Environmental Disadvantages

- Certain gasification processes could produce small amounts of residue that require special handling or disposal considerations, such as those from gas cleanup, wastewater treatment, and air emissions control systems.

Other Disadvantages

- Project delivery options are limited, and would typically require more involvement from the technology provider due to the specialized and often proprietary equipment.
- Could require robust and ongoing public communication to ease potential concerns related to a new and unfamiliar technology.

2.5 Anaerobic Digestion

2.5.1 Summary of the Technology

Process Objective

Anaerobic digestion is a biological process that uses bacteria to decompose biodegradable organic materials (such as food waste, yard waste, and non-recyclable paper) in the absence of oxygen. The process results in biogas consisting primarily of methane and carbon dioxide. The biogas can be used to generate electricity, or it can be upgraded to pipeline-quality gas or other types of fuel. The remaining material that is not converted to biogas is called digestate. The digestate can be marketed as a fertilizer or soil amendment, typically after composting and curing. If there is not a market for the digestate, it can be gasified to extract the remaining energy value or be landfilled. Anaerobic digestion can result in residue requiring landfill disposal, both from pre-processing of the feedstock and post-processing of the digestate.

There are many variations of anaerobic digestion technology including: wet and dry systems; continuous and batch processing; single stage or multi-stage processing; differing temperature profiles that support different types of bacteria, and various options for mixing (or not mixing) the feedstock before and during the digestion process. In all cases, anaerobic digestion operates within an enclosed tank, vessel or bunker, under controlled conditions and without the addition of air or oxygen. The variations offer differing advantages and disadvantages relating to retention times to complete the process, biogas yields, space requirements, energy needs, and other infrastructure needs.

Anaerobic digestion facilities are highly suitable for processing source-separated food waste or source-separated food and yard waste. When yard waste is processed, the woody components may be removed and used as a bulking agent in a post-digestion composting process, rather than being used as feedstock to the digester, since these materials are slow to digest and yield low levels of biogas. Anaerobic digestion facilities can also process mixed waste but would usually be paired with a mixed waste processing facility (integrated or as part of a separate operation) to recover recyclables, remove non-biodegradable materials, and digest an organic-rich fraction separated from the mixed waste. Without such pre-processing, the digesters would need to be substantially oversized to handle waste constituents with little or no biogas generation potential, and the resulting digestate would have significantly reduced potential for beneficial use.

Almost all anaerobic digestion technologies use some type of pre-processing to prepare the feedstock for digestion, including facilities that accept source separated organics for processing. Pre-processing may consist of opening and removing bags, removing contaminants (e.g., removing silverware and plastic from food waste), size reduction, moisture control, and blending. The following table provides a basic process overview for anaerobic digestion.

Table 2-5
Anaerobic Digestion Process Overview

Process Input	Process Output
▪ Source separated organics, mixed waste and/or organic fraction from mixed waste processing ▪ Electrical energy and heat	▪ Separated recyclables (if processing mixed waste) ▪ Biogas (subsequently converted to electricity or upgraded to pipeline quality gas or other fuels) ▪ Digestate (subsequently composted) ▪ Residue (to landfill)

Key Operating Systems and Elements

Typical anaerobic digestions systems consist of integrated processes that include pre-processing systems, digestion tanks or bunkers and related components, digestate management (e.g., composting and curing), wastewater treatment, and biogas storage and utilization. Manual labor may be used for feedstock handling and management, the front-end recovery of recyclables, and digestate management (composting), but the core digestion systems are typically automated processes. Experienced staff is needed for operational oversight, repair and maintenance, product marketing, and regulatory functions.

The key operating systems and elements of anaerobic digestion technology are broadly summarized in the process flow diagram in Figure 2.4.

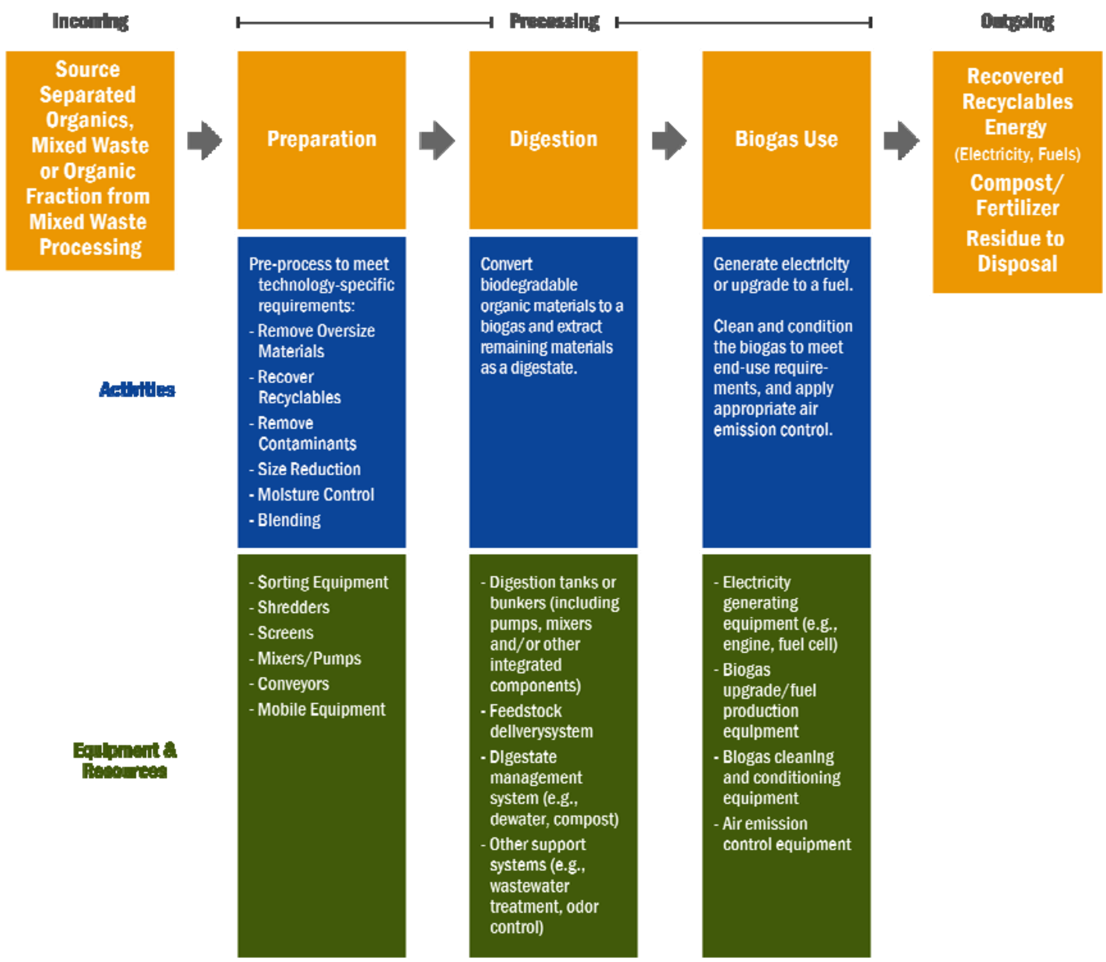


Figure 2.4. Anaerobic Digestion Process Flow

2.5.2 Status of Development

Outside of the United States, there are many commercially operational anaerobic digestion facilities processing mixed waste and source separated organics (sometimes in combination with other types of organic feedstock). Many of these facilities have operated for five to 10 years, and some facilities have operating histories that approach

20 years. These facilities are widespread across Europe, including large numbers in Germany, Spain, France, Italy, and Portugal, and they are also located in numerous other countries. While the total installed capacity for anaerobic digestion is quite large in aggregate, most of the individual anaerobic digestion facilities have a relatively small digestion capacity (generally less than 50,000 tons per year, with a small number of facilities with larger digestion capacity). There are a handful of facilities in Europe that process more than 100,000 tons per year of mixed waste. However, for these facilities, the digestion capacity is typically much smaller than the overall facility capacity. For example, the DRANCO facility in Alicante, Spain (operational since 2008), has a facility capacity of approximately 180,000 tons per year of mixed waste, of which approximately 30,000 tons per year are digested. As another example, the Valorga facility serving Zaragoza, Spain (operational since 2007), has a facility capacity of approximately 380,000 tons per year of mixed waste, of which approximately 109,000 tons per year are digested. To a lesser extent than Europe, anaerobic digestion of source separated organic waste is also commercially established in Canada, for example, the Canada Composting/BTA Dufferin Organics Processing Facility in Toronto, which first began operations in 2012.

In the United States, anaerobic digestion has been commercially established for many years for feedstock from farms (e.g., manure), biosolids, and process streams from the food and beverage industry (e.g., brewery waste). Recently, there has been steady progress on development of anaerobic digestion projects in the United States for source-separated organic waste (predominantly food waste and also yard waste from residential and commercial sources), and for the organic fraction separated from mixed waste. While some of the focus has been on site-specific feasibility studies and procurement activities, several projects are at advanced development stages, particularly in California where there are legislated mandates for increased waste diversion. This includes a facility in San Jose that began operations in 2013, designed to process 90,000 tons per year of commercial organic waste and produce electricity (Zero Waste Energy/Kompoferm). It also includes the CR&R/Eisenmann facility in Perris, California, that has completed permitting and initiated construction. This facility will process approximately 80,000 tons per year of source separated yard waste and food waste from residential and commercial sources and will produce compressed natural gas from the biogas.

Based on operational experience in other countries and recent developments in the United States, it is reasonable to consider anaerobic digestion facilities processing source-separated organic waste with capacities of approximately 100,000 tons per year. For anaerobic digestion facilities processing mixed waste, a facility capacity of approximately 365,000 tons per year may be achievable, as this would equate to a digestion capacity of approximately 100,000 tons per year (assuming the organic fraction recovered from the mixed waste ranges from 25 to 30 percent). Larger facility capacities may be possible, subject to land availability and in consideration of project-specific operation logistics, such as digestate management (e.g., having available space to compost and cure the digestate, having sufficient markets available for the sale or beneficial use of the finished compost product, and having on-site or off-site storage for the compost product to accommodate seasonal or otherwise variable market conditions).

2.5.3 Potential Impacts to Current Collection, Processing and Disposal Operations

Anaerobic digestion is compatible with the City's current single stream recycling program, and it would also be compatible with potential future mixed waste processing. The removal of commonly recycled metal, glass, and plastic from the mixed waste is necessary prior to the digestion process. Food waste and other organics (e.g., food-soiled and non-recyclable paper, such as napkins and tissues) remaining in mixed waste after single stream recycling can be separated and digested. Mixed waste processing, if implemented as a future processing operation in the City, could be tailored to not only recover recyclables, but to also separate an organic-rich fraction suitable for digestion. Anaerobic digestion would also be compatible with City composting operations, assuming the digestate can be composted with other feedstock as part of those operations.

Based on the results of the waste composition study completed for the City (refer to Section 1), approximately 30 percent of the residential and commercial waste currently going to the McCommas Bluff Landfill is potential feedstock for anaerobic digestion (including food waste, yard waste, other organics, and non-recyclable paper, but excluding paper that might potentially be recycled through expanded recycling operations). The Project Team believes that even if the City capitalizes on opportunities to increase recycling, anaerobic digestion could be incorporated into an integrated system to further extend the life of the McCommas Bluff Landfill.

Anaerobic digestion is compatible with current collection practices, since it can process the organic fraction recovered from mixed waste. However, changes to current collection operations to provide separate collection of source-separated organics can provide for more efficient process operations by significantly reducing the amount of pre-processing that is required ahead of digestion and improving the quality of the final compost product. Implementing an anaerobic digestion system could have a negative impact on the quantity of gas generated from the landfill gas to energy system at the McCommas Bluff Landfill.

2.5.4 Facility Capital, Operational, and Regulatory Requirements

Typical Capital Requirements

Anaerobic digestion facilities can be capital-intensive for highly automated systems, particularly those that process mixed waste as well as those that upgrade the biogas to pipeline-quality gas or other fuels. Systems that process source-separated organic waste, as well as dry digestion systems that are batch processes, may have less capital requirements compared to the other technologies evaluated in this analysis. Capital requirements may include the items listed below.

- Land
- Building with adequate space for receipt and storage of feedstock, pre-processing equipment, storage for recovered recyclables (as applicable), process control equipment and other monitoring and support systems, and facilities for staff (such as breakrooms, shower and locker rooms, and administrative offices)

- Dedicated space for digestion (typically self-contained tanks located outside of a building, or sometimes sealed bunkers located inside of a building), water and wastewater treatment systems to manage liquids generated from the digestion process, biogas cleaning equipment, power generation or fuel production equipment, and air emissions and odor control equipment (e.g., biofilters)
- Dedicated space for digestate management, potentially within an enclosed building for blending, composting, and screening operations, as well as space to store the finished compost product until it can be moved to markets (unless off-site storage is available)
- Equipment service and repair shops and tools, including spare parts storage
- Utility systems
- Site roadways, vehicle-weighing facilities, parking, stormwater control, and buffer/green (landscaped) areas

Typical Building Footprint Size and Site Acreage

The building size required for an anaerobic digestion facility can vary significantly based on the quantity and type of material being processed, the extent of pre-processing required, design elements of the anaerobic digestion system and support processes, and the ability to locate certain equipment and structures (including digestion tanks) outside of the building. For a large-scale facility receiving approximately 100,000 tons per year of source-separated organic waste, a building footprint of 50,000 square feet to 200,000 square feet could be expected. For a large-scale facility receiving approximately 365,000 tons per year of mixed waste, which would correspond to a digestion capacity of approximately 100,000 tons per year (as described above), additional building area would be required. It could be expected that the building size would increase to 200,000 square feet or larger to provide for receipt of the larger quantity of material and associated pre-processing equipment.

Site size is driven by building size and layout requirements for other equipment and structures, roadways and requirements for large truck queuing and movements, digestate management activities (composting, curing and storage), stormwater control, and landscaping and green buffer zones. For a large-scale facility (as described above), a site size of 15 acres to 30 acres would be common. The larger site size would provide for the most optimum facility layout, including allowing for greater amounts of landscaping and green buffer areas, and would meet the space requirements of the majority of anaerobic digestion technologies with on-site digestate management (composting and curing). The smaller site size would be suitable for facilities processing separated organic waste (rather than mixed waste requiring extensive pre-processing). Smaller site sizes (less than 15 acres) may be feasible if digestate management activities are conducted at an offsite location, such as at an existing composting facility.

Typical Operations and Maintenance Requirements

Staffing needs for anaerobic digestion facilities vary based on the size and throughput of the facility, the type of material being processed, and the associated amount of pre-processing required, design elements of the anaerobic digestion system, and the design and operation of integrated systems that use the biogas to generate electricity or fuels. Anaerobic digestion facilities are typically operated five or six days per week, one or two shifts per day, although the digestion process itself would occur on a continuous basis (unstaffed or minimal staffing during a second or third shift). Considering these variables, staff sizes inclusive of supervisory and maintenance staff for a large-scale facility processing separated organic waste would typically range from 10 to 25 staff. Staff sizes would increase significantly for a facility receiving mixed waste, potentially to a level of 60 to 80 staff.

Facility operation would typically require a range of skills, including lower skilled tipping floor operators and general laborers as well as highly skilled staff. Labor costs are commonly the largest component of anaerobic digestion facility operation and maintenance costs. Other operating and maintenance requirements include:

- Building and site maintenance
- Equipment repair and replacement
- Utilities, including electrical power, natural gas, water, and sewer
- Chemicals and other expendables for process operations
- Disposal of residue

Typical Revenue Sources

Aside from tipping fees, anaerobic digestion facilities generate revenue primarily from the sale of electricity or fuel. Markets for these energy products are established; however, pricing can vary significantly based on various regulatory policies and economic factors. For fuel products, such as pipeline quality gas, it can be difficult to secure the right to inject the gas into the pipeline. There is expected to be a strong market for other fuel products (such as compressed natural gas), subject to the availability of fleets or other vehicles in the project area that can use this gas in large quantities over a long-term period. At the McCommas Bluff Landfill, consideration could be given to combining the biogas with landfill gas for beneficial use, subject to existing contractual obligations for the landfill gas system.

In addition to energy sales, anaerobic digestion facilities can also generate revenue from recyclables that are recovered during pre-processing (as applicable) and potentially from compost that is generated from the digestate. Due to the lack of commercial anaerobic digestion facilities in the United States processing mixed waste or source-separated organic waste, markets for composted digestate are not established. This is particularly the case when the compost is generated from digestion of organics separated from mixed waste (as opposed to handling typically cleaner, source-separated organics). At a minimum, however, there may be potential for beneficial use of the compost, such as for erosion control, thereby avoiding the cost of landfill disposal.

Project Delivery Methods

Anaerobic digestion facilities can vary significantly in technical complexity, particularly in consideration of the various feedstock options and opportunities for biogas use. In addition, while anaerobic digestion is established in the United States for feedstock such as farm waste and biosolids, and projects are being developed or actively considered for source-separated organics and mixed waste, the technology is not well established in the United States for source-separated organic waste and mixed waste. Therefore, a public agency with no experience in owning and operating an anaerobic digestion facility may want to limit its risk exposure by selecting an implementation option that transfers responsibility for design and operational risks to other parties. In addition, some individual anaerobic digestion technologies have proprietary features, which require specific consideration for design, construction and operation. Consideration of these factors, and subject to Texas laws and regulations governing procurement methods[7], would suggest an approach that limits project delivery options to the following.

- Design-build-operate (DBO)
- Design-build-own-operate-transfer (DBOOT)
- Contracted services (CS)

These delivery methods are discussed in more detail in Appendix B.

Infrastructure and Utility Requirements

An anaerobic digestion facility would require connection to the power network to receive electricity for startup (and for operations, if not producing electricity) and to export electricity (as applicable) when the facility is in operation. It would also require water and possibly natural gas to support operations. In addition, there may be process wastewater discharges that require a sewer connection. If the facility is located within the boundaries of the McCommas Bluff Landfill, most of these infrastructure requirements are available for development on or adjacent to the site, and existing infrastructure (scales, scalehouse, roadways) may be used for the facility. Water, wastewater and natural gas utilities, which are available in adequate capacity on or adjacent to the landfill, would be extended to the facility site. Electrical service would be extended to the facility, to meet facility load and to provide for sale of electricity to the grid as applicable.

Permitting Requirements

As discussed in Section 2.3.4, an anaerobic digestion facility would be classified as a Type VI or a Type IX MSW facility and would require a Permit to operate in accordance with 30 TAC 330.7. To date the TCEQ has not issued a MSW Permit for an anaerobic digestion facility in the State and may not be technically comfortable with the technology. Therefore it is anticipated that both the Technical Review and the Public Hearing processes will be time consuming, and, in fact, may not lead to Permit Approval. Appendix B provides further detail on facility permitting.

[7] There have been a number of changes in Texas state law over the last five years that could impact the procurement methods available to the City for capital project and services. The Project Team recommends that the City consult with legal counsel to fully understand its options for project delivery.

2.5.5 Advantages and Disadvantages

There are a number of advantages and disadvantages of anaerobic digestion technology to be considered relative to other technologies discussed in this study.

Advantages

Technological Advantages

- There are many variations of anaerobic digestion technology, ranging from more basic, batch operations to highly automated and complex systems. This variability provides for flexibility to implement a system that works well with the anticipated feedstock characteristics, available site acreage and configuration, and other project-specific objectives (such as desired energy product).
- Anaerobic digestion can be readily integrated with other processing options. For example, a mixed waste processing facility can be configured to produce an organic-rich stream suitable for digestion, and the digestate from the anaerobic digestion process can potentially be managed at existing composting facilities.

Diversion Advantages

- Anaerobic digestion offers higher diversion potential than single stream recycling as a stand-alone program by supporting continued (as well as increased) recycling while also converting organic feedstock to energy and other products. Anaerobic digestion technologies processing source separated organics can achieve 80 percent or higher diversion of organics from landfill disposal. Anaerobic digestion technologies processing mixed waste can achieve approximately 60 percent diversion of mixed waste, inclusive of the recovery and diversion of recyclables and the beneficial use of the compost. If the compost resulting from mixed waste processing is not marketable, the overall diversion rate could be reduced to around 45 percent.

Economic Advantages

- Anaerobic digestion produces an energy-rich biogas that can be used for a variety of purposes, including electricity generation and fuel production. The biogas can also be combined and managed with landfill gas, if allowable at the McCommas Bluff Landfill subject to existing contractual obligations. These alternative energy production options provide increased opportunity for optimizing project economics.
- The more complex anaerobic digestion facilities, particularly those that process mixed waste or that upgrade the biogas to a fuel, require a medium to large labor force including some skilled positions, which can have a positive impact on the local economy.

Environmental Advantages

- Anaerobic digestion (particularly in combination with recycling) increases diversion rates achieved through recycling, preserving valuable landfill capacity and reducing landfill gas emissions and leachate generation.

- Anaerobic digestion is a net producer of energy (electricity and/or fuels), resulting in greenhouse gas reductions, particularly through the generation of energy that would otherwise have been generated with fossil fuels and potential for removal of carbon dioxide from the biogas.

Other Advantages

- Anaerobic digestion has garnered a high level of interest from local, state and federal officials across the United States, due to its environmental benefits.
- Compared to gasification technology, anaerobic digestion is better understood and more readily accepted as a suitable processing option by regulatory agencies, public officials and employees, and the public in general.

Disadvantages

Technological Disadvantages

- Anaerobic digestion is commercially established overseas and to a lesser extent in Canada for source-separated organics and mixed waste. In the United States, it has primarily been established for other feedstock such as biosolids, farm waste, and food and beverage industry waste. This lack of industry experience in the United States for source-separated organic waste and mixed waste may lead to longer start-up periods and early operational difficulties.

Diversion Disadvantages

- The highest rates of diversion that are potentially achievable by anaerobic digestion require sale or beneficial use of the compost produced from the digestate. The ability to achieve regulatory approval for beneficial use and to consistently identify markets is uncertain, particularly for compost generated from processing organic material separated from mixed waste. Effective marketing of the compost could require additional processing costs to produce a higher quality material. Diversion rates would be significantly reduced if the compost required landfill disposal (e.g., due to lack of regulatory approval or the absence of steady markets for beneficial use).

Economic Disadvantages

- Compared to the other technologies considered in this analysis, anaerobic digestion requires the largest amount of land, particularly if receiving mixed waste (which requires significant pre-processing) and if composting the digestate on-site.
- Compared to gasification, anaerobic digestion has a significantly lower energy recovery rate.
- Optimal project design and operation as well as improved project economics may require handling source-separated organics, rather than the organic fraction separated from mixed waste. Collection of source-separated organics would require a change to current collection practices and add cost, and it would require residents and commercial establishments to implement new practices at their homes and businesses.

- The City has invested in a sophisticated landfill gas collection system, and the diversion of organics from the landfill to an anaerobic digestion facility would reduce the generation of landfill gas and may impact the effectiveness of the system.

Environmental Disadvantages

- For implementation of anaerobic digestion of source-separated organics, associated changes to collection practices could require additional truck routes with resulting environmental, street and neighborhood impacts.

Other Disadvantages

- Project delivery options are limited, and would typically require more involvement from the technology provider due to the specialized and sometimes proprietary equipment.

3.1 Introduction

The Project Team worked with City staff to conduct a screening analysis. The purpose of the analysis was to select up to three technologies for further, more detailed review. The process included development of screening criteria, application of the criteria on a comparative basis to the potential technologies described in Section 2 of this report, and selection of a short list of technologies for further analysis. The process was an interactive and collaborative effort between the Project Team and City staff, including a half-day workshop to review preliminary findings and finalize the screening analysis.

3.2 Screening Criteria

Six screening criteria were established to comparatively determine which technologies, at the current time, could best facilitate the City's transition from a landfill-based solid waste management system to a resource recovery-based system. The screening criteria are listed and summarized in Table 3-1.

Table 3-1
Screening Criteria

Criteria	Criteria Explanation
Level of Diversion Achievable	This criterion addresses the level of diversion achievable for the residential waste stream and also considers diversion that may be achievable for the overall waste stream (residential as well as commercial). The level of diversion achievable is based on City-specific data from the Municipal Solid Waste Composition Study (July 2013), and includes practical limits for facility sizing. Diversion includes both recycling and energy recovery.
Capital and Operating Cost	This criterion addresses the comparative magnitude of capital and operating costs, generally reflected by the amount of land required, the range of building size needed to support the technology, and typical staffing requirements.
Status of Development	This criterion considers whether the technology has been commercially proven and viable for large-scale operation. This criterion focuses on each technology's development status in North America processing MSW.
Compatibility with Current Operations	This criterion address compatibility with current City operations, including residential waste collection services, the existing single stream recycling program, and the recovery and sale of landfill gas from the McCommas Bluff Landfill.
Permitting Complexity	This criterion addresses whether the technology could be implemented with an existing permit modification or whether it would require registration or a new permit, each with progressively increasing schedules and costs.
Project Delivery Options Available	This criterion considers available implementation options for a technology, including fully public or fully private options with public private partnership variations in between.

The screening criteria were established in consideration of City goals and objectives that were discussed during initial project activities. One of the primary goals reflected in the screening criteria is to increase waste diversion from landfill disposal while moving towards a sustainable solution that demonstrates both environmental stewardship and fiscal responsibility. The screening criteria were also established in consideration of key issues specific to the City, including the potential effect of newly implemented technologies on current City operations and the opportunities associated with public private partnership options.

3.3 Application of Screening Criteria

The screening criteria were applied to the following six potential resource recovery technologies identified and described in Section 2 of this report:

- Single stream recycling facility processing source-separated recyclables;
- Mixed waste processing facility, including variations that would combine mixed waste processing with gasification or anaerobic digestion;
- Gasification facility processing mixed waste; and
- Anaerobic digestion facility processing source-separated food waste.

Each of these potential resource recovery technologies were reviewed based on the screening criteria described in Table 3-1. The criteria were applied in a comparative fashion and documented using a color/shape symbol, with a designation of most favorable (green star), somewhat favorable (yellow diamond), and least favorable (red square). The findings are presented in the PowerPoint presentation provided in Appendix D. A summary of key elements associated with the application of each criterion are presented below.

3.3.1 Level of Diversion Achievable

For purposes of the screening analysis, diversion is defined to include both recycling and energy recovery. For all technology options, recycling includes continuation of the current residential single stream program with an increase in the participation and/or recovery rate and a corresponding increase in the quantity of materials collected. Specifically, the analysis assumes that 100,000 tons per year of residential recyclables will be collected and delivered to a single stream recycling facility. As applicable, the technologies also include recycling from mixed waste processing. Energy recovery includes the generation of energy (e.g., electricity, fuels) from gasification and anaerobic digestion technologies. For simplicity in this screening analysis, energy recovery also includes the potential beneficial use of other marketable products associated with energy recovery technologies, as applicable, such as digestate from anaerobic digestion and vitrified aggregate from gasification.

The level of diversion achievable is a function of the quantity and characteristics of the waste and the performance capabilities of the technology. In some cases, potential diversion is also limited by assumptions made on the maximum facility size that would likely be considered by the City. This is particularly relevant for the diversion potentially achievable from the combined residential and commercial waste stream. In these cases, additional diversion could be achieved with the development of multiple facilities or with a larger facility capacity, as appropriate.

3.3.2 Capital and Operating Cost

As noted above for level of diversion and as further outlined in Section 2 of this report, a range of annual throughputs for each type of technology were defined based on waste composition and characteristics and assumptions regarding the maximum facility size that would likely be considered by the City. For these annual throughputs, estimated land and building requirements and projected staffing levels were established for representative project configurations. These estimates were used to comparatively evaluate the magnitude of expected capital and operating costs.

3.3.3 Status of Development

The different technologies evaluated are at various levels of commercial development for processing MSW, ranging from commercially proven and well established in North America, to commercially proven overseas but with limited development activity in North America. Technologies with limited development activity in North America for processing MSW were comparatively ranked with a lower development status.

3.3.4 Compatibility with Current Operations

The City currently collects waste and recyclables from City residents in separate collection bins, and has expended considerable time and effort educating the public about the collection system. The application of this criterion considers whether future programs would be compatible with current operations, or otherwise readily implementable with measurable benefits (e.g., cost savings, reduced vehicle traffic, etc.). In addition, the City has invested significant capital into an enhanced leachate recirculation landfill, which is designed to increase landfill gas production on an accelerated time line. The City has entered into a lease agreement with a third party granting use of property at the landfill to operate a landfill gas processing facility. The Lessee has constructed a facility, and collects, treats and sells the landfill gas. The City receives rent and royalty payments under this lease agreement, which has a 30-year term ending in 2024. This compatibility criterion considers the potential impact a technology may have on the existing landfill gas recovery system and lease agreement.

3.3.5 Permitting Complexity

As described in Section 2 of this report, each technology would be subject to classification by TCEQ as a Type V, VI or IX facility. Depending on the technology, a facility located within the permit boundary of the McCommas Bluff Landfill could require a Notice or Non-Notice Permit Modification, Registration, or a new Permit. Each of these regulatory conditions has progressively increasing requirements, with both cost and schedule implications as summarized in Appendix B, Table B-1.

3.3.6 Project Delivery Options Available

The review of potential technologies (Section 2) identifies a range of project delivery methods or options that are considered to be appropriate for each technology. These options are listed below and are more fully described in Appendix B of this report.

The project delivery options are presented in order of highest City control with correspondingly high City financing and operating risk, with decreasing levels of control and risk proceeding through the listed options. Figures included in Appendix B graphically depict the amount of control and risk for each of the project delivery options. Application of this criterion to the technology options assigned the highest comparative rating to those technology options with the most flexibility to utilize different project delivery options, such as:

- Conventional Design-Bid-Build (DBB);
- General Contractor/Construction Manager (GC/CM) or Construction Manager at Risk (CM);
- Design-Build (DB);
- Design-Build-Operate (DBO);
- Design-Build-Own-Operate-Transfer (DBOOT); and
- Contracted Services (CS).

