MONROE COUNTY SOLID WASTE MANAGEMENT DISTRICT

MIXED WASTE PROCESSING FEASIBILITY STUDY

JANUARY 2018

Prepared for: **Monroe County Solid Waste Management District**
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Rev. 2/27/2018

Kessler Consulting, Inc. is a member of, or was awarded, the following:

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List of Acronyms

C&D	Construction and Demolition
County	Monroe County
District	Monroe County Solid Waste Management Disctrict
EPS	Expanded polystyrene
G&A	General and administrative
GBN	Green Business Network
HDPE	High density polyethylene
Hoosier	Republic Services, dba Hoosier Disposal and Recycling
IDEM	Indiana Department of Environmental Management
IPF	Intermediate processing facility
IU	Indiana University
KCI	Kessler Consulting, Inc.
MRF	Materials recovery facility
MSW	Municipal solid waste
MWF	Mixed waste processing facility
OCF	Organics composting facility
PET	Polyethylene terephthalate
PPP	Public-private partnership
Region	Monroe County and adjacent counties
SWMD	Solid Waste Management District, referring to districts in adjacent counties.
WCS	Waste composition study

Executive Summary

Overview

The District contracted with KCI to conduct a materials processing feasibility study to help drive the District's policy, program, and infrastructure decisions. The study involved a series of specific tasks: Assessment of the existing waste management system, a waste composition study, a technology assessment, defining material processing scenarios, and an assessment of those scenarios. After each task, KCI submitted a technical memorandum to the District that served as progress reports to facilitate ongoing input from the District and refinement of the project. This final report is an integration and synthesis of those memoranda into a consolidated document.

Regional Waste Management System

As a first step in the feasibility study, KCI researched the solid waste management system in the Region. The purpose of this research was to understand the types and quantities of MSW generated, how it is collected, who controls the waste, and where it is ultimately disposed. This information established a baseline understanding regarding the availability of materials needed for assessing the feasibility of processing options.

Table E-1 shows the tons of mixed waste collected in the County by which hauler and its final disposition. Most mixed waste collected in the County is collected by private haulers (approximately 88 percent), while the District, the City, and IU collected the remainder. Nearly 92 percent of the mixed waste collected in the County is disposed at the Hoosier Transfer Station, including all mixed waste collected by public haulers.

Table E-1: Tons of Mixed Waste Generated Within Monroe County by Hauler

Hauler	Tons	Percent	Transfer Station	Final Disposal
City	4,933	4%	Hoosier	Sycamore Ridge
IU	6,542	6%	Hoosier	Sycamore Ridge
District	2,880	2%	Hoosier	Sycamore Ridge
Private Haulers	93,784	88%	Hoosier	Sycamore Ridge
Private Haulers	6,351		*	Medora
Private Haulers	2,496		Rays	**
Private Haulers	1,089		*	Indy RRP
Total	**118,075**	**100%**		

*Direct hauled. **Transferred out of Region.

Table E-2 shows the tons of mixed waste and recyclables collected in the Region. Approximately 44 percent of mixed and 71 percent of recyclables are generated in the County. Private haulers collect and control most of mixed waste. Conversely most recyclables are collected by public entities in the Region, in particular, the county solid waste management districts. The City and IU also generate a significant amount of recyclables. Except for the City, most recyclables are collected as source-separated recyclables.

Table E-2: Tons of Mixed Waste and Recyclables Generated in the Region

County	Mixed Waste	Recyclables
Monroe	118,075	11,404
Morgan	38,610	887
Jackson	41,728	1,596
Lawrence	35,630	1,042
Greene	12,882	446
Owen	12,247	0
Brown	9,216	581
Total	**268,388**	**15,956**
Out-of-Region	63,787	N/A

Waste Processing Technology Assessment

The three types of physical processing facilities that were assessed in this project were:

- IPF
- MRF
- MWF

IPFs are the most basic form of materials processing. They primarily prepare materials for sale as commodities with limited sorting to segregate materials or remove contaminants. They receive source-separated materials and generate very little residue. However, due to the requirement to source separate, communities with only an IPF usually have lower diversion rates because of lower generator participation. Compared to other processing options, IPFs have a lower cost to construct, due to less equipment, and a lower net operating cost per ton. IPFs are generally associated with smaller community recycling programs and handle a few tons per hour of materials.

MRFs receive commingled recyclables, generally dual stream or single stream, that have been source-separated from mixed waste. They use a combination of mechanical technologies and manual processes for sorting materials into marketable commodities. MRFs produce more residue than IPFs because some of the inbound recyclables are not sorted out due to contamination and processing inefficiency. Single stream collection and MRFs can achieve higher recovery rates than IPF-based systems due to the collection convenience and higher participation by citizens and businesses. MRFs have a high cost to construct and operate and need to handle more recyclables than an IPF in order to be economically viable. Design capacities of MRFs currently operating in the U.S. range from 10 to 70 tons per hour. MRFs smaller than 10 tons per hour are difficult to justify economically due to the capital cost and the number of staff needed to operate the facility.

MWFs are similar to MRFs in that they use mechanical and manual methods to sort a mixed stream of materials to recover marketable commodities. The difference is that MWFs process the entire mixed waste to recover recyclables and, in some cases, compostable or combustible materials. MWFs use specialized equipment at the front end to process and sort mixed waste into streams that can then be handled by equipment similar to that used in MRFs. MWFs produce more residue than MRFs. They can achieve high overall recovery rates compared to IPF- or MRF-based systems because materials are recovered from mixed waste. MWFs do not necessarily replace the need for source-separation and MRFs, and in fact many are operated in conjunction with source-separation programs and have the ability to accept and process source-separated recyclables.

Waste Composition Study

KCI conducted a 5-day WCS to measure the composition of mixed waste generated from five different generation sectors: District, City, IU, private haulers in the County, and out-of-county. During this study 40 samples of mixed waste were pulled from collection vehicles delivering waste from these different sectors to the Hoosier Transfer Station. Samples were hand sorted into 42 material categories.

The results (see Figures E-1 – E5) indicate that recyclable paper and containers comprise 25 to 35 percent of mixed waste being disposed. In addition, compostable materials (green in the pie charts) account for approximately 40 percent of the County's waste stream. Many communities across the US are focusing new diversion programs on compostable materials because of the opportunity they represent. Given these results, it was decided to include composting of source-separated organics as one of the processing scenarios assessed in this project.

Figure E-1: Composition of District Mixed Waste

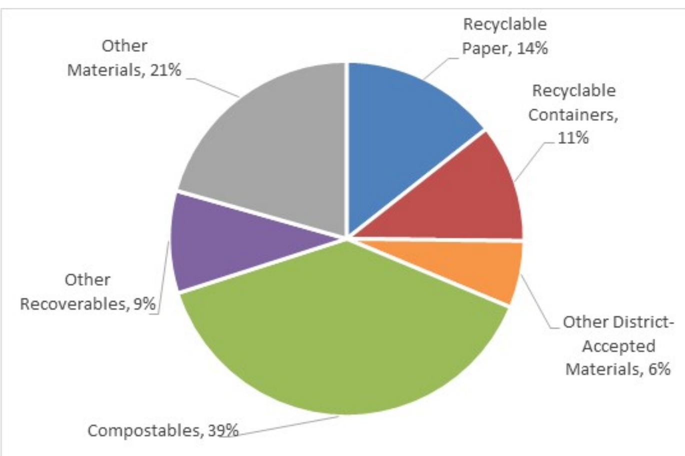


Figure E-2: Composition of City Mixed Waste

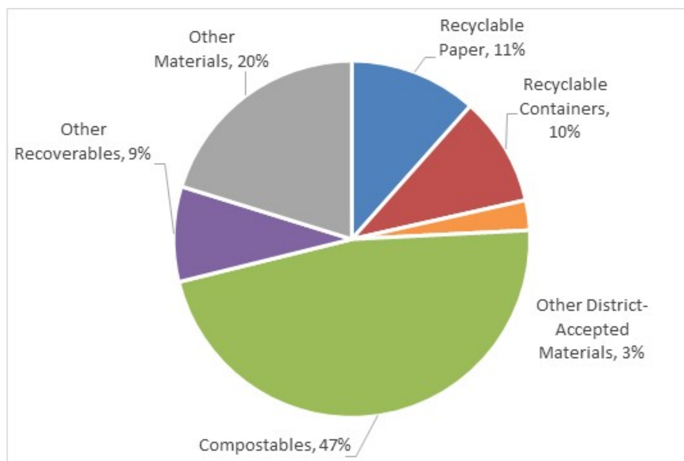


Figure E-3: Composition of IU Mixed Waste

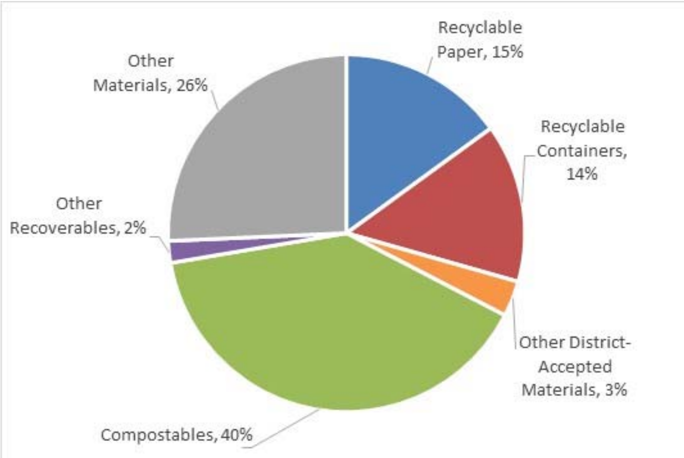


Figure E-4: Composition of Private Mixed Waste

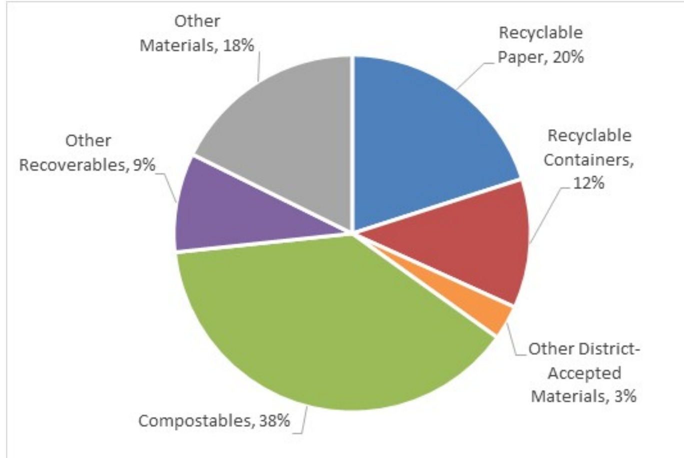
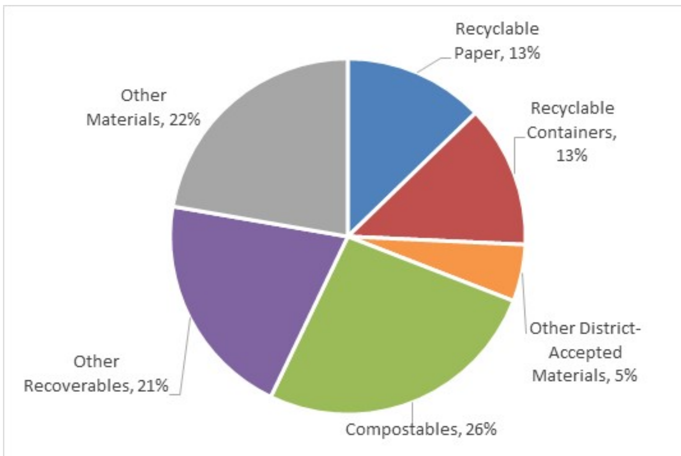


Figure E-5: Composition of Out-of-County Mixed Waste



Scenario Assumptions and Projections

Four materials processing facility options were identified for subsequent analysis: IPF, MRF, MWF, plus an OCF. For each scenario, KCI developed a list of assumptions regarding the sources of material and how much of that material may be handled by a facility. It is important to note that the assumptions are hypothetical for the purpose of conducting the financial assessment (Section 6) and supporting the District's planning process. Table E-3 summarizes each facilities' estimated tonnage and impact on the County recovery rate.