3.4 Selection of Technologies for Further Analysis

The Project Team completed a preliminary screening analysis, submitted that preliminary analysis to City staff for review, and then conducted a workshop with City staff to refine and finalize the analysis and to determine which technologies would be selected for further evaluation. During the workshop, City staff presented their perspectives on the screening analysis, including input on the level of importance of each criterion. The workshop was a collaborative discussion between the Project Team and City staff, and resulted in the following findings:

- A single stream recycling facility processing source-separated recyclables is comparatively the most favorable technology option. It is consistent with the City's intent to build upon existing successful operations. Although it does not provide the highest potential diversion, it is expected to provide increased diversion for a comparatively lower level of capital and operating cost. This technology option is fully compatible with existing operations, commercially proven and well established in North America (including in the United States), and offers the least complex permitting pathway. In addition, a single stream recycling facility could be implemented with any of the identified project delivery options, and is the only technology evaluated to provide this full flexibility.
- A mixed waste processing facility with landfill disposal of residual material is also a comparatively favorable technology option. Mixed waste processing improves upon the diversion achieved with single stream recycling, although, with potentially increased capital and operating cost and with somewhat increased permitting complexity. Mixed waste processing is commercially proven with several facilities in North America. It is compatible with the City's current operations, and provides the potential to be developed in an integrated fashion with a single stream recycling facility.

- A mixed waste processing facility with gasification of residual material offers the highest level of potential diversion. However, the gasification component will comparatively increase the capital and operating costs and will result in the most complex permitting pathway with risk of non-approval (new Permit with public notice and potential public hearing, with costs on the order of $1-2 million and a lengthy permitting schedule ranging from 2-5 years). Gasification technology is commercially proven overseas, and there are a few projects in North America that are in advanced development stages (some with mixed waste and some with other feedstock). However, gasification technology is comparatively less developed for processing MSW than single stream and mixed waste processing technologies. In addition, the Project Team recommends that gasification is most appropriately implemented by private entities or under a public private partnership, with limited opportunities and increased risk for public options with greater City control.
- A mixed waste processing facility with anaerobic digestion of the organic fraction of residual material offers increased diversion compared to single stream and mixed waste processing technologies. However, mixed waste processing with anaerobic digestion has many of the same comparative limitations noted above for mixed waste processing with gasification. These limitations include increased cost, increased permitting complexity with risk of non-approval, and limitations regarding appropriate project delivery options. Also, achieving the level of diversion estimated for mixed waste processing with anaerobic digestion requires long-term, beneficial use of the digestate (or compost produced from the digestate), for which markets are uncertain.
- A gasification facility processing mixed waste is generally comparable to mixed waste processing with gasification of residual material, for the evaluation criteria applied in this screening analysis. While a gasification facility may include some level of pre-processing to meet technology needs (e.g., shredding, drying) and/or to recover recyclables with high economic value that otherwise provide no energy value (e.g., ferrous metal and aluminum), this analysis assumes that the gasification facility has less pre-processing than mixed waste processing with gasification. Capital and operating costs would still be comparatively high, and the most complex permitting pathway would be expected. While gasification and mixed waste processing with gasification both achieve similar levels of diversion, gasification without extensive pre-processing would have a higher amount of diversion attributable to energy recovery (and product recovery) as compared to diversion from recycling.
- An anaerobic digestion facility processing separately collected food waste offers comparable or less diversion than could be achieved with mixed waste processing, primarily due to the limitations in the amount of food waste available in the waste stream and assumptions regarding the capture rate of that food waste for processing. In addition, achieving the level of diversion estimated for anaerobic digestion of food waste requires long-term, beneficial use of the digestate (or compost produced from the digestate), for which markets are uncertain (but potentially more stable than anaerobic digestion produced from mixed waste). In addition, the level of diversion that could be achieved is generally low in consideration of the anticipated permitting complexity. Finally, of all the technologies considered, anaerobic digestion of food waste is the least compatible

with current City operations. This technology would require separate collection of source-separated food waste, and would reduce landfill gas recovery resulting in loss of revenues from landfill gas royalties. It is uncertain whether revenues from sale of biogas or energy produced from biogas could equal the royalties from the sale of landfill gas.

Based on the findings summarized above, two technologies were selected for detailed analysis: a single stream recycling facility processing source-separated recyclables and a mixed waste processing facility with disposal of residuals. It was determined that gasification and anaerobic digestion technologies should be monitored, particularly in regards to development activities in North America, and that these technologies could be considered for potential future integration with single stream recycling or mixed waste processing or for stand-alone application, as appropriate.

Section 4
DETAILED ANALYSIS OF TECHNOLOGIES

4.1 Introduction

As described in Section 3 of this report, the City selected single stream recycling and mixed waste processing for detailed analysis. As such, the Project Team analyzed the following for each technology:

- Diversion potential;
- Status of development;
- Permitting and regulatory issues;
- Technical and business risk; and
- Financial feasibility.

This section provides detailed analysis for single stream recycling and mixed waste processing. In addition, the Project Team provides discussion on the potential benefits of developing a combined single stream and mixed waste processing facility.

4.2 Key Assumptions

The following are key assumptions used in developing this analysis:

- The capital and operating costs included in this section are planning-level.[1] Detailed engineering and facility design work would be required to develop precise cost estimates for project implementation.
- The City could consider various financing options for a resource recovery facility, as listed below.
  - General Obligation Bonds (GO) – Typical funding mechanism for municipal projects. The analysis included in this section assumes capital is funded through GO bonds at five percent interest.
  - Revenue Bonds – Bonds payable through revenues derived from an income-producing facility. These are generally higher cost instruments than other municipal bonds.
  - Certificates of Obligation (CO) – May be issued to pay for contractual obligations, including construction costs. Terms may be limited to 10 years.
  - Bank Financing – City secures a bank loan to fund a project. This would be a relatively atypical approach.

[1] Planning-level cost estimates could reasonably be 20 percent higher or 20 percent lower than precise cost estimates that would accompany a detailed design.

    - Vendor Financing – Private company pays for construction at its cost of capital and transfers ownership to the City at the end of the contract term. This option could be considered as part of a procurement process.

- The cost estimates assume a City-owned facility, and therefore, a cost of capital of five percent is assumed. The Project Team used the following depreciation periods for capital purchases.

    - Construction of facility and site development – 20 years
    - Processing equipment – 10 years
    - Mobile equipment – 7 years

- The cost estimates assume operation by a private contractor. However, a private contractor would likely achieve an operating cost lower than what the Project Team has shown in its analysis due to proprietary business practices and ability to achieve market pricing in excess of published indices. As such, the Project Team has excluded profit and tax from the operating cost estimates to ensure the costs are not overly conservative.

- The facility would be constructed on City-owned land located at the McCommas Bluff Landfill. Appendix B contains a description of the specific site that has been identified as a possible site for a resource recovery facility. There are numerous advantages to co-locating a facility with the landfill, including, but not limited to, the items listed below. For each item shown below, the Project Team has indicated the additional cost that would be incurred if a facility were constructed at a different location than the site identified at the landfill. These costs would add approximately $1.5 to $2.5 million in capital cost and $75,000 to $150,000 in annual operating cost to the cost estimates described in this analysis.

    - Land purchase costs would not be incurred. The Project Team estimates that land purchase for South East Dallas industrial land would cost between $150,000 and $300,000.
    - A resource recovery facility would be able to utilize the existing scale house and support facilities that already exist at the landfill. The Project Team estimates that a scale house would cost between $400,000 and $600,000 and site roads would cost between $300,000 and $400,000.
    - Existing infrastructure, such as utilities (stormwater, waste water, water supply, electrical supply, natural gas, and fire service), are readily available at the landfill or in the vicinity of the landfill. Development of these utilities would cost between $500,000 and $1,000,000 at an undeveloped site.
    - Co-locating resource recovery at the landfill minimizes transportation cost of residual material. The Project Team estimates that hauling cost for residual material would cost between $75,000 and $150,000 annually for a single stream facility and $200,000 to $400,000 annually for mixed waste processing.
    - Resource recovery would create additional employment opportunities for the City of Dallas.

  - The City could begin to develop a Resource Recovery Park (RRP) on site, including end users of recycled material. Further discussion of RRP is provided in Section 5.
  - The City would have the flexibility to expand resource recovery capabilities over time. For instance, it could add mixed waste processing capabilities after single stream recycling was already in place.
- The following are other project costs included in the analysis, which would be capitalized.
  - U.S. Green Building Council LEED “Silver” certification, including LEED certification support costs estimated at 0.75 percent of construction. The Project Team would expect that these costs would account for various features including, but not limited to, the following:
    - Rainwater harvesting and reuse;
    - Natural daylighting (skylights and translucent wall panels) with automated artificial light dimming;
    - Use of local/regional construction materials;
    - Use of recycled materials in the construction;
    - Construction debris recycling;
    - Water efficient landscaping;
    - Landscape and exterior design to reduce heat island effect;
    - Optimized energy performance;
    - Fundamental building system commissioning;
    - Generation of renewable energy (such as photovoltaic power);
    - Purchase of green energy;
    - Use of low emitting materials (air quality);
    - Controllability of HVAC systems;
    - Stormwater management (treatment); and
    - Minimized site disturbance.
  - Project contingency of 10 percent for construction costs and five percent for processing equipment.
  - Design costs of 12 percent of construction and five percent of processing equipment.
  - Permit support costs of 3.50 percent of construction.
  - Owner’s Advisory (OA) costs of $1 million. These costs would be for the procurement and construction management for the facilities that could be

constructed at the McCommas Bluff Landfill.[2] The Project Team estimates that these costs would represent the following.

- Development and implementation/management of a Request for Qualifications (RFQ)/Request for Proposals (RFP) process, including contract negotiation: 50 percent of OA cost.
- Assistance with administration of the DBO contract, including design review and oversight of field construction: 40 percent of OA cost.
- Public outreach and involvement: five percent of OA cost.
- Assistance with operational startup: five percent of OA cost.

■ The City is considering a new entrance facility for the landfill, including a scale house and a scale system. The existing entrance facility was constructed in the year 2000 and consists of: 1) a scale house that is a 20ft x 40ft pre-engineered metal building with transaction windows facing the inbound and outbound scales and 2) two inbound and one outbound steel and concrete deck type truck scales. The existing scales are currently functional, but require frequent maintenance and, as they are nearing their expected service life, should be replaced. The Project Team estimates that the cost for a new entrance facility, including scales and a scale house, would be between $400,000 and $600,000. This is a cost that the City will likely incur regardless of the development of a resource recovery facility; therefore, these costs were excluded from the financial analysis for single stream recycling and mixed waste processing.

4.3 Single Stream Recycling

This section provides the Project Team's detailed analysis of a single stream recycling facility. A schematic diagram of a potential facility is shown in Appendix E.

4.3.1 Diversion Potential

The following table shows the potential diversion that could be achieved through single stream and the impact on the City's diversion rate.

As discussed in Section 2.2.3 of this report, the City implemented single stream recycling for residential households in 2008. While the City currently is on track to collect approximately 55,000 tons per year through single stream (based on recent monthly volumes), the Project Team believes that it is feasible for the City to collect between 75,000 and 100,000 tons annually through this program. For the purpose of this analysis, the Project Team assumed annual volume of 75,000 tons from the City's single stream program.

[2] The Project Team notes that if the City chooses to enter into a PSA that OA services would be significantly lower and primarily include development and implementation of an RFP process and contract negotiation.

Table 4-1
Potential Residential Diversion –
Single Stream Recycling [1]

Waste Generated	Tons
Residential Waste Generated	315,019
Direct Disposal	240,019
Single Stream Throughput	75,000
Recycled	63,000
Residue Disposed	12,000
Total Recycled	63,000
Total Disposed	252,019
Single Stream Diversion Rate	20%

[1] This table shows the diversion that could be achieved through single stream only and excludes other diversion programs (e.g. brush processing, electronics recycling).

4.3.2 Status of Development

The status of development of single stream recycling is described in Section 2.2.2 of this report. Single stream recycling is a commercially-proven technology that is widely used throughout the United States. Single stream's strong record of performance in the United States is a key reason this technology was selected by the City for further analysis.

4.3.3 Permitting and Regulatory Issues

The permitting requirements for a single stream recycling facility are discussed in Section 2.2.4 of this report. Under certain requirements outlined in 30 TAC 328, a single stream recycling facility may be considered as an Exempt Facility and may require a Notification of Intent (NOI) to TCEQ. Appendix B provides additional detail on the requirements, timeframe, and expected cost submit an NOI.

4.3.4 Technical and Business Risk

The Project Team identified the key technical and business risks associated with a City-owned and operated single stream recycling facility, as listed below. The Project Team would note that many of these risks can be mitigated if the City were to obtain a private operator for a City-owned facility.

Business Risks

- As shown in the financial analysis, facility economics improve significantly at higher tonnage levels due to economies of scale. Therefore, the economic viability of single stream will depend on the operator's ability to obtain tonnage from other sources and surrounding communities. The City would likely have to compete with other single stream processors to obtain this tonnage.

- The City lacks experience marketing recyclable commodities on a large scale. Producing material to market specifications and obtaining buyers for that material at competitive prices are key aspects of operating a single stream processing facility. Large operators who are bringing large quantities of materials to market from multiple facilities are in a strong position to obtain high market pricing for materials. The City would not necessarily be in a similar position and may have a challenge securing contracts with end users if volumes are relatively low.
- Facility economics are significantly affected by the revenue from the sale of commodities, which fluctuates based on market conditions and cannot be precisely projected. If the City were to develop a facility, the City would be taking on more commodity price risk than in the past contracting with a private facility. However, the Project Team would note that many recent municipal processing contracts with private companies developed in Texas have shown that private companies are requiring municipalities to share more commodity price risk than in the past. This takes the form of higher processing fees than have previously been seen in processing contracts.

Technical Risks

- While single stream has become widespread across the United States, recycling and waste management practices and technologies will continue to develop and change over time. If the City develops a single stream facility, there is risk that the technology and program will need to change in the future to stay competitive. While this risk applies to any owner/operator of a single stream facility, a municipal entity is less able to quickly adapt to changing industry practices and technologies.
- The City lacks experience operating a single stream recycling facility. While the City has been successful operating other types of solid waste facilities in the past, the City would need to obtain experienced personnel who could manage and operate a single stream recycling facility. This could be accomplished through hiring of internal personnel or obtaining a private operator.

4.3.5 Financial Feasibility

This section summarizes planning-level cost estimates for the City to develop a single stream recycling facility. The Project Team based these cost and revenue estimates on extensive single stream recycling work for other municipalities. In addition, the cost estimates include contingency factors to account for unanticipated additional costs.

Capital Cost Assumptions

The Project Team developed the following assumptions as the basis for capital costs for a City-owned single stream recycling facility. The Project Team expects that if the City were to develop a single stream recycling facility that it would be in the form of a partnership with a private company. As such, if a facility were designed and constructed by a private company, that company may propose a different approach to providing single stream recycling services (e.g. slightly different processing equipment, different sized building, etc.). The intent of the following capital assumptions and cost estimates is to determine whether a single stream facility is a feasible project to be pursued by the City and not to prescribe a specific method of approach.

- Capacity
  - Facility sized to process 75,000 tons per year, operating two, eight-hour shifts per day, five days per week. Additional tonnage could be processed by adding shifts on weekend days or extending week day shifts from eight to 10 hours. This would allow the capacity to increase to 115,000 tons per year.
  - Single stream processing line to process 20 tons per hour.
- Building and site
  - Fully enclosed, insulated building with significant indoor material storage and performance-coated primary structural steel.
  - 30 foot wide canopy at delivery end of building to extend the potential tip area at peak times.
  - Two-story, 10,000 square foot operations building with offices, break rooms, locker and shower rooms, an education room, and mechanical and electrical support spaces.
  - 20,000 square foot tipping floor with 12,000 square feet receiving a nominal, 1.5 inch abrasion resistant floor topping. Tip floor could accommodate five to seven vehicles tipping at the same time.
  - Environmental separation between tipping and processing floors.
  - Fire sprinklers throughout the building.
  - Translucent skylights and daylighting wall panels.
  - Four door loading dock.
  - Fifteen acre site area, not including scale facility.
  - Assumed existing scale facility at McCommas Bluff Landfill to be utilized for weighing delivery vehicles (no new scales).
- Equipment
  - Single stream processing equipment line including conveyors, screens, optical sorters, magnetic and eddy current separators, primary and secondary two-ram balers, pre-sort and sorting platforms, news screen, drum feeder, and bunkers.
  - Mobile equipment, including one, medium-sized, diesel powered front end loader, one diesel powered skid-steer, and one propane powered forklift.

Labor Assumptions

The Project Team developed assumptions for the number of personnel required to operate the single stream recycling facility, as shown in Table 4-2. Hourly rate assumptions for these employees include fringe benefits and payroll taxes. The financial analysis shown in this section also accounts for holidays and vacations for personnel (excluding contract personnel). The baseline financial analysis accounts for two, eight-hour shifts, five days per week.

Table 4-2
Personnel Assumptions for Single Stream Recycling

Description	Full-Time Equivalent Employees	Hourly Rate per Employee [1]	Baseline Hours per Year [2]
Facility Manager	1	$70.00	2,080
Administrative / Clerical	1	$28.00	2,080
Shipping Clerk	1	$35.00	2,080
Building/Grounds Maintenance	1	$40.00	2,080
Tipping Floor Equipment Operators	1 (per shift)	$45.00	4,160
Floor Spotter/Laborer	1 (per shift)	$25.00	4,160
Pre-Sort Labors (Contract)	3 (per shift)	$14.00	12,480
Sort/QC Labors (Contract)	12 (per shift)	$14.00	49,920
Operations Lead	1 (per shift)	$60.00	4,160
Baler/Skidsteer/Forklift Operator/End Product QC	2 (per shift)	$38.00	8,320
Maintenance Lead	1 (per shift)	$56.00	4,160
Maintenance Tech	1 (per shift)	$53.00	4,160
Total Hours per Year			99,840
FTEs (based on hours per year)			48

1. Hourly rate includes fringe benefits and payroll taxes (excluding contract laborers).
2. Number of employee hours per year required for baseline scenario of two, eight-hour shifts, 5 days per week.

Other Key Operating Cost Assumptions

Additional key operating cost assumptions included in this analysis are listed below.

- Material recovery rate of 95 percent of acceptable recyclable materials.
- Building and site annual maintenance one percent of initial capital cost.
- Processing equipment annual maintenance of three percent of initial capital cost.
- Ninety percent plant availability (i.e. 10 percent down time for equipment repair).
- Baling wire cost of $4.00 per ton of baled material.

Revenue Assumptions

The Project Team utilized historical commodity prices to develop revenue projections for a single stream recycling facility. The following table shows the average yearly commodity prices for each material accepted in the City's recycling program. The table also includes the City's most recent single stream composition. The composition shown in the table excludes residual material, which consists of approximately 16 percent of incoming tons.

Table 4-3
Assumed Material Composition and Historical Material Index Pricing (per ton) [1, 2]

Material	Composition [3]	12-Month Average Price [4]					Average
		2008	2009	2010	2011	2012	
OCC	12.4%	$99	$59	$139	$142	$100	$108
Residential Mixed Paper	15.5%	$84	$38	$100	$125	$74	$84
ONP	37.2%	$125	$61	$96	$124	$68	$95
#1 Plastic	3.7%	$346	$205	$381	$631	$438	$400
#2 Plastic (natural)	0.8%	$697	$398	$528	$714	$618	$591
#2 Plastic (colored)	1.6%	$500	$265	$417	$522	$498	$440
#3-#7 Plastic	0.3%	$0	$0	$0	$0	$0	$0
Aluminum Cans	0.7%	$1,668	$1,031	$1,448	$1,723	$1,498	$1,474
Ferrous Containers	1.3%	$198	$80	$119	$122	$122	$128
Other Ferrous	0.1%	$0	$0	$0	$0	$0	$0
Glass	26.3%	$0	$0	$0	$0	$0	$0
Blended Value	100%	$112	$59	$105	$134	$90	$100

1. Represents the composition of recyclable material only and excludes residue of 16.2 percent of incoming tons.
2. Minor arithmetic errors are due to rounding.
3. Based on material audit provided by the City of Dallas; percentage by weight.
4. Historical commodity values based on indices published by RecyclingMarkets.net (formerly Waste and Recycling News) and Pulp and Paper Weekly (formerly Official Board Markets).

As shown in the table, the average blended value of recyclable commodities, assuming the City's composition of materials, over a five-year period is $100 per ton. It is important for the City to consider the impact of the volatility in commodity values on the overall economic feasibility of a single stream recycling facility. Therefore, the Project Team included a range of commodity values in this analysis from $60 per ton (a five-year low) to $140 per ton (a five-year high).

Throughput Assumptions

The City's residential single stream recycling program is currently on track to generate approximately 55,000 tons per year based on recent monthly volumes. As discussed in Section 2 of this report, the Project Team believes that the City has the potential to capture between 75,000 and 100,000 tons per year through this program. In addition, if the City developed a single stream processing facility, it would have the opportunity to source additional recyclable materials from other sources and surrounding communities in order to use the reserve processing capacity of the facility.

The annual throughput of the single stream recycling facility has a significant impact on its financial feasibility. Therefore, the Project Team conducted a sensitivity analysis to project changes in cost if the facility processed between 60,000 and 115,000 tons per year.

The baseline operating costs for the facility would include two, eight-hour shifts, five days per week. With these hours of operation, the facility could process up to 75,000 tons per year. For tonnage above 75,000 tons per year, additional hours of operation would be needed. Additional hours of operation could be achieved by extending the weekday shifts from eight to 10 hours in length and adding shifts on the weekends. The Project Team estimates that for every 10,000 tons per year above 75,000, 556 additional operating hours per year would be required. The sensitivity analysis accounts for additional operating costs that would be incurred and additional revenue that would be generated from higher throughput levels.

Capital Costs

The table below shows the capital cost estimates for a single stream recycling facility, developed by the Project Team. More detailed capital and operating cost estimates are included in Appendix E.

Table 4-4
Single Stream Recycling Capital Cost Estimates

Description	Cost Estimate
Site Work	$1,141,200
Single Stream Building	$8,176,800
Single Stream Equipment	$6,550,000
Mobile Equipment	$530,000
Other Project Costs [1]	$4,606,000
Total Capital Cost	$21,004,000

[1] Includes contingency for construction and equipment, design and engineering, surveying, permitting, construction management, LEED Certification support, and owner's advisory services.

Financial Analysis Summary

The following table summarizes the annual costs for a single stream recycling facility at different levels of throughput. As shown in the table, the total annual cost increases as the throughput of the facility increases. However, the cost on a per-ton basis decreases as the throughput increases. Therefore, it would be a financial benefit to the City, if a single stream facility were developed, to maximize tonnage processed at the facility.

The Project Team would note that the financial summary shown in this section applies to the facility as a whole. As previously discussed, this analysis assumes a public private partnership. The sharing of cost and revenue between a private entity and the City of Dallas are unknown and would be negotiated as part of a procurement process.

Table 4-5
Summary of Annual Costs for Single Stream Recycling Facility [1]

	Annual Throughput (Tons)					
	60,000	75,000	85,000	95,000	105,000	115,000
Capital Cost [2]						
Site Work	$91,573	$91,573	$91,573	$91,573	$91,573	$91,573
Single Stream Building	$656,128	$656,128	$656,128	$656,128	$656,128	$656,128
Other Project Costs	$369,597	$369,597	$369,597	$369,597	$369,597	$369,597
Single Stream Equipment	$848,255	$848,255	$848,255	$848,255	$848,255	$848,255
Mobile Equipment	$91,595	$91,595	$91,595	$91,595	$91,595	$91,595
Total Capital Cost	$2,057,147	$2,057,147	$2,057,147	$2,057,147	$2,057,147	$2,057,147
Capital Cost Per Ton	$34.29	$27.43	$24.20	$21.65	$19.59	$17.89
Operating Cost						
Labor	$2,544,000	$2,544,000	$2,741,936	$2,939,872	$3,137,808	$3,335,744
Building and Site Maintenance	$89,000	$89,000	$89,000	$89,000	$89,000	$89,000
Equipment Maintenance	$285,000	$285,000	$296,843	$308,686	$320,528	$332,371
Utilities	$148,000	$148,000	$167,582	$187,165	$206,747	$226,329
Rolling Stock Fuel	$92,000	$92,000	$104,321	$116,642	$128,963	$141,284
Consumables/Services	$24,000	$24,000	$24,000	$24,000	$24,000	$24,000
Baling Wire	$240,000	$300,000	$340,000	$380,000	$420,000	$460,000
Insurance	$52,000	$52,000	$52,217	$52,434	$52,651	$52,867
Residual Disposal	$124,764	$155,955	$176,749	$197,543	$218,337	$239,131
Contingency	$359,876	$368,996	$399,265	$429,534	$459,803	$490,073
Admin	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
Total Operating Cost	$3,966,641	$4,066,951	$4,399,913	$4,732,875	$5,065,838	$5,398,800
Operating Cost Per Ton	$66.11	$54.23	$51.76	$49.82	$48.25	$46.95
Total Annual Cost	$6,023,788	$6,124,098	$6,457,060	$6,790,023	$7,122,985	$7,455,947
Total Annual Cost Per Ton	$100.40	$81.65	$75.97	$71.47	$67.84	$64.83

1. Minor arithmetic errors are due to rounding.
2. Amortized annual costs based on interest rate and depreciation periods described in Section 4.2.

The following table shows the net cost or revenue for the facility at different levels of tonnage and commodity values. As shown in the table, the facility would need to have throughput of 85,000 tons per year in order to break even (assuming average commodity values of $100 per ton). In average commodity price conditions, the facility could expect to generate up to $14.76 per ton in net revenue if the facility were to process 115,000 tons per year.

Table 4-6
Commodity Value and Tonnage Sensitivity Analysis
Net Cost/(Revenue) Per Ton [1]

Blended Value of Commodities	Annual Throughput (tons)					
	60,000	75,000	85,000	95,000	105,000	115,000
$60 per ton	$52.64	$33.90	$28.21	$23.72	$20.08	$17.08
$80 per ton	$36.72	$17.98	$12.29	$7.80	$4.17	$1.16
$100 per ton	$20.81	$2.06	$(3.63)	$(8.12)	$(11.75)	$(14.76)
$120 per ton	$4.89	$(13.85)	$(19.54)	$(24.04)	$(27.67)	$(30.67)
$140 per ton	$(11.03)	$(29.77)	$(35.46)	$(39.95)	$(43.59)	$(46.59)

[1] Red, positive values represent a net cost per ton to the City. Black, negative values represent net revenue per ton to the City. Project Team chose this formatting to be consistent with Table 4-5.

Under the current processing agreement, the City has consistently generated between $30 and $40 per ton in net revenue. The financial terms of the existing processing agreement are very favorable to the City. However, in evaluating the sensitivity analysis in Table 4-6, the City should consider that recent processing agreements negotiated between municipalities and processing companies in Texas have required municipalities to share much more of the risk (and cost) associated with single stream processing. Therefore, the Project Team does not expect that the City would have similar financial terms for any processing contract that would be negotiated in the future.

4.3.6 Single Stream Recycling Key Findings and Recommendations

Following are the Project Team's key findings from analyzing the City's opportunity to develop a single stream recycling facility.

- While there are technical and business risks to developing a facility, the City's previous experience with single stream, as well as the fact that single stream technology is commercially developed in North Texas, makes the technology technically feasible for the City.
- Increases in throughput, while increasing overall cost, has a positive benefit on cost per ton. For instance, if the facility processed 60,000 tons per year, the cost would be $100.40 per ton. However, if the City increased throughput to 115,000 tons per year through sourcing material from other sources and surrounding communities, the cost would drop to $64.83 per ton.
- Based on the sensitivity analysis shown in Table 4-5, the City would need to obtain additional tonnage, either through increasing material generated through the current City program and/or through obtaining processing contracts with other communities to make a single stream facility financially viable.
- The City currently has a very favorable processing contract with Waste Management Recycle America, that was originally developed in 2007. While the financial terms of this contract are favorable toward the City, the Project Team

would not expect the terms of a future processing contract with a private company to compare to the current terms. Based on a review of processing contracts developed in Texas and the Southwest in the past two to three years, private companies have required that cities share more of the economic risk of single stream by charging higher processing fees and/or sharing less revenue.

- The single stream financial analysis could change significantly if it were not co-located with the McCommas Bluff Landfill. As stated in Section 4.2, the additional cost to develop a facility at an undeveloped site would be between $1.5 million and $2.5 million in initial capital cost and $75,000 to $150,000 in annual operating cost.

Based on the findings from this analysis, the Project Team would recommend the following.

- In order to maximize throughput for the facility, as well as mitigate the technical risk of operating a new type of facility, the Project Team would recommend that the City obtain a private operator for a single stream facility.
- The City should conduct a procurement that allows them to directly compare developing a City-owned, privately-operated facility with obtaining a processing agreement with an existing or to be constructed facility. Procurement options and recommendations will be discussed further in the Implementation Plan in Section 7 of this report.

4.4 Mixed Waste Processing

This section provides the Project Team's detailed analysis of mixed waste processing. A schematic diagram of a potential facility is shown in Appendix E.

4.4.1 Diversion Potential

The following table shows the potential diversion that could be achieved through mixed waste processing and the resulting impact on the City's residential diversion rate. The Project Team assumed that the mixed waste processing facility would operate concurrently with a single stream recycling program.

Table 4-7
Potential Diversion – Mixed Waste Processing [1]
Assumes Throughput of 250,000 Annual Tons

Waste Generation	Residential
Waste Generated	315,019
Direct Disposal	0
Single Stream Throughput	75,000
Recycled	63,000
Disposed	12,000
Mixed Waste Throughput	240,019
Recycled	44,115
Disposed	195,904
Total Recycled	107,115
Total Disposed	207,904
Diversion Rate	34.0%

[1] This table shows the diversion that could be achieved through technologies being considered for this study and excludes other existing or potential diversion programs.

4.4.2 Status of Development

Mixed waste processing is in use in in the United States but is not widespread. Most of the operational mixed waste processing facilities are located in communities where legislated mandates for diversion are in place. While mixed waste processing is not as common as single stream recycling, there has recently been renewed interest in the technology due to a focus on high diversion rates and zero waste initiatives.

More detailed information regarding the development status of mixed waste processing, including a representative list of facilities, can be found in Section 2.3.2 of this report.

4.4.3 Permitting and Regulatory Issues

The permitting requirements for a mixed waste processing facility are discussed in Section 2.3.4 of this report. A mixed waste processing facility would be classified by TCEQ as a Type V facility, requiring a Registration, or potentially a Notice Permit Modification if located at the McCommas Bluff Landfill. Appendix B provides additional detail on the requirements, timeframe, and expected cost to obtain a Permit Modification and Registration.

4.4.4 Risk Assessment

The Project Team identified the key technical and business risks associated with a city-owned and operated mixed waste processing facility, as listed below. The Project Team would note that many of these risks can be mitigated if the City were to obtain a private operator for a City-owned facility.