Table E-3: Facility Tonnage and Impact on County Recovery Rate

	Scenario 1 IPF	Scenario 2 MRF	Scenario 3 MWF	Scenario 4 OCF
Tons/Year – Year 1	5,400 – 6,410	7,460 – 14,630	81,510 – 102,640	2,560 – 3,720
Tons/Day – Year 1*	21 – 25	29 – 56	314 – 395	10-14
County Recovery Rate	11% – 12%	11% – 12%	22% – 27%	12% – 15%
Recovery Rate Increase	2% – 3%	2% – 3%	13% – 18%	3% – 6%

* Based on operating 5 days per week.
Note: tonnage data includes all County and non-County sources handled by the facility while County Recovery percentages are based only on County tonnage.

Assumptions made to develop the results in Table E-3 are summarized below. It is important to note that the estimates are based only on reported quantities of materials, potential compatibility of materials with each processing method, and assumptions regarding the amount of material that might be received at a facility. No discussions were had with potential sources of materials. The estimates are presented for assessment and planning purposes only.

IPF

- The amount of recyclables collected by the District increases due to additional drop-off locations, mobile collection, and expanded Green Business Network (GBN).
- The IPF receives all the District's source-separated recyclables and some recyclables from IU and Morgan County.
- The IPF would handle approximately 5,400 to 6,410 tons of recyclables in the first year and would increase the Countywide recovery rate by 2 to 3 percentage points over the current 9 percent.

MRF

- The District switches to single stream collection, which increases the amount of recyclables collected by the District.
- The amount of recyclables collected by the District increases due to additional drop-off locations, mobile collection, and expanded GBN.
- The MRF receives all of the District's single stream recyclables and either all or none of the City's and IU's recyclables. The MRF also receives material from privates and some adjacent counties in the Region.
- The MRF would handle approximately 7,500 to 14,600 tons of recyclables in the first year, depending on whether it receives tonnage from the City and/or IU, and would increase the Countywide recovery rate by 2 to 3 percent.

MWF

- The MWF handles both single stream recyclables and mixed waste.
- The amount of recyclables collected by the District increases due to switching to single stream recycling and additional drop-off locations, mobile collection, and expanded GBN.

- The MWF receives all recyclable and mixed waste from the District, City, and IU. The MWF also receives a portion of mixed waste and recyclables from private haulers and the adjacent counties.
- The MWF would handle approximately 81,500 to 102,600 tons of recyclables in the first year and would increase the Countywide recovery rate by 13 to 18 percent, depending on how much material is received from private haulers and adjacent counties.

OCF

- The District, City, and IU implement or expand food waste collection and yard waste collection that divert a portion of these materials from the mixed waste.
- The OCF receives all organic material collected by the District, City, and IU, and some material from private haulers in the County.
- The OCF would handle approximately 2,560 to 3,720 tons of compostables in the first year and increases the Countywide recovery rate by 3 to 6 percent.

Feasibility Assessment

The feasibility assessment included consideration of both financial and non-financial factors. The financial feasibility assessment entailed developing planning-level estimates of development and operating costs, projecting financial performance over a 15-year time period. The assessment also considered non-financial and strategic factors relevant to the District's decision-making process about whether and which kind of processing facility it should implement. The following bullet points and Table E-3 summarize the results of the financial assessment.

- An IPF is generally well suited for comparatively small throughput, comparable to what is currently managed by the District and other entities that recover source segregated recyclables in the County and Region. The assessment estimated a range of $5 per ton net revenue to $8 per ton net cost.
- A MRF's typical minimum design capacity is in the range of 10 tons per hour. The financial assessment demonstrates that operating a single stream MRF without material from the City and IU may be difficult to justify strictly from a financial perspective based on avoided disposal costs. The MRF's net cost is estimated in the range of $42 per ton with City and IU tonnage versus $95 per ton without.
- As an alternative to developing a MRF, the District could convert its existing operations to single stream collection and deliver recyclables to Hoosier for processing. This option would require limited capital investment and could achieve a similar impact on the County recovery rate as developing a MRF.
- MWFs currently operating in the U.S. have design capacities in the range of 75 to 100 tons per hour, although design capacities in the 35 tons per hour range are available. To meet this lower throughput level, a MWF would need to handle all waste from the District, City, and IU as well as a portion of waste from private haulers and/or neighboring counties. The net cost is estimated in the range of $36 to $43 per ton.

Without all the tonnage from the City and IU plus tonnage from other source, a MWF would not be financially viable based on current disposal costs.

- OCFs can be developed at a wide range of design capacities. They can be scaled to comparatively small throughput using a basic windrow composting method. The financial assessment estimated a net cost per ton in the range of $41 to $48 per ton.

Table E-4: Summary of Financial Assessment

Capital Cost	Annual Cost	Annual Revenue	Net Annual	Net Per Ton
		IPF		
$3,100,000 - $3,200,000	$573,000 - $597,000	$532,000 - $631,000	($35,000) - $41,000	($5) - $8
		MRF		
$10,300,000 - $10,900,000	$1,400,000 - $2,000,000	$711,000 - $1,400,000	$616,000 - $712,000	$42 - $95
		MWF		
$38,800,000 - $39,900,000	$6,300,000 - $7,100,000	$2,800,000- $3,400,000	$3,500,000 - $3,700,000	$36 - $43
		OCF		
$992,000 to $1,100,000	$213,000 - $251,000	$9,000 - $12,000	$204,000 - $239,000	$41 - $48

Notes:
Annual cost includes annualized capital and operating cost.
Revenue is in parentheses, e.g., ($35,000) is revenue of $35,000.
Rows may not appear to add due to rounding.

Some of the key non-financial strategic factors that play an important role in the feasibility of these processing options include:

- Financing the development of a material processing facility typically requires a predictable and reliable future revenue stream in order to validate or obtain the commitment of capital.
- Because most materials in the Region are controlled by private haulers, how much material is actually available for a processing facility will be critical to its financial viability. As noted previously, MRFs and MWFs, in particular, have a minimum design capacity below which they can be difficult to operate effectively.
- Indiana Code 13-21-3-14.5 limits the ability of solid waste districts to provide waste management services either by themselves or through contracted services. The District would have to demonstrate there is a need for the service and that the service is not already available at a reasonable cost in the County or Region.

- The District's 2004 agreement with Hoosier contains provisions that also impact the District's ability to develop materials processing infrastructure. Article 7 of the agreement states that neither party "…will own, open, operate, encourage, support or otherwise establish the opening or operating of another landfill, transfer station, incinerator, or similar facility for the management and/or disposal of MSW in Monroe County…"
- There are many different types of public- private partnerships (PPPs) possible in the waste management sector: Public contracts with privately owned and operated facilities (like the current District contract with Hoosier, or publicly owned and privately-operated facilities, and even privately financed, developed and operated facilities that transfer to public ownership after time. Some type of PPP may provide an appropriate strategy for the District.
- Many stakeholders are involved in MSW management: Citizens, businesses, the City, IU, private haulers, Hoosier, and neighboring counties. Each has preferred ways of doing business and could be impacted positively or negatively by a District materials processing initiative. The diversity of impacts should to be taken into consideration through some type of stakeholder engagement process.

Conclusion

In conclusion, it appears that potentially financially viable options for new materials processing infrastructure in Monroe County include an IPF, MWF and OCF based on the material flow assumptions developed for this study (financial viability being based on prevailing costs of disposal). But financial viability depends in large part on how much material is actually handled by a facility. Given the fact that the private sector manages a significant amount of the recyclables and mixed waste in the County and Region, it can be expected that the possible development and operation of a materials processing facility in the District will depend to a large degree on the private sector's role in it. Existing statutory and contractual limitations also pose a challenge to a possible District material processing facility which may possibly be addressed through some kind of public-private partnership.

Moving forward, the District can use the information analysis provided in this feasibility study as a starting point for further internal discussions possibly followed by discussions with other key stakeholders with the goal to determine whether and how the District can facilitate the growth of enhanced recovery programs and practices, and the infrastructure to support them, in Monroe County.

Section 1 Introduction

1.1 Overview

The District contracted with KCI to evaluate the feasibility for the District to construct and operate a facility to process recyclables and/or recover recyclables from the mixed waste stream. The feasibility study consisted of the following tasks:

- Task 1 - Assessment of District and Regional Waste Management System
- Task 2 - Recyclables and Waste Composition Study
- Task 3 - Feasibility Study Strategy Session
- Task 4 - Scenario Development and Conceptual Design Parameters
- Task 5 - Scenario Assessment

The results of each task were presented to the District in separate technical memoranda. This report synthesizes them into sections as follows:

- Section 2: Regional Waste Management System
- Section 3: Waste Processing Technology Assessment
- Section 4: WCS
- Section 5: Materials Processing Scenarios: Assumptions and Projections
- Section 6: Materials Processing Scenarios: Feasibility Assessment
- Section 7: Conclusions and Recommendations

Note: While the strategy session was a separate task of the project, it is not discussed separately in this report because the results of the strategy session are incorporated in other tasks/sections.

1.2 Background

The County is located in southern Indiana and is the largest one among its adjacent counties, with a population of 145,496. Most of the County's population resides in the City, which has a population of 84,465. Other municipalities in the County are the Town of Ellettsville, with a population of 6,622, and the Town of Stinesville, with a population of 213.[1] The County includes IU, which has a total student population of 43,710.[2]

[1] STATS Indiana, Population, http://www.stats.indiana.edu/topic/population.asp
[2] Indiana University, Ranking and Campus Statistics, https://www.indiana.edu/about/rankings-statistics.html

The District was created in 1990 under HB 1240 as a local governmental entity with the purpose of managing solid waste in the County. The mission of the District "is to secure a healthier environment in south-central Indiana, by eliminating waste going to final disposal through reduction of source materials, reuse of reusable materials, and recovery of recyclable materials and by offering educational resources and programs; and by promoting sustainable materials practices throughout our communities.[3]"

The District operates five recycling centers throughout the County: A central facility (South Walnut) and four rural collection centers (Dillman Road, Oard Road, Bethel Lane, and Ellettsville). Source-separated recyclables and hazardous waste are collected at these locations. Additionally, bagged mixed waste in the District's pay-as-you-throw Orange Bag program and bulky mixed waste are collected at the rural collection centers.

The District maintains a GBN that provides assistance to businesses in the County to implement or improve their recycling program. Through the GBN, the District provides source-separated recyclables collection service to participating businesses using 64- or 96-gallon roll carts, which are collected by the District in a box truck.

1.3 Acknowledgments

KCI would like to acknowledge and thank the District staff members who assisted us throughout the course of this project. KCI specifically thanks Tom McGlasson and Scott Morgan for their critical role in the project. The cooperation, positive attitudes, comments on draft memoranda, and knowledge of local solid waste management contributed by all team members were essential to the success of the study.

KCI also thanks the staff of Hoosier for allowing KCI to use their transfer station to conduct the WCS and for their cooperation during the WCS. KCI specifically thanks KRD Trucking's loader operators for their essential role in pulling samples at the transfer station during the WCS.

Finally, KCI would like to thank the City and IU staff members, as well as representatives from the adjacent counties, for information they provided during the initial research for the project.

[3] About the District, http://gogreendistrict.com/about.

Section 2
Regional Waste Management System

2.1 Introduction

As a first step in the feasibility study, KCI conducted research into the solid waste management system in the Region. The purpose of this research was to understand the types and quantities of waste generated, how it is collected, who controls the waste, and where it is ultimately disposed. This will represent the baseline data for use in the feasibility assessment. Research also included disposal costs at facilities to gain an understanding of the disposal economics in the Region.

2.2 Summary of District Solid Waste Management System

The District manages five drop-off recycling centers throughout the County for use by its residents. At these centers, the District collects source-separated recyclables, mixed waste in its pay-as-you-throw Orange Bag program, and bulky mixed waste (mixed waste is collected at rural collection centers only). Additionally, the District collects recyclables from businesses in its GBN. Table 2-1 shows the tons of these materials managed by the District in 2014, 2015, and 2016.

Table 2-1: Tons of Mixed Waste and Recyclables Collected at District Recycling Centers

Material	2014	2015	2016
Recyclables	2,880	2,922	2,759
Bagged Mixed Waste	2,083	2,141	2,147
Bulky Mixed Waste	510	675	733
Total	**5,474**	**5,739**	**5,639**

The District has an agreement with Hoosier to haul these materials (at a cost of $100 per load) to Hoosier's transfer station located at 6660 State Road 37 South, except for metals which are hauled to local metal recyclers and glass which is hauled by K&S Trucking to Strategic Materials in Indianapolis.

The District has a contract with Hoosier for disposal of mixed waste at the transfer station and currently pays a $41.86/ton disposal fee. Hoosier pays a $2.75/ton host fee to the District for mixed waste generated within the County and disposed at the facility, excluding mixed waste delivered by the City, mixed waste collected by the District's Orange Bag program, and the District's bulky mixed waste.[4] Material received at the transfer station is

[4] The tip fee for other waste generated in Monroe County is $52.26/ton including the $2.75/ton host fee and $54.57/ton for out-of-County waste. There are minimum charges of $27.80 per load and $3.75 per bag.

transferred to Sycamore Ridge Landfill in Terre Haute or other facilities at Hoosier's discretion.

As part of this agreement, the District is restricted from opening or operating any other landfill, transfer station, waste-to-energy facility or other disposal facility for mixed waste. This does not apply to recycling facilities or other waste reduction programs.

2.3 Regional Solid Waste Management System

To evaluate the feasibility of a materials processing facility for the District, KCI evaluated the waste management system of the Region (the County and six adjacent counties of Morgan, Lawrence, Jackson, Greene, Owen, and Brown). KCI interviewed county SWMDs and municipal solid waste managers in the adjacent counties. An overview of the solid waste infrastructure in each county is presented below.

KCI also analyzed mixed waste data largely compiled from IDEM 2016 solid waste reports.[5] County-wide recycling data from the IDEM 2016 recycling report were also compiled and analyzed.[6] IDEM recycling data only include recyclables diverted from mixed waste sources (e.g., not including construction and demolition debris or industrial recycling, etc.). Recycling data reported by individual SWMDs are from the annual reports they submit to the state under Senate Bill 131.[7]

2.3.1 Monroe County

The City, IU, and various private haulers collect mixed waste and recyclables in the County, in addition to the materials managed by the District

The City collects curbside residential mixed waste and recyclables within the City. The City has an informal agreement to deliver its mixed waste to the Hoosier Transfer Station at a tip fee of $41/ton. Dual stream recyclables are delivered to the Hoosier Transfer Station as well at a $0/ton tip (the City does not pay or receive revenue for its recyclables). In 2016, the City reported that it collected 4,933 tons of mixed waste and 2,609 tons of recyclables. The City transitioned to single stream carted collection in October, which likely increased the tons of recyclables and decreased tons of mixed waste they collect, although updated tonnage figures were not available at the time of this study.

On IU's campus, both IU and Hoosier collect mixed waste and recyclables. All material is delivered to the Hoosier Transfer Station. IU also has an organics collection program collecting pre-consumer food waste from campus dining hall and pre- and post-consumer food waste at athletic venues. IU estimates it collected approximately 6,542 tons of mixed

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[5] IDEM, Complete Solid Waste Quarterly Report Database: http://www.in.gov/idem/landquality/2406.htm. For the purposes of this analysis, individual sources of mixed waste of less than 1,000 tons per year are considered negligible.

[6] IDEM, 2016 Recycling Activity Summary: http://www.in.gov/idem/recycle/files/reporting_2016_activity_report.pdf

[7] Department of Local Government Finance. SB 131 Report: Additional Reporting for Solid Waste Management Districts: https://gateway.ifionline.org/report_builder/Default3a.aspx?rptType=sb131&rpt=SB131&rptName=SB%20131.

waste and 1,050 tons of recyclables in 2016. Approximately 70% of the mixed waste was self-hauled by IU, while the remainder was hauled by Hoosier. Regarding recyclables, IU was not able to provide sufficient data to estimate the percentage of recyclables hauled by IU versus Hoosier. At the time of KCI's research, IU was currently reevaluating how it calculates the tonnage hauled by Hoosier based on recently conducted audits.

All other mixed waste and recyclables in the County are collected by private haulers. The vast majority of the mixed waste is disposed at the Hoosier Transfer Station. Some mixed waste is disposed at out-of-county disposal facilities, namely the Medora Landfill, Rays Transfer Station in Indianapolis, and the Indianapolis Resource Recovery Park. Table 2-2 shows the amount of waste generated within the County, the collection provider, and transfer and/or disposal facilities.

Table 2-2: Tons of Mixed Waste Generated Within Monroe County

Hauler	Tons	Percent	Transfer Station	Final Disposal
City	4,933	4%	Hoosier	Sycamore Ridge
IU	6,542	6%	Hoosier	Sycamore Ridge
District	2,880	2%	Hoosier	Sycamore Ridge
Private Haulers	93,784	88%	Hoosier	Sycamore Ridge
Private Haulers	6,351		*	Medora
Private Haulers	2,496		Rays	**
Private Haulers	1,089		*	Indy RRP
Total	**118,075**	**100%**		

*Direct hauled. **Transferred out of Region.

IDEM reports have less robust data on the generation and fate of recyclables. IDEM reported 11,604 tons of recyclables were generated in the County, which includes the tonnages collected by the District, the City, and IU described above. Most of this material is delivered to the Hoosier Transfer Station, although some material is delivered to other recycling facilities or brokers.

2.3.2 Morgan County

Mixed waste and recyclables in Morgan County are predominantly collected by private haulers. Martinsville has its own municipal collection for curbside residential waste. Additionally, the town owns and operates a transfer station, which is used by the city as well as private haulers and residents. The transfer station's tip fee is $30/ton for up to 1,000 pounds or $48/ton for more than 1,000 pounds. The town has a contract with Waste Management to haul the material to its Twin Bridges Landfill in Danville at a cost of $44/ton. Other private haulers operating in the county haul to other privately-owned disposal facilities. For example, Rays hauls to its transfer station in Clayton, Hoosier hauls to its transfer station in the County, and Best Way hauls to its South Side Landfill in Indianapolis. Table 2-3 shows the tonnage of mixed waste generated in Morgan County.

Table 2-3: Tons of Mixed Waste Generated Within Morgan County

Hauler	Tons	Transfer Station	Final Disposal
Private Haulers	5,737	*	Indy RRP
Private Haulers	5,045	Rays	**
Private Haulers	6,635	*	Twin Bridges
Private Haulers	8,736	*	South Side
Martinsville & Private	7,739	Martinsville	Twin Bridges
Private Haulers	4,718	Hoosier	Sycamore Ridge
Total	**38,610**		

*Direct hauled. **Transferred out of Region.

Rays provides curbside collection of recyclables in Mooresville, which is the only curbside recycling program in the county. Additionally, the Morgan County SWMD maintains six drop-off facilities around the county at which it collects source-separated recyclables and sends them to local markets for processing. It reported that it collected 888 tons of recyclables at its drop-offs in 2016. This is the same as the total tons of recyclables reported by IDEM in 2016 for the county; hence, the tonnage collected by Rays is unknown.

2.3.3 Lawrence County

Lawrence County has two municipal mixed waste haulers: Bedford and Mitchel. Private haulers serve the rest of the county. The Lawrence County SWMD also operates nine drop-off centers for self-haul recyclables and mixed waste by county residents. The county owns a transfer station that is operated by the district and receives mixed waste from municipal and private haulers and self-haul by county residents. The tip fee for private haulers is $36.50/ton, while residents can drop-off their mixed waste at no charge. The transfer station has a contract with Ecotech to haul waste to the Clark Floyd Landfill in Borden. Table 2-4 shows the tonnage of mixed waste generated in Lawrence County

Table 2-4: Tons of Mixed Waste Generated Within Lawrence County

Hauler	Tons	Transfer Station	Final Disposal
Private Haulers	3,280	*	Medora
Municipalities & Private	26,537	Lawrence County	Clark-Floyd
Private Haulers	2,741	Hoosier	Sycamore Ridge
Private Haulers	3,072	*	Clark-Floyd
Total	**35,630**		

*Direct hauled.

Both municipal haulers provide curbside recyclables collection in Lawrence County. The district owns a processing facility where the source-separated materials are baled and shipped to end users and brokers. The district reported that it managed 1,024 tons of recyclables in 2016. No other recycling tons were reported by IDEM in 2016.

2.3.4 Jackson County

In Jackson County, the City of Seymour provides residential curbside collection of recyclables and mixed waste. All other collection is by private haulers, primarily Best Way and Rumpke. Best Way owns the Jackson County Transfer Station, which receives 34 percent of the county's mixed waste that is then transferred to Best Way's Decatur Hills Landfill in Greensburg. The rest of mixed waste is disposed at Rumpke's Medora Landfill. The current tip fee at the Medora Landfill is $32/ton; the Jackson County Transfer Station has a similar tip fee. Table 2-5 shows the tons of mixed waste generated within Jackson County.

Table 2-5: Tons of Mixed Waste Generated Within Jackson County

Hauler	Tons	Transfer Station	Final Disposal
Rumpke & Other Private Haulers	27,409	*	Medora
Best Way & Other Private Haulers	14,319	Jackson County	Decatur
Total	**41,728**		

*Direct hauled.

As mentioned above, Seymour collects residential recyclables through a single stream curbside program. Brownstown and Crothersville have a contract with Rumpke for curbside recyclables collection. Private haulers also offer curbside collection to the remainder of the county as a subscription service. Additionally, the Jackson County SWMD operates four drop-off locations in the county that receive recyclables. The district reported that it managed 824 tons of recyclables in 2016. A total of 1,596 tons of recyclables were reported in the county by IDEM.

Rumpke opened a recyclables transfer station at its Medora landfill in 2017 that bales and markets cardboard, and transfers other recyclables to Rumpke's single stream MRF in Cincinnati, Ohio.

2.3.5 Greene County

In Greene County, Linton and Bloomfield have municipally-provided residential curbside collection of mixed waste. All other mixed waste collection is through private haulers. The Greene County SWMD has a drop-off facility, which receives self-haul mixed waste at $2/bag. Table 2-6 shows the tons of mixed waste generated in Greene County.

Table 2-6: Tons of Mixed Waste Generated Within Greene County

Hauler	Tons	Transfer Station	Final Disposal
Municipalities & Private Haulers	8,084	*	Sycamore Ridge
Municipalities & Private Haulers	2,112	Hoosier	Sycamore Ridge
Municipalities & Private Haulers	2,686	Wallace	**
Total	**12,882**		

*Direct hauled. **Transferred out of Region.

The only reported collection of recyclables in Greene County is provided at the district's drop-off facilities. The district bales and markets corrugated cardboard, while all other recyclables are collected as single stream and hauled by Hoosier to the Republic Services MRF in Indianapolis. The district reported that it collected 446 tons of recyclables in 2016, but IDEM did not report any recyclables collected in the county.

2.3.6 Owen County

Owen County does not have a formal SWMD and very little information could be obtained about the county. Presumably all collection is private and mixed waste is delivered to the Hoosier Transfer Station (Table 2-7).

Table 2-7: Tons of Mixed Waste Generated Within Owen County

Hauler	Tons	Transfer Station	Final Disposal
Private Haulers	12,247	Hoosier	Sycamore Ridge

It is assumed that recycling is very limited in Owen County, as IDEM reported no tonnage of recyclables collected in the county.

2.3.7 Brown County

All curbside collection of mixed waste is provided by private haulers in Brown County. The Brown County SWMD operates six drop-off facilities where mixed waste is accepted at a charge of $2/bag. This mixed waste is hauled by Knight's at a fee of $1.50/bag. Table 2-8 shows the tons of MSW generated in Brown County.