Business Risks

- As shown in the financial analysis, facility economics improve significantly at higher tonnage levels in which residential tonnage is combined with commercial tonnage. Therefore, the City would need to continue to maintain volumes from commercial customers at the landfill to make a corresponding mixed waste processing facility most feasible. A mixed waste processing facility would add fixed cost to the overall landfill operation, therefore, any decreases in volume would result in an increase in the cost per ton of material processed and disposed at the joint facility.
- Facility economics are significantly affected by the revenue from the sale of commodities, which fluctuates based on market conditions and cannot be precisely predicted. In addition, the financial analysis is based on the average residential composition of waste based on the waste characterization analysis. The financial analysis would change (either improve or worsen) if the actual composition of material processed at the mixed waste processing facility deviated from the assumptions in this analysis.
- The City lacks experience marketing recyclable commodities on a large scale. Producing material to market specifications and obtaining buyers for that material at competitive prices are key aspects of operating a mixed waste processing facility. Furthermore, additional effort and coordination may be required for the City to obtain buyers for material that was collected commingled with non-recyclable municipal solid waste.
- The Project Team recommends that a mixed waste processing facility be evaluated as an integrated part of the existing landfill operation to make the facility operationally viable. However, this approach also increases the risk that negative performance of the mixed waste processing facility would have an increase landfill operating cost and, therefore, impact the future competitiveness of the landfill in the Dallas-Fort Worth marketplace.
- Since there are not as many mixed waste processing facilities, as compared to single stream, there is less certainty regarding the capital and operating costs for mixed waste processing facilities.
- There are currently no mixed waste processing facilities in the Dallas-Fort Worth Metroplex that would compete with a potential future City facility. However, there is a risk that other large waste management companies would develop mixed waste processing facilities and, due to having large-scale commercial hauling operations, would divert their recyclable-rich loads to their own facilities.

Technical Risks

- The City lacks experience operating a mixed waste processing facility. While the City has been successful operating other types of solid waste facilities in the past, the City would need to obtain experienced personnel that could manage and operate a mixed waste processing facility. This could be accomplished through hiring of internal personnel or obtaining a private operator.

4.4.5 Financial Analysis

This section summarizes planning-level cost estimates for the City to develop a mixed waste processing facility. These cost estimates include contingency factors to account for unanticipated additional costs.

Capital Cost Assumptions

The Project Team developed the following assumptions as the basis for capital costs for a City-owned and operated mixed waste processing facility.

- Capacity
  - Facility sized to process 250,000 tons per year, operating two, nine-hour shifts per day, five days per week. Additional tonnage could be processed by adding shifts on weekend days and/or extending shifts from nine to 10 hours. This would allow the capacity to increase to 400,000 tons per year if commercial waste were included.
  - Two, 30 ton-per-hour mixed waste processing equipment lines.
- Building and Site
  - Fully enclosed, insulated building with significant inside material storage and performance-coated primary structural steel.
  - 30 foot wide canopy at delivery end of building to extend the potential tip area at peak times.
  - Two-story, 12,500 square foot operations building with offices, break rooms, locker and shower rooms, and mechanical and electrical support spaces.
  - 37,500 square foot tipping floor with 23,000 square feet receiving a nominal 1.5” thick abrasion resistant floor topping. Tip floor could accommodate six to eight trucks tipping at the same time.
  - Environmental separation between tipping and processing floors.
  - Fire sprinklers throughout the building.
  - Translucent skylights and daylighting wall panels.
  - Four door loading dock.
  - Fifteen acre site area requirement not including scale facility.
  - Assumed existing scale facility at McCommas Bluff Landfill to be utilized for weighing delivery vehicles (no new scales).
- Equipment
  - Mixed waste processing equipment including: size reducer, conveyors, screens, optical sorters, magnetic and eddy current separators, two-ram baler, pre-sort and sorting platforms with climate controlled cabin for sorting platform, drum feeder, and bunkers.

- Mobile equipment including one large, diesel-powered front end loader, one diesel-powered material handler, two diesel-powered skid-steers, and two propane-powered forklifts.

Labor Assumptions

The Project Team developed assumptions for the number of personnel required to operate the mixed waste processing facility, as shown in Table 4-8. Hourly rate assumptions for these employees include fringe benefits and payroll taxes. The financial analysis shown in this section also accounts for holidays and vacations for personnel (excluding contract personnel). The baseline financial analysis accounts for two, nine-hour shifts, five days per week.

Table 4-8
Personnel Assumptions for Mixed Waste Processing

Description	Full-Time Equivalent Employees	Hourly Rate per Employee [1]	Baseline Hours per Year [2]
Facility Manager	1	$70.00	2,080
Administrative / Clerical	1	$28.00	2,080
Shipping Clerk	1	$35.00	2,080
Building/Grounds Maintenance	1	$40.00	2,080
Tipping Floor Equipment Operators	2 (per shift)	$45.00	9,360
Floor Spotter/Laborer	2 (per shift)	$25.00	9,360
Pre-Sort Labors (Contract)	8 (per shift)	$14.00	37,440
Sort/QC Labors (Contract)	26 (per shift)	$14.00	121,680
Operations Lead	1 (per shift)	$60.00	4,680
Baler /Skidsteer/Forklift Operator/End Product QC	4 (per shift)	$38.00	18,720
Maintenance Lead	2 (per shift)	$56.00	9,360
Maintenance Tech	2 (per shift)	$53.00	9,360
Total Hours per Year			228,280
FTEs (based on hours per year)			110

1. Hourly rate includes fringe benefits and payroll taxes.
2. Number of employee hours per year required for baseline scenario of two, nine-hour shifts, 5 days per week for per-shift personnel and one, eight-hour shift, five days per week for indirect staff such as Facility Manager, Administrative, Shipping, and Building/Grounds Maintenance.

Other Key Operating Cost Assumptions

Additional key operating cost assumptions included in this analysis are listed below.

- Building and site annual maintenance one percent of initial capital cost.
- Processing equipment annual maintenance of three percent of initial capital cost.
- Ninety percent plant availability (10 percent down time for equipment repair).
- Baling wire cost of $4.00 per ton of baled material.

Revenue and Material Recovery Assumptions

The Project Team utilized historical commodity prices to develop revenue projections for a mixed waste processing facility. The following table shows the high, low, and average commodity prices for each material that would be recovered at a mixed waste processing facility. The table also includes the composition of material that would be processed at the mixed waste processing facility, based on the waste characterization analysis conducted by the Project Team. For the purpose of this analysis, it was assumed that the mixed waste processing facility would process primarily residential tonnage; therefore, the Project Team used the residential waste composition numbers from the waste characterization analysis.

Table 4-9
Material Composition, Recovery Rate, and Historical Material Index Pricing (per ton) [1, 2]

Material	Composition		Assumed Recovery Rate	5-year High [4]	5-year Low [5]	5-year Average
	All Materials [3]	Recovered Materials				
OCC	2.3%	9%	65%	$142	$59	$108
Mixed Paper	10.4%	39%	75%	$125	$38	$84
#1 Plastic	2.5%	9%	80%	$631	$205	$400
#2 Plastic	1.1%	4%	80%	$618	$332	$516
#3-#7 Plastic	1.4%	5%	90%	$0	$0	$0
Film Plastic	6.4%	24%	35%	$0	$0	$0
Aluminum Cans	0.8%	3%	95%	$1,723	$1,031	$1,474
Ferrous Containers	1.1%	4%	95%	$198	$80	$128
Other Ferrous	1.0%	4%	90%	$198	$80	$128
Not Recovered [5]	73.0%	n/a	0%	N/A	N/A	N/A
Blended Value (per ton)				$215	$97	$161

1 Historical commodity values based on indices published by RecyclingMarkets.net (formerly Waste and Recycling News) and Pulp and Paper Weekly (formerly Official Board Markets).
2 Minor arithmetic errors are due to rounding.
3 Based on composition of residential waste from the waste characterization study.
4 Represents the highest yearly average commodity values between 2008 and 2012.
5 Represents the lowest yearly average commodity values between 2008 and 2012.
6 Includes all recyclable and non-recyclable material that would not be recovered at the mixed waste processing facility and would be disposed.

As shown in the table, the five-year high blended value of recyclable commodities is $215 per ton. It is important for the City to consider the impact of increases or decreases in commodity values on the overall economic feasibility of a mixed waste processing facility. Therefore, the Project Team included a range of commodity values in this analysis from $100 per ton (approximately a five-year low) to $160 per ton (approximately the five-year average). The Project Team excluded the five-year high values from the range of pricing considered in this analysis based on feedback from private companies about local market pricing for recyclables from mixed waste, as summarized in Section 6 of this report.

Capital Costs

The table below shows the capital cost estimates for a mixed waste processing facility. More detailed capital and operating cost estimates are included in Appendix E.

Table 4-10
Mixed Waste Processing Capital Cost Estimates

Description	Cost Estimate
Site Work	$1,141,200
Mixed Waste Building	$13,296,000
Mixed Waste Equipment	$14,000,000
Mobile Equipment	$1,060,000
Other Project Costs [1]	$7,458,000
Total Capital Cost	$36,955,200

1 Includes contingency for construction and equipment, design and engineering, surveying, permitting, construction management, LEED Certification support, and owner's advisory services.

Financial Analysis Summary

The following table summarizes the annual costs for a mixed waste processing facility at different levels of throughput. The Project Team would note that the financial summary shown in this section applies to the facility as a whole. As previously discussed, this analysis assumes a public private partnership. The sharing of cost and revenue between a private entity and the City of Dallas are unknown and would be negotiated as part of a procurement process.

Table 4-11
Summary of Annual Mixed Waste Processing (MWP) Costs [1]

	Annual Throughput (Tons)			
	250,000	300,000	350,000	400,000
Capital Cost [2]				
Site Work	$91,573	$91,573	$91,573	$91,573
MWP Building	$1,066,905	$1,066,905	$1,066,905	$1,066,905
Other Project Costs	$ 598,449	$598,449	$598,449	$598,449
MWP Equipment	$1,813,064	$1,813,064	$1,813,064	$1,813,064
Mobile Equipment	$183,189	$183,189	$183,189	$183,189
Total Capital Cost	$3,753,181	$3,753,181	$3,753,181	$3,753,181
Operating Cost				
Labor	$5,255,000	$6,223,519	$7,192,192	$8,160,788
Building and Site Maintenance	$139,000	$139,000	$139,000	$139,000
Equipment Maintenance	$590,000	$629,444	$668,895	$708,343
Utilities	$246,000	$294,472	$342,952	$391,428
Rolling Stock Fuel	$204,000	$244,296	$284,599	$324,899
Consumables/Services	$48,000	$48,000	$48,000	$48,000
Baling Wire	$183,800	$220,560	$257,320	$294,080
Insurance	$72,000	$73,130	$74,259	$75,389
Contingency	$673,780	$787,242	$900,722	$1,014,193
Admin	$16,000	$16,000	$16,000	$16,000
Total MWP Operating Cost	$7,427,580	$8,675,663	$9,923,940	$11,172,120
Total MWP Cost	$11,180,761	$12,428,844	$13,677,120	$14,925,300
Total Cost Per Ton Processed	$44.72	$41.43	$39.08	$37.31

1. Minor arithmetic errors are due to rounding.
2. Amortized annual costs based on interest rate and depreciation periods described in Section 4.2.

As previously discussed in this section, a mixed waste processing facility would be most financially viable if it were located at the McCommas Bluff Landfill. In addition, unlike a single stream recycling facility, a mixed waste processing facility would be an integrated part of the overall landfill operation, since the majority of material processed at the facility would ultimately be disposed. Because of this, the Project Team conducted the financial analysis to show the costs and revenue associated with a mixed waste processing facility as part of the overall landfill revenue requirement. To do this analysis, the Project Team used the landfill financial analysis recently conducted for the City of Dallas. This analysis provided a detailed understanding of the current landfill revenue requirement as well as how the landfill costs would change if volumes being disposed were to decrease.

A mixed waste processing facility for the City would process primarily residential tonnage. However, the economics of mixed waste processing improve at higher tonnage levels. Therefore, the Project Team conducted a sensitivity analysis to show the financial impact if the City supplemented the mixed waste processing facility with commercial tonnage. In Table 4-12, all tonnage over the initial 250,000 tons per year are assumed to be commercial.[3]

Table 4-12
Summary of Landfill Revenue Requirement with Mixed Waste Processing (MWP) [1]
Assumes Blended Value of $130 per Ton

	Annual Throughput (Tons) to MWP			
	250,000 (Residential)	300,000 (Combination)	350,000 (Combination)	400,000 (Combination)
Landfill Revenue Requirement				
Salaries and Wages	$5,602,095	$5,553,036	$5,536,954	$5,519,494
Supplies and Materials	$2,817,213	$2,817,213	$2,817,213	$2,817,213
Other Services and Charges	$7,666,593	$7,603,254	$7,582,490	$7,559,948
Other Expenses	$1,756,980	$1,742,129	$1,737,261	$1,731,975
Total Revenue Requirement	$17,842,882	$17,715,633	$17,673,917	$17,628,630
MWP Costs Capital Cost				
Capital Cost	$3,753,181	$3,753,181	$3,753,181	$3,753,181
Operating Cost	$7,427,580	$8,675,663	$9,923,940	$11,172,120
Commodity Revenue	$(5,973,500)	$(7,339,800)	$(8,706,100)	$(10,072,400)
Total MWP Cost	$5,207,261	$5,089,044	$4,971,020	$4,852,900
Net Revenue Requirement	$23,050,143	$22,804,676	$22,644,938	$22,481,530
Per Ton	$16.40	$16.23	$16.11	$16.00
% Increase/(Decrease) in Revenue Requirement	29%	29%	28%	28%

1. Minor arithmetic errors are due to rounding.

As shown in the table, assuming commodity values of $130 per ton (the mid point in the range used for this analysis), a mixed waste processing facility would represent a net annual cost to the City of approximately $4.8 to $5.2 million, depending on throughput. This would have a negative impact on the annual landfill revenue requirement, increasing costs by 28 to 29 percent.

[3] This analysis assumes that the first 250,000 tons received at the mixed waste processing facility are residential. However, the analysis shown in Table 4-7 shows that if the City were to process 75,000 tons per year through its single stream program, the City would only have approximately 240,000 residential tons remaining that could be processed at a mixed waste processing facility. However, for the sake of simplicity, the Project Team assumed the first 250,000 tons of material are residential waste.

Table 4-13 shows how the overall landfill revenue requirement per ton would change at all levels of mixed waste processing throughput and commodity values. According to the analysis previously conducted by the Project Team, the current landfill revenue requirement is $12.86 per ton.

Table 4-13
Commodity Value and Tonnage Sensitivity Analysis
Net Revenue Requirement for Landfill with Mixed Waste Processing

Blended Value of Commodities	Annual Throughput (tons)			
	250,000	300,000	350,000	400,000
$100 per ton	$17.38	$17.43	$17.54	$17.65
$115 per ton	$16.89	$16.83	$16.83	$16.82
$130 per ton	$16.40	$16.23	$16.11	$16.00
$145 per ton	$15.91	$15.63	$15.40	$15.17
$160 per ton	$15.42	$15.02	$14.68	$14.34

As shown in the table, the addition of a mixed waste processing facility at the landfill would increase the landfill revenue requirement per ton at all tonnage levels within the range of estimated commodity values.

4.4.6 Mixed Waste Processing Key Findings and Recommendations

Following are the Project Team's key findings from analyzing the City's opportunity to develop a mixed waste processing facility.

- Development of a mixed waste processing facility large enough to handle the City's residential waste stream after source-separated recycling and with supplemental commercial waste (i.e., up to 400,000 tons per year) is not financially viable at this time since it would increase the per-ton landfill revenue requirement.
- If the City develops a single stream facility at the landfill, there could be an opportunity to utilize some of the infrastructure to process select, recyclable-rich, dry loads of mixed waste. These loads would likely be generated from commercial sources. As the City develops a procurement for single stream processing, the City should request that vendors state their willingness to use equipment to process select loads of mixed waste and what would be their approach to providing this service.

4.5 Potential Community Impacts

Both single stream and mixed waste facilities would have an impact on the community where the landfill is located. This section discusses the potential impacts of a resource recovery facility located at the landfill.

- Traffic: A mixed waste processing facility would have minimal impact on traffic in the surrounding community, as all of the trucks that would deliver material at the facility are currently delivering material to the landfill for disposal. There would be additional truck traffic associated with the delivery of recyclable materials to markets, but the increase would be very small. There would be an increase in vehicle traffic associated with single stream processing at the landfill, for delivery of material to the facility and for delivery of recyclables to markets. However, the Project Team would note that the landfill currently accepts over 1.4 million tons per year of waste. Single stream processing would add a maximum of 115,000 tons per year of material coming to the facility and 92,000 tons per year of material going to markets, which conservatively represents a potential overall tonnage increase of around 15 percent. The actual increase would likely be lower since some of the material could already be going to the landfill as waste, and loads of material going to markets would be sent via container truck loads and/or possibly rail. Therefore, it is unlikely that single stream processing would create a significant additional traffic burden.

- Nuisance: Both single stream and mixed waste would be conducted in an enclosed building with controls in place for dust suppression, noise control, and odor control.
- Emissions: The processing equipment for both facilities would be electrically powered and would not create additional emissions. The mobile equipment for each facility would create some diesel emissions, however, there would only be three pieces of mobile equipment for single stream operations and six pieces of mobile equipment for mixed waste processing operations.
- Employment: The facilities would create significant additional employment opportunities, with an increase in annual payroll of up to about $3.3 million for single stream processing and up to about $8.2 million for mixed waste processing (for the largest facility sizes, including benefits). The Project Team would expect that the City could target residents of the local community to fill these positions.
- LEED Silver: Both facilities would comply with LEED Silver, according to City requirements. As such, they would be facilities that the City could highlight to its residents.

4.6 Combined Single Stream and Mixed Waste Processing Facility

The Project Team conducted separate analyses of single stream and mixed waste processing to enable the City to understand the feasibility of each technology. However, if the City were to pursue the development of both technologies, there could be many benefits of integrating both technologies into a single facility. Some key benefits of a combined facility are listed below.

- The combined facility would allow sharing of the support facilities, such as administration, break areas, and locker rooms, as well as shared tipping and process material storage areas. The result would be a combined facility that might be up to 10 percent smaller than aggregate size of two separate facilities. This could amount to a building footprint reduction of 25,000 square feet which would represent a capital cost savings of approximately $2,000,000.

- The single stream recycling and mixed waste processing lines would be able to share some of the downstream sorting equipment such as optical sorters and screens which are common to both systems. This could amount to a capital cost savings of more than $1,000,000 in processing equipment.
- A facility that used combined downstream sorting technology would also likely have some reduction in staffing in the downstream portion of the sorting system compared to two stand-alone facilities. This would result in reduced operating costs.
- A combined facility would be a much larger enterprise which would attract more competition from private industry and likely result in more competitive pricing in a public private partnership approach.
- There will be some cost saving in the management oversight, administration and marketing labor with a combined facility.

Section 5
RESOURCE RECOVERY PARK EVALUATION

5.1 Overview

Resource Recovery Parks (RRPs) or Eco-Industrial Parks are typically a collection of environmentally-minded businesses, industries, and/or governmental agencies that form a synergistic relationship by collaborating to conserve natural resources. The waste and/or energy produced by one operation is used as feedstock by another.

RRPs typically co-locate activities such as reuse, recycling, composting, processing, manufacturing, and distribution of end products. They can be centers for drop-off of recyclable materials, including hard-to-recycle items such as mattresses, electronic waste, textiles, and C&D debris. The facilities that make up a RRP are usually located in industrial-zoned areas and often are developed on brownfield sites (i.e., abandoned commercial or industrial property that may be or may have been contaminated by a hazardous substance or pollutant). Some RRPs include an energy element such as landfill gas-to-energy (LFGTE), wind energy, and/or solar energy to provide electricity to the tenants of the RRP.

There is no prescribed model for a RRP; each is unique. However, some common objectives include:

- Use of waste from one industry to manufacture a new product for another industry;
- Centralization of materials drop-off, processing, reuse, and/or manufacturing;
- Diversion of waste from disposal; and
- Stimulation of economic growth, including job creation.

Landfills and transfer stations are often the base or the anchor of a RRP because they are typically the centers of waste generation. A RRP can make the landfill or transfer station more sustainable by diversifying revenue, conserving capacity, and extending the useful life of those facilities.

The Project Team has evaluated various RRP options for the City to consider for planning purposes. This section provides two case studies of successful RRPs and discusses issues to address when developing a RRP, including:

- Identify potential materials;
- Evaluate potential end markets;
- Potential facilities;
- Planning level capital and O&M costs;
- Overview of potential partners; and
- Next steps.

To better understand the RRP concept, the Project Team has provided two case studies of currently operating RRPs that are owned by public municipalities: the City of Edmonton in Alberta, Canada and the Monterey Regional Waste Management District in Marina, California.

5.2 Case Studies

The Project Team provided two detailed case studies of RRPs for the City's review. In addition, Appendix C includes limited information for additional RRPs identified by the Project Team.

5.2.1 City of Edmonton - Alberta, Canada

Overview

The City of Edmonton owns and operates the Edmonton Waste Management Centre (Centre). It is an integrated solid waste management system containing numerous programs and processes, all located on one site. The 576-acre site includes the following facilities:

- Landfills – Class II (with liner and leachate collection system) and III (containment of inert waste);
- Public recycling depot (drop-off);
- Single stream processing facility;
- Composting facility;
- Integrated mixed waste processing and transfer facility;
- Electronics recycling facility;
- Landfill gas recovery facility (4.8 megawatt facility produces enough electricity for 4,600 homes);
- C&D waste recycling;
- Biosolids composting;
- Paper and glass recycling facility;
- Hazardous waste facility;
- Research and development facility;
- Advanced energy research facility; and
- Waste-to-biofuels facility – will convert non-recyclable and non-compostable waste into biofuels.

Approximately 450,000 to 550,000 metric tonnes (496,000 – 606,270 U.S. tons) of waste is handled each year at the Centre (of which approximately 50 to 60 percent is generated by residents). The City's goal is to increase its landfill diversion rate from

60 percent to 90 percent through the following processes: 20 percent recycled, 40 percent composted, and 30 percent biofuels.

The Project Team provided details below for a few key processes and facilities at the Centre.

Single Stream Processing Facility

The City's single stream processing facility is 64,000 square feet and is designed to process 44,000 tons of commingled recyclable materials per year. The recyclables are collected commingled from both the public drop-off depots and in blue bags at the curb from residents. The facility is a public-private business partnership; the City retains ownership and Waste Management of Canada Inc. is responsible for operation of the facility.

Together with the Composting Facility, the City is able to divert up to 60 percent of residential waste from the landfill.

Composting Facility

The City's composting operation is located on 62 acres and includes a 400,000 square foot enclosed composting building and a 42-acre outdoor composting and curing area for aerated static piles and turned windrows. Since 2000, the City has been processing the organic waste collected from residential households, along with biosolids from the wastewater treatment plant. Additional feedstocks include: chipped wood waste, yard waste, commercial food waste, and horse bedding material.

The composting facility is owned by the City and operated with a combination of City staff and a private contractor.

Between 88,000 and 99,000 tons of material (not including biosolids) are diverted by composting on an annual basis while 55,000 to 66,000 tons of finished compost are produced. The finished compost is sold locally in bulk and in bags.

Integrated Processing & Transfer Facility

The Centre has an integrated processing and transfer facility (IPTF) that contains three systems: transfer station, pre-processing, and refuse derived fuel (RDF) production.

- Transfer station, operational in 2009. Commercial waste and residuals from the Composting and Recycling Facilities are deposited into semi-trailers for transport to Beaver Regional Waste Management Commission Landfill near Ryley, Alberta or the West Edmonton Landfill. Average daily throughput is estimated at 1,100 tons per day.
- Pre-processing of waste, operational in 2010 (mixed waste processing). Residential and suitable commercial MSW is pre-processed by sorting into three streams: organic materials for composting; metals, cardboard, and plastics for recycling; and non-recyclable, non-compostable waste for conversion into refuse-derived fuel. The sorting is done both manually and mechanically. The pre-processing capacity is up to 1,100 tons per day.

- RDF. A process in which non-recyclable and non-compostable waste is shredded, glass, stones, and inert materials are screened out (and used as roadway aggregate), the metals are removed, the waste is screened again and converted to RDF. The RDF will be converted to methanol and ethanol at the planned Biofuels Facility. The RDF operation will produce up to 440 tons of RDF per day; approximately 110,000 tons per year.

Waste-to-Biofuels Facility (Gasification)

The Waste-to-Biofuels Facility is currently being constructed and will be owned and operated by Enerkem Alberta Biofuels. It will convert 110,000 tons of MSW (in the form of RDF) into 38 million litres (over 10 million gallons) of biofuels annually via gasification.

C&D Waste Recycling

The C&D materials recycling facility began operations in January 2012. The facility accepts mixed loads, but approximately 80 percent of the load must contain typical C&D materials.

The facility uses both mechanical and manual sorting to separate the loads into various commodities. The facility is sized to process 110,000 tons of mixed C&D waste per year and is expected to recover up to 70 percent of the material for recycling.

Paper and Glass Recycling Facility

Another facility located at the Centre is a paper and glass recycling facility owned and operated by Grey's Paper Recycling Industries, Ltd. (Grey's Paper). Grey's Paper combines recycled waste paper with cotton fiber to create high-quality recycled paper products. In addition to the paper processed by the City's MRF, Grey's Paper receives waste paper from other local businesses and uses old cotton fabric collected from hotels and from the clothing and linens collected at 14 recycling depots in Edmonton.

The paper-making process utilizes a technology from India that uses no chemicals and only a fraction of the water of traditional paper mills, so there are no emissions or pollution. The plant is a partnership between the City and Grey's Paper; the City contributed $5 million for the construction of the facility and also receives a share of the profits.

In addition to paper manufacturing, Grey's Paper is developing a process to manufacture pavement blocks from waste glass and other waste products using a mechanized molding method. The composition of the blocks will be 30 percent waste glass, 20 percent recycled aggregates, 20 percent fly ash and 30 percent cement.

Financial Information

The city's waste management programs are financed through a combination of property taxes (31 percent), user fees (56 percent) and revenues (13 percent).

The gross operating budget in 2012 was $49.5 million (up 63 percent from 2008). The revenue budget in 2012 was $20.2 million (up 14 percent from 2008).

Net expense per metric tonne of material received was $25 in 2008 and approximately $65 in 2012.

5.2.2 Monterey Regional Waste Management District – Marina, California

Overview

The Monterey Regional Waste Management District (District) serves approximately 170,000 people in the region south of San Francisco. The District operates a Regional Environmental Park in Marina, California. The site is 470 acres and includes the 315-acre Monterey Peninsula Landfill. The landfill is permitted to accept 3,500 tons per day (TPD) and currently receives less than 1,000 TPD (approximately 300,000 tons per year). In addition to the landfill, the site also includes:

- Public drop-off recycling station (for paper, glass, plastic, and metal);
- Last Chance Mercantile resale facility;
- Material recovery facility (MRF);
- LFGTE plant;
- Permanent HHW collection facility;
- C&D recycling operation;
- Composting facilities for green waste and food scraps;
- Anaerobic Digestion Compost Pilot project;
- Soils blending facility; and
- Administration building, scale house, maintenance buildings.

Some of the more unique aspects of the Park are detailed below.

Last Chance Mercantile

The District constructed the 8,000 square foot building and two-acre paved storage yard in 1996. The warehouse-like reuse store contains household goods for resale including furniture, clothing, books, etc. An outdoor storage yard includes building material such as windows, doors, cabinets, sinks, toilets, and used lumber. Items are either donated or salvaged from the single stream recycling facility tipping floor. Landscaping supplies such as soil, mulch, and wood chips (processed from recycled wood and yard waste) are also for sale by the bag at the Last Chance Mercantile or by the ton at the MRF. Reusable paint, cleaners, and pesticides from the HHW facility are made available at the reuse store free of charge.

Materials Recovery Facility

The District has a MRF on-site that processes dry commercial waste (primarily C&D debris) and self-haul recyclable/recoverable materials (not curbside recyclables).[1] More than 50 percent of the incoming waste is recycled or reused. The following materials are processed at the MRF:

- C&D debris;
- Green waste;
- Clean wood waste;
- Mattresses;
- Appliances; and
- Tires.

The MRF's original construction was completed in 1996. The District is now planning a $17 million improvement project for the MRF to add new capacity and the ability to process mixed commercial and multi-family dwelling waste.

LFGTE Plant

Built in 1983, the LFGTE plant has four generators that produce 5,000 kilowatts of electricity, meeting all of the District's power needs for its site operations. The surplus provides electricity to more than 4,000 homes. Annual revenue is approximately $3 million from the sale of electricity to Pacific Gas & Electric Company. The District is registered with the Climate Action Reserve and sells its carbon offset credits.

HHW Collection Facility

On an annual basis, over 8,000 residents and small businesses drop off more than one million pounds of HHW for processing, disposal, reuse, and recycling.

Approximately 60 percent of the incoming HHW is reused or recycled. Household products such as latex and oil-based paint, stains, varnish, cleaners, waxes, and adhesives that are still usable and still in their original containers, are available free of charge at the Last Chance Mercantile to members of the community.

Used electronics, batteries, and fluorescent bulbs are sent to recycling facilities for processing.

C&D

The District contracts with a private company to process the C&D materials received on site. The District uses some of the crushed material on site for roads and other projects. The company uses most of the C&D material it processes in area construction projects. The company provides the District with a royalty of 50 cents

[1] Garbage trucks hauling residential garbage and wet commercial waste go directly to the landfill.

for every ton processed. They also process contaminated soils, paying the District a royalty of $1.50 for every ton they process at the site.

Green Waste & Food Scrap Composting

The District leases part of its site to several local composting companies for a nominal fee. As part of their contracts, the District requires them to use the organics processed on site at the MRF as feedstock for their products. The District sells the finished compost made from the yard waste at the Last Chance Mercantile reuse store.

Anaerobic Digestion Compost Pilot Project

The District has partnered with Zero Waste Energy (ZWE) on the installation of a 5,000 ton per year "SmartFerm" anaerobic digester on the RRP site. ZWE is a company that designs, builds, and operates facilities throughout the country that transform organic waste into energy through an anaerobic digestion process. The feedstock for the digesters will be a blend of food scraps and yard waste.