Table 2-8: Tons of Mixed Waste Generated Within Brown County

Hauler	Tons	Transfer Station	Final Disposal
Private Haulers	3,478	*	Medora
Private Haulers	5,738	Hoosier	Sycamore Ridge
Total	**9,216**		

*Direct hauled.

Brown County SWMD also collects source-separated recyclables at its drop-off facilities. There is no curbside collection of recyclables in the county; however, the district does have a collection route in Nashville collecting cardboard and cans from businesses. The district processes, bales, and markets all materials. In 2016, the district reported that it collected 308 tons of recyclables. IDEM reported a total of 581 tons of recyclables from the County in 2016.

2.3.8 Out-of-Region

In addition to the tonnage generated within each county, a significant volume of mixed waste is disposed at facilities within the Region (see Table 2-9).

Table 2-9: Tons of Mixed Waste Generated Out of Region and Disposed within Region

Source	Tons	Transfer Station	Final Disposal
Unknown	1,887	Hoosier	Sycamore Ridge
Unknown	45,998	*	Medora
Unknown	15,902	Jackson	Decatur
Total	**63,787**		

*Direct hauled.

2.4 Regional Mixed Waste Flow

Table 2-10 summarizes the tonnages detailed in Tables 2-2 through 2-9. Approximately 268,400 tons of mixed waste and 16,000 tons of recyclables are generated in the Region. In addition, approximately 63,800 tons of mixed waste are brought in from outside. The County is the largest source of mixed waste and recyclables, accounting for 44 percent and 71 percent, respectively, of materials generated in the Region.

Table 2-10: Tons of Mixed Waste and Recyclables Generated in the Region

County	Mixed Waste	Recyclables
Monroe	118,075	11,404
Morgan	38,610	887
Jackson	41,728	1,596
Lawrence	35,630	1,042
Greene	12,882	446
Owen	12,247	0
Brown	9,216	581
Total	**268,388**	**15,956**
Out-of-Region	63,787	N/A

Table 2-11 shows that approximately 288,600 tons of mixed waste are received at transfer stations and landfills in the Region. In addition, approximately 43,600 tons of mixed waste are directly hauled to facilities outside the Region. The Hoosier Transfer Station handles 48 percent of mixed waste received by facilities in the Region, followed by the Rumpke's Medora landfill which handles 30 percent of mixed waste received at facilities in the Region.

Table 2-11: Tons of Mixed Waste Received at Regional Transfer Stations & Landfills

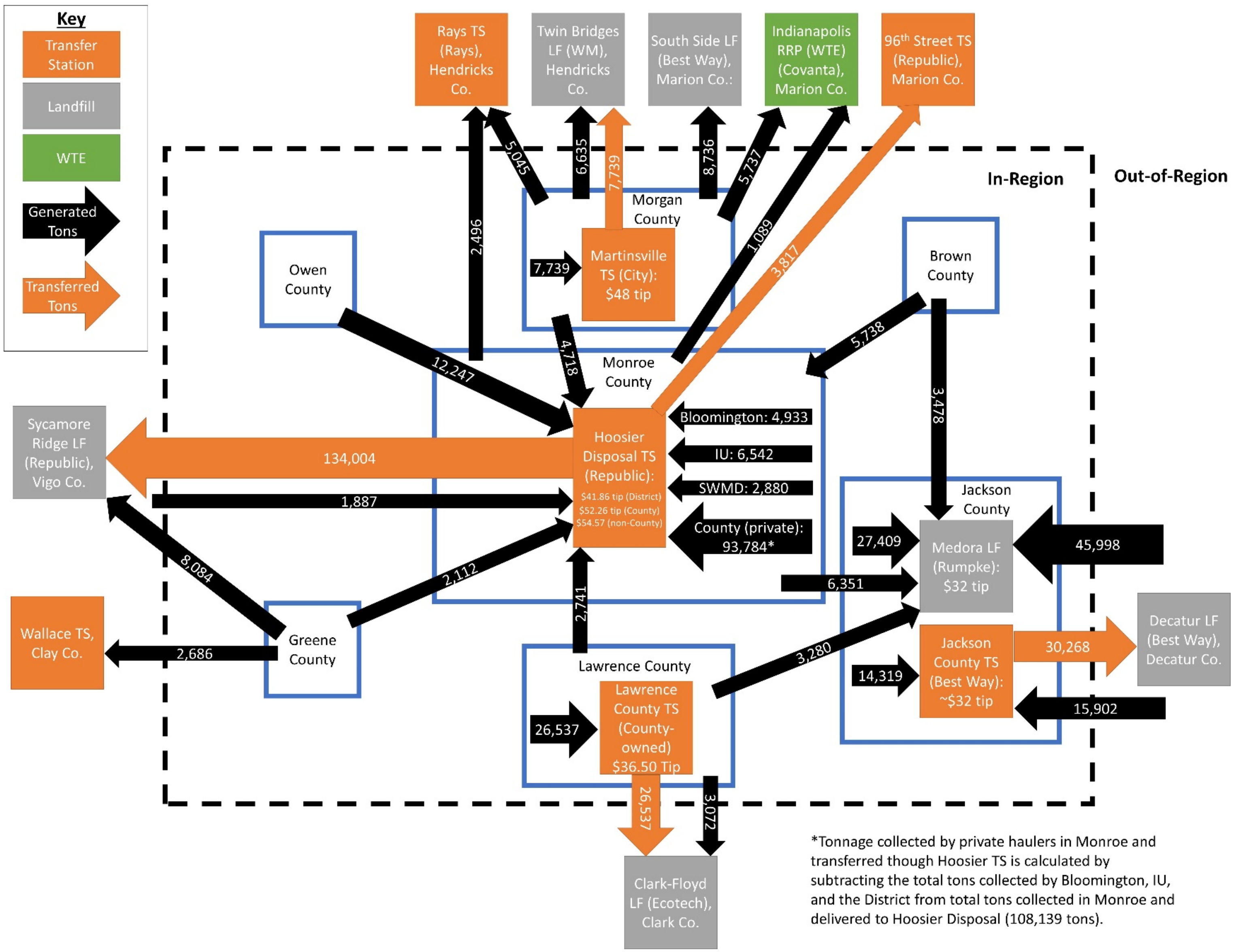
Transfer Station or Landfill	Tons
Hoosier TS	137,582
Medora LF	86,516
Jackson County TS	30,221
Lawrence County TS	26,537
Martinsville TS	7,739
Total	**288,595**
Direct-hauled out of Region	43,580

Notes: TS = Transfer Station; LF = Landfill

Figure 2-1 (next page) is a process flow diagram depicting the flow of mixed waste in the Region. In this diagram, black arrows represent generated tons and orange arrows represent transferred tons. The blue boundaries represent the counties showing tons that are generated within and are hauled or transferred into or out of the county. Similarly, the dotted black line represents the regional boundary showing mixed waste that flows into or out of the Region. The solid boxes represent transfer and disposal facilities and contain the name of the facility, the owner, county (if out of Region) and tip fee (if available).

Due to the lack for robust data of the flow of recyclables, a similar diagram could not be developed for recyclables in the Region.

Figure 2-1: Process Flow Diagram for Mixed Waste in the Region



*Tonnage collected by private haulers in Monroe and transferred though Hoosier TS is calculated by subtracting the total tons collected by Bloomington, IU, and the District from total tons collected in Monroe and delivered to Hoosier Disposal (108,139 tons).

2.5 Mixed Waste Projections

To estimate future amounts of mixed waste in the Region, KCI calculated each county's per capita waste generation rate based on data presented above and their 2016 population as reported by STATS Indiana.[8] Future projections were then made using counties' baseline generation rates and STATS Indiana population projections. Table 2-12 depicts these estimates. The County's mixed waste generation is projected to increase 16 percent between 2016 and 2035. However, mixed waste generation is only projected to grow slightly in two other counties, Morgan and Jackson, and projected to decline slightly in the other counties based on population projections.

Table 2-12: Mixed Waste Generation and MSW Projections - 2020 through 2035

County	2016 Mixed Waste (tons)	2016 Population	Per Capita Mixed Waste (tons)	Projected Mixed Waste (tons)			
				2020	2025	2030	2035
Monroe	118,075	145,496	0.81	122,900	128,000	132,700	136,800
Morgan	38,610	69,698	0.55	39,700	40,400	40,900	41,200
Jackson	41,728	44,013	0.95	41,300	41,600	41,800	41,700
Lawrence	35,630	45,518	0.78	35,900	35,600	35,100	34,500
Greene	12,882	32,211	0.40	13,200	13,100	12,900	12,700
Owen	12,247	20,840	0.59	12,500	12,400	12,100	11,800
Brown	9,216	14,912	0.62	9,500	9,400	9,200	8,900
Total	**268,388**	**372,688**		**275,200**	**280,100**	**283,800**	**286,100**

Note: Projected mixed waste rounded to nearest 100.

[8] STATS Indiana, Indiana IN Depth:
http://www.stats.indiana.edu/profiles/profiles.asp?scope_choice=a&county_changer=18000

Section 3
Waste Processing Technology Assessment

3.1 Introduction

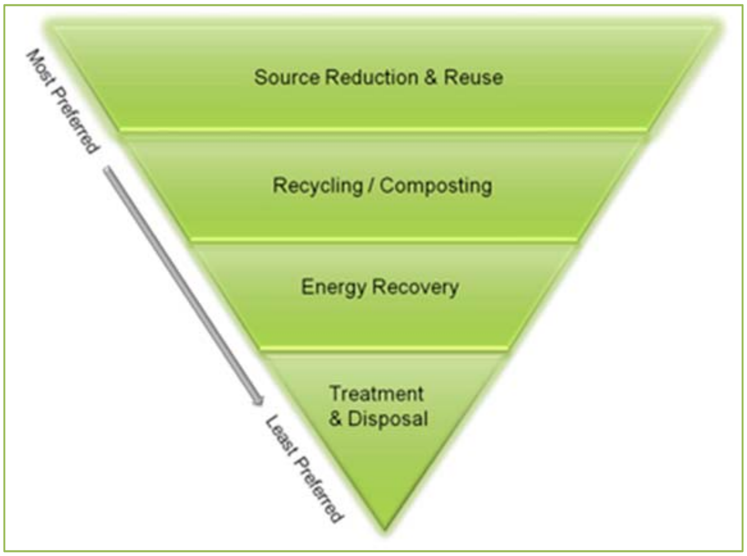
Materials processing technologies can be placed in three general categories: Physical, biological, and thermal.

- Physical processing relies on mechanical and manual means to sort, segregate, and consolidate materials to produce recoverable commodities. Primary examples are materials recycling and mixed waste processing.
- Biological processing optimizes natural decomposition processes to convert organic materials into usable product such as compost, digestate, and biogas. Primary examples are composting and anaerobic digestion.
- Thermal processing utilizes high temperatures to combust or convert carbon-based materials and produce energy or fuels. Primary examples are waste-to-energy, pyrolysis, and gasification.

The categories overlap to some degree. For example, physical and thermal processing can be combined in a single facility that produces and combusts refuse-derived fuel. Physical and biological processing can be combined in a facility that recovers recyclables and anaerobically digests organic materials.

Similarly, some materials can be processed by more than one method. All three can readily handle paper while plastics can be handled by physical and thermal technologies. The waste management hierarchy helps provide a framework for identifying the preferred technology (see Figure 3-1). In general, after reduction and reuse opportunities have been maximized, recoverable materials should be handled by physical processing and degradable organic materials should be handled by biological processes to the degree that economically viable markets exist, followed by thermal processes to recover energy.

Figure 3-1: Waste Management Hierarchy



This feasibility study is focused on physical processing, which entails sorting collected materials into clean, separated recyclable materials (e.g., metal, glass, plastics, and paper), then processing (e.g., baling, flattening, granulating, shredding, etc.) and aggregating them to meet specifications so they can be marketed as commodities for use in manufacturing new products and packaging.

KCI identified the following types of physical processing facilities to be assessed (listed in order of increasing technical/mechanical complexity):

- IPF
- MRF
- MWF

Each option is briefly profiled using a uniform outline: general overview, materials handled, major facility components, products and byproduct, performance, and scalability and economics. The information presented in these profiles is intended to provide a general frame of reference and understanding of the facility types. It is important to note that the quantitative information is on an order of magnitude basis. The cost to develop and operate a facility is highly dependent on local conditions, such as site acquisition cost, development requirements, materials for construction, and local building costs.

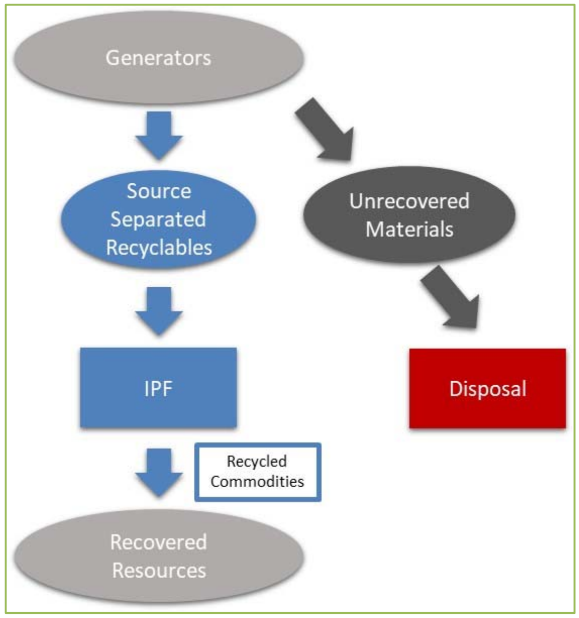
3.2 Intermediate Processing Facility

3.2.1 Overview

IPFs are the most basic form of materials processing (Figure 3-2). Their primary functions are to prepare recyclable materials for sale as commodities (i.e., baling, densifying, shredding, etc.)

and accumulate enough of them to achieve transportation efficiency. IPFs may perform limited sorting to remove contaminants or segregate specific sub-grades of commodities, but very little if any sorting of mixed materials takes place at IPFs. Instead, they rely on generators to separate materials into specific categories (e.g., polyethylene terephthalate (PET) versus high density polyethylene (HDPE)) containers and newspaper versus mixed paper).

Figure 3-2: General Flow Diagram of IPF-based Recovery Systems



3.2.2 Materials Handled

IPFs handle materials that have been separated by generators by material type, e.g., cardboard, newspaper and magazines, mixed paper, containers, PET containers, HDPE containers, other plastics containers, aluminum cans, steel cans, glass containers, etc. IPFs can also handle a wide variety of hard-to-recycle materials which pose sorting and processing challenges for MRFs and MWFs. Examples include textiles, electronics, batteries, and plastic film.

3.2.3 Major Facility Components

IPFs generally include receiving areas for segregated materials, processing equipment, and storage areas for processed material. Balers are the most commonly used piece of processing equipment. Other types of processing equipment that may be used include shredders, densifiers, and crushers.

3.2.4 Products & Byproducts

IPFs' primary products include common recyclable commodities, such as mixed paper, cardboard, PET containers, HDPE containers, other plastic containers, aluminum cans, steel cans, ferrous and non-ferrous scrap metal, etc. Because IPFs handle materials that have been separated by material type, they typically produce very little residue for disposal.

3.2.5 Performance

Because IPFs handle segregated materials, they can achieve very high recovery rates of the materials delivered. Recovery rates in the range of 95 percent and greater are achievable. However, their impact on a community's overall recovery rate may be limited due to comparatively low generator participation and material capture rates. Community recovery programs that use IPFs for materials processing can achieve diversion rates in the range of 10 to 15 percent of mixed waste generated (not including diversion associated with organics recovery programs). One university community recently studied by KCI diverted approximately 10 percent of mixed waste with a well-established curb-sort collection and IPF.

3.2.6 Scalability & Economics

IPFs are generally associated with smaller community recycling programs and handle a few tons per hour of materials. Communities with potential to recover larger amounts of recyclables generally have programs with MRFs. A recent cost analysis performed by KCI established development factors and cost ranges in Table 3-1 for an IPF capable of handling approximately 5 tons per hour, or 9,000 tons per year, of recyclables.

Table 3-1: IPF Capital and Operating Cost Factors

Capacity (Tons/Hour)	Approximate Building (Sq. Ft.)	Site (Acres)	Equipment Cost[1] ($ thousand)	Staff	Annual Cost[2] (Revenue) ($/Ton)
5	8,000	1 - 2	$200 - $300	4 - 6	($35) - ($45)

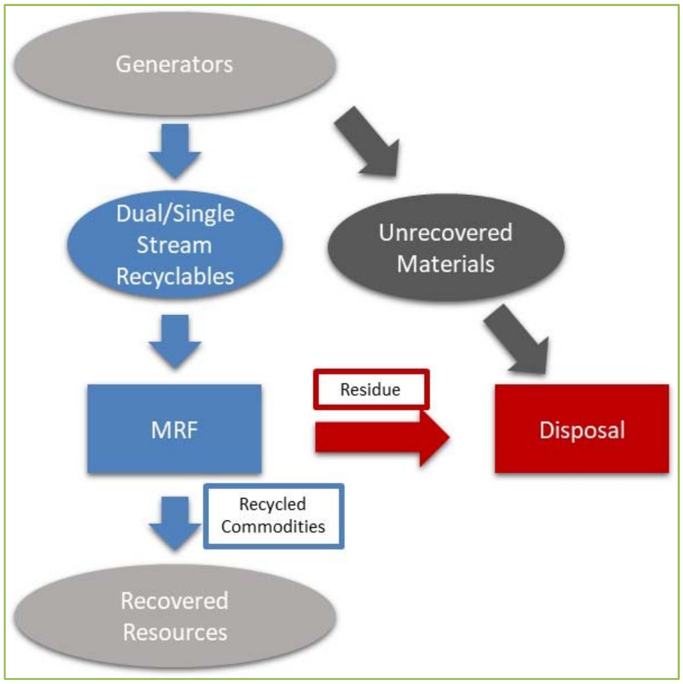
Notes:
[1] Equipment cost includes sorting and processing equipment and rolling stock.
[2] Annual costs (revenue) includes costs for buildings and equipment, annual operating and maintenance costs, and revenue from recycled materials. It does not include site acquisition and development costs.

3.3 Materials Recovery Facility

3.3.1 Overview

MRFs are the most common type of physical processing facility in the U.S. MRFs are different from IPFs because they must first sort the commingled materials into specific recyclable commodities (Figure 3-3). Sorting equipment is arranged in a manner to sequentially separate materials into marketable commodities. Two primary types of MRFs exist: Dual stream and single stream. Dual stream MRFs process recyclables that are collected in two separate streams – one for fiber and one for containers (plastic, metal, and glass). Single stream MRFs process recyclables that are collected in one stream – all fiber and containers mixed together. Based on a recent analysis, approximately 450 MRFs were operating in the U.S. in 2016 of which approximately 63 percent were single stream facilities.[9] In recent years, the total number of MRFs has declined slightly and the percent of single stream MRFs has increased as small, old dual stream facilities closed and large, regional single stream MRFs came on line.

Figure 3-3: General Flow Diagram of MRF-based Recovery Systems



3.3.2 Materials Handled

MRFs handle Commingled materials that have been separated from mixed waste by generators, e.g., cardboard, newspaper and magazines, mixed paper, PET containers, HDPE containers, other plastics containers, aluminum cans, steel cans, glass containers, etc. While some MRFs are designed to recover other recyclable materials (e.g., plastic film, shredded paper, or expanded polystyrene), most consider any material other than traditional types of paper and packaging to be a contaminant.

3.3.3 Major Facility Components

MRFs generally include a tip floor for incoming materials, mechanical technologies and manual processes for sorting materials, processing equipment, conveyor belts and air ducts to move materials through the system, and storage areas for processed material. Sortation technology continues to evolve, with improvements resulting in higher material recovery and waste diversion rates. Balers are the most widely used processing equipment because of relative ease of storing and shipping baled commodities.

[9] Governmental Advisory Associates, Inc. *2016-2017 Materials Recycling and Processing in the United States Database,* 2016.

Various types of equipment can be used depending on the composition of incoming mixed waste and desired end-products, including those listed in Table 3-2. As our society's material stream evolves (witness the increase in multi-laminate, flexible pouch packaging on store shelves) MRF sorting and processing equipment needs to evolve as well.

Table 3-2: Common Types of MRF Sorting and Processing Equipment

Equipment	Usage Description
Air Drum Separator	Uses air separation combined with rotating drums and an expansion chamber to separate materials based on density and shape.
Baler	Compacts recyclable commodities into bales that can easily be stacked and transported.
Ballistic Separator	A series of flat screen panels that rise and fall in an elliptical pattern to agitate and separate materials. Panels are set at an angle so that flat materials climb up the panels, 3-dimensional materials tumble back down, and fines fall through the screen panels.
Eddy Current Separator	Magnetic rotors spin to induce electric current in the nonferrous metal (e.g., aluminum) which is then repelled away by the opposing electrical fields.
Disc or Star Screen	Discs mounted on a series of parallel spinning shafts agitate and separate materials. Small materials fall through the discs while large flat items move across the screen. Different disc sizes and spacing are used to separate materials.
Manual Sort Lines	Flat conveyor belts move materials past a series of human sorters each with a specific task to pick out a designated material (positive sort) or contaminants (negative sort).
Magnetic Separator	Magnetically pulls ferrous materials from other material.
Materials Storage Bunker	Large enclosures for storing separated materials prior to processing them (i.e., baling). This interim storage allows a baler to sequentially handle multiple material types.
Optical Separator	Uses near infrared (NIR) and/or visible light detect different types of materials in the waste stream. Air jets are then used to change the trajectory of materials as they fall off a conveyor belt.
Polishing Screen	A specialized type of disc screen where discs are mounted on an elevated series of parallel spinning shafts that agitate and separate materials. Small materials fall through the discs, flat items move up the screen, and large 3-dimensional items tumble back down the screen.
Robotic Separator	An emerging technology that uses visual detection cameras to identify specific materials on a conveyor belt and robotic arms to remove individual items. Separators can be capable of sorting multiple materials.

3.3.4 Products & Byproducts

MRFs' primary products are common recyclable commodities, such as mixed paper, cardboard, PET containers, HDPE containers, other plastic containers, aluminum cans, steel cans, scrap metal, etc. MRFs also produce non-recyclable residue comprised of non-recyclables (contaminants) and un-recoverable materials, which are recyclables not recovered by the MRF due to processing inefficiency. Residue rates reported by MRFs range widely due to differences in the performance of collection programs and MRF sorting and processing efficiency; however, residue rates are commonly in the range of 15 to 25 percent of inbound tonnage. In general, dual stream MRFs produce less residue than single stream MRFs on a percentage basis.

3.3.5 Performance

As noted above, MRFs do not recover all the recyclables from inbound materials. Table 3-3 shows the range of material recovery rates that can be achieved at MRFs depending on the effectiveness of mechanical equipment and manual sort staff.

Table 3-3: MRF Material Recovery Rates

Material	Recovery
Fiber:	
Newspaper and Mixed Paper	85% - 95%
Cardboard	90% - 95%
Plastics:	
PET & HDPE Containers	90% - 97%
Other containers	90% - 95%
Metals:	
Ferrous	95% - 97%
Aluminum	95% - 97%

Municipal recovery programs based on single stream collection and MRFs typically achieve higher diversion rates than IPFs and dual stream programs. Greater convenience for generators (less effort to separate materials and the use of large roll carts versus small bins for collection) generally leads to higher participation rates (number of generators participating) and capture rates (percent of designated recyclables separated by generators). A recent survey of municipal recovery programs conducted by KCI found that communities can generally divert 15 to 25 percent of mixed waste with single stream collection and MRFs.