For this pilot project, the District's Board approved an agreement with ZWE to install a SmartFerm system at the District site under a five-year demonstration program. ZWE is providing the system at no charge to the District. ZWE will receive the tipping fee revenue for food waste and yard waste processed at the facility along with the revenues on the electrical power sales to the adjacent wastewater treatment plant.

Financial Information

From the District's 2012 Annual Report, a summary of income and expenditures for fiscal year 2011-2012 are provided in Table 5-1.

Table 5-1
Monterey Regional Waste Management District
Financial Information FY2011-12

Income - Source of Funds	FY 2011-12
Disposal Fees	$14,323,000
Material Sales	$2,006,000
Landfill Gas Power	$2,789,000
Other Revenue(1)	$363,000
Total Income	$19,481,000
Expenditures - Use of Funds	
Operating Expenses(2)	$16,706,000
Acquisition of Fixed Assets	$2,078,000
Debt Reduction (Principal)	$1,783,000
Total Expenditures	$20,567,000

(1) Income from investment earnings, rents/leases, operational services, HHW fees, and finance charges.

(2) Non-cash expenses such as amortization/depreciation and closure/post closure expenses are not included.

5.3 Identify Potential Materials

Based on the Waste Composition Analysis conducted by the Project Team in June 2013, the materials listed in Table 5-2 comprise the largest percentage of the municipal solid waste stream disposed at the McCommas Bluff Landfill by weight. The municipal solid waste stream includes aggregated residential and commercial waste and does not include self-hauled waste or dedicated loads of construction and demolition debris, bulky waste, or yard trimmings. Not all of these materials are recyclable, however some may be recoverable for reuse or for feedstock for an industry.

Table 5-2
Top Ten Waste Composition Material Categories
at McCommas Bluff Landfill and Potential Recovery Processes

	Material	Mean %	Potential Recovery Process/Facility
1.	Food Waste	15.2%	Compost/AD
2.	Recyclable Old Corrugated Cardboard (OCC)	9.2%	Mixed Waste Processing Facility
3.	Non-Recyclable Paper	8.8%	Compost/AD
4.	Clean/Unpainted C&D Wood	6.3%	C&D MRF
5.	Plastic Bags and Film Wrap	5.2%	Mixed Waste Processing Facility
6.	Textiles	4.9%	Mixed Waste Processing Facility/Reuse Store
7.	Other Plastic	4.8%	None
8.	Yard Waste	4.5%	Compost/AD
9.	Bulky Waste	3.2%	Reuse Store
10.	Treated/Painted C&D Wood	2.9%	None

5.4 Evaluate Potential End Markets

Potential end markets were evaluated for the most prevalent materials in the MSW stream, as listed in Table 5-2.

5.4.1 Organics: Food Waste and Yard Waste

Food waste made up the largest portion of the City’s MSW stream, not only in the aggregate, but also for the individual generator sectors – residential and commercial waste. As curbside recycling programs mature and more materials are diverted from the waste stream, food waste comprises a larger percentage of the remaining waste stream. Many municipalities are now focusing their diversion efforts on organics. When organic materials such as food and yard waste are combined in the correct proportions under proper design conditions, they can be composted to create a rich soil amendment. Organics composting operations can be aerobic or anaerobic (with oxygen or without oxygen, respectively) and may incorporate other organic streams such as biosolids. The City has dedicated 100 acres of land at the landfill for future composting operations and has completed the permitting process for that land.

Most organics recycling/composting programs rely on the generator (the resident or the business) to separate the organic material from the other waste in preparation for collection. However, more organics recovery operations are being developed each year in which organics are removed from the waste stream at the final waste disposal site. An example of this is the City of Edmonton's Waste Management Centre, discussed previously in this section. The City of Edmonton separates organics from MSW, composts the organic material, and sells the finished product to farmers, landscapers, nurseries, and oilfield reclamation companies.

Depending on the quantity and quality of organic material available for composting, some municipalities sell finished compost (either in bulk or bagged) while others give it away or use it internally for public works and parks projects. The market price for finished compost varies by region, but averages between $2 to $5 per bag depending on the blend, and $20 to $30 per cubic yard when sold in bulk.

5.4.2 Recyclable Old Corrugated Cardboard (OCC)

OCC is likely the easiest material to divert from the MSW stream and the most marketable. Processing recyclable OCC to prepare it for market would require separating it from the MSW via a sort line, typically within a MRF, and baling it in preparation for transport.

The primary market for recovered cardboard is reutilization in cardboard and paperboard packaging. The market for OCC is well established within the Dallas-Fort Worth Metroplex. The average monthly price for OCC in 2013 (January through August) was between $100 and $109 per ton[2] for the Southwest region, with minimal variation on a monthly basis.

The price for OCC (and all recyclable materials) fluctuates based on supply and demand. For example, OCC market prices declined nationwide during the economic downturn of 2008-2009. Table 5-3 shows the 12-month average low and average high price per ton for OCC for the past six years, as well as the range showing the lowest and the highest published market prices for each year.

[2] Source: Pulp & Paper Week, Southwest Region.

Table 5-3
OCC Published Market Price per Baled Ton[1]

Year	Average Low	Average High	Range
2012	$93	$100	$55 - $130
2011	$132	$142	$90 - $170
2010	$129	$139	$105 – $180
2009	$54	$59	$20 – $85
2008	$90	$99	$20 - $125
2007	$95	$103	$55 – $120

1. Source: Official Board Markets (OBM)/Pulp & Paper Week, Southwest Region. In October 2012 the OBM merged with Pulp & Paper Week. Paper pricing from 2007 through September 2012 was published by OBM. Paper pricing from October 2012 to the present is published by Pulp & Paper Week.

Although the price for OCC varies based on market conditions, the Project Team would expect that the City would be able to generate revenue from the sale of baled OCC, based on the quantities determined to be in the waste stream.

5.4.3 Non-Recyclable Paper

Typically there are no end-markets for non-recyclable paper (e.g., soiled napkins, paper towels, frozen food packaging, etc.); however, this material category is often used as feedstock in organics composting or anaerobic digestion operations.

Removing non-recyclable paper from the waste stream would require hand separating it from the MSW via a sort line. This material can be wet and heavy so transportation should be avoided to minimize cost.

5.4.4 Clean/Unpainted C&D Wood

Clean/unpainted C&D wood includes dimensional lumber, wooden crates and pallets uncontaminated by paint, stain, or preservative treatment. Generally, the markets for recovered wood include use as a component of engineered woods, landscape mulch, animal bedding, compost additive, and boiler fuel.

While 6.3 percent of the residential and commercial MSW stream contained clean/unpainted wood, larger quantities of this material are brought to the landfill in dedicated C&D loads or self-haul loads.

Removing clean/unpainted C&D wood from the waste stream would require hand separating it from the MSW via a C&D sort line (see Section 5.6.3 - C&D Debris MRF).

Wood that is salvageable such as dimensional lumber or pallets could be sold at a reuse store. Wood that is not salvageable could be processed using a horizontal-bed grinder equipped with a screen and screened into various sizes to be used as landscape mulch, animal bedding, or a compost bulking agent. Markets for these end products vary depending on other available materials located in the region. In 2009, members of the Project Team conducted a market analysis for the North Texas Municipal Water District (NTMWD) and determined there may be market outlets for these materials. Should the City choose to separate and process clean/unpainted C&D wood, a localized market analysis should be conducted to determine the best end use for the ground wood.

5.4.5 Plastic Bags & Film Wrap

While plastic bags and film wrap are lightweight, these materials make up over five percent of the overall waste stream, by weight, disposed at the landfill based on the recent waste characterization analysis. There is a limited market for this type of plastic, and there are additional benefits to diverting plastic film from disposal including a reduction in the amount of errant plastic bags that create litter at the landfill and a potential reduction in mechanical problems caused when plastic film gets tangled in landfill machinery.

Removing plastic bags and film wrap from the waste stream would require separating it from the MSW via a sort line using manual separation and/or vacuum systems. The film plastic could then be baled and marketed.

As with all recyclable materials, the price for plastic film fluctuates based on supply and demand. Further research would need to be conducted to determine if markets exist in the region for plastic film that may be contaminated from the MSW. [3]

5.4.6 Textiles

Textiles make up five percent of municipal solid waste disposed at the landfill. There are markets for textiles; however, most require that the material be clean and free from contamination.

The City currently promotes a shoe recycling program in partnership with the Dallas-based World Wear Project in which shoes are collected at over 70 locations throughout Dallas. The shoes are repaired, sorted, and shipped to third world countries. The World Wear Project also collects used clothing and textiles for recycling and repurposing as do many other companies and organizations[4] in the Dallas region.

If the City were to construct a MRF at the landfill site, further research could be done to determine if markets exist in the region for textiles that may be contaminated from the MSW. If the City were to develop a reuse store as part of a RRP, then used, clean textiles could be accepted as donations from the public for reuse/resale.

[3] It should be noted that the market prices for film plastic (as well as other recyclable materials that are exported to China) may be adversely affected by China's "Operation Green Fence." In February 2013, China implemented higher standards on imports of recyclable material to prevent shipments that were heavily contaminated with solid waste. The tighter restrictions have resulted in shipments being returned and many commodity brokers looking for domestic markets.

[4] Source: Earth 911: http://search.earth911.com/?what=Clothing&where=dallas,%20tx

5.4.7 Other Plastic

Other plastic makes up 4.8 percent of municipal solid waste disposed at the landfill. For the waste composition study, the Other Plastic category was defined as "all non-container rigid plastics such as plastic pipe, plastic casings, plastic hangers, toys, plant pots." This category does not include recyclable plastics such as polyethylene (PET), high density polyethylene (HDPE), containers labeled #3-#7, or plastic film, nor does it include expanded polystyrene (i.e., Styrofoam™).

There are very few, if any, markets for scrap plastic. If the City were to construct a MRF at the landfill site, then further research could be done to determine if local markets exist for scrap plastic that may be contaminated from the MSW. It is possible that there may be a company or an industry interested in a particular type of scrap plastic to be used as a feedstock for the manufacture of a new product.

5.4.8 Bulky Waste

Bulky waste makes up approximately 3.2 percent of municipal solid waste disposed at the landfill and includes large items such as furniture, appliances, and mattresses.

There are a few mattress recycling programs in the United States[5] in which used mattresses and box springs are disassembled and materials such as steel, cotton, foam, and wood are reclaimed and recycled. One of the case studies highlighted in this section, the Monterey Regional Waste Management District, recycles mattresses at its Regional Environmental Park. The Project Team did not identify any mattress recycling programs in the Dallas area, so there may be an opportunity for the City to explore mattress recycling as part of a RRP operation. The City should be able to separate mattresses from the MSW disposed at the landfill because they can easily be identified. In addition, the City's Sanitation Services Department collects mattresses and box springs as part of the once-a-month collection of bulky waste from residents at the curb. Furniture, appliances, mattresses, and box springs are accepted, however they are commingled with large tree limbs, shrubbery, bagged leaves.

If the City were to develop a reuse store as part of a RRP, then used, clean furniture could be accepted as donations from the public for reuse/resale.

5.4.9 Treated/Painted C&D Wood

For the waste composition study, treated/painted C&D wood was defined as "Any wood with paint, stain or preservative treatment. Also includes plywood, particleboard, chipboard, and Masonite due to their resin content." While this material rounded out the top ten of material categories that make up the overall all MSW disposed at the landfill, at 2.8 percent, there are few, if any, markets for this type of material because of the hazards associated with the paint and other treatments. For example, treated wood should never be chipped or processed through a grinder

[5] Examples of mattress recycling programs include: Duluth, MN and King County, WA:
http://www.goodwillduluth.org/wordpress/recycling/mattress-recycling-program/
http://your.kingcounty.gov/solidwaste/wdidw/detail.asp?ID=775

because the chemicals can become airborne. Mulch or compost consisting of treated wood can leach out heavy metals that can potentially pollute surface water and groundwater. In addition, treated wood should not be burned as it creates an air pollution problem. The proper disposal practice for treated wood is to dispose in a lined, permitted landfill.

If the City were to develop a reuse store as part of a RRP, then treated or painted wood furniture and salvageable pieces of plywood, particleboard and Masonite™ may be diverted for reuse or resale.

5.4.10 Additional Materials

In addition to the materials listed above, other materials recycled at existing RRPs include:

- C&D debris (concrete, asphalt, drywall, shingles, as well as wood);
- Appliances;
- Carpeting;
- Tires;
- Books/textbooks;
- Fats, Oils, and Greases (FOGs);
- Electronics; and
- HHW.

The City currently has collection/recycling programs in place for some of these materials (e.g., appliances, tires, FOGs, and electronic waste) but could expand on them with the addition of a RRP.

5.5 Potential Facilities

Based on the potential recoverable materials and end markets discussed in Sections 5.3 and 5.4 respectively, the City may consider the following types of facilities for inclusion in a potential RRP.

- Mixed Waste Processing Facility;
- Composting/Anaerobic Digestion Facility;
- C&D MRF;
- Reuse Store; and/or
- HHW Satellite Collection Facility.

The Project Team would note that household hazardous waste was not one of the top 10 materials identified in the City's waste stream by the Waste Composition Study. However, the City may consider including an HHW Satellite Collection Facility in a potential RRP due to the following: the hazardous nature of HHW materials, the potential to partner with an existing program, and the relatively low capital cost associated with the development of a satellite facility.

5.5.1 Mixed Waste Processing Facility

A mixed waste processing facility would allow for recyclable and recoverable material to be removed (mechanically and by hand) from the MSW stream. The mixed waste processing technology is discussed in detail in Section 2 of this report.

5.5.2 Composting or Anaerobic Digestion Facility

Organic materials such as yard waste and food waste, along with non-recyclable paper, could be diverted from the waste stream and processed through composting and/or anaerobic digestion. Because the City has studied composting and has completed the permitting process for 100 acres of land at the landfill for future composting operations, that type of processing facility will not be discussed in this report. The anaerobic digestion technology is discussed in detail in Section 2 of this report.

5.5.3 C&D Debris MRF

One option for the City to consider as part of a RRP is the development of a C&D MRF. In recent years, members of the Project Team have conducted two C&D MRF-related studies: 1) a C&D MRF Siting Study for the NTMWD in 2009 and 2) a C&D MRF Feasibility Study for the North Central Texas Council of Governments (NCTCOG) in 2007. Both of these studies address the feasibility of a C&D MRF in the Dallas-Fort Worth Metroplex.

A C&D MRF processes mixed C&D debris from construction, demolition, and renovation projects. The most valuable products recovered from C&D loads include wood, metal, concrete, and cardboard. Other C&D materials have less value, but as processes and products develop, more materials will have market value.

While some of the by-products of a C&D MRF are not considered valuable in the marketplace, there may be customers willing to accept the material at no cost, including the landfill. For example, much of the screened residuals may be used at the landfill for use as alternative daily cover or road stabilization.

In addition, there are emerging recycling markets for certain materials, including the following.

- Drywall/Gypsum: Clean (free from paint or wallpaper) drywall can be ground and used as a soil amendment, although this practice may be limited in the Dallas-Fort Worth Metroplex. If the City were to develop a reuse store as part of a RRP, clean drywall could be diverted for reuse or resale.
- Shingles: Asphalt shingles can be included in the manufacturing process for hot mix asphalt, aggregate road base, dust control on rural roads, and fuel. The Texas Department of Transportation allows recycled asphalt shingles to be used in hot mix asphalt and has specifications providing the technical requirements for their

use. The Project Team identified two shingle recycling companies located in Dallas that may be interested in obtaining recovered shingles if the City were able to divert the shingles from the MSW stream.[6]

5.5.4 Reuse Store

A reuse store, similar to the District's Last Chance Mercantile detailed in Section 5.1.1 of this report, would provide the City with an outlet to divert reusable material from disposal in the landfill.

The reuse store would offer for resale household goods including furniture, clothing, and books, as well as building material such as windows, doors, cabinets, sinks, toilets, and used lumber.

Options for the reuse store facility would depend on the City's overall RRP plan and could include the following activities:

- Accepting donations of household items from the public and making items available for resale;
- Recovering usable items from the waste stream in a mixed waste processing facility and making items available for resale;
- Selling bulk or bagged finished compost from a composting operation is sold in bulk or in bags;
- Wood chips and/or mulch from a clean wood processing operation is sold in bulk or in bags; and/or
- Reusable paint, cleaners, and pesticides from an HHW satellite collection facility are made available to residents free of charge.

5.5.5 HHW Satellite Collection Facility

Satellite HHW collection facilities are drop-off locations designed to support a permanent HHW collection and processing facility. HHW materials are regularly collected from the satellite sites and transported to the permanent facility where materials are sorted, bulked and lab packed for recycling or disposal.

Currently, Dallas County oversees the HHW collection program and operates a Home Chemical Collection Center in northeast Dallas. With the development of a RRP, it may be feasible for the City and County to collaborate on creating an HHW satellite collection facility in which HHW materials would be collected and/or consolidated at the RRP and then transported to the County's main facility for processing and packaging in preparation for final disposal/recycling.

A satellite facility could consist of a permanent structure with an enclosed office with utilities, as well as a hazardous materials storage unit. Most satellite HHW facilities accept the same materials that are collected at the main HHW collection facility.

[6] These companies are Sustainable Pavement Technologies and Southwest Shingle Recycling.

Another HHW option is the development of a program that only collects four material types: batteries, oil, paint, and antifreeze (BOPA). Most BOPA programs transport the collected materials to a main HHW collection facility for processing. However, it may be possible for the City to find end users/recyclers for the antifreeze, batteries, and used motor oil and only transport the paint to the County's permanent facility.

An HHW satellite collection facility paired with a reuse store would offer convenient drop-off services to City residents.

5.6 Planning Level Capital and Operations & Maintenance (O&M) Costs for a RRP

The Project Team has provided planning level capital and O&M costs for various components of a potential RRP below.

5.6.1 Mixed Waste Processing Facility

Planning level estimates for a mixed waste processing facility are provided in Section 4 of this report.

5.6.2 Composting or Anaerobic Digestion Facility

The City has studied the composting operation option and has completed its own cost estimates for this type of facility. As discussed in Section 3 of this report, the City and Project Team elected to not develop detailed capital and operating cost estimates for anaerobic digestion.

5.6.3 C&D Debris MRF

In 2009, members of the Project Team completed a C&D MRF Facility Siting Study for the NTMWD which included planning level cost estimates. Even though the cost estimates were developed for the NTMWD region, they are applicable for other municipalities and are provided here for reference.

The estimated capital expenditures for a C&D MRF range from $10 - $12 million and include the following:

- Building and site construction - $7 to $8 million;
- Processing equipment - $2 to $2.5 million; and
- Rolling stock - $1 to $1.5 million.

O&M costs are estimated to be between $1.7 and $2.1 million, including:

- Personnel - $1.3 to $1.5 million;
- Rolling stock O&M - $175,000 to $250,000;
- Processing equipment O&M - $80,000 to $90,000; and

- Other operating expenses (utilities, fuel, supplies, training, etc.) - $225,000 to $260,000.

The conceptual facility was sized to process 135,000 tons of C&D debris (including residuals) and increasing to 160,000 tons over ten years. Other assumptions include a debt issuance of 20 years for the facility/site development and a 5.0 percent interest rate on debt. Sales tax was excluded.

5.6.4 Reuse Store

The District's Last Chance Mercantile reuse store was constructed in 1996 for approximately $739,000 and included the 8,000 square-foot building and a paved 2-acre yard. The adjusted cost for 2013[7] is $1,100,000. The Project Team expects that the inflation-adjusted cost is representative of typical cost for a reuse store.

In FY2012, the revenue generated from the Last Chance Mercantile was $945,000 and the expenses totaled $1,052,000.

5.6.5 HHW Satellite Collection Facility

Based on work completed for other solid waste clients, the Project Team would expect that the cost to develop a HHW Satellite Collection Facility would be between $500,000 and $1 million, including items such as:

- Site preparation and utilities;
- HHW building; and
- HHW storage facility.

Operation and maintenance costs for HHW collection facilities vary widely based on the following factors:

- Hours of operation;
- Staffing levels;
- Quantity of materials collected; and
- Processing costs for materials collected.

5.7 Overview of Potential Partners

5.7.1 Public/Private or Public/Public Partnerships

Most RRPs include public/private partnerships. Typically, such partnerships utilize the financing advantages of the public sector entity (i.e., lower cost of capital) and the operational expertise of the private sector. Both RRPs described in the case studies contract with private companies. For example, the District has contracts with private

[7] Source: The Bureau of Labor Statistics CPI Inflation Calculator. http://www.bls.gov/data/inflation_calculator.htm

companies to provide composting and C&D recycling services at its Regional Environmental Park. The City of Edmonton owns its own MRF and contracts with Waste Management to operate it and has several facilities on-site that are owned and operated by private firms (e.g., biofuels and paper/glass recycling facilities).

The HHW satellite collection facility option provides a public/public partnership opportunity between the City and Dallas County, should the County wish to expand its current HHW collection opportunities.

5.7.2 Colleges and Universities

Many RRPs partner with local colleges and universities. For example, the Catawba County, NC EcoComplex partnered with Appalachian State University and added a $3.2 million Biodiesel Facility to their site. The funding for the facility came from the university, the U.S. Department of Energy, as well as other foundations and grants. Another example is Rutgers University in New Jersey which has a partnership with the Burlington County Landfill to use its landfill gas to operate a research greenhouse. More information on these examples and other university partnerships can be found in the list of RRPs in Appendix C.

The City may want to reach out to local colleges and universities to offer partnership opportunities at a RRP for research projects and/or the design and construction of a specific facility. In the 1990's, the City originally planned to partner with Texas A&M University Engineering Extension Service, Paul Quinn College, and the Dallas County Community College District on the Floral Farms neighborhood brownfield project which eventually led to the construction of the City's Eco-Park Building.

Additional options exist for the City to potentially partner with either private companies or universities interested in researching solar and wind energy that could be created at the landfill site.

5.8 Next Steps

The landfill already has in place several key elements of a RRP, including:

- E-waste collection site. The City has a drop-off collection site for televisions and computers located at the Customer Convenience Recycling Center at the landfill.
- Eco-Park Building. Located approximately one mile north of the landfill, this facility is used for educational programs, training, and meetings.
- Composting. The City has dedicated land for a future composting operation.
- LFGTE plant. Although the landfill gas is committed for use by Dallas Clean Energy and cannot be used to directly power buildings in the potential RRP, it is providing an environmental benefit just by being captured instead of being released into the atmosphere. The recovered gas is processed and delivered into gas pipelines and is used to power homes in place of conventional natural gas.

RRPs are typically built in phases over time. The City has an opportunity to re-brand and dedicate the existing landfill site as a RRP and phase-in different programs and facilities over time. The planning approach should be flexible to allow time to build partnerships, secure funding, etc. Next steps for the City to consider include:

- Establish goals/objectives of building a RRP (i.e., waste diversion, economic development);
- Form a Stakeholder Group to discuss the options for potential facilities to be included in a RRP;
- Evaluate additional facilities to be incorporated into an RRP; and
- Develop a detailed funding plan for future implementation.

The Project Team would note that, while the landfill may be the obvious choice for the location of a RRP, other options may exist, including industrial areas and brownfield sites. The City offers financial incentives in the form of Tax Increment Financing Districts (TIFs) and Public Improvement Districts (PIDs). The goal of the TIFs is to stimulate new private investment and thereby increase real estate values.[8] A PID is a special assessment area created at the request of the property owners in the district. These owners pay a supplemental assessment on property within the PID boundaries for the purpose of improving services and infrastructure. The City could consider establishing a TIF or PID in the area around the landfill in an effort to stimulate private investment and promote economic development.

In evaluating the potential additional facilities identified in this section, the City should use the results of this Study to determine whether the more complicated technologies (mixed waste processing and AD) should be implemented as part of the RRP. Once the City has developed an implementation plan for the primary waste processing technologies that will be used in the future, the City will be able to make a strategic and informed decision about what facilities would complement their primary resource recovery approach.

[8] The landfill is not located in a TIF district.

Section 6
INDUSTRY SURVEY ON PROCUREMENT AND PUBLIC-PRIVATE PARTNERSHIP OPTIONS

6.1 Introduction

As described in Section 4, the Project Team recommended that the City develop an RFP for single stream processing that would allow the City to directly compare a PSA to the development of a public-private partnership. To gain an understanding of the types of public-private partnerships that could be mutually beneficial and that would be of most interest from a private perspective, the Project Team conducted interviews with representative private recycling companies. The interviews were intended to gauge the overall level of interest of the recycling industry for the various options that the City will consider. In addition, the interviews were used to help inform the City about potential trends in the recycling industry, as might be applicable to the City.

The methodology of the interview process and the findings are described below. The interviews were conducted by the Project Team on a confidential basis, and the findings have been aggregated to represent the overall input of the industry.

6.2 Interview Methodology

The Project Team identified nine private recycling companies to participate in the interview process. These companies are:

- Balcones Resources;
- Community Waste Disposal;
- Organic Energy Corporation;
- Pratt Industries;
- Progressive Waste Solutions;
- ReCommunity;
- Republic Services;
- Texas Disposal Systems; and
- Waste Management.

These nine companies were identified as being representative of the recycling industry in the Dallas and Texas market. They represent both large and small companies, providing services locally, regionally, and/or nationally. Identification of these companies for the interview process is separate from any future procurement that the City may conduct. These companies have not been pre-qualified for a future procurement and would not be given any advantages in such a procurement because of their participation in the interview process.

The Project Team coordinated with and interviewed all nine of the recycling companies in April and May 2014. The Project Team issued a memorandum to the companies in advance of the interviews, providing an introduction to the City's planning process and an overview of the procurement and public-private partnership options that are common in the recycling industry and of potential interest to the City. The memorandum included a list of questions to guide the interview process and provide consistency in the topics discussed with each of the companies. A copy of this memorandum is provided in Appendix F.

The Project Team conducted the interviews by telephone. As agreed by the City and the companies, the responses from individual companies are confidential. City staff did not participate in the interviews, and individual responses are not disclosed in this report. All results have been aggregated for purpose of understanding the interest and opinions of the industry as a whole.

6.3 Key Findings from Interviews

Based on discussions with the recycling companies during the interviews, there is a strong interest from the private sector in providing recycling processing services to the City, either under a PSA or in a public-private partnership with the City. In fact, all companies interviewed by the Project Team expressed interest in the opportunity.

Aggregated findings from the interviews are summarized below, presented in topic areas corresponding with the interview questions that were discussed with the companies.

6.3.1 Private Sector Interest

There is strong interest from the private sector in providing recycling processing services to the City. The industry understands that a future procurement by the City could have multiple proposal options, since the City is amenable to either a PSA for an existing or new private processing facility, or a public-private partnership for a new facility at the McCommas Bluff Landfill. The industry is accustomed to procurements that have multiple options and generally expects this approach for municipal applications.

Private sector concerns associated with a multi-option procurement process include the possibility that the options would become too expansive, making it difficult to prepare focused proposals. The companies reported that they invest a lot of time and money in preparing proposals, particularly for one that is associated with a public-private partnership for development of a new facility. While multiple options are reasonable and expected, they would generally like to see City preferences clearly stated, with options limited to those preferences. The companies would want to be able to have the flexibility to propose on just the option(s) that were suitable for their circumstances, as not all options may be suitable for all companies. Finally, the companies expressed concern that adequate time be allowed for preparing proposals, accounting for the number and type of options included and the level of detail required.

6.3.2 Preferred Approach to Providing Processing Services

As noted above, processing services could be provided under a new PSA at an existing or new private facility, or at a new facility located on City-owned land at the McCommas Bluff Landfill (public-private partnership). Based on the interviews, a City procurement including all of these options could potentially result in one or more proposals for each option. The preferred approach is unique to each company and its specific circumstances, and would ultimately depend on the terms and conditions that would be negotiated with the City.

Existing recycling processing infrastructure is limited in the Dallas area. The companies that have existing facilities would consider using the existing capacity, with expansion if needed through installation of additional equipment or changes in operating schedules. Companies that do not have existing capacity within reasonable proximity to the City expressed interest in a new private facility, but not necessarily a commitment to this option as a preferred approach. Nearly all of the companies expressed interest in a public-private partnership for a new facility at the landfill, or at least a willingness to consider this option. The benefits of a public-private partnership for a facility at the landfill compared to a new private facility located elsewhere would need to be assessed by the companies during the procurement process. Several of the companies that were familiar with the landfill indicated it was a potentially good location.

6.3.3 Preferred Public-Private Partnership Scenario

Industry comments regarding optimal or preferred public-private partnership scenarios for a facility at the landfill were generally conditioned as being dependent on contractual obligations and liabilities that may be imposed by the City, with a willingness to consider various options. Scenarios discussed included ownership options for the site and the building; ownership options for the equipment; and the term of the contract. Some companies also discussed other project elements that would be preferred or otherwise instrumental in overall project success. Based on the interviews, general findings are listed below.

- Most companies expressed the ability and willingness to privately finance a facility with no ownership stake by the City, but would welcome City investment to improve project economics. Many companies commented that with City ownership, the private company should be allowed input to the design of the building and the equipment to ensure maximum functionality of the facility.
- Most companies expressed an interest in private ownership of the equipment, since they would be responsible for operating and maintaining the equipment and would have contractual performance obligations. A particular benefit that was noted for private ownership of equipment was increased flexibility to make changes as technology evolves. Private ownership of the equipment would require contractual consideration of the disposition of the equipment at the termination of the contract; for example, providing the company the right to remove the equipment. Despite the majority preference for private ownership of the equipment, several companies suggested that with good contractual arrangements, successful operations could be built around public ownership of equipment.
- One company suggested that the City consider the option of public ownership and operation of the facility. Under this scenario, the private company could provide, install, and maintain equipment; train City staff to operate the equipment, perhaps providing some level of operating oversight; and market all materials.

- A common opinion of the industry representatives was that the term of an agreement would need to correspond to the level of private capital, to ensure a suitable return on the private investment. Generally, it appears that a term of 3-7 years would be agreeable for a PSA for an existing facility or for an operating contract for a public facility. For a new facility with private investment, a longer term would be required; the term would likely need to be at least 10 years for private ownership of the equipment, and 15-20 years for private ownership of the building and equipment.
- For project success, it was noted that there must be a justifiable and sustainable processing fee that covers operations, financing, and profit; operations should not be dependent on commodity revenues. Similar comments were made regarding the need to balance commodity-pricing risk and to provide for contractual changes to accommodate the dynamics of the recycling industry (e.g., changing composition of single stream materials such as single-serve containers and film plastic).
- For a public-private partnership at the McCommas Bluff Landfill, some companies indicated the need to consider how this would beneficially fit into their overall business plans. For example, private investment may be more attractive if contractual arrangements would allow for development of a larger facility for their exclusive use, or otherwise allow for private use of the leased site for other business activities (e.g., fleet storage or other types of material handling and processing).
- For purposes of a successful procurement, it was requested that the City be specific about the site that would be leased, the infrastructure that exists or that would be made available by the City, terms and conditions associated with the site lease and other project agreements, and other requirements (e.g., performance requirements, residue handling and disposal, and public outreach and education obligations).

6.3.4 Implementation Schedule

For development of a new facility, most companies estimated an implementation schedule of about 18 to 24 months (groundbreaking to equipment startup), with 24 months being the most common estimate. Consistently, the companies indicated that the greatest uncertainty regarding the overall implementation schedule would be associated with permitting (primarily City of Dallas permitting). With permits already in hand or the need for only limited, accelerated permitting efforts, there was some indication that the schedule could possibly be shortened to about 12 to 18 months. For a PSA for an existing facility, startup could be very quick. These estimates exclude contract negotiation and other procurement activities.

6.3.5 Short-term Processing Services

There are only a limited number of companies that currently have existing processing capacity in or sufficiently close to Dallas to effectively provide short-term services. The companies that have this capacity indicated a willingness and ability to provide short-term processing services. Companies without this capacity indicated they could develop a temporary solution if short-term processing services were required pending the completion of new processing capacity. A temporary solution could include a portable processing system, transfer to a more distant facility, or contractual arrangements with another facility in the Dallas area.

6.3.6 Potential Tax Credits and Financial Incentives

Industry representatives participating in the interviews generally did not share detailed information regarding potential tax credits or financial incentives. However, there was a consistent willingness to seek further information from a corporate level and to consider, for proposal purposes, potential opportunities to benefit project economics. There was a general interest in further exploring New Market Tax Credits to determine applicability for a project in Dallas.

6.3.7 Experience with Mixed Waste Processing

The financial analysis provided in Section 4 of this report shows that mixed waste processing is not financially feasible at this time. As part of the interviews, the Project Team sought further feedback from the industry on the potential to develop mixed waste processing in combination with single stream processing. A key part of the discussion was to assess the experience of the industry with mixed waste processing, and to understand how this experience may influence industry interest in this option for the City of Dallas. Based on the interviews, general findings are listed below.

- The companies that were interviewed had varying levels of experience with mixed waste processing, ranging from investigatory and analytical work to design and operating experience. In one case, mixed waste processing was identified as a primary business focus of the company.
- Based on responses from the companies with operating experience, the cost to operate a mixed waste processing facility would be expected to be as much as five times the current cost of disposal in the Dallas marketplace.
- Based on the majority of responses from the companies interviewed, contamination rates generally increase with mixed waste processing and recovery is less than that observed from single stream programs. As end users become more stringent in the quality specifications for the recovered materials, marketing becomes more difficult; this can result in decreased revenues, or in the worst-case scenario, being shut-off by the market. Anecdotal stories were shared about practices of blending materials from mixed waste processing with materials from single stream processing, to more effectively move the lower-quality materials to market. More than one company suggested that for planning purposes and feasibility analyses, the value of materials recovered from mixed waste processing should be discounted (at least 25 percent, and maybe more for fiber).
- Despite the concerns with the high cost of mixed waste processing and the reduced quality of the recovered materials, several companies commented that mixed waste processing could be viable in some circumstances. For example, it was suggested that mixed waste processing may be cost effective if applied in a selective manner, such as to process high fiber loads from commercial trucks. This could potentially be accomplished using the single-steam system. Also, although not consistent with

the City's current plans, it was suggested that cost savings associated with eliminating collection of single stream recyclables could help to offset the higher costs and potentially lower revenues of mixed waste processing.

- Several companies commented that although mixed waste processing is effectively implemented in some locations, on a broader basis the national trend seems to be continuing with single stream recycling. These companies indicated that single stream processing remains "state-of-the-art" in the recycling industry.

6.3.8 Interest in Providing Mixed Waste Processing Services

Most of the companies interviewed had only limited interest in mixed waste processing, primarily due to concerns about financial viability in the Dallas marketplace. In general, these companies did not reject the option of providing mixed waste processing, particularly if there was a strong interest or City preference for this option. However, it was indicated that the option would need to be reviewed carefully for economic viability, in consideration of both cost to the City and a fair return to the company. Multiple companies expressed that they have no interest in mixed waste processing. Another company expressed a strong preference for this option.

6.3.9 Ability to Commit Waste to a City Project

The ability to commit non-City materials to a City project varied based on the level of services currently provided by the company in the Dallas marketplace. Some companies collect and control non-City waste and recyclables and may have the ability to commit that material to a project, but their interest in doing so would need to be evaluated during the procurement process and through negotiations with the City. In general, the willingness to make such a commitment would be a strategic decision that would largely be based on cost. In some cases, companies not currently in the collection market in the Dallas area indicated an intent to grow their businesses, with the potential to attract materials in the future.

Through the discussion of facility capacity and waste commitments, some companies indicated a desire to build a facility larger than that needed to manage City materials, with a preference to use that additional capacity for their own needs and benefit. Some companies indicated a willingness to pay a host fee to the City for processing of non-City materials.

6.3.10 Markets for Film Plastic

The interviews included discussions regarding the market for film plastic to assess the management of this material as a possible trend in recycling programs. Generally, the companies indicated that there is a market for film plastic, but it is not consistently available. Markets have been strongest for clean, dry film plastic from industrial processes, which have had recent values of $500 per ton or higher. Film plastic from mixed waste processing generally has the lowest value, potentially on the order of $100 per ton or else providing an avoided disposal cost but not necessarily a net revenue. The companies reported that plastic bags are often contaminated with food or liquid, or otherwise with materials left in the bag, which reduces the market value.

Companies indicated that film plastic is routinely removed out of necessity (i.e., to keep it from wrapping around equipment), even if it carries a low value in the marketplace. The film plastic is removed by hand or by a vacuum system; it can cost more to remove it than the market value.

6.3.11 Other Findings

Other unique comments shared during the interviews by one or more of the companies included the following, each of which may have broader interest to other proposers.

- As a variation to mixed waste processing, a suggestion was made to consider a wet/dry system where the dry portion could be handled through the recycling processing system.
- Interest was expressed in a MRF to process construction and demolition materials, co-located with a single stream processing facility.
- It was requested that if the City is issuing a request for proposals that includes multiple options, it consider adding an option for "outside-the-box" proposals.
- Interest was expressed in potentially recovering film plastic for use in a plastic-to-oil system.
- The ability to have a rail spur at a processing facility was cited as providing improved economical access to end markets.

Section 7
IMPLEMENTATION PLAN

7.1 Introduction

In Section 4, the Project Team provided a detailed analysis of the feasibility of single stream recycling and mixed waste processing in the City of Dallas. In this analysis, the Project Team found that single stream recycling is technically and financially feasible to be developed at the McCommas Bluff Landfill. Mixed waste processing is not financially feasible at this time.

The City has made a substantial investment in curbside single stream recycling, and currently has a PSA in place for processing City-collected material at a privately-owned and operated facility. The current PSA will expire at the end of 2016 and is not subject to further extension. Therefore, in order to continue the single stream recycling program, the City must now plan to implement new services for processing of this material after the expiration of the current agreement. Future processing could be under a new PSA or at a new single stream processing facility located on City-owned land. Either approach requires that the City conduct a procurement.

The current PSA is financially strong for the City. However, in recent years, private companies have been requiring municipalities to share in more of the risk of single stream recycling via higher processing fees and/or lower revenue sharing. A future PSA negotiated by the City is likely to result in lower revenue to the City than under the current PSA. A procurement will allow the City to obtain market-competitive proposals for a PSA. A procurement that is also open to development of a new single stream facility on City-owned land will allow the City to directly compare that option to a PSA.

This section is organized to provide an understanding of key issues that will help the City determine the best plan for implementation, as follows:

- Section 7.2 describes different levels of involvement that the City could have in a single stream facility based on land ownership, capital investment and facility operations.
- Section 7.3 discusses the facility procurement options that are available to the City.
- Implementation recommendations for the facility procurement are provided in Section 7.4.

Prior to conducting any procurement, the Project Team recommends consulting with the City's legal counsel and purchasing staff to ensure compliance with state and local regulations.

7.2 Options for a City Facility

As previously discussed, the City has a PSA with a privately-owned and operated facility for its current single stream program. The City must determine how recyclable materials will be processed upon the expiration of the current agreement. The City can solicit and negotiate a new PSA or pursue the development of a City facility. The Project Team recommends that the City develop a procurement that will allow them to compare a PSA to a City facility.

There are various levels of involvement that both the City and the private sector could have in a new single stream facility. Prior to conducting a procurement, the City should determine the level of involvement that they should have in the following aspects of a single stream facility:

- Land ownership;
- Capital investment (i.e. facility ownership); and
- Operations.

The different public private partnership combinations, as well as examples of communities that have taken these approaches, are shown in Table 6-1.

Table 7-1
Options for Public-Private Partnership

	City Owned and Operated	City Owned with Private Operations	Privately Owned and Operated on City Land
Land Ownership	City	City	City
Capital Investment	City	City	Private
Operation	City	Private	Private
Example	Glendale, AZ	Phoenix, AZ	Denton, TX

7.2.1 Land Ownership

For a variety of public-private partnership options, a new facility could be developed on City-owned land. Such a facility could be owned by the City or by a private company under a site lease arrangement with the City, and it could be operated by the City or by a private company as further discussed below.

The City has identified a potential site at the McCommas Bluff Landfill, described in Appendix B, which could be used for the development of a single stream recycling facility. The City has expressed some interest in having a single stream recycling facility at the landfill, if the site and corresponding public-private partnership provides a favorable combination of financial terms and quality service.

7.2.2 Capital Investment

Public financing (i.e., City ownership) would typically be the lowest cost option to finance a single stream processing facility located on City-owned land. The advantages of the City making the capital investment include:

- The municipal cost of capital is likely lower than the private cost of capital, thus lowering the overall cost of the facility.

- The City would not be required to earn a return on capital investment for the facility. Private companies must earn a return on capital invested, thus increasing the cost to the City.
- Private companies would likely compress the depreciation period for its capital investment based on the length of the contract with the City rather than the expected useful life of the facility. This is a common approach of private companies in order to ensure that costs are recovered under the term of the contract given the uncertainty of contract extensions. An operating contract with a private company would likely be 10 to 15 years, while the facility would likely have a useful life of at least 20 years with an adequate asset management and capital repair and replacement program.
- At the end of the operating contract, the City would own the facility and would have the flexibility to continue operations under an extended or new contract without having to transfer assets to the City.

If public funding is not available or otherwise not of interest to the City, the facility could be developed with private financing (i.e., private ownership). Private financing may also be beneficial if there are any applicable tax credits or other incentives available to the private sector. For example, the New Market Tax Credit (NMTC) Program is a federal program operated by the Department of Treasury that provides investors with federal tax credits for qualified development in low income communities. If a program like this was determined to be applicable to the project, private ownership could potentially be beneficial. Under a public-private partnership that includes private ownership of a facility on City-owned land, contractual arrangements would need to be provided for transfer of ownership of at least the building, and potentially also the processing equipment, to the City at the end of the operating contract.

The City could also consider shared financing, whereby the City and the private company would finance different aspects of the project. For example, with private operation it could potentially be beneficial to have the private company make the capital investment for the processing equipment. This arrangement could provide greater flexibility in equipment design as well as operating incentives. In addition, at the end of the contract, the City would have more flexibility regarding disposition of equipment from the previous contract, either acquiring the equipment or requiring its removal for installation of new equipment by a new operator.

7.2.3 Operation

A City facility could be publicly or privately operated. The Project Team recommends that the facility be privately operated for the reasons listed below.

- Many private companies have extensive prior experience operating single stream facilities in other communities. A private company would be able to leverage this experience to the benefit of the City.
- A private operator could be a partner with the City in sourcing additional material for the single stream facility. Volume of material processed greatly contributes to the overall financial performance and operational efficiency of a facility. Private

operators have expertise in marketing processing services to customers such as municipalities and private haulers.

- Private operators have the potential to market high volumes of material by aggregating material that comes from multiple sources. High volumes can lead to greater prices received for material. In addition, if marketing functions are centralized for multiple single stream facilities, it can reduce overall sales and marketing overhead costs attributable to the City.

7.2.4 Public-Private Partnership Options Summary

A City facility should be developed on City-owned land and operated by a private operator. There are potential advantages to City and private company financing. More information is also needed in order to determine whether City or private capital investment would be more beneficial. Table 6-2 shows the public-private partnership options that should be considered by the City.

Table 7-2
Options for Public-Private Partnership –
Outlined Options Should be Considered

	City Owned and Operated	City Owned with Private Operations	Privately Owned and Operated on City Land
Land Ownership	City	City	City
Capital Investment	City	City	Private
Operation	City	Private	Private
Example	Glendale, AZ	Phoenix, AZ	Denton, TX

7.3 Procurement Options

This section discusses the different procurement approaches available for a PSA and for a City facility. As discussed in Section 7.2 (and shown in Table 7-2), the City should consider a single stream facility on City land that is operated by a private company.

7.3.1 Procurement Options for PSA

If the City chooses to procure a PSA for single-steam processing, this could be accomplished through an RFP process. The key steps involved in this process are:

- Develop procurement documents;
- Release RFP;
- Conduct pre-proposal meeting;
- Evaluate proposals;
- Conduct interviews with proposers;

- Select highest-ranked proposer for contract negotiation; and
- Negotiate and execute contract.

The procurement process for a PSA would take six to nine months. If the PSA is with an existing facility, limited start up time would be needed for services. However, there is a very limited number of existing single stream recycling facilities available to the City. Therefore, the Project Team recommends that the procurement schedule allow sufficient time for companies to be able to construct a new facility to provide service to the City. Based on discussions with private companies summarized in Section 6, permitting, construction and start-up of a new facility would require an additional 18 to 24 months after the contract is negotiated before the facility could be on-line and available to receive single stream materials under the PSA. Between the date of this report and the expiration of the City's current agreement, there are approximately 30 months. Therefore, procurement activities should be initiated quickly to avoid or limit the need to procure interim processing services until a new facility would be completed.

7.3.2 Procurement Options for City Facility

Two options for project delivery that are specific to a new City facility are traditional project delivery (Design-Bid-Build) and alternative project delivery (Design-Build-Operate).

Traditional Project Delivery (Design-Bid-Build)

In traditional Design-Bid-Build (DBB), the City would procure a design firm that would complete the design of the single stream facility prior to engaging with an operator or construction firm. The City would put the facility design out for bid for construction and would separately procure an operator or coordinate for City operation. While there are some advantages to traditional project delivery, such as a high level of control for the City and institutional familiarity with the process, there are a number of disadvantages, listed below.

- There is no collaboration between the design engineer and the construction contractor to address potential constructability issues or between the designer and the operating firm to address operating issues in the design phase.
- Because all involved firms must be procured separately, the project schedule is longer than alternative delivery.
- The City is the ultimate manager of the entire process, from design to construction.

A sample project schedule for traditional project delivery is shown in Figure 7-1.

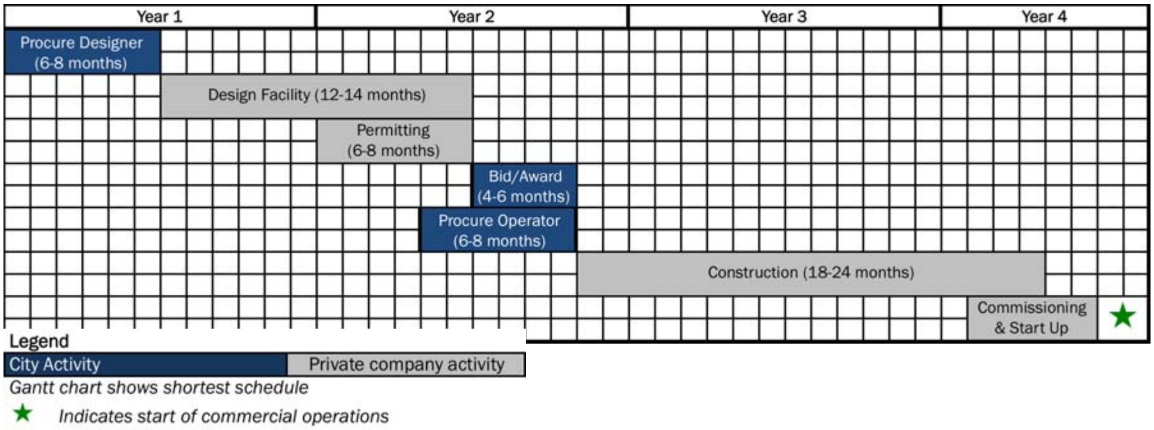


Figure 7-1: Traditional Project Delivery Sample Schedule (42-54 months)

As shown in the figure, the minimum schedule for traditional project delivery is approximately 42 months.[1] Between the date of this report and the expiration of the City's current agreement, there are approximately 30 months. Therefore, if the City chooses to use a traditional DBB process, it is expected that interim processing services would need to be procured until the new facility could be completed.

Alternative Project Delivery (Design-Build-Operate)

To save time and shift risk to private companies, municipalities have transitioned to using alternative project delivery methods. While there are many different formats for alternative delivery, Design-Build-Operate (DBO) would be a suitable approach for a new single stream processing facility located on City property.

In DBO, the City selects one firm or team of firms that will design, construct, and operate the single stream facility. The DBO firm is selected through a process in which a short list of firms is identified through a request for qualifications (RFQ) and then a firm is selected through an RFP. It is also possible to combine the steps into a Request for Qualifications and Proposals (RFQP). While there are some disadvantages to alternative project delivery, such as reduced control for the City and a high cost on the part of the vendor community for preparation of a proposal (which can limit competition), there are a number of advantages, listed below.

- There is a high degree of collaboration between the designer, construction contractor, and operator, as all are part of a single team.
- Parallel processes, such as final design, construction, and permitting, and the single procurement process reduce the overall project schedule.
- There is a single point of accountability for all aspects of the project.
- Management of the overall project shifts from the City to the DBO contractor.

[1] The schedule could be reduced if the City would utilize the current Project Team to provide design services.

Based on these advantages, the Project Team recommends the City use alternative project delivery (DBO) if procuring a new single stream processing facility on City-owned property. A sample project schedule for alternative project delivery is shown in Figure 7-2.

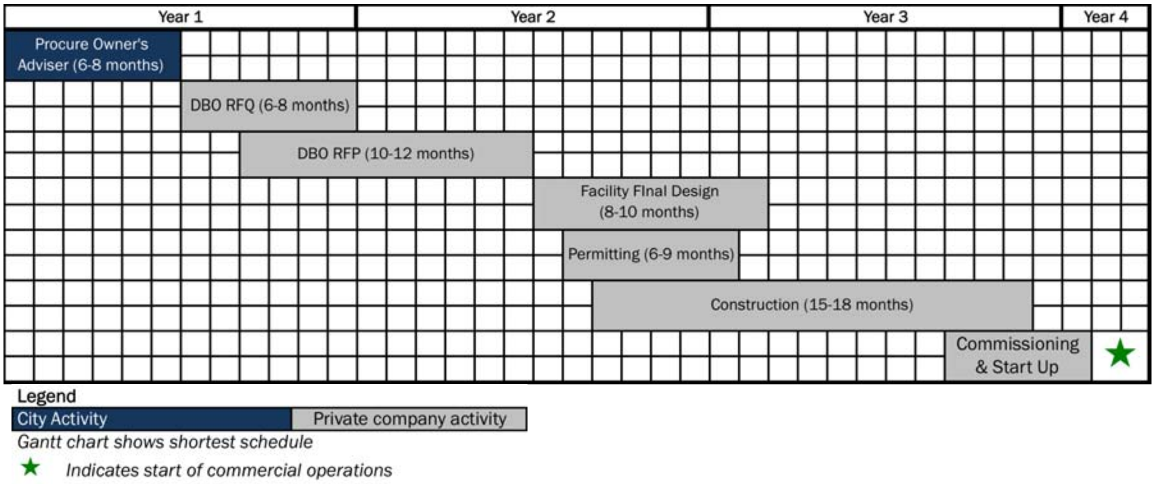


Figure 7-2: Alternative Project Delivery Sample Schedule (37-48 months) [2]

As shown in the figure, the minimum schedule for alternative project delivery is approximately 37 months, which is five months less than the minimum schedule for traditional project delivery. However, between the date of this report and the expiration of the City's current agreement, there are approximately 30 months. Therefore, unless early tasks are accelerated there may be a need for interim processing services until the new facility would be completed. One option for the City to accelerate the project schedule would be to utilize the current Project Team as Owner's Advisor.

7.4 Implementation Recommendations

The City has made a substantial investment in curbside single stream recycling, and currently has a PSA in place for processing City-collected material at a privately-owned and operated facility. The current PSA will expire at the end of 2016, and is not subject to further extension. Therefore, in order to continue the single stream recycling program, the City must implement new services for processing of this material after the expiration of the current agreement. Future processing could be under a new PSA or at a new facility located on City-owned land.

The City should conduct a procurement to obtain processing services for single stream materials beginning in 2017

[2] In DBO it is quite common for site preparation design to be completed and a grading permit to be issued (and possibly a demolition permit too) so that the site preparation construction is started while design of the remaining site facilities is still underway.

7.4.1 Develop an RFP

While preliminary financial analyses indicate a range of single stream options are feasible, there is presently insufficient information to know if one option provides a more favorable combination of financial terms and quality service. Based on the results of the vendor survey summarized in Section 6, the Project Team recommends the City conduct a procurement using an RFP process focused on a specific approach or a set of approaches. The RFP should allow vendors to propose on multiple options and should provide the City with the opportunity for direct comparison of options.

Options recommended for inclusion in the RFP include the following.

- PSA for single stream processing at an existing or new private facility
- DBO of a single stream processing facility at the landfill
  - Owned by the City and privately operated, or
  - Privately owned and operated, under a site lease with the City and with contractual conditions for transfer of ownership at the end of the operating contract.

It is critical that the City begin this procurement process as soon as possible in order to minimize the risk of having to procure interim processing services until a facility is complete. As shown in Figure 7-3, the overall procurement schedule could potentially be shortened by accelerating activities within the first six months, which could include utilizing the current members of the Project Team to serve as the City's Owner's Adviser. To the extent possible, the RFP process should be initiated sooner than the six-month mark shown on the schedule.

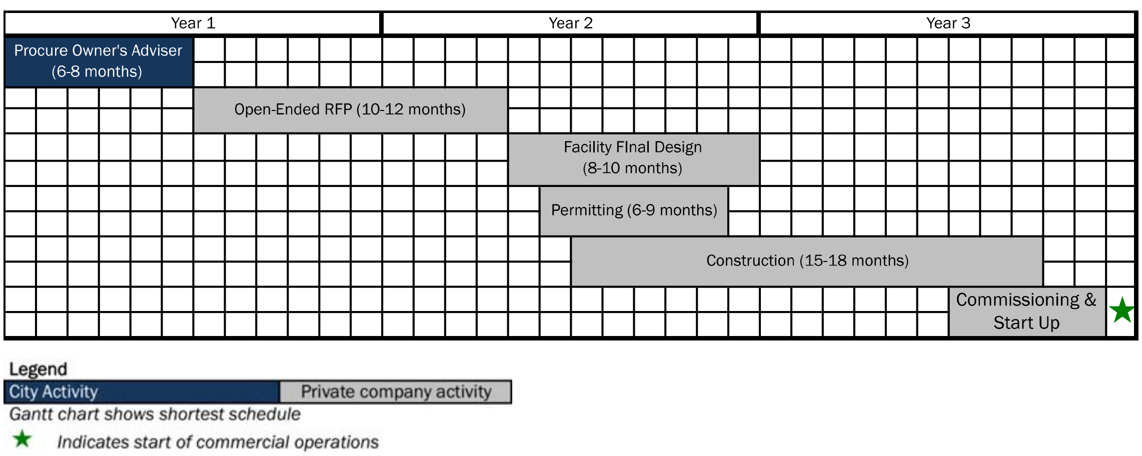


Figure 7-3: Potential Procurement for PSA or City Facility

The Project Team is providing the following additional recommendations for the RFP.

- For a new facility located on City-owned land, the Project Team recommends the City consider the site located at the McCommas Bluff Landfill, as described in Appendix B.

- The Project Team recommends that the procurement take a non-prescriptive approach to facility requirements, allowing vendors maximum flexibility to develop a facility according to their business and operational practices, while providing excellent service to the City.
- If the procurement involves use of the site located at the McCommas Bluff Landfill, the City could consider asking companies for proposals concerning how their facility would enhance the opportunity to further establish a resource recovery park (see Section 5 for further detail). For example, the evaluation criteria for the RFP could ask vendors what commitments they would include as a part of their proposal.

7.4.2 Integrate Stakeholder Communication

Stakeholder communication should be integrated into project procurement and implementation, to provide an open and transparent process that solicits stakeholder input as appropriate. Stakeholders include elected City officials (City Council), environmental and other interest groups, the South Dallas community, and the wider public community. These Stakeholders will have different levels of interest and may require different levels of communication, as summarized below. The Project Team recommends developing a detailed stakeholder communication plan early in the procurement process.

City Council

City Council should be routinely advised of project activity and key findings, with an emphasis on schedules and decision-making steps to ensure the process moves forward in the right direction and at a suitable pace to meet City objectives. Communication with City Council should be as needed as well as on a periodic basis, through briefings and in accordance with existing City practices.

Interest Groups

Certain interest groups, such as environmental groups, may have an interest in the City's plans for a facility, particularly if the facility includes mixed waste processing. The City should conduct one-on-one meetings with these groups, as needed, to hear their comments and have the opportunity to address their concerns if possible.

South East Dallas

It will be particularly important for the City to proactively communicate and engage with South East Dallas residents if a new facility is constructed at the landfill. The Project Team recommends engaging with the neighborhood associations as early in the process as appropriate to inform them of the City's plans, solicit feedback, and inform residents about the benefits of this facility to the community. If a facility is to be constructed at the landfill site, it may be beneficial for the City to rely on its internal Public Relations staff or engage the services of an outside public relations firm.

General Public

It will be beneficial for the City to conduct one or more public meetings to inform the public at-large about the project and answer any questions that they may have. The timing of these public meetings could be toward the end of the process to focus the meetings on any changes that may affect the public and to educate the public about the benefits of the project.

As detailed in Appendix B of this report, the Project Team does not anticipate that formal public notice or public hearings will be required for permitting purposes for a potential new facility.

Appendix A
WASTE CHARACTERIZATION ADDITIONAL INFORMATION

Appendix A includes the following documentation related to the waste characterization analysis, as included in Section 1:

- A.1 – Material Category Definitions. This includes the detailed definitions for each of the 48 material categories.
- A.2 – Sample Photographs. A photograph was taken of each selected load and 200 pound sample before it was sorted. This includes photographs of two samples, one residential and one commercial. Photos of all 52 loads were saved to a compact disc and provided to City staff.
- A.3 – Sample Summary. This includes a summary of each sample, including truck type, generator sector, residential district, and net weight.

A.1 Material Category Definitions

Material Category		Material Definition
Paper		
1	Newsprint	Printed and unprinted ground wood newsprint. This category includes glossy paper inserts included with the newspaper at the time of distribution.
2	Recyclable Old Corrugated Cardboard (OCC)	Kraft linerboard and containerboard cartons and shipping boxes with corrugated paper medium.
3	Non-Recyclable OCC	Wax or plastic coated OCC. Any OCC contaminated with food waste, including pizza boxes.
4	Kraft Paper	Kraft paper bags and brown Kraft packing paper.
5	Paperboard	Paperboard and boxboard such as that used for cereal and tissue boxes.
6	High Grade Office Paper	Bond, rag-content, manila, or stationery grade paper with or without color. Includes ledger, photocopy paper, computer printouts, manila folders, index cards, and envelopes (with and without windows or gummed labels).
7	Magazine/Glossy	Magazines and catalogs printed on glossy, coated paper stock.
8	Polycoated/Aseptic Containers	Polycoated gable top beverage cartons (such as milk and orange juice cartons) and aseptic drink boxes. Excludes non-beverage polycoated paperboard boxes.
9	Mixed (Other Recyclable)	Low grade recyclable paper. Includes phone books, text books, other books and catalogs with groundwood paper; construction paper, junk mail, blue prints, and glossy, coated paper.
10	Other (Non-recyclable)	Paper that does not fall into any of the above categories. Low grade non-recyclable paper. Includes tissue paper, napkins, paper towels, paper plates, paper food cartons, frozen food packaging, cigarette packages, photographs, waxed paper, coated fax paper, and carbon paper, whether or not they are contaminated with fluids or food. Includes all other grades of paper if substantially contaminated with fluids or food waste.
Plastic		
11	PET Bottles, Jars,	Blow molded plastic bottles, jars, and containers labeled #1 PET.

	Material Category	Material Definition
	Containers	
12	HDPE Containers - Natural	Unpigmented or translucent blow molded plastic bottles and jars labeled #2 HDPE.
13	HDPE Containers - Colored	Pigmented blow molded plastic bottles and jars labeled #2 HDPE.
14	#3 - #7 Bottles, Jars, Containers	Blow molded plastic bottles, jars, and containers labeled #3, #4, #5 #6 and #7. Excludes expanded polystyrene (e.g., Styrofoam).
15	Expanded Polystyrene	Food service polystyrene, polystyrene protective packaging, foam egg cartons, and "peanuts." Any expanded foam product labeled #6.
16	Plastic Bags and Film/Wrap	Includes plastic grocery, retail shopping bags, and other bags provided at retail (of any color) used for carrying items home. Any film plastic including garbage bags, cereal box liners, sheet plastic, shrink wrap, tarping, and other non-rigid plastic.
17	Other Plastic	Includes all non-container rigid plastics such as plastic pipe, plastic casings, plastic hangers, toys, plant pots.
Metal		
18	Aluminum Used Beverage Containers	Used beverage containers (UBC) made from aluminum used for containing soda, fruit juice, sports drinks, iced tea, beer, etc.
19	Ferrous Metal Food Containers	All ferrous food and beverage cans. Includes coated and bi-metal cans.
20	Other Ferrous Metal	Ferrous and alloyed ferrous scrap metals, including cast iron. Includes empty aerosol cans, clothes hangers, sheet metal products, pipes, miscellaneous metal scraps, and other magnetic metal items.
21	Other Non-Ferrous Metal	Other non-ferrous metal, aluminum scrap, tin foil, pie plates, brass, or copper. Includes bronze, lead, nickel, gold, silver, platinum, and other non-magnetic metal. Stainless steel may or may not be magnetic.
Glass		
22	Clear Glass	Clear glass food and beverage bottles and jars.
23	Green Glass	Green glass food and beverage bottles and jars.
24	Amber Glass	Amber (brown) glass food and beverage bottles and jars.
25	Other Glass	Glass items other than food and beverage containers. Includes ceramics, drinking glasses, glass plates, light bulbs (incandescent), mirrors, decorative items and fixtures, window glass, safety glass, and cooking ware.
Organics		
26	Yard Waste	Yard waste including grass clippings, leaves, and garden trimmings.
27	Wood (non-C&D)	Brush, branches, tree limbs.
28	Food Waste	Putrescible food preparation waste, food scraps, spoiled food. Includes beverages in sealed containers.
29	Textiles	Fabric materials including natural and man-made textile materials made from cottons, wools, silks, nylon, rayon, polyesters, and other materials. This category includes clothing, rags, curtains, and other fabric materials. Leather and leather goods are also included such as belts and wallets. Includes all shoes.
30	Diapers	Diapers and adult sanitary products.