3.3.6 Scalability & Economics:

Design capacities of MRFs currently operating in the U.S. range from 10 to 70 tons per hour, or approximately 18,000 to 127,000 tons per year based on 1,820 operating hours per year.[10] MRFs can handle more tons by operating more than one shift per day. MRFs smaller than 10 tons per hour are difficult to justify economically due to the capital cost and the number of staff needed to operate the facility. There is not enough tonnage to justify the capital investment, while the alternative of manually sorting the wide range of recyclables can require too many staff to justify the operating cost. Table 3-4 summarizes key development factors and cost ranges based on recent MRF development projects with which KCI was involved.

[10] One 8-hour shift with 7 hours of productive operations, 5 days per week, and 52 weeks per year equals 1,820 operating hours per year.

Table 3-4: MRF Capital and Operating Cost Factors

Capacity (Tons/Hour)	Approximate Building (Sq. Ft.)	Site (Acres)	Equipment Cost[1] ($ million)	Staff	Annual Cost[2] (Revenue) ($/Ton)
10	9,000	2 - 3	$4.0 - $4.5	14 - 18	($5) - ($10)
25	50,000	5 - 7	$9 - $10	20 - 25	($15) - ($20)
50	75,000	8 - 10	$14 - $16	32 - 38	($15) - ($20)

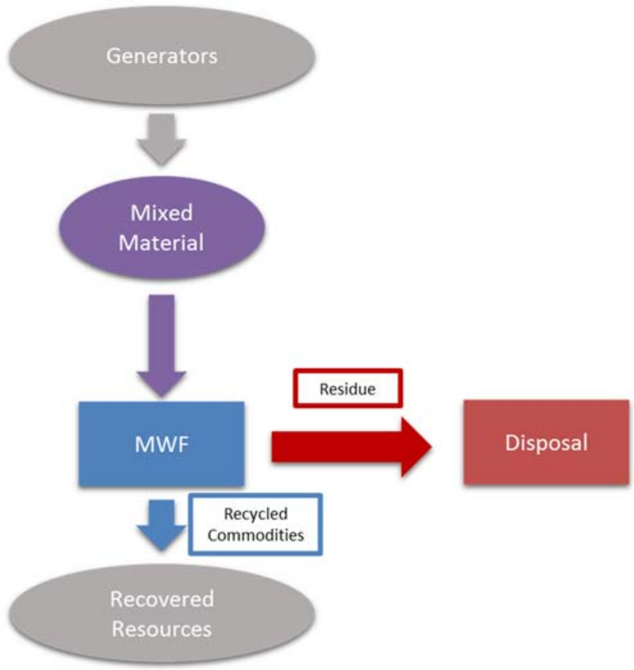
Notes:
[1] Equipment cost includes sorting and processing equipment and rolling stock.
[2] Annual cost(revenue) includes costs for buildings and equipment, annual operating and maintenance costs, and revenue from recycled materials. It does not include site acquisition and development costs.

3.4 Mixed Waste Processing Facility

3.4.1 Overview

MWFs separate various materials from mixed waste for beneficial use, recovery, or combustion (Figure 3-4). MWFs can be used in lieu of source-separated collection and an IPF or MRF. However, some are designed to also handle single stream recyclables and complement source-separated programs by recovering recyclable materials remaining in mixed waste. In this way, MWFs can enable a community to achieve higher recycling rates than source-separation programs alone. The remaining waste stream that is not recovered for recycling can potentially be used as feedstock for some other form of biological or thermal conversion technology. It is important to note that nearly all MWFs currently operating in North America are in California where state-wide diversion mandates and disposal costs provide the context for making MWFs economically viable.

Figure 3-4: General Flow Diagram of MWF-based Recovery Systems



3.4.2 Materials Handled

MWFs generally receive unprocessed residential and commercial mixed waste. Some facilities target loads of mixed waste that are rich in recyclable materials, such as dry commercial waste. Many accept both single stream recyclables and mixed waste and utilize an integrated processing system to handle both material streams. If yard waste is collected in a separate stream, it is generally not handled at MWFs but taken to a dedicated organics recycling facility.

3.4.3 Major Facility Components

MWF facility components generally include a tip floor for incoming materials, mechanical technologies and manual processes for sorting materials, processing equipment, conveyor belts, and air ducts to move materials through the system, and storage areas for processed material. Sortation technology continues to evolve, with improvements resulting in higher material recovery and waste diversion rates. Balers are the most commonly used equipment for preparing recyclable materials for storage and marketing. MWFs rely on the same kinds of equipment as MRFs (listed in Table 3-2). Additional types of equipment that are in MWFs are listed in Table 3-5 below.

Table 3-5: Additional Types of Equipment Used in MWF

Equipment	Usage Description
Air Classifier	Blows air to separate lighter materials (e.g., plastic film and paper) from heavier materials.
Bag Breaker/Bag Opener	Opens bags of mixed waste and releases the contents for subsequent sortation.
Shredder	Used to size reduce materials for subsequent sorting and processing functions.
Trommel Screen	A rotating cylinder on a declining angle lined with screens. The rotation creates a tumbling action to move materials through while smaller objects fall through the screens and larger objects move through and exit the screen.

3.4.4 Products & Byproducts

MWFs' primary products are common recyclable commodities, such as mixed paper, cardboard, PET containers, HDPE containers, other types of plastics, aluminum cans, steel cans, scrap metal, etc. Some MWFs also produce an organics stream (i.e., food waste and yard waste) for subsequent biological conversion technologies, while others may produce a fuel product from dry carbon-based materials such as paper and plastic for thermal conversion technologies.

3.4.5 Performance

By processing mixed waste, MWFs can target recyclables in the waste stream, not just those that have been source-separated. Consequently, they can recover greater quantities of materials than MRFs even when accounting for increased residue and loss of recyclable materials. Overall diversion rates reported by MWFs operating in the U.S. range from 25 to 75 percent of inbound tonnage with 25 to 35 percent attributable to materials recovery and 40 to 50 percent attributable to organics recovery.

However, because the recyclables in mixed waste can be more contaminated and difficult to sort, MWF's typically recover a lower percentage of the materials (recovery rate) compared to MRFs. Recovery rates depend on the composition of incoming materials, the types of equipment used, the sophistication of technologies, and the system design and performance. Table 3-6 provides a range of potential recovery rates based on information compiled from various system vendors and field analyses.

Table 3-6: MWF Material Recovery Rates

Material	Recovery
Fiber:	
Mixed fiber	30%-70%
Cardboard	60%-90%
Plastics:	
PET & HDPE Containers	40%-90%
Other containers	10%-80%
Film	6%-40%
Metals:	
Ferrous	50%-95%
Aluminum	40%-95%

Note: Percentages reflect that portion of each material type that might be recovered, not the percentage of that material in the mixed waste stream.

3.4.6 Scalability and Economics

MWFs currently operating in the U.S. have design capacities in the range of 75 to 100 tons per hour, which equals approximately 136,500 to 182,000 tons per year based on 1,820 operating hours per year. MWF processing system vendors can also offer design capacities in the 35 tons per hour range as well, which reduces the possible minimum design capacity to approximately 63,700 tons per year. Like MRFs, MWFs can handle more tonnage by operating more than one shift per day.

The cost to build a MWF is highly dependent on local conditions. It also depends on facility design capacity. Table 3-7 summarizes key development factors and cost ranges provided by vendors in published documents and proposals reviewed by KCI.

Table 3-7: MWF Capital and Operating Cost Factors

Capacity (Tons/Hr)	Approximate Building (Sq. Ft.)	Site (Acres)	Equipment Cost[1] ($ million)	Staff	Annual Cost[2] (Revenue) ($/Ton)
75	90,000	10 – 12	$16 - 18	50 - 60	$35 - $40
100+	110,000+	12 – 15	$24 - 25	60 – 70	$35 - $40

Notes:
[1] Equipment cost includes sorting and processing equipment and rolling stock.
[2] Annual cost (revenue) includes costs for buildings and equipment, annual operating and maintenance costs, and revenue from recycled materials. It does not include site acquisition and development costs.

3.5 Potential Applicability to the District and Region

Determining the appropriate method(s) of physical processing for the District depends in large part on three factors: capacity, compatibility, and control.

- Capacity: Does the District, the County, and/or adjacent counties generate sufficient amounts of waste to match the design capacity of different types of processing facilities?
- Compatibility: What processing technology options are compatible with the way that materials are collected?
- Availability: Is the tonnage in the County and Region potentially available for a District processing facility given the legal, contractual, and financial landscape?

3.5.1 Capacity

Regarding capacity, Table 3-8 integrates results of the regional waste management system research (Section 2) and the processing technology research to show how the quantities of materials generated in the Region align with the potential design capacity of processing technologies (blue highlight in Table 3-8). Considering the amounts of recyclables generated, it is evident that a small-scale MRF would be viable if the quantity of recyclables from the District and the County increases and regional recyclables are handled. The City's conversion to single stream recycling in September 2017 likely increased recycling tonnage (the quantified increase was not available at the time of this report). The amount of mixed waste generated by the District is not enough to justify a MWF. However, the amount of mixed waste generated in the County and Region could be sufficient for a MWF.

Table 3-8: Sources and Quantities of Materials Versus Processing Technology Options

		Processing Technology & Design Capacity		
Source/Material	Tons/Year	IPF	MRF	MWF
District				
Recyclables	2,759	<9,000	>18,000	--
Mixed waste	2,880	--	--	>63,700
Monroe County				
Recyclables	8,645	<9,000	>18,000	--
Mixed waste	115,195	--	--	>63,700
Neighboring Counties				
Recyclables	4,106	<9,000	>18,000	--
Mixed waste	150,313	--	--	>63,700
Regional Total				
Recyclables	15,510*	<9,000	>18,000	--
Mixed waste	268,388	--	--	>63,700

Note:
Design capacities shaded in blue are compatible with the amount of material generated by the applicable source(s).
Design capacity is based on the one-shift tons/year design capacity ranges stated previously.
* Sufficient tonnage for a MRF will potentially be available now that the City has single stream collection.

3.5.2 Compatibility

Regarding the compatibility factor, major sources of recyclables in the County are or will be collected single stream. The City and IU accounted for 32 percent of recyclables collected in the County in 2016 (expected to be greater with the City conversion to single stream).[11] The District collects segregated recyclables, while adjacent counties collect both segregated and single stream commingled materials. Private haulers in the County are a major potential source of recyclables that could be recovered from commercial, multi-family, and unincorporated residential generators, if recycling capacity is available at a competitive price. Given this context of collection, the most compatible technology for recyclables would be an integrated IPF/MRF, i.e., a facility with a small-scale single stream processing system plus additional capacity to process segregated recyclables.

Regarding mixed waste compatibility, KCI conducted a WCS, discussed in Section 4 of this report. The WCS quantified the percentage of recyclables within the mixed waste stream, and helped to verify the waste stream would be compatible with a MWF. The results of the WCS and their use in evaluating the potential material recovery in a MWF are discussed in subsequent sections of this report.

3.5.3 Availability

The third factor to be considered is whether a processing facility developed by the District would receive enough tonnage to be technically and economically viable. As shown in Figure 2-1 and Table 2-10, the private sector plays a major role in the County and the regional solid waste management system. Private haulers are responsible for collecting and hauling mixed waste, except for the District, the City, a portion of IU, and several smaller adjacent communities and counties. The Hoosier Transfer Station, Medora landfill, and Jackson transfer station handle 88% of the regional mixed waste. Reported mixed waste tip fees are in the range of $32.00 to $39.50 per ton, which is comparable to generic estimated costs for MWFs.

The District is also constrained in its ability to accept waste at any type of processing facility due to statutory and contractual limits as summarized in the following bullets and further detailed in Section 6:

- Indiana Code 13-21-3-14.5: The District has limited ability to provide waste management services either by itself or through contracted services. Most notably, it cannot do so if the service is already available at a reasonable cost in the District or in other similar areas in Indiana. What may be open to interpretation is whether mixed waste processing is distinct from waste transfer and thus a type of service not already available.
- Hoosier-District Contract: The District and Hoosier have a solid waste disposal agreement in place until 2023 that includes a $2.50 per ton host fee. Hoosier charges the host fee for all mixed waste delivered to its transfer station and pays this host fee to the District. The host fee is a significant source of revenue for the District. The

[11] Bloomington 2,609 tons and IU 1,050 tons versus a total Monroe County estimate of 11,404 tons.

contract stipulates that the District agrees not to engage in processing or disposing mixed waste, or Hoosier can cease paying the host fee.

- The City and IU Agreements: Both the City and IU seem to prefer short term or verbal agreements for materials management services. Typically, it is necessary to have long term commitments or assurances that sufficient materials will be available before it is possible to secure financing for a large processing facility. This also needs to be considered when determining suitable processing opportunities for the District.

Section 4
Waste Composition Study

4.1 Introduction

In October 2017, KCI conducted a 5-day WCS of the solid waste generated within the County and adjacent counties. The WCS consisted of sampling and sorting mixed waste to determine the types and percentages of specific materials coming from five main generator sectors:

- District: Residential mixed waste collected at the District's four rural collection sites in their Orange Bag program.
- City: Residential mixed waste collected by the City.
- IU: Mixed waste collected from and by IU. Samples were pulled from on-campus housing, dining halls, academic buildings, and athletics.
- Private haulers: Mixed waste collected by private haulers from commercial and multi-family properties throughout the County as well as single-family residential properties in the unincorporated County.
- Out-of-County: Mixed waste collected by private haulers in adjacent counties. Out-of-County waste includes residential and commercial mixed waste.

The goal of this WCS was to develop a more accurate understanding of the mixed waste generated in the Region to be used in the material recovery projections and feasibility assessment discussed in Sections 5 and 6 of this report. Additionally, the results of the WCS support the District's planning and operational improvements by providing information regarding potential opportunities for increased recovery.

4.2 Methodology

The methodology for this WCS followed industry-accepted standards for statistical sampling, as outlined in the ASTM *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste* (D5231-92; reapproved 2008).

A total of 40 samples were pulled and sorted over the course of the sorting event. The number of samples from each generator sector was determined based on the relative importance to the waste processing feasibility study, as well as the relative tonnage delivered to the transfer station, as reported in 2016. KCI pulled samples from 40 randomly selected collection vehicles or roll-off containers according to the sampling schedule in Table 4-1.

Table 4-1: Sampling Schedule

	Mon	Tue	Wed	Thu	Fri	Total
District	1	1	0	4	0	**6**
City	2	2	2	3	0	**9**
IU	1	0	3	1	2	**7**
Private	4	3	3	1	2	**13**
Out-of-County	1	2	0	1	1	**5**
Total	**9**	**8**	**8**	**10**	**5**	**40**

Figure 4-1: Example of Mixed Waste Sampled During the WCS

Figure 4-2: Sorting Activities During the WCS

Following the procedures described in the sampling and sorting protocol prepared by KCI and approved by the District, the selected vehicle tipped its entire load on the tip floor of the transfer station. A loader, at the direction of KCI's sampling supervisor, pulled a randomly selected 200-pound sample of the load. The sample was then transferred to the sorting area. Each of the 40 samples was sorted into 42 material categories, which are defined in the Task 2 technical memorandum. After the entire sample was sorted, the sorted materials were weighed and recorded.

Following completion of the sorting event, the percentage by weight of each material category was calculated for each of the five generator sectors. Where appropriate, 90 percent confidence intervals were calculated, using a standard statistical t-test, for each material category. The confidence interval indicates that, with a 90 percent level of confidence, the actual arithmetic mean is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of that material category found in the samples sorted. Generally, the more homogeneous the waste stream and the greater the number of samples sorted, the higher the level of accuracy achieved and the narrower the margin between the upper and lower bounds of the confidence interval. Note: Because this is a statistical analysis, the lower end of the confidence interval may be a negative number.

4.3 WCS Results

4.3.1 Introduction to Results

Unless otherwise stated, results are expressed in percentage on a weight-basis. This report provides summary results for each of the five generator sectors; detailed results for each sample were provided in the Task 2 technical memorandum.

For the purposes of discussion and analysis, materials were grouped into six broad categories based on diversion potential:

- Recyclable paper: These are paper materials that are currently accepted at the District's recycling stations and the City's single stream recycling program, consisting of the following material categories:
    - Newspaper
    - Corrugated cardboard
    - Office paper
    - Mixed recyclable paper
- Recyclable containers: These are plastic, glass, and metal containers accepted at the District's recycling stations and the City's single stream recycling program, consisting of the following material categories:
    - PET bottles (#1)
    - HDPE bottles (#2)
    - Non-bottle #1 and #2 plastics containers
    - #3-7 plastic containers
    - EPS, coded #6
    - Tin/steel cans
    - Aluminum cans
    - Glass containers
- Other District-accepted recyclables: These are other materials accepted for recycling at the District's recycling centers, consisting of the following material categories:
    - Books
    - EPS packing peanuts
    - Ferrous scrap metal

    - Non-ferrous scrap metal
    - White goods/small appliances
    - Special wastes
    - Electronics (E-waste)
    - Electronic media

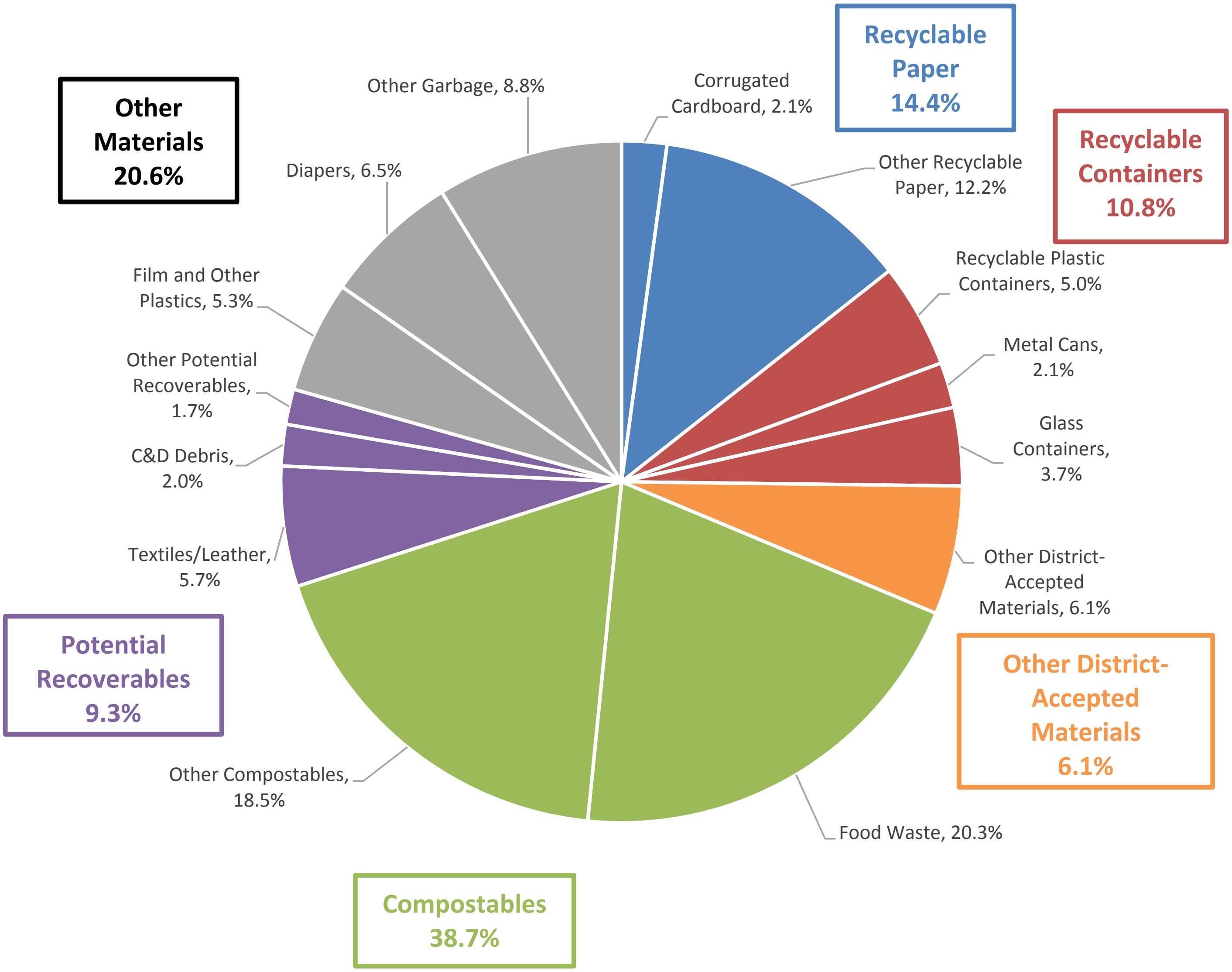
- Potentially compostable materials: These are materials that potentially could be composted in a commercial anaerobic digestion or composting facility if properly source-separated or separated from inorganic material in mixed waste processing, consisting of the following material categories:
    - Compostable paper
    - Other organics
    - Clean wood waste
    - Yard waste
    - Food waste
- Potentially recoverable materials: These are materials that have the potential to be recovered or recycled, but are not currently collected for recycling at the District's collection centers or in the City's single stream recycling program. Some of these materials, such as textiles/leather and C&D debris, would require source-separation and/or additional processing to recover, rather than recovery through mixed waste processing. These include the following material categories:
    - Aseptic/polycoated containers
    - Bulky rigid plastics
    - Aluminum foil
    - Textiles/leather
    - C&D debris
    - Tires and rubber
- Other materials: These are any materials not classified above and not feasible to recover with traditional programs or technology, consisting of the following material categories:
    - EPS, not coded #6
    - Non-rigid plastic film
    - All other plastics
    - Other glass
    - Household batteries
    - Treated wood waste
    - Diapers
    - All other garbage
    - Liquids
    - Grit

4.3.2 District Mixed Waste

Figure 4-3 and Table 4-2 depict the composition of District mixed waste. Below are key findings for the composition of District mixed waste:

- Recyclable paper and containers comprised approximately 25 percent of the mixed waste collected in the District's Orange Bag program. Mixed recyclable paper was the largest component (approximately 12 percent), followed by glass containers (approximately 4 percent).
- Approximately 6 percent of the District waste was other materials accepted at the District's drop-off programs. Nearly half of this was e-waste, such as large electronic devices (e.g. printers and TVs) in multiple samples.
- Nearly 40 percent of the waste was potentially compostable over half of which was food waste, but compostable paper comprised a significant portion as well.
- Other potential recoverables comprised over 9 percent of the waste, which was mostly textiles/leather.
- Other materials comprised approximately 21 percent of the waste. This was mostly diapers, all other garbage, and plastic film.
- Based on these results, the 2,880 tons of District waste collected by the District in 2016 contained approximately 900 tons of recyclable materials (approximately 31 percent) and approximately 1,110 tons of compostable materials (38.7 percent).

Figure 4-3: Composition of District Mixed Waste (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, office paper, and mixed recyclable paper.
- Recyclable plastic containers include the categories of PET bottles (#1), HDPE bottles (#2), non-bottle #1 and #2 plastic containers, #3-7 plastic containers, and expanded polystyrene (EPS), coded #6.
- Metal cans include the categories of aluminum cans and tin/steel cans.
- Other District-accepted materials include the categories of books, EPS packing peanuts, retail plastic bags, ferrous scrap metal, non-ferrous scrap metal, white goods/small appliances, special wastes, electronics, and electronic media.
- Other compostables include the categories of compostable paper, clean wood waste, yard waste, and other organics.
- Other potential recoverables include the categories of aseptic/polycoated containers, bulky rigid plastics, aluminum foil, and tires and rubber.
- Other garbage includes the categories of EPS not coded #6, other glass, household batteries, treated wood waste, all other garbage, liquids, and grit.