Material Category		Material Definition
31	Other Organics	Organic materials not otherwise categorized, such as natural fibers, manure/feces, cork, hemp rope, wicker products, sawdust, and lint. Includes rubber products made from natural or artificial rubber such as latex gloves, mats, automotive belts/hoses, etc.
Construction & Demolition (C&D) Debris		
32	Clean/Unpainted C&D Aggregates	Unpainted concrete, brick, asphalt and other aggregates.
33	Painted C&D Aggregates	Painted concrete, brick, asphalt and other aggregates.
34	Clean/Unpainted C&D Wood	Wood and dimensional lumber construction materials from new construction, remodeling, or demolition, uncontaminated by paint, stain or preservative treatment. Includes easily separable wood from furniture, tools, and other durable products. Includes untreated wood crates and pallets.
35	Treated/Painted C&D Wood	Any wood with paint, stain or preservative treatment. Also includes plywood, particleboard, chipboard, and masonite due to their resin content.
36	Composition Roofing	Composite shingles composed of fiberglass or organic felts saturated with asphalt and covered with inert aggregates as well as attached roofing tar and tar paper. Commonly known as three tab roofing. Examples include asphalt shingles and attached roofing tar and tar paper. Does not include built-up roofing.
37	Other Asphalt Roofing (Built-up Roofing)	Other roofing material made with layers of felt, asphalt, aggregates, and attached roofing tar and tar paper normally used on flat/low pitched roofs usually on commercial buildings. Sometimes referred to as torch-down roofs.
38	Gypsum Board	Gypsum-based wallboard, sheetrock, and blueboard used in the drywall or plaster trades.
39	Other C&D	C&D material not otherwise classified such as carpet, carpet padding, fiberglass insulation, etc.
Problem Materials		
40	Batteries	Includes lead-acid automotive batteries, nickel-cadmium (Ni-Cad), lithium-ion, button batteries, and other batteries such as AAA, AA, C, D, and 9-volt.
41	Televisions	Televisions with cathode ray tubes and flat screen TVs.
42	Computers	Computer monitors, processors, mice, keyboards, disk drives, etc.
43	Other Electronics/Appliances	Scanners, copiers, printers, and other consumer electronics such as cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras. Also includes electrically powered household products fabricated from metals and plastics not easily separable into individual materials. Examples include hair dryers, toasters, coffee makers, etc.
44	Household Hazardous Waste (HHW)	Wastes resulting from products purchased by the general public for household use or similar commercial use which, because of their quantity, concentration, or physical, chemical, or infections characteristics, may pose a hazard to human health. Examples include paints, solvents, flammable liquids, toxics, corrosives, pesticides and herbicides, batteries, syringes, reactives and explosives. Empty HHW containers are not considered HHW.
45	Bulky Waste	Large items made of several material types and not easily separated by material. Includes, furniture, couches, mattresses, etc.
Other Inorganics		
46	Tires	Pneumatic tires from vehicles, including bicycles.
47	Other Inorganics	Inorganic material not otherwise classified, such as rock, dirt, sand, and certain manufactured products composed of entirely inorganic materials.
48	Fines	Remnants less than 1 inch in length, left after sorting is complete. Typically consists of dirt, sawdust, small food scrap, small pieces of paper, etc.

A.2 Sample Photographs

Provided below are sample photographs of a residential load and a commercial load that were sorted for the waste composition study. A compact disc containing pictures of all loads sampled will be provided to the City of Dallas.

Figure A-1. Sample #1 – Residential Loads

Figure A-2. Sample #31 – Commercial Load

Figure A-3. Sample #31 – Commercial Load Sample Section.

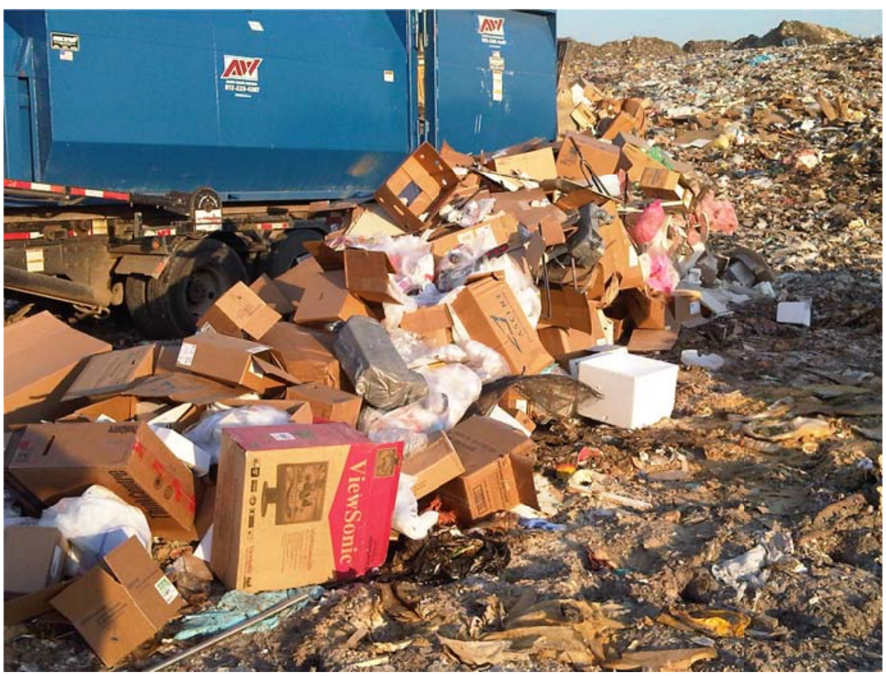


Figure A-4. Example of a Dry Commercial Load Disposed at Landfill

A.3 Sample Summary

Sample Number	Date	Truck Type	Generator Sector	Residential District	Net Weight
1	6/24/2013	Side Loader	Residential	2	14,960
2	6/24/2013	Side Loader	Residential	1	12,760
3	6/24/2013	Front End Loader	Commercial	-	17,500
4	6/24/2013	Side Loader	Residential	2	14,160
5	6/24/2013	Side Loader	Residential	1	16,320
6	6/24/2013	Rear Loader	Residential	5	13,380
7	6/24/2013	Rear Loader	Residential	3	12,080
8	6/24/2013	Rear Loader	Residential	4	14,820
9	6/24/2013	Front End Loader	Commercial	-	31,220
10	6/24/2013	Front End Loader	Commercial	-	14,580
11	6/24/2013	Rear Loader	Residential	5	7,120
12	6/25/2013	Front End Loader	Commercial	-	14,100
13	6/25/2013	Side Loader	Residential	1	15,820
14	6/25/2013	Side Loader	Residential	2	13,300
15	6/25/2013	Side Loader	Residential	2	15,880
16	6/25/2013	Side Loader	Residential	5	12,260
17	6/25/2013	Side Loader	Residential	3	13,920
18	6/25/2013	Side Loader	Residential	4	15,460
19	6/25/2013	Front End Loader	Commercial	-	12,940
20	6/25/2013	Front End Loader	Commercial	-	10,700
21	6/25/2013	Side Loader	Residential	4	15,360
22	6/26/2013	Front End Loader	Commercial	-	19,280
23	6/26/2013	Front End Loader	Commercial	-	27,900
24	6/26/2013	Front End Loader	Commercial	-	19,180
25	6/26/2013	Front End Loader	Commercial	-	25,960
26	6/26/2013	Front End Loader	Commercial	-	18,360
27	6/26/2013	Front End Loader	Commercial	-	10,980
28	6/26/2013	Front End Loader	Commercial	-	18,800
29	6/26/2013	Front End Loader	Commercial	-	31,260
30	6/26/2013	Front End Loader	Commercial	-	8,260
31	6/27/2013	Compactor	Commercial	-	9,020
32	6/27/2013	Front End Loader	Commercial	-	14,860
33	6/27/2013	Front End Loader	Commercial	-	23,420
34	6/27/2013	Side Loader	Residential	3	14,820
35	6/27/2013	Side Loader	Residential	5	16,200
36	6/27/2013	Side Loader	Residential	4	11,890
37	6/27/2013	Side Loader	Residential	5	13,820
38	6/27/2013	Side Loader	Residential	2	15,680

Sample Number	Date	Truck Type	Generator Sector	Residential District	Net Weight
39	6/27/2013	Side Loader	Residential	2	14,920
40	6/27/2013	Side Loader	Residential	1	14,640
41	6/27/2013	Side Loader	Residential	1	17,700
42	6/27/2013	Front End Loader	Commercial	-	8,600
43	6/28/2013	Front End Loader	Commercial	-	19,760
44	6/28/2013	Front End Loader	Commercial	-	25,440
45	6/28/2013	Front End Loader	Commercial	-	17,500
46	6/28/2013	Side Loader	Residential	1	16,240
47	6/28/2013	Side Loader	Residential	4	11,830
48	6/28/2013	Side Loader	Residential	3	13,180
49	6/28/2013	Side Loader	Residential	5	15,360
50	6/28/2013	Side Loader	Residential	2	13,780
51	6/28/2013	Side Loader	Residential	2	9,140
52	6/28/2013	Side Loader	Residential	4	8,840

Appendix B
CLARIFYING INFORMATION FOR THE POTENTIAL TECHNOLOGIES REVIEW

B.1 Introduction

This Appendix contains supplemental information related to the following topics discussed in Section 2 – Review of Potential Technologies.

- Project delivery methods
- Potential site for a resource recovery facility
- Facility permitting

B.2 Project Delivery Methods

The potential technologies review identifies a range of potential project delivery methods or options that are considered to be appropriate for each technology. This analysis recognizes that there have been a number of changes in Texas state law over the last several years that impact the procurement methods available to the City for capital projects and services. The Leidos Project Team recommends that the City consult with legal counsel to fully understand its options for project delivery.

The following is a summary discussion of the various options. The following four options would all involve construction of a facility on City owned property.

- **Conventional Design-Bid-Build (DBB)** in which the City would contract with a design consultant for the design of the facility and then contract for the construction (which could involve several construction/procurement contracts if portions of the project such as the vendor design and installation of the processing equipment are bought separately from the construction of the balance of the facility). Under this method, the City would operate and maintain the facility or could hire a private facility operator.
- **General Contractor/Construction Manager (GC/CM)**, or **Construction Manager-at-Risk**, in which the City would contract with a design consultant for the design of the facility and contract for pre-construction services, and possibly construction services, with a construction management/general contractor to help during the design to ensure the design incorporates solid input from the construction industry. As design advances towards completion, the GC/CM provides the City with refined construction pricing and schedules and eventually near the final design stage provides a Maximum Allowable Construction Cost (MACC) which obligates the GC/CM to build the project for the stated cost. Under this method, the City would operate and maintain the facility or could hire a private facility operator.

- **Design-Build (DB)** in which the City would select a short list (3 to 4) of well qualified design-build teams who would develop conceptual designs along with pricing and schedule proposals that the City would evaluate and select from for the facility. In this option the City might wish to have an outside consultant experienced with the DB process to assist with preparation of the fairly elaborate DB procurement documents and with proposal evaluation and contract negotiation process. Under this method, the City would operate and maintain the facility or could hire a private facility operator.
- **Design-Build-Operate (DBO),** which is similar to DB, but which includes procurement of a long term operating and maintenance partner for the facility as part of the selection process. Under this option, the City could retain certain rights to terminate the operating contract at any time and take over operation and maintenance of the facility or hire another operator.

The foregoing following option, in addition to the previous four options, would all involve design of the single stream processing system by a vendor who specializes in these systems.

- **Design-Build-Own-Operate-Transfer (DBOOT)** which is somewhat similar to DBO, but in which the DBOOT entity would own the facility for a length period of time following which the City would have the right to assume full ownership and operating responsibility for the facility. Under this option the facility could be constructed on property not initially owned by the City, or on property owned by the City. In the former case, the property ownership would pass to the City along with the facility at the conclusion of the contract period.

The following option is the process that the City used to procure the current Agreement with Waste Management Recycle America.

- **Contracted Services (CS)** which is the option the City currently uses to obtain single stream recycling services and in which the City has no ownership or operating and maintenance responsibility for the facility.

Figure B-1 illustrates in a simplistic and non-quantitative measure several key aspects of the City's risk and control across the continuum of the six implementation methods available for the technologies under consideration.

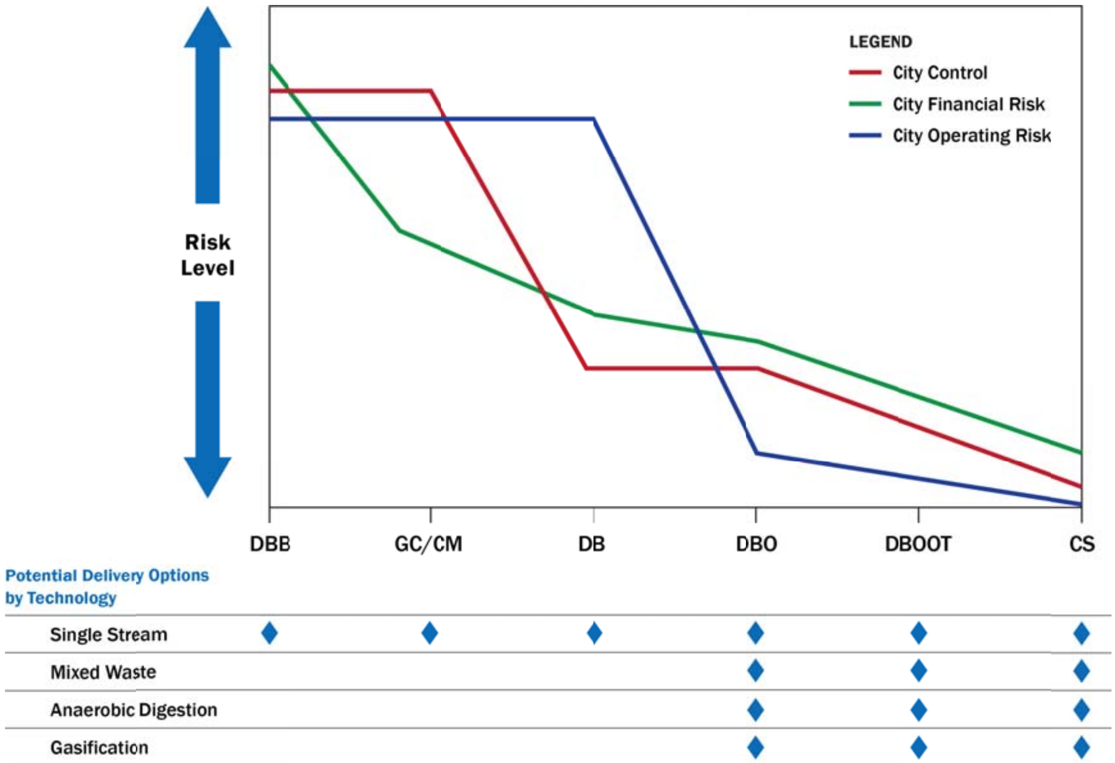


Figure B-1. Project Delivery Risk Levels by Technology

B.3 Description of Potential Site for Resource Recovery Facility

Section 2 provides a discussion of basic siting requirements for each of the resource recovery technologies considered in this study. The Project Team has identified a potential site for a facility at the McCommas Bluff Landfill in Figure B-2. This area occupies the space designated for landfill waste Cell 14, and is approximately 30 acres in size. Eliminating this area from the waste fill plan would remove approximately 7.5 to 8.0 million cubic yards of waste disposal capacity (airspace) from the landfill, resulting in approximately 3.5 to 4.5 fewer years of landfill capacity at present fill rates. To prepare a 15 acre site for the construction of the proposed facility, with a minimal amount of earthwork, approximately 100,000 CY of fill must be placed. This accounts for levelling of uneven areas and to accommodate general stormwater conveyance. In the permitting process for a facility located in the footprint of Cell 14, it may be possible to reclaim some or all of the lost waste disposal capacity in another location at the landfill. Currently, the far eastern portion of the landfill, within the levee system, is not included in waste fill plans, as it was previously removed due to an overfilling occurrence elsewhere at the site. TCEQ allows for such activities if the total waste capacity of the landfill is not increased above current capacity. As discussed in the briefing paper, the site size needed for a resource recovery facility would be dictated by a variety of factors, including building size and vehicle traffic requirements.

The land surrounding Eco Park was also evaluated for siting the facility. This property is currently designated as 100-year floodplain, and would require extensive permitting and mitigation prior to any construction.

B.4 Facility Permitting Analysis

The State of Texas regulates the management and control of municipal solid waste (MSW) facilities including, but not limited to, storage, collection, handling, transportation, processing and disposal under 30 TAC Chapter 330 of the Texas Health and Safety Code. The state agency responsible for this program regulation is the Texas Commission on Environmental Quality (TCEQ).

Section 2 provides a brief description of the permitting requirements for each of the resource recovery technologies. The location of a resource recovery facility – whether it is stand-alone or co-located with another permitted facility – and the type of facility will determine the authorization process required by TCEQ.

There are several facility types that the resource recovery technologies may fall under. These are defined below.

Type V Facility

Stand-alone solid waste processing facilities are classified as Type V. These facilities include processing plants that transfer, incinerate, shred, grind, bale, salvage, separate, dewater, reclaim, and/or provide other storage or processing of solid waste. A single stream recycling processing facility or a MWP facility would be classified as a Type V.

Type V facilities generally require a Permit to operate in accordance with 30 TAC §330.7. However, if the facility is located within the property boundaries of an existing permitted MSW facility owned by the permittee (e.g. McCommas Bluff Landfill), it may be operated through a Registration process in lieu of a Permit, in accordance with 30 TAC §330.9. The submittal information required for either a Permit or Registration of a Type V MSW Processing facility is very similar. A comparison of the Permit process to a Registration process is shown in Table B-1.

Furthermore, for certain types of processing facilities located within the permit boundary an existing permitted site, authorization for a processing facility operation may be obtained through the less complex process of a Notice or Non-notice Permit Modification of the existing Permit rather than a separate Registration.

Lastly, a single-stream recycling facility may operate under a Notification instead of a Permit or Registration provided that it meets the requirements of TAC 328.4 related to Incidental Amounts of Non-Recyclable Waste (no more than 10 percent by volume or scale weight of each incoming load with an average of no more than five percent of the total scale weight or volume of all materials received in the last six-month period) and TAC 328.5 related to ownership and reporting.

Type VI Facility

A Type VI facility or operation is a facility using a new or unproven method of managing or utilizing MSW, including resource and energy recovery projects for processes that are not currently in use in Texas. The commission may limit the size of these facilities until the method is proven. A gasification or anaerobic digestion facility may be classified as a Type VI facility, as it appears there are no such facilities currently permitted in Texas. For these technologies, a Permit is required to operate, regardless of location.

Type IX Facility

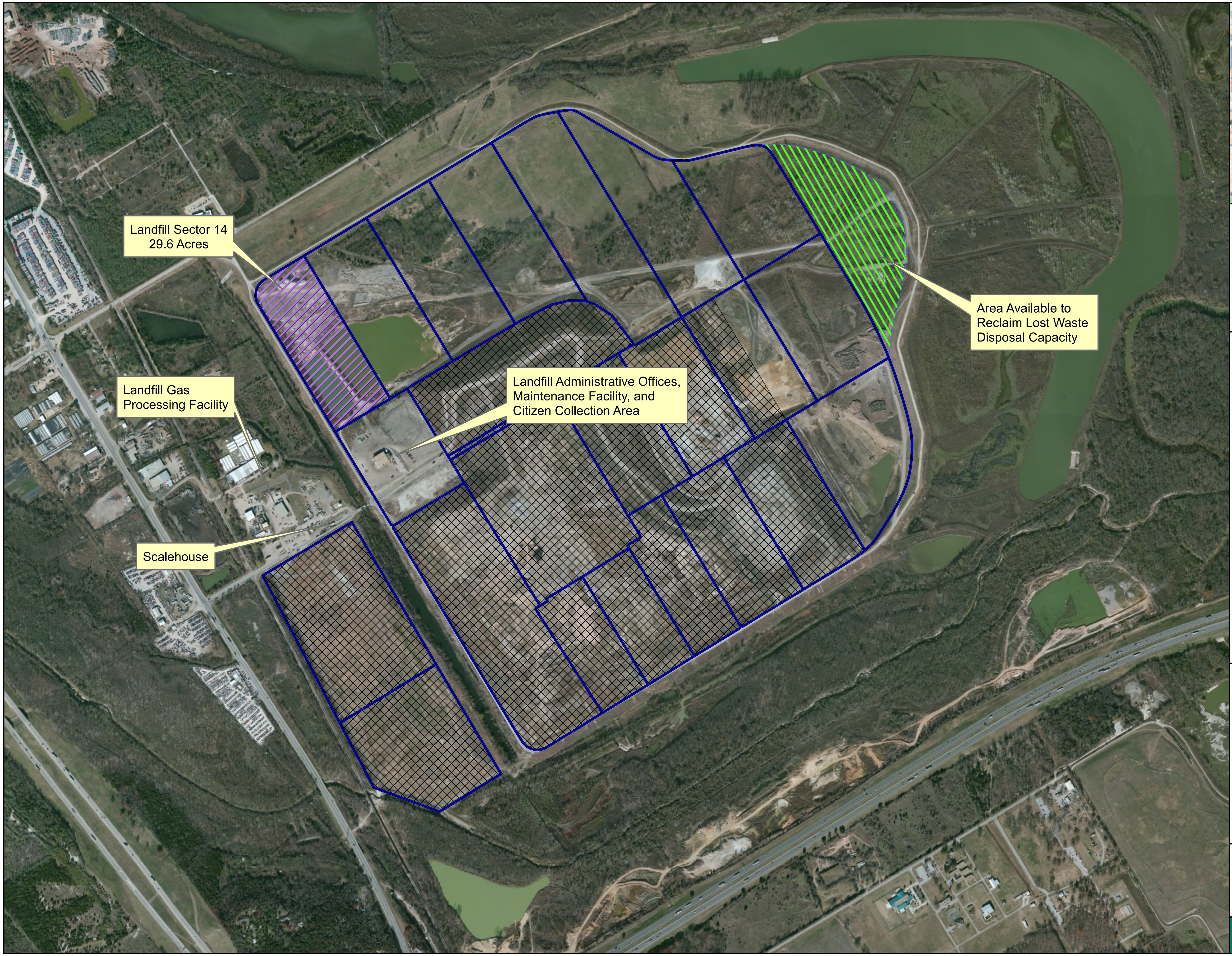
A Type IX facility is an energy, material, gas recovery for beneficial use, or landfill mining facility located within or adjacent to a closed disposal facility, an inactive portion of a disposal facility, or an active disposal facility, used for extracting materials for energy and material recovery or for gas recovery for beneficial use. It may be possible to classify a gasification or anaerobic digestion facility as a Type IX. Of the facilities proposed, a Permit is required to operate, regardless of location.

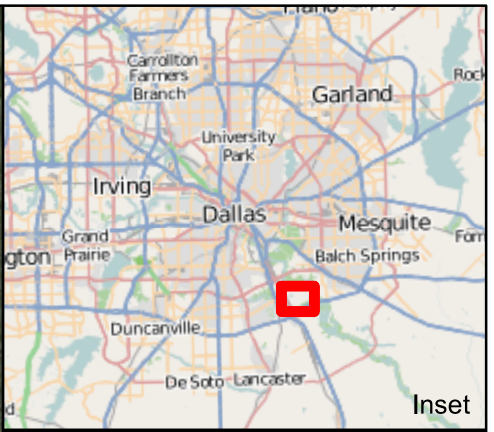
Permitting Approaches

The primary difference between a Permit and a Registration is the processing of the Application after Technical Review by the TCEQ. A major component of the permit process is a land use compatibility assessment, or "Fatal Flaw" analysis. The McCommas Bluff Landfill operates under a current Permit and the land use compatibility for solid waste activities has been fully vetted. Additionally, the procedure for a Permit is more formal and includes the opportunity for a Public Hearing. This Public Hearing is conducted by the State Office of Administrative Hearings (SOAH) in a format similar to a State District Court, and can be a long protracted process before approval. The procedures for a Registration approval includes the requirement for a Public Meeting to present information and receive comments, and generally can be completed within a few months after Technical Review and Approval. If the Authorization for the Processing Facility can be obtained through a Notice or Non-notice Modification of the existing Permitted Facility, there is no longer a requirement for a Public Meeting. As noted in Section B.3, should the facility be located within the existing footprint of the McCommas Bluff Landfill, some landfill disposal capacity would be lost. The TCEQ allows a landfill to make changes to the excavation plan which do not increase the landfill's capacity or reduce the effectiveness of the groundwater monitoring system through a Permit Modification [30 TAC §305.70(k)(8)]. Simply put, space lost in one area may be gained elsewhere. Knowing this, it is possible and recommended that the excavation plan be offset to reclaim some or all of the lost airspace during the permit process. Table B-1 is a graphic summarizing the basic requirements of each permitting approach.

Table B-1
Comparison of Permitting Approaches

	New Permit	Registration	Existing Permit Modification	Notification
Schedule	2-3 year time frame (no major opposition); Could require 1-2 additional years with major opposition	18 months	6-12 months	6 months
Potential Cost	$750,000 to $1 million (no major opposition); Could require additional $500,000 to $1 million with major opposition	$500,000	$50,000-$100,000	$25,000
Key Steps	▪ Applicant information ▪ Facility information ▪ Evidence of competency ▪ Site development plan ▪ Land use compatibility determination (Fatal Flaws) ▪ Site operating plan ▪ Separate financial assurance ▪ Public notice ▪ Potential for a public hearing	▪ Provide information incorporated into an existing permit ▪ Update site development plan ▪ Update site operating plan ▪ Public notice ▪ Public meeting(s)	▪ Provide additions to a Permit ▪ Update site development plan ▪ Update site operating plan ▪ No public notice ▪ Notification of surrounding property owners of modifications	▪ Applicant Information ▪ Type of waste ▪ Waste management & processing methods ▪ Other information requested by the ED





N

0 500 1,000 2,000

Feet

Legend

- Sector Limits
- Previously Landfilled Area
- Proposed Site
- Potential Reclamation Area

DRAFT

CP&Y

F-1741

1820 Regal Row
Dallas, TX 75235
214-638-0500

McCommas Bluff Landfill
Facility Siting

FIGURE B-2

Appendix C
RESOURCE RECOVERY PARKS

In addition to the two Resource Recovery Park (RRP) case studies provided in Section 5 of the report, Appendix C contains information on seven other RRP examples in the United States including:

- Denton, Texas;
- Newton, North Carolina;
- Austin, Texas;
- Milpitas, California;
- San Leandro, California;
- Burlington, New Jersey; and
- Eugene, Oregon

The list includes public and private RRPs as well as information on the diversion/recycling programs they operate.

Resource Recovery Parks
Examples of Currently Operating Facilities and Programs

	ECO-W.E.R.C.S. (Waste to Energy, Recycling, Composting, Solar) Facility City of Denton, TX	Catawba County Ecocomplex Newton, NC	Eco-Industrial Park Austin, TX	Newby Island Resource Recovery Park Milpitas, CA	Davis Street Resource Recovery Complex San Leandro, CA	Rutgers University Ecocomplex Burlington, NJ	St. Vincent de Paul Eugene, OR
Owner	City of Denton, TX	Catawba County, NC	Texas Disposal Systems (TDS)	Republic Services	Waste Management, Inc.	Rutgers University	St. Vincent de Paul
Population of Service Area	113,000	154,358	800,000 (Austin, TX)	953,000 (San Jose, CA)	1,500,000 (Alameda County, CA)	450,000 (Burlington County, NJ)	157,000 (Eugene, OR)
RRP/Facility Size	250 acre site with 150 acre landfill waste footprint	805 acres	Eco-Industrial Park: 210 acres; Landfill: 1,750 acres	342 acres	52 acres	32,000 sq. ft. Ecocomplex facility; 522 acre site with 123 acres of landfill	
Throughput	600 TPD	418 TPD	MRF: 300 TPD Landfill: 1,800 TPD	4,000 TPD	1,000 TPD		5,329 tons diverted in 2012

Facilities/Services	▪ Landfill
	▪ Building Materials Recovery (BMR) program (C&D)
	▪ Biosolids & yard waste composting
	▪ MRF
	▪ E-waste, appliance recycling
	▪ LFGTE
	▪ Wind energy
	▪ HHW curbside collection
	▪ Reuse Store for HHW
	▪ Pharmaceutical take-back program
		▪ Landfill
		▪ Wood manufacturing plant
		▪ Pallet mfg plant
		▪ Energy Recovery Facility (LFGTE)
		▪ Biodiesel Research Facility
		▪ Crops for biodiesel research
		▪ Crop processing facility
			▪ MRF
			▪ Landfill
			▪ Yard waste composting
			▪ Tree farm
			▪ C&D recycling
			▪ Recycling & Resale Center (reuse store)
				▪ Landfill
				▪ LFGTE
				▪ MRF – single-stream (dry) and organics (wet)
				▪ C&D recycling
				▪ Composting facility
					▪ Transfer station
					▪ MRF
					▪ C&D recycling
					▪ Organics recovery (composting offsite)
					▪ E-waste, tires, appliance & mattress recycling
						▪ Research facilities & laboratories
						▪ Conference Center
						▪ R & D Greenhouse
						▪ Environmental Incubator for start-up businesses
						▪ Burlington County Landfill:
						  ▪ LFGTE
						  ▪ Co-composting facility (biosolids & wood waste)
						  ▪ HHW & Small Quantity Generator waste
						  ▪ E-waste recycling
						  ▪ Bulky waste recycling (drywall, carpet, shingles, tires, wood, appliances)
							▪ Mattress, appliance, propane recycling
							▪ Glass recycling
							▪ Candle wax recycling
							▪ Pet bed mfg
							▪ Furniture mfg
							▪ Retail thrift store

Resource Recovery Parks
Examples of Currently Operating Facilities and Programs

	ECO-W.E.R.C.S. (Waste to Energy, Recycling, Composting, Solar) Facility City of Denton, TX	Catawba County Ecocomplex Newton, NC	Eco-Industrial Park Austin, TX	Newby Island Resource Recovery Park Milpitas, CA	Davis Street Resource Recovery Complex San Leandro, CA	Rutgers University Ecocomplex Burlington, NJ	St. Vincent de Paul Eugene, OR
Future/Potential Facilities	▪ Food waste composting and/or food waste-to-livestock ▪ Wood waste recycling ▪ Solar-generated electric energy	▪ Biosolids processing ▪ Algae research for biodiesel production ▪ Composting facility ▪ Greenhouse ▪ Anaerobic digestion ▪ Wood gasification/energy facility ▪ Wood ethanol facility ▪ Brick specialties company	TDS hopes to add recycling businesses and manufacturers to its Eco-Industrial Park so the recyclable materials could be used as feedstock onsite instead of transported across the country for end-use.			Auxilium Energy is building a pilot plant at the EcoComplex producing biofuels using landfill gas as feed.	
Partnerships with Private Business or Universities and Colleges	▪ Pratt Industries (MRF) ▪ University of North Texas (pharmaceutical take-back) ▪ NextEra Energy Power Marketing, LLC (wind energy)	▪ Appalachian State University Biodiesel Research, Development & Production Facility ▪ Univ of NC Charlotte ▪ NC Ag & Technical State University ▪ NC State University					▪ Lane Community College (Oakridge Business Incubator)
Website(s)	http://www.cityofdenton.com/departments-services/departments-q-z/solid-waste-recycling	http://www.catawbacountync.gov/ecocomplex/index.asp http://biodiesel.appstate.edu/	http://www.texasdisposal.com/ http://www.texasdisposal.com/index.php/services-eco-industrial-park	http://newbyisland.com/	http://www.dsgardencenter.com/index.asp	http://ecocomplex.rutgers.edu/ http://www.co.burlington.nj.us/upload/Solid_Waste/Images/Resource_Recovery_Complex.pdf	http://www.svdp.us/what-we-do/recycling-and-manufacturing/

Appendix D
SCREENING ANALYSIS WORKSHOP PRESENTATION

This appendix includes a copy of the screening analysis presented in a workshop with City staff.

City of Dallas Resource Recovery Planning and Implementation

Screening Analysis Workshop

Scott Pasternak, Susan Higgins, Frank Pugsley, Karl Hufnagel, Bill Hindman
November 14, 2013

NATIONAL SECURITY • ENERGY & ENVIRONMENT • HEALTH • CYBERSECURITY

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Screening Analysis Overview and Purpose

- Purpose: Select up to three technologies for further, more detailed evaluation according to analysis of selected criteria. (NOT to make final decisions about implementation.)
  - Level of Diversion Achievable
  - Capital and Operating Cost
  - Compatibility with City's Current Operations
  - Project Delivery Options Available (e.g. Public Private Partnerships)
  - Permitting Complexity
  - Status of Development
- SAIC applied evaluation criteria to each technology and assigned a color/shape based on most favorable (♠), somewhat favorable (◆) and least favorable (■)

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Today's Agenda

Task	Schedule
1. Review analysis of technologies according to screening criteria	12:00 – 1:45 pm
Break	1:45 – 2:00 pm
2. Select 3 technologies for further evaluation (Project Team to lead facilitated process)	2:00 – 4:00 pm
3. Define parameters for detailed analysis for selected technologies	4:00 – 4:30 pm

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Review Analysis of Technologies According to Screening Criteria

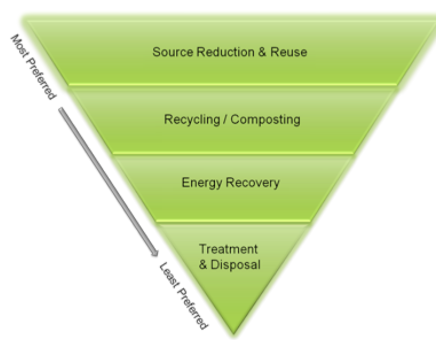
Potential Technologies Reviewed

- Single-stream recycling facility processing source-separated recyclables
- Mixed waste processing facility
  - With landfill disposal of residual material
  - With gasification of residual material
  - With anaerobic digestion of residual material
- Gasification facility processing mixed waste
- Anaerobic digestion facility processing separately collected food waste

Categories of Diversion Explained

- Recycling – For purposes of this analysis, includes recycling of materials from single-stream and MWP.
- Energy Recovery – For purposes of this analysis, includes recovery of energy from gasification and AD.
- Diversion – Includes recycling and energy recovery.

Waste Management Hierarchy
Source: U.S. EPA



Level of Diversion Achievable
(see handouts for detail)

Technology	Residential			Residential and Commercial			Score
	Recycle	Energy	Total	Recycle	Energy	Total	
Single Stream	26%	0%	26%	10%	0%	10%	◆
MWP *with disposal*	37%	0%	37%	16%	0%	16%	◆
MWP *with gasification*	37%	54%	90%	16%	39%	55%	★
MWP *with AD*	37%	18%	55%	16%	6%	22%	★
Gasification	26%	63%	89%	10%	39%	49%	★
AD	26%	5%	31%	10%	5%	16%	◆

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Capital and Operating Cost

Technology	Throughput Range (annual tons)	Land (acres)	Building (sq. ft.)	Staff	Score
Single Stream	100,000-120,000	10-15	120,000-150,000	40-60	★
MWP *with disposal*	250,000-310,000	10-15	150,000-210,000	60-80	◆
MWP *with gasification*	MWP: 250,000-310,000 Gas: 210,000-365,000	15-25	250,000-400,000	70-100	■
MWP *with AD*	MWP: 250,000-310,000 AD: 70,000-100,000	15-30	200,000 -400,000	70-100	■
Gasification	250,000-365,000	15-25	150,000-300,000	50-75	■
Anaerobic Digestion	20,000-80,000	5-30	50,000-200,000	10-25	◆

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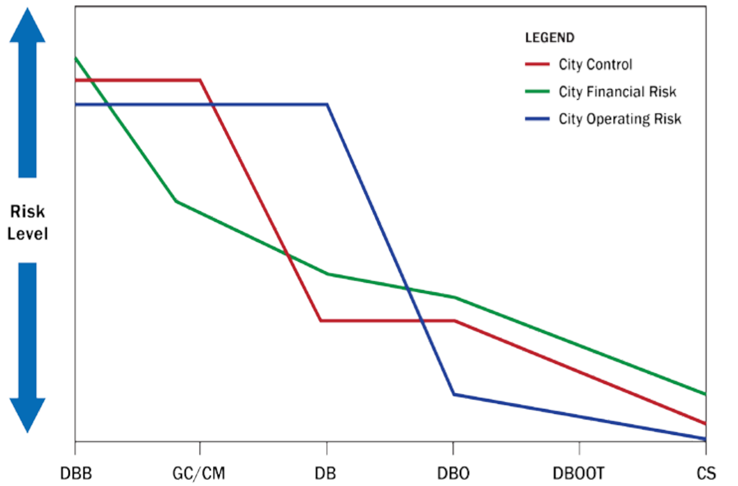
Compatibility with Existing City Operations

Technology	Collection System	LFG Recovery	Score
Single Stream	Consistent with current operation	Minimal impact	★
MWP *with disposal*	Compatible with current collection system and single stream; Systems could be integrated	Minimal impact	★
MWP *with gasification*	Compatible with current collection system and single stream	May reduce LFG recovery	◆
MWP *with AD*	Compatible with current collection system and single stream; Could benefit from source separated collection of organics	Would reduce LFG recovery	◆
Gasification	Compatible with current collection system and single stream	May reduce LFG recovery	◆
Anaerobic Digestion	Compatible with single stream; Requires separate collection of source-separated food scraps	Would reduce LFG recovery	■

Project Delivery Options Available

Technology	DBB	GC/CM or CM at Risk	DB	DBO	DBOOT	CS	Score
Single Stream	Yes	Yes	Yes	Yes	Yes	Yes	★
MWP *with disposal*	No	No	No	Yes	Yes	Yes	◆
MWP *with gasification*	No	No	No	Yes	Yes	Yes	◆
MWP *with AD*	No	No	No	Yes	Yes	Yes	◆
Gasification	No	No	No	Yes	Yes	Yes	◆
Anaerobic Digestion	No	No	No	Yes	Yes	Yes	◆

Project Delivery Options Available (continued)



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Permitting Complexity

Technology	Description	Score
Single Stream	Non-notice Permit Modification for MBL	★
MWP *with disposal*	Registration OR Notice Permit Modification for MBL with potential additional time for technical review	◆
MWP *with gasification*	If TCEQ considers MSW facility integral part of gasification → Permit If considers separate from gasification → see MWP with disposal	■
MWP *with AD*	If TCEQ considers MSW facility integral part of AD → Permit If considers separate from AD → see MWP with disposal	■
Gasification	Permit; Some risk of non-approval	■
Anaerobic Digestion	Permit; Some risk of non-approval	■

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Permitting Complexity (continued)

	New Permit	Registration	Existing Permit Modification
Schedule	2-3 years; Potential additional 1-2 years if major opposition	18 months	6-12 months
Potential Cost	$750,000 - $1 million; Potential additional $500,000 - $1 million with major opposition	$500,000	$50,000 - $100,000
Key Steps	• Applicant information • Facility information • Evidence of competency • Site development plan • Land use compatibility determination • Site operating plan • Financial assurance • Public notice • Potential public hearing	• Provide information incorporated into an existing permit • Update site development plan • Update site operating plan • Public notice • Public meeting(s)	• Provide additions to a Permit • Update site development plan • Update site operating plan • No public notice

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Status of Development

Technology	Commercial Status	North American Development	Score
Single Stream	Commercially proven	Well established in North America	★
MWP *with disposal*	Commercially proven	Several facilities in North America	★
MWP *with gasification*	Commercially proven overseas	A few projects in North America are in advanced development stages	◆
MWP *with AD*	Commercially proven overseas for mixed waste	A few projects in the United States for source separated organics	◆
Gasification	Commercially proven overseas	A few projects in North America are in advanced development stages	◆
Anaerobic Digestion	Commercially proven overseas for mixed waste	A few projects in the United States for source separated organics	◆

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Summary of Evaluation Criteria

Technology	Level of Diversion	Capital and O&M Cost	Development Status	Compatible with Operations	Permitting Complexity	Delivery Options Available
Single Stream	◆	★	★	★	★	★
MWP *with disposal*	◆	◆	★	★	◆	◆
MWP *with gasification*	★	■	◆	◆	■	◆
MWP *with AD*	★	■	◆	◆	■	◆
Gasification	★	■	◆	◆	■	◆
Anaerobic Digestion	◆	◆	◆	■	■	◆

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Select Three Technologies for Further Evaluation

Group Discussion Parameters

- Purpose of discussion is to select 3 technologies for detailed analysis
  - NOT selecting technologies that will be implemented at this time
  - Can select based on choosing preferences or eliminating low priority options
- Goal is endorsement, not consensus.
  - Acknowledges the balance between having everyone's input and needing to move forward to get things done.
  - May not agree with all of the details, but can the group move forward with broad support?

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Discussion

- Review list of criteria on slide 15.
  - Which criteria are most important? (voting exercise)
  - How should technologies be prioritized based on these criteria?
- Review "tradeoff" matrices on slides 19-23. As you review, consider:
  - Which technologies should be prioritized based on these tradeoffs?
  - Are there any technologies that can be eliminated from consideration based on these tradeoff analyses?

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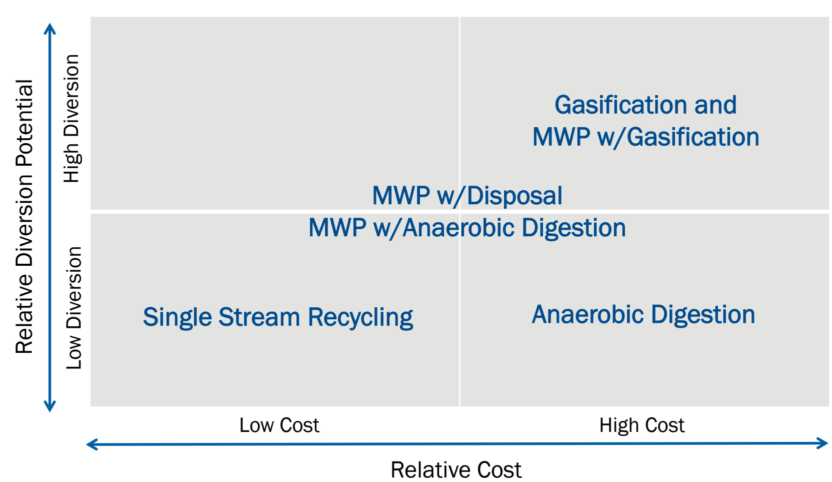
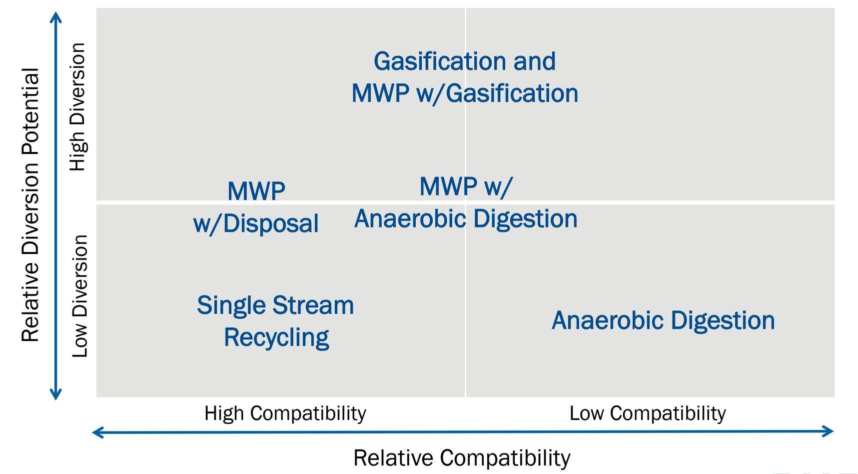
Voting Exercise: Place Five Votes to Any Combination of the Evaluation Criteria Categories

Criteria	Place Votes Below
Level of Diversion	13
Capital and O&M Cost	10
Compatible with Operations	8
Delivery Options Available	1 (or 2?)
Permitting Complexity	4
Development Status	9

Relationship between Diversion and Cost



Relationship between Diversion and Compatibility with Current Operations



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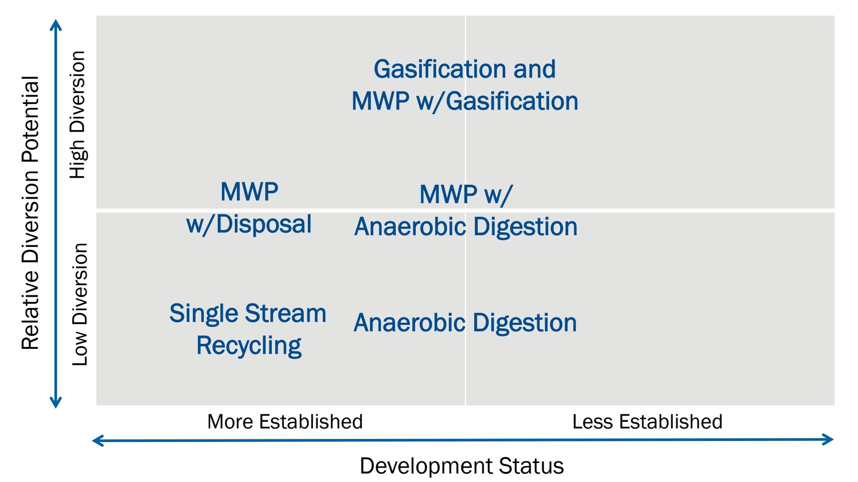
Relationship between Diversion and Development Status



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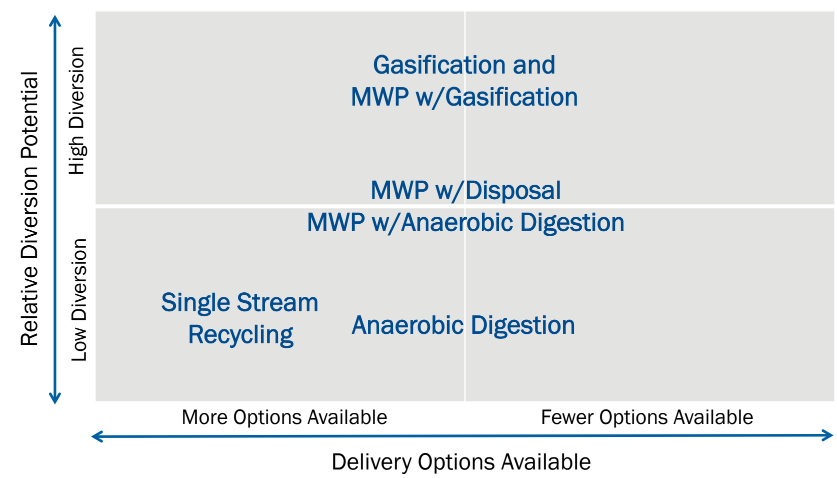
Relationship between Diversion and Delivery Options Available



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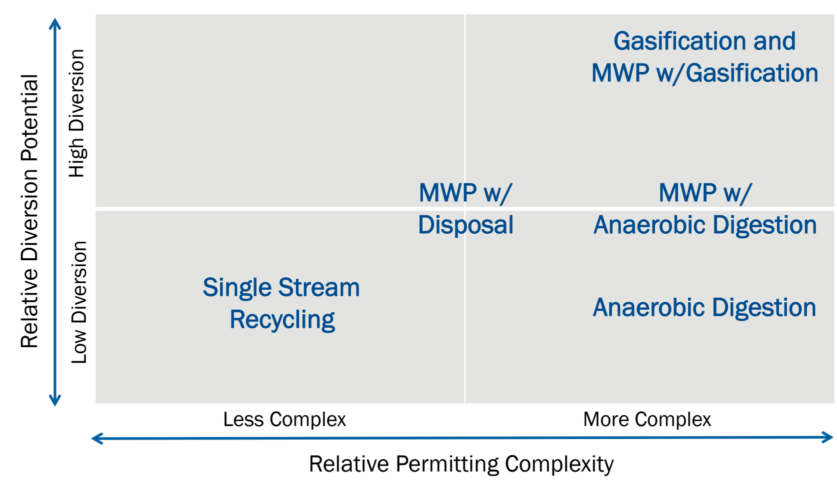
Relationship between Diversion and Permitting Complexity



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Define Parameters for Detailed Analysis

Feedback Needed from the City of Dallas

- For three selected technologies, clarify the following:
  - Will commercial and residential waste be included, or only residential?
  - Should we assume continuation of single stream recycling?
  - What should be the facility capacity?
  - What ownership structure (private, public, or a partnership) should be assumed?

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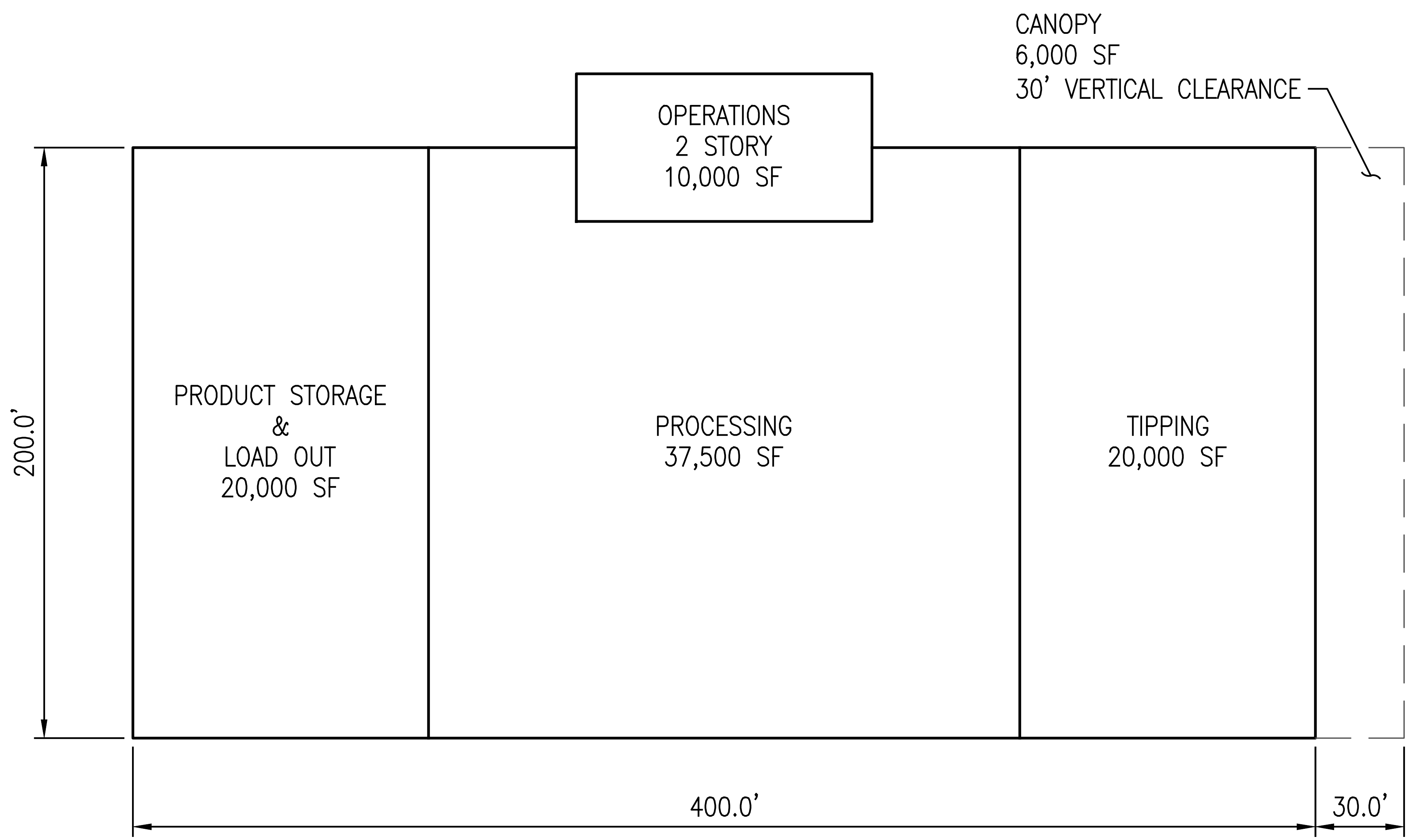
Questions?

Scott Pasternak, Assistant Vice President
Tel: 512.651.6405 | Email: scott.r.pasternak@saic.com

Appendix E
DETAILED TABLES AND DIAGRAMS FOR SINGLE STREAM RECYCLING AND MIXED WASTE PROCESSING

This Appendix includes schematic diagrams for potential single stream and mixed waste processing facilities. In addition, it includes detailed capital and operating cost estimates for both facility types.



E-1
SSR Facility

City of Dallas
Resource Recovery Planning

1"=50' 50 25 0 50 100
Scale Feet

Single Stream Recycling Facility
80,000 SF - 75,000 tons per year

leidos

Project:	City of Dallas Resource Recover Planning
Facility:	Single-Stream Recycling
Estimator:	K. Hufnagel
Date:	December 5, 2013
Estimate Basis:	Planning Level
Costs:	2013
Location:	Dallas Texas

SITEWORK

Item	Quantity	Units	Unit Price	Item Cost
Survey and Setout	1	LS	$20,000.00	$ 20,000
Clearing and Grubbing	15	Acres	$500.00	$ 7,500
Temporary Erosion and Sediment Control	15	Acres	$700.00	$ 10,500
Demolition and Disposal	1	LS	$20,000.00	$ 20,000
Earthwork				
Excavation & Backfill-Trench (1)	2000	CY	$12.00	$ 24,000
General Earthwork (2)	100000	CY	$2.50	$ 250,000
Finishing Grading	3	Acres	$3,000.00	$ 9,000
Roadways Concrete (3)	200	SY	$40.00	$ 8,000
Gravel Base (4)	3000	CY	$28.00	$ 84,000
Asphalt Pavement, Parking (5)	2000	Tons	$75.00	$ 150,000
Concrete Retaining Walls (6)	50	CY	$500.00	$ 25,000
Concrete Cleanout Pad	12	CY	$350.00	$ 4,200
Site Utilities (Distribution)				
Existing Utility Relocates Allowance	1	LS	$25,000.00	$ 25,000
Fire Protection (7)	2000	LF	$65.00	$ 130,000
Water Supply (8)	1000	LF	$35.00	$ 35,000
Sewer System (9)	1000	LF	$65.00	$ 65,000
Electrical (10)	1000	LF	$65.00	$ 65,000
Communications (11)	1000	LF	$18.00	$ 18,000
Site Drainage				
Collection system (12)	2000	LF	$30.00	$ 60,000
Detention ponds (NIC earthwork)	1	LS	LS	$ 25,000
Site Lighting (25 foot Pole Mounted)	20	EA	$2,500.00	$ 50,000
Fencing and Gates	100	LF	$20.00	$ 2,000
Pavement Striping	1	LS	LS	$ 10,000
Site Signage	30	EA	$300.00	$ 9,000
Tempoary Irrigation System	1	LS	LS	$ 10,000
Landscaping (13)	1	LS	LS	$ 25,000
Subtotal				$ 1,141,200

SSR MRF BUILDING

Item	Quantity	Units	Unit Price	Item Cost
Metal Building (14)				
Manufacturer Shop Drawings	1	LS	LS	$ 100,000
Manufacture & Deliver (15)	82500	SF	$20.00	$ 1,650,000
Erection	82500	SF	$10.00	$ 825,000
Building Enhancements				
Masonry Wall Cladding (Bottom 10 Feet)	7000	SF	$25.00	$ 175,000
Translucent Wall Siding/Panels (Optional)	10000	SF	$25.00	$ 250,000
Skylights (Optional)	7000	SF	$25.00	$ 175,000
R19 Wall Insulation w/ Scrim Faciing	17000	SF	$2.00	$ 34,000
R19 Roof Insulation w/ Scrim Faciing	80000	SF	$1.50	$ 120,000
30' canopy	6000	SF	$40.00	$ 240,000
25'x18' Rubber Coiling Vehicle Door	5	EA	$37,000.00	$ 185,000
30'x24' Rubber Coiling Vehicle Door	3	EA	$61,000.00	$ 183,000
18'x16' Rubber Coiling Vehicle Door	1	EA	$30,000.00	$ 30,000
12'x10' Coiling Steel Fork Lift Door	1	EA	$17,500.00	$ 17,500
8'x8' Dock Door w/ Dock Seal, bumpers & Leveler	4	EA	$15,000.00	$ 60,000
3'x7' Personnel Door w/ Hardware	12	EA	$1,500.00	$ 18,000
Coating of Structural Steel	1	LS	$100,000.00	$ 100,000
Alum. Fixed Windows	200	SF	$50.00	$ 10,000
Wall Louvers w/ Gravity Backdraft Dampers	400	SF	$35.00	$ 14,000

Elevator 2 Stop	1	LS	LS	$	75,000
Loading Dock Canopy	500	SF	$30.00	$	15,000
Employee Break Area Canopy	160	SF	$30.00	$	4,800
LEED Silver Certification (Optional)	82500	SF	$5.00	$	412,500
Concrete Slab (16)	600	CY	$350.00	$	210,000
Concrete Slab Tipping Floor (17)	750	CY	$375.00	$	281,250
Abrasion Resistant Topping for Portion of Tippin Floor (18)	12000	SF	$30.00	$	360,000
Concrete Footings & Foundation Walls	500	CY	$475.00	$	237,500
Waterproofing/Waterstops for Top Load Bay	0	SF	$2.00	$-	
Concrete Push Walls (19)	70	CY	$1,000.00	$	70,000
Environmental Separation Tipping Floor/Processing Floor	6000	SF	$10.00	$	60,000
Miscellaneous Metal	20000	LB	$2.75	$	55,000
Building Signage	10	EA	$200.00	$	2,000
Operations Building Support Facilities (partially within main building envelope)					
Mens and Womens Restrooms	500	SF	$120.00	$	60,000
Breakroom with Furniture	500	SF	$120.00	$	60,000
Offices	500	SF	$90.00	$	45,000
Wire Storage Room	250	SF	$50.00	$	12,500
Janitor/Storage	100	SF	$50.00	$	5,000
Electrical Room	350	SF	$50.00	$	17,500
Spinkler Riser Rooms	400	SF	$50.00	$	20,000
Mechanical					
Fire Sprinkler System	82500	SF	$5.00	$	412,500
Washdown Non-Potable Water System	1	LS	$75,000.00	$	75,000
Roof Exhaust Fans	16	EA	$10,000.00	$	160,000
Emergency Eyewash & Shower	1	EA	$6,000.00	$	6,000
Dust Control Misting System (3 zones)	1	LS	$80,000.00	$	80,000
HVAC Systems for Pickline Areas	1	LS	$50,000.00	$	50,000
HVAC for Support Rooms	10000	SF	$20.00	$	200,000
Compressed Air System, 120 psi	1	LS	$30,000.00	$	30,000
Plumbing & Drainage Systems	1	LS	$50,000.00	$	50,000
Top Load Bay Pumping System	0	LS	$20,000.00	$-	
Electrical					
Electrical Distribution Equipment	1	LS	$100,000.00	$	100,000
Interior Lighting	82500	SF	$6.00	$	495,000
Exterior Wall Pak Lighting	10	EA	$500.00	$	5,000
Lightning Protection System	1	LS	LS	$	25,000
Power Outlets	82500	SF	$2.00	$	165,000
Signal, Alarm and Communications	82500	SF	$1.50	$	123,750
Heat Tracing Systems	1	LS	$10,000.00	$	10,000
Subtotal				$	8,176,800

MRF EQUIPMENT (20 tph Sorting System)

Item	Item Cost
Design	$100,000
Presort Platform (4-6 sort stations)	$300,000
Conveyors	$800,000
OCC Disk Screen	$350,000
News Screen	$250,000
Polishing Screen	$250,000
Post-Sort Platform (4 sort stations)	$350,000
Bunkers	$300,000
Drum Feeder	$200,000
Eddy Current Separator	$250,000
Magnetic Separator	$250,000
Optical Sorters	$1,000,000
3D Sort Platforms (4 sort stations)	$350,000
Primary Baler with Feed Conveyor	$700,000
Secondary Baler with Feed Conveyor	$500,000
Ship, Installation, Startup and Testing	$500,000
Warranty Responsibility	$100,000
Subtotal	$ 6,550,000

MOBILE EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost
Front Loader	1	EA	$400,000	$400,000
Forklift	1	EA	$60,000	$60,000
Skid Steer	1	EA	$70,000	$70,000
Subtotal				$ 530,000

PROJECT COSTS

DESIGN / ENGINEERING/SUPPORT FOR CONTRACTOR PRICING (12% of Construction/5% of MRF Equipment)	$ 1,509,000
PERMIT ACQUISITION (0.5% of Construction + $100,000 for a Landfill permit amendment)	$ 149,000
SURVEYING AND SOILS REPORT	$ 70,000
CONSTRUCTION MANAGEMENT/INSPECTION (3% of Construction & MRF Equipment)	$ 492,000
LEED Silver Certification (0.75% of Construction)	$ 74,000
PROJECT CONTINGENCY (10% of Construction and 5% of MRF Equipment) (1)	$ 1,312,000
OWNERS ADVISORY SERVICES AND INTERNAL ADMIN COSTS	$ 1,000,000
Subtotal	$ 4,606,000
Total Capital Cost	**$ 21,004,000**

Notes:
(1) No demolition required
(2) General earthwork includes excavation, moving soil, importing soil, embankments, placement and compaction
(3) Roadway concrete includes rolled curb and gutter and isolated concrete pavement slabs
(4) 12" thick grave base
(5) 5" thick asphalt pavement
(6) Assume miscellaneous walls, average height of 4 feet
(7) Assume 8" PVC primary loop with 4 fire hydrants and dbl. check valve backflow protection in vault
(8) Assume 6" PVC supply, 3" meter
(9) Assume 6" PVC with gravity drainage to existing on site manhole
(10) Assume underground from property line with padmount 2,500 kVA transformer by PUD
(11) Assume 2" PVC conduit to Com Room.
(12) Assume 8" PVC with catch basins and oil/water separators
(13) Modest amount in disturbed areas
(14) Assume 200' clear span Main Frames 30 feet on center, 30' minimum interior vertical clearance
(15) Manufacturer's standard metal siding profile w/ standing seam roof; 20-year warranteed fluoropolymer finish
(16) 8" thick slab fc' = 4,000 psi
(17) 10" thick slab fc' = 6,000 psi
(18) 1.5" thick emery aggregate topping
(19) 12" thick x 12' high w/ 1/2" steel armor plate to 8' high

Project:	City of Dallas Resource Recovery Planning
Estimator:	K. Hufnagel
Date:	December 5, 2013
Estimate Ba:	Planning Level
Costs:	2013
Location:	Dallas Texas

LABOR (1)

Job Classification	Personnel (2)	$/hr(3)	hrs/year (4)	Annual Cost
Facility Manager	1	70.00	2080	$ 145,600
Administrative / Clerical	1	28.00	2080	58,240
Shipping Clerk	1	35.00	2080	72,800
Building/Grounds Maintenance	1	40.00	2080	83,200
Tipping Floor Equipment Operators	1	45.00	4160	187,200
Floor Spotter/Laborer	1	25.00	4160	104,000
Pre-Sort Labors (Contract)	3	14.00	4160	174,720
Sort/QC Labors (Contract)	12	14.00	4160	698,880
Operations Lead	1	60.00	4160	249,600
Baler Operator/Skidsteer & Forklift Operator/End Product QC	2	38.00	4160	316,160
Maintenance Lead	1	56.00	4160	232,960
Maintenance Tech	1	53.00	4160	220,480
Subtotal	26	Total FTE (day shift)		$ 2,544,000

BUILDING AND SITE MAINTENANCE (5)	$ 88,880
Subtotal	$ 89,000

EQUIPMENT MAINTENANCE COSTS

Item	No. Veh.	Quantity	Units	Unit Price	Annual Cost
MRF Equipment Maintenance and Repair (6) in addition to maintenance labor above, 3% of capital					$ 196,500
Front Loader (7)	1	4160	hrs	$15.00	$ 62,400
Forklift (8)	1	2912	hrs	$4.00	$ 11,648
Skidsteer (8)	1	2912	hrs	$5.00	$ 14,560
Subtotal					$ 285,000

UTILITIES - BUILDING AND SITE

Item		Quantity	Units	Unit Price	Annual Cost
Electricity (<999kW load)					
	Customer Charge (9)	12	Months	$100.00	$ 1,200
	Delivery Demand Charge (10)	6,600	kW-Mo	$7.00	$ 46,200
	Energy Charge (11)	1,500,000	kWh	$0.06500	$ 97,500
Sewer (12)		300	1000 gal	$4.00	$ 1,200
Water (13)					
	Commodity Charge	400	1000 gal	$4.00	$ 1,600
Subtotal					$ 148,000

ROLLING STOCK FUEL COSTS

Item	No. Units	Quantity	Unit	Unit Price	Annual Cost
Material Handler	4160	4	gal/hour	$4.00	$ 66,560
Forklift	2912	1	gal/hour	$4.00	$ 11,648
Skidsteer	2912	1.2	gal/hour	$4.00	$ 13,978
Subtotal					$ 92,000

CONSUMABLES/SERVICES

Item	Quantity	Unit	Unit Price	Annual Cost

Sorters' Personal Protective Equipment	32	person/year	$0	$ -
Uniform/Laundry Service	12	Month	$1,500	$ 18,000
Breakroom/Locker Room Supplies	12	Month	$500	$ 6,000
Subtotal				$ 24,000

BALER WIRE

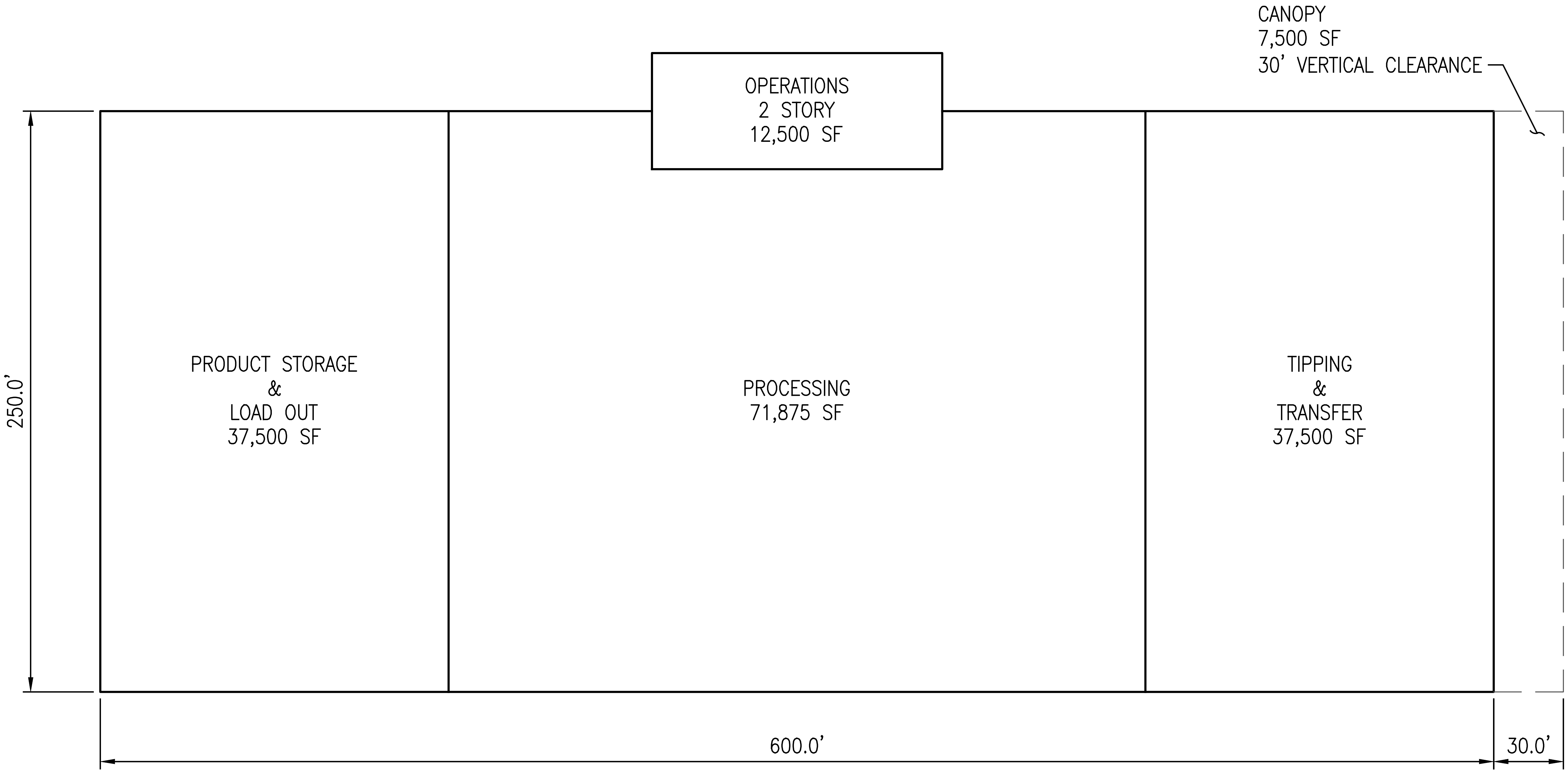
Item	Quantity	Unit	Unit Price	Annual Cost
Baler Wire	46500	Ton Baled	4.00	$ 186,000
Subtotal				$ 186,000

INSURANCE

Item	Quantity	Unit	Unit Price	Annual Cost
Workers Compensation	25,440	$100 payroll	$0.12	$3,053
General & Polution Liability				$26,000
Property	$ 15,000,000	$100 Facility Value	$0.15	$22,500
Subtotal				$ 52,000

SUBTOTAL OPERATION & MAINTENANCE	$ 3,420,000
CONTINGENCY (10%)	$ 342,000
ACCOUNTING, SUPPLIES, MISC. (0.25%)	$ 8,000
TOTAL ANNUAL OPERATION & MAINTENANCE COST	$ 3,770,000

Notes:
(1) Based on private partner operating the facility
(2) Full time equivalent staffing; assumed "lean" staffiing levels
(3) Includes fringe benefits and payroll taxes, holidays and vacations
(4) Based on two 8 hour shifts/day, 5 days/week, 52 weeks/year
 0% sick and training (non-productive) time; so 2080 hrs/year for employees
 Non-productive time does not apply to contract labor, so 2080 hours/shift/year
(5) Calculated as 1.0% of initial $8,888,000 of capital cost per year for the site work and building
(6) 3% of MRF Equipment Capital Cost of $6,000,000
(7) Assume front loader operates continuously during station operating hours
(8') Assume forklift and skidsteer are operated 70% of station operating hours
(9) Assume Customer Charge $75/month for <999kW
(10) Assume Billing Demand Charge Average $7/kW/month and estimated 550 kW Demand
(11) Assume Energy Charge Average ~ $0.065/kWh
(12) Assume $4/1000 gal
(13) Assume 25 staff/visitors @ 25 gal/shift, 520 shift-days per year = ~325,000 gal/yr
 Remainder of water usage involved in washdown and irrigation



E-2
MWP Facility

City of Dallas
Resource Recovery Planning

50 25 0 50 100
1"=50'
Scale Feet

Mixed Waste Processing Facility
150,000 SF - 250,000 tons per year

leidos

Project:	City of Dallas Resource Recovery Planning
Facility:	Mixed Waste Processing
Estimator:	Karl Hufnagel
Date:	December 5, 2013
Estimate Basis:	Planning Level
Costs:	2013
Location:	Dallas Texas

SITEWORK

Item		Quantity	Units	Unit Price	Item Cost
Survey and Setout		1	LS	$20,000.00	$ 20,000
Clearing and Grubbing		15	Acres	$500.00	$ 7,500
Temporary Erosion and Sediment Control		15	Acres	$700.00	$ 10,500
Demolition and Disposal		1	LS	$20,000.00	$ 20,000
Earthwork					
	Excavation & Backfill-Trench (1)	2000	CY	$12.00	$ 24,000
	General Earthwork (2)	100000	CY	$2.50	$ 250,000
	Finishing Grading	3	Acres	$3,000.00	$ 9,000
Roadways Concrete (3)		200	SY	$40.00	$ 8,000
Gravel Base (4)		3000	CY	$28.00	$ 84,000
Asphalt Pavement, Parking (5)		2000	Tons	$75.00	$ 150,000
Concrete Retaining Walls (6)		50	CY	$500.00	$ 25,000
Concrete Cleanout Pad		12	CY	$350.00	$ 4,200
Site Utilities (Distribution)					
	Existing Utility Relocates Allowance	1	LS	$25,000.00	$ 25,000
	Fire Protection (7)	2000	LF	$65.00	$ 130,000
	Water Supply (8)	1000	LF	$35.00	$ 35,000
	Sewer System (9)	1000	LF	$65.00	$ 65,000
	Electrical (10)	1000	LF	$65.00	$ 65,000
	Communications (11)	1000	LF	$18.00	$ 18,000
Site Drainage					
	Collection system (12)	2000	LF	$30.00	$ 60,000
	Detention ponds (NIC earthwork)	1	LS	LS	$ 25,000
Site Lighting (25 foot Pole Mounted)		20	EA	$2,500.00	$ 50,000
Fencing and Gates		100	LF	$20.00	$ 2,000
Pavement Striping		1	LS	LS	$ 10,000
Site Signage		30	EA	$300.00	$ 9,000
Tempoary Irrigation System		1	LS	LS	$ 10,000
Landscaping (13)		1	LS	LS	$ 25,000
Subtotal					$ 1,141,200

MWP MRF BUILDING

Item			Quantity	Units	Unit Price	Item Cost
Metal Building (14)						
	Manufacturer Shop Drawings		1	LS	LS	$ 100,000
	Manufacture & Deliver (5)		153125	SF	$20.00	$ 3,062,500
	Erection		153125	SF	$10.00	$ 1,531,250
	Building Enhancements					
		Masonry Wall Cladding (Bottom 10 Feet)	12000	SF	$25.00	$ 300,000
		Translucent Wall Siding/Panels (Optiona	20000	SF	$25.00	$ 500,000
		Skylights (Optional)	13000	SF	$25.00	$ 325,000
		R19 Wall Insulation w/ Scrim Faciing	30000	SF	$2.00	$ 60,000
		R19 Roof Insulation w/ Scrim Faciing	150000	SF	$1.50	$ 225,000
		30' canopy	7500	SF	$40.00	$ 300,000
		25'x18' Rubber Coiling Vehicle Door	5	EA	$37,000.00	$ 185,000
		30'x24' Rubber Coiling Vehicle Door	4	EA	$61,000.00	$ 244,000
		18'x16' Rubber Coiling Vehicle Door	2	EA	$30,000.00	$ 60,000
		12'x10' Coiling Steel Fork Lift Door	1	EA	$17,500.00	$ 17,500
		8'x8' Dock Door w/ Dock Seal, bumpers	4	EA	$15,000.00	$ 60,000
		3'x7' Personnel Door w/ Hardware	12	EA	$1,500.00	$ 18,000
		Coating of Structural Steel	1	LS	$130,000.00	$ 130,000
		Alum. Fixed Windows	250	SF	$50.00	$ 12,500

Wall Louvers w/ Gravity Backdraft Damp	500	SF	$35.00	$	17,500
Elevator 2 Stop	1	LS	LS	$	75,000
Loading Dock Canopy	500	SF	$30.00	$	15,000
Employee Break Area Canopy	160	SF	$30.00	$	4,800
LEED Silver Certification (Optional)	153125	SF	$5.00	$	765,625
Concrete Slab (16)	900	CY	$350.00	$	315,000
Concrete Slab Tipping Floor (17)	825	CY	$375.00	$	309,375
Abrasion Resistant Topping for Portion of Tippin Floor (18)	23000	SF	$30.00	$	690,000
Concrete Footings & Foundation Walls	650	CY	$475.00	$	308,750
Waterproofing/Waterstops for Top Load Bay	0	SF	$2.00	$	-
Concrete Push Walls (19)	90	CY	$1,000.00	$	90,000
Environmental Separation Tipping Floor/Processing Floor	7000	SF	$10.00	$	70,000
Miscellaneous Metal	23000	LB	$2.75	$	63,250
Building Signage	12	EA	$200.00	$	2,400
Operations Building Support Facilities (partially within main building envelope)					
Mens and Womens Restrooms	600	SF	$120.00	$	72,000
Breakroom with Furniture	600	SF	$120.00	$	72,000
Offices	600	SF	$90.00	$	54,000
Wire Storage Room	300	SF	$50.00	$	15,000
Janitor/Storage	100	SF	$50.00	$	5,000
Electrical Room	400	SF	$50.00	$	20,000
Spinkler Riser Rooms	400	SF	$50.00	$	20,000
Mechanical					
Fire Sprinkler System	153125	SF	$5.00	$	765,625
Washdown Non-Potable Water System	1	LS	$80,000.00	$	80,000
Roof Exhaust Fans	18	EA	$10,000.00	$	180,000
Emergency Eyewash & Shower	2	EA	$6,000.00	$	12,000
Dust Control Misting System (3 zones)	1	LS	$100,000.00	$	100,000
HVAC Systems for Pickline Areas	1	LS	$80,000.00	$	80,000
HVAC for Support Rooms	12500	SF	$20.00	$	250,000
Compressed Air System, 120 psi	1	LS	$30,000.00	$	30,000
Plumbing & Drainage Systems	1	LS	$60,000.00	$	60,000
Top Load Bay Pumping System	0	LS	$20,000.00	$	-
Electrical					
Electrical Distribution Equipment	1	LS	$120,000.00	$	120,000
Interior Lighting	153125	SF	$6.00	$	918,750
Exterior Wall Pak Lighting	16	EA	$500.00	$	8,000
Lightning Protection System	1	LS	LS	$	30,000
Power Outlets	153125	SF	$2.00	$	306,250
Signal, Alarm and Communications	153125	SF	$1.50	$	229,688
Heat Tracing Systems	1	LS	$10,000.00	$	10,000
Subtotal				$	13,296,000

MRF EQUIPMENT	
Design	$200,000
Shredder	$700,000
Presort Platform (4-6 sort stations)	$700,000
Conveyors	$1,600,000
OCC Disk Screen	$1,000,000
Polishing screen	$600,000
Post-Sort Platform (4 sort stations)	$900,000
Bunkers	$800,000
Drum Feeder	$400,000
Eddy Current Separator	$500,000
Magnetic Separator	$500,000
Optical Sorters	$3,000,000
3D Sort Platforms (4 sort stations)	$700,000
Primary Baler with Feed Conveyor	$700,000
Secondary Baler with Feed Conveyor	$0
Control Systems	$500,000
Ship, Installation, Startup and Testing	$1,000,000
Warranty Responsibility	$200,000

Subtotal	$ 14,000,000

MOBILE EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost
Front Loader	1	EA	$400,000	$400,000
Material Handler	1	EA	$400,000	$400,000
Forklift	2	EA	$60,000	$120,000
Skid Steer	2	EA	$70,000	$140,000
Subtotal				$ 1,060,000

OTHER PROJECT COSTS

DESIGN / ENGINEERING/SUPPORT FOR CONTRACTOR PRICING (12% of Construction/5% of MRF Equipment)	$ 2,560,000
PERMIT ACQUISITION (0.5% of Construction, Includes $500,000 for landfill permit amendment)	$ 577,000
SURVEYING AND SOILS REPORT	$ 70,000
CONSTRUCTION MANAGEMENT/INSPECTION (3% of Construction & MRF Equipment)	$ 885,000
LEED Silver Certification (0.75% of Construction)	$ 116,000
PROJECT CONTINGENCY (10% of Construction and 5% of MRF Equipment) (1)	$ 2,250,000
OWNERS ADVISORY SERVICES AND INTERNAL ADMIN COSTS	$ 1,000,000
Subtotal	$ 7,458,000
Total Capital Cost	$ 36,955,200

Notes:
(1) No demolition required
(2) General earthwork includes excavation, moving soil, importing soil, embankments, placement and compactic
(3) Roadway concrete includes rolled curb and gutter and isolated concrete pavement slabs
(4) 12" thick grave base
(5) 5" thick asphalt pavement
(6) Assume miscellaneous walls, average height of 4 feet
(7) Assume 8" PVC primary loop with 4 fire hydrants and dbl. check valve backflow protection in vault
(8) Assume 6" PVC supply, 3" meter
(9) Assume 6" PVC with gravity drainage to existing on site manhole
(10) Assume underground from property line with padmount 2,500 kVA transformer by PUD
(11) Assume 2" PVC conduit to Com Room.
(12) Assume 8" PVC with catch basins and oil/water separators
(13) Modest amount in disturbed areas
(14) Assume 250' interior column support Main Frames 30 feet on center, 30' minimum interior vertical clearan
(15) Manufacturer's standard metal siding profile w/ standing seam roof; 20-year warranteed fluoropolymer finis
(16) 8" thick slab fc' = 4,000 psi
(17) 10" thick slab fc' = 6,000 psi
(18) 1.5" thick emery aggregate topping
(19) 12" thick x 12' high w/ 1/2" steel armor plate to 8' high

Facility:	Mixed Waste Processing
Estimator:	Karl Hufnagel
Date:	December 5, 2013
Estimate Basis:	Planning Level
Costs:	2013
Location:	Dallas Texas

LABOR (1)

Job Classification	Personnel (2)	$/hr(3)	hrs/year (4)	Annual Cost
Facility Manager	1	70.00	2080	$ 145,600
Administrative / Clerical	1	28.00	2080	$ 58,240
Shipping Clerk	1	35.00	2080	$ 72,800
Building/Grounds Maintenance	1	40.00	2080	$ 83,200
Tipping Floor Equipment Operators	2	45.00	4680	$ 421,200
Floor Spotter/Laborer	2	25.00	4680	$ 234,000
Pre-Sort Labors (Contract)	8	14.00	4680	$ 524,160
Sort/QC Labors (Contract)	26	14.00	4680	$ 1,703,520
Operations Lead	1	60.00	4680	$ 280,800
Baler Operator/Skidsteer & Forklift Operator/End Product QC	4	38.00	4680	$ 711,360
Maintenance Lead	2	56.00	4680	$ 524,160
Maintenance Tech	2	53.00	4680	$ 496,080
Subtotal	51	Total FTE (day shift)		$ 5,255,000

BUILDING AND SITE MAINTENANCE	$ 139,470
Subtotal	$ 139,000

EQUIPMENT MAINTENANCE COSTS

Item	No. Veh.	Quantity	Units	Unit Price	Annual Cost
MRF Equipment Maintenance and Repair (6) in addition to maintenance labor above, 3% of capital					$ 420,000
Material Handler (7)	1	4680	hrs	$15.00	$ 70,200
Front Loader (8)	1	4680	hrs	$15.00	$ 70,200
Forklift (9)	2	3276	hrs	$4.00	$ 13,104
Skidsteer (9)	2	3276	hrs	$5.00	$ 16,380
Subtotal					$ 590,000

UTILITIES - BUILDING AND SITE

Item	Quantity	Units	Unit Price	Annual Cost
Electricity (<999kW load)				
Customer Charge (10)	12	Months	$100.00	$ 1,200
Delivery Demand Charge (11)	6,600	kW-Mo	$7.00	$ 46,200
Energy Charge (12)	3,000,000	kWh	$0.06500	$ 195,000
Sewer (13)	300	1000 gal	$4.00	$ 1,200
Water (14)				
Commodity Charge	650	1000 gal	$4.00	$ 2,600
Subtotal				$ 246,000

ROLLING STOCK FUEL COSTS

Item	No. Units	Quantity	Unit	Unit Price	Annual Cost
Material Handler	4680	3.8	gal/hour	$4.00	$ 71,136

Front Loader	4680	4	gal/hour	$4.00	$	74,880
Forklift	6552	1	gal/hour	$4.00	$	26,208
Skidsteer	6552	1.2	gal/hour	$4.00	$	31,450
Subtotal					$	204,000

CONSUMABLES/SERVICES

Item	Quantity	Unit	Unit Price	Annual Cost	
Sorters' Personal Protective Equipment	80	person/year	$0	$	-
Uniform/Laundry Service	12	Month	$3,000	$	36,000
Breakroom/Locker Room Supplies	12	Month	$1,000	$	12,000
Subtotal				$	48,000

BALER WIRE

Item	Quantity	Unit	Unit Price	Annual Cost	
Baler Wire	46000	Ton Baled	4.00	$	184,000
Subtotal				$	184,000

INSURANCE

Item	Quantity	Unit	Unit Price	Annual Cost	
Workers Compensation	52,550	$100 payroll	$0.12		$6,306
General & Polution Liability					$25,000
Property	274,470	$100 Facility Value	$0.15		$41,171
Subtotal				$	72,000

CONTINGENCY	$	674,000
ADMIN	$	16,000
TOTAL OPERATING COST	$	7,428,000

Notes:
(1) Based on private partner operating the facility
(2) Full time equivalent staffing; assumed "lean" staffiing levels
(3) Includes fringe benefits and payroll taxes, holidays and vacations
(4) Based on two 8 hour shifts/day, 5 days/week, 52 weeks/year
0% sick and training (non-productive) time; so 2080 hrs/year for employees
Non-productive time does not apply to contract labor, so 2080 hours/shift/year
(5) Calculated as 1.0% of initial $13,947,000 of capital cost per year for the site work and building
(6) 3% of MRF Equipment Capital Cost of $13,500,000
(7) Assume material handler operates continuously during station operating hours
(8) Assume front loader operates continuously during station operating hours
(9) Assume forklifts and skidsteers are operated 70% of station operating hours
(10) Assume Customer Charge $75/month for <999kW
(11) Assume Billing Demand Charge Average $7/kW/month and estimated 550 kW Demand
(12) Assume Energy Charge Average ~ $0.065/kWh
(13) Assume $4/1000 gal
(14) Assume 50 staff/visitors @ 25 gal/shift, 520 shift-days per year = ~650,000 gal/yr
Remainder of water usage involved in washdown and irrigation

Appendix F
CITY OF DALLAS SINGLE STREAM AND MIXED WASTE MRF PUBLIC-PRIVATE PARTNERSHIP INTERVIEW MEMO

To: Private Recycling Companies

From: Scott Pasternak, Burns & McDonnell

Subject: City of Dallas Single-Stream and Mixed Waste MRF Public-Private Partnership Interview

Date: March 24, 2014

Introduction

The City of Dallas (City) has made a substantial investment in curbside single-stream recycling, and currently has a processing services agreement (PSA) in place for processing City-collected material at a privately-owned and operated facility. The current PSA will expire at the end of 2016. Therefore, the City will implement new services for processing of this material after the expiration of the current agreement.

As a part of a Project Team, Burns & McDonnell and ARI have been retained by the City to explore potential opportunities relating the processing of recyclables for the City of Dallas, which might include public/private partnerships. As part of this effort, we are conducting confidential, telephone interviews with representative private recycling companies. The purpose of these informational interviews is to gain an understanding of the types of public-private partnerships that could be mutually beneficial and that would be of most interest from a private perspective.

The public-private partnership options that are common in the industry include the following.

- Processing services agreement (PSA) for single-stream processing at an existing, private facility
- PSA for single-stream processing at a new, private facility
- Design-Build-Operate (DBO) of a single-stream processing facility at the McCommas Bluff Landfill
- DBO of a combined single-stream/mixed waste processing facility at the McCommas Bluff Landfill

The results of the interview process will be used to gauge the overall level of interest of the recycling industry in the different service options and specifically those types of options in the Dallas market. The results will help inform the City about potential industry trends and the interest of the recycling industry in processing agreements and public/private partnerships.

Interview Questions

Thank you for your participation in this effort for the City. Listed below are the questions that we would like to discuss during the interview. **All responses from individual companies will**

be held as confidential and will be aggregated before being presented to the City. Please do not hesitate to contact Scott Pasternak at (512) 589-3411 if you have any questions.

1. How does you your company feel about RFP's issued with multiple proposal options? What concerns might your company have about such a procurement process?
2. What would be your company's preferred approach to providing processing services to the City, including: use of an existing facility in the region; development of a new private facility; or, development of a facility in partnership with the City at the McCommas Bluff Landfill?
3. What would be the optimal or preferred public-private partnership scenario for a facility at the McCommas Bluff Landfill:
    a. Public or private ownership and financing of site and structures?
    b. Public or private ownership and financing of processing equipment?
    c. Term of operating contract?
    d. Other key project elements?
4. For your company's preferred approach(es) to providing processing services, what would you suggest as a reasonably conservative estimate of the amount of time following contract award that the facility would be on-line and available to receive materials for processing? What would be the fastest possible time to start-up, and what type of actions would be required by the City to enable an accelerated schedule?
5. Would your company have an interest in providing processing services for one to two years while a long-term option is developed, independent of what that long-term option may be? If yes, please elaborate on how this service could be provided (e.g., what facility(ies) would be used, minimum/maximum contract term, minimum/maximum quantities of material that could be processed, etc.). Could you accommodate a portion of the recycling stream from the City?
6. Is your company aware of any potential tax credits or other financial incentives that could be available to a facility that would be developed as a public-private partnership?
7. What level of experience does your company have with mixed waste processing?
8. Would your company have an interest in developing a combined single-stream/mixed waste processing facility at the McCommas Bluff Landfill?
9. Would your company have the ability to commit waste to a mixed waste processing facility to provide greater financial security for the project? What incentives could the City offer to increase interest in committing waste to such a project?

10. Does your company think that there is a market for film plastic that would be separated as part of a mixed waste processing system? If yes, what is a reasonable price range for this type of material?