Table 4-2: Composition of District Mixed Waste (% by weight)

	Material Category	Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Newspaper	2.2%	1.04%	3.34%
2	Corrugated Cardboard (OCC)	2.1%	-0.19%	4.47%
3	Office Paper	1.2%	-0.23%	2.69%
4	Mixed Recyclable Paper	8.8%	5.79%	11.85%
	Total Accepted Recyclable Paper	**14.4%**		
8	PET Bottles (#1)	1.5%	1.10%	1.91%
9	HDPE Bottles (#2)	0.8%	0.43%	1.18%
10	Non-Bottle #1 and #2 Plastic Containers	0.5%	0.21%	0.73%
11	#3-7 Plastic Containers	1.5%	1.11%	1.82%
13	Expanded Polystyrene (EPS), Coded #6	0.7%	0.53%	0.89%
19	Tin/Steel Cans	1.6%	0.79%	2.31%
21	Aluminum Cans	0.6%	0.21%	0.98%
25	Glass Containers	3.7%	1.93%	5.49%
	Total Accepted Recyclable Containers	**10.8%**		
5	Books	0.2%	-0.23%	0.69%
15	EPS Packing Peanuts	0.0%	0.00%	0.00%
16	Retail Plastic Bags	1.1%	0.82%	1.43%
20	Ferrous Scrap Metal	0.4%	-0.28%	1.03%
23	Non-Ferrous Scrap Metal	0.0%	-0.02%	0.08%
24	White Goods/Small Appliances	0.4%	-0.13%	1.02%
28	Special Wastes	1.2%	-1.06%	3.46%
29	Electronics (E-waste)	2.7%	-0.36%	5.76%
30	Electronic Media	0.0%	0.00%	0.00%
	Other District-Accepted Materials	**6.1%**		
6	Compostable Paper	8.0%	5.69%	10.35%
32	Clean Wood Waste	0.1%	-0.07%	0.20%
36	Yard Waste	5.0%	-0.27%	10.28%
37	Food Waste	20.3%	12.28%	28.29%
38	Other Organics	5.4%	1.16%	9.57%
	Total Potential Compostables	**38.7%**		
7	Aseptic/Polycoated Containers	0.2%	0.07%	0.31%
12	Bulky Rigid Plastics	0.8%	-0.01%	1.65%
22	Aluminum Foil	0.4%	0.23%	0.58%
27	Textiles/Leather	5.7%	2.22%	9.18%
34	C&D Debris	2.0%	-0.87%	4.80%
35	Tires and Rubber	0.3%	-0.21%	0.72%
	Other Potential Recoverables	**9.3%**		
14	EPS, Not Coded #6	0.2%	0.06%	0.30%
17	Non-Rigid Plastic Film	4.4%	3.50%	5.37%
18	All Other Plastics	0.9%	0.59%	1.17%
26	Other Glass	0.8%	-0.14%	1.77%
31	Household Batteries	0.1%	0.00%	0.13%
33	Treated Wood Waste	0.1%	-0.05%	0.23%
39	Diapers	6.5%	2.16%	10.77%
40	All Other Garbage	6.2%	6.05%	6.37%
41	Liquids	1.4%	0.44%	2.36%
42	Grit	0.1%	-0.08%	0.25%
	Other Materials	**20.6%**		

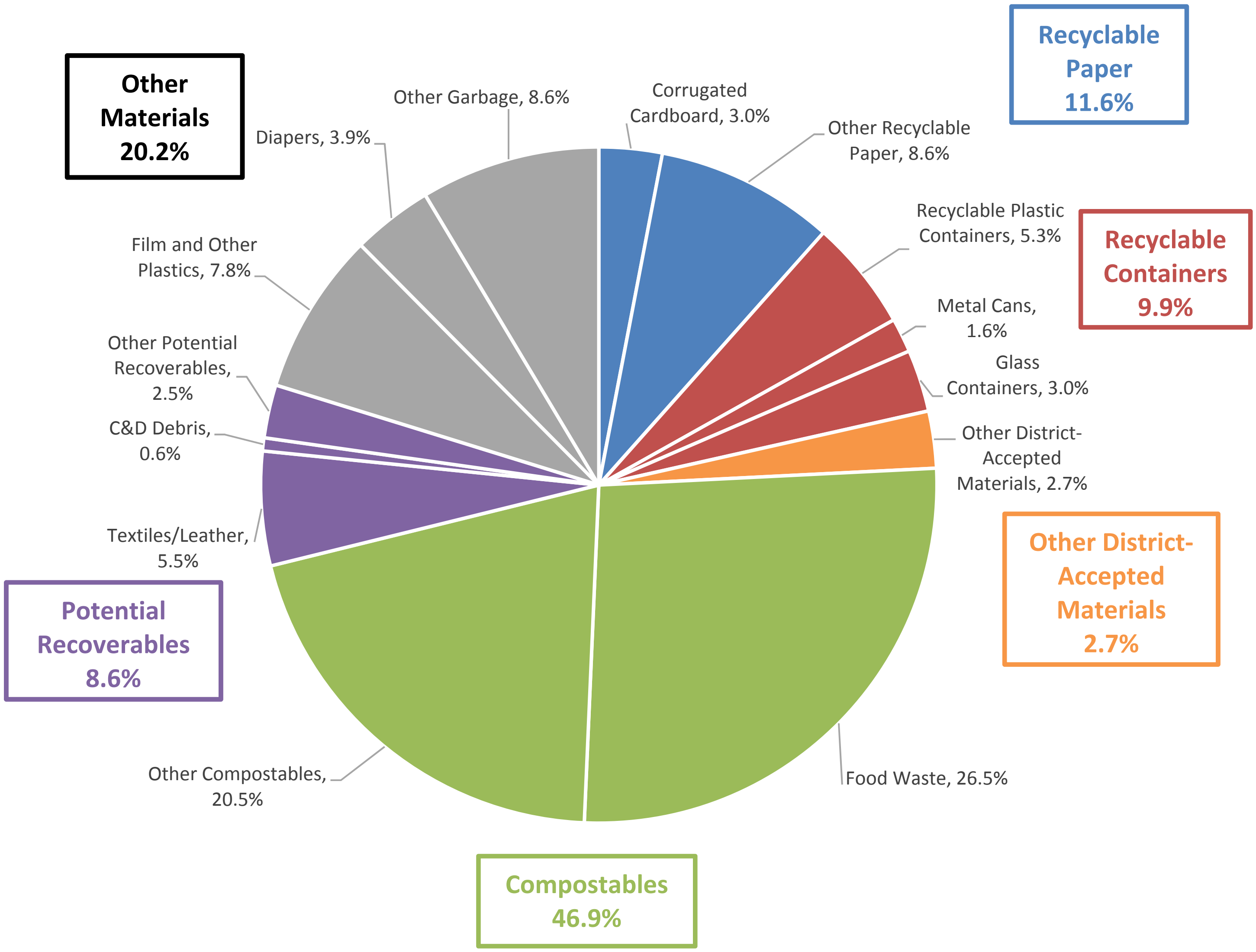
Note: Columns may not appear to calculate correctly due to rounding.

4.3.3 City Mixed Waste

Figure 4-4 and Table 4-3 depict the composition of City mixed waste. Below are key findings for the composition of City mixed waste:

- Mixed waste collected by the City is approximately 22 percent recyclable paper and containers. This is lower than any other sectors, which may be due to the City's recent implementation of single stream collection.
- Other materials accepted by the District comprise less than 3 percent of the City waste, with retail plastic bags as the largest component.
- City waste had the largest compostable fraction of any generator sector; nearly half of the waste was potentially compostable. Over 26 percent was food waste, while compostable paper and other organics (mostly cat litter) were each over 8 percent.
- Nearly 9 percent of the waste was potential recoverables; textiles/leather was the largest component.
- City mixed waste was approximately 20 percent other materials, which was mostly plastic film, all other garbage, and diapers.
- Based on the WCS results and the 4,933 tons of waste reportedly collected by the City in 2016, approximately 1,190 tons were materials recycled by the District (24 percent) and approximately 2,310 tons were compostable materials (47 percent).

Figure 4-4: Composition of City Mixed Waste (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, office paper, and mixed recyclable paper.
- Recyclable plastic containers include the categories of PET bottles (#1), HDPE bottles (#2), non-bottle #1 and #2 plastic containers, #3-7 plastic containers, and expanded polystyrene (EPS), coded #6.
- Metal cans include the categories of aluminum cans and tin/steel cans.
- Other District-accepted materials include the categories of books, EPS packing peanuts, retail plastic bags, ferrous scrap metal, non-ferrous scrap metal, white goods/small appliances, special wastes, electronics, and electronic media.
- Other compostables include the categories of compostable paper, clean wood waste, yard waste, and other organics.
- Other potential recoverables include the categories of aseptic/polycoated containers, bulky rigid plastics, aluminum foil, and tires and rubber.
- Other garbage includes the categories of EPS not coded #6, other glass, household batteries, treated wood waste, all other garbage, liquids, and grit.

Table 4-3: Composition of City Mixed Waste (% by weight)

	Material Category	Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Newspaper	0.5%	0.29%	0.77%
2	Corrugated Cardboard (OCC)	3.0%	1.35%	4.69%
3	Office Paper	1.0%	-0.09%	2.00%
4	Mixed Recyclable Paper	7.1%	5.39%	8.75%
	Total Accepted Recyclable Paper	**11.6%**		
8	PET Bottles (#1)	1.5%	1.03%	2.04%
9	HDPE Bottles (#2)	1.0%	0.66%	1.38%
10	Non-Bottle #1 and #2 Plastic Containers	0.6%	0.40%	0.78%
11	#3-7 Plastic Containers	1.5%	1.06%	1.97%
13	Expanded Polystyrene (EPS), Coded #6	0.6%	0.49%	0.79%
19	Tin/Steel Cans	0.9%	0.69%	1.04%
21	Aluminum Cans	0.8%	0.31%	1.23%
25	Glass Containers	3.0%	1.54%	4.39%
	Total Accepted Recyclable Containers	**9.9%**		
5	Books	0.1%	-0.04%	0.23%
15	EPS Packing Peanuts	0.0%	-0.03%	0.09%
16	Retail Plastic Bags	1.1%	0.86%	1.39%
20	Ferrous Scrap Metal	0.3%	0.16%	0.52%
23	Non-Ferrous Scrap Metal	0.1%	-0.01%	0.26%
24	White Goods/Small Appliances	0.3%	-0.32%	0.94%
28	Special Wastes	0.0%	0.01%	0.08%
29	Electronics (E-waste)	0.5%	0.24%	0.76%
30	Electronic Media	0.2%	-0.08%	0.39%
	Other District-Accepted Materials	**2.7%**		
6	Compostable Paper	8.4%	6.83%	9.92%
32	Clean Wood Waste	0.2%	0.00%	0.31%
36	Yard Waste	3.6%	0.18%	7.04%
37	Food Waste	26.5%	22.33%	30.63%
38	Other Organics	8.3%	4.39%	12.27%
	Total Potential Compostables	**46.9%**		
7	Aseptic/Polycoated Containers	0.2%	0.13%	0.35%
12	Bulky Rigid Plastics	1.8%	-0.29%	3.83%
22	Aluminum Foil	0.5%	0.29%	0.72%
27	Textiles/Leather	5.5%	3.96%	6.96%
34	C&D Debris	0.6%	0.15%	1.10%
35	Tires and Rubber	0.0%	0.00%	0.06%
	Other Potential Recoverables	**8.6%**		
14	EPS, Not Coded #6	0.2%	0.12%	0.26%
17	Non-Rigid Plastic Film	6.8%	4.94%	8.66%
18	All Other Plastics	1.0%	0.49%	1.47%
26	Other Glass	0.3%	0.11%	0.47%
31	Household Batteries	0.1%	0.02%	0.09%
33	Treated Wood Waste	0.3%	-0.23%	0.87%
39	Diapers	3.9%	2.14%	5.57%
40	All Other Garbage	5.5%	3.95%	7.10%
41	Liquids	1.4%	0.80%	1.92%
42	Grit	0.8%	-0.74%	2.42%
	Other Materials	**20.2%**		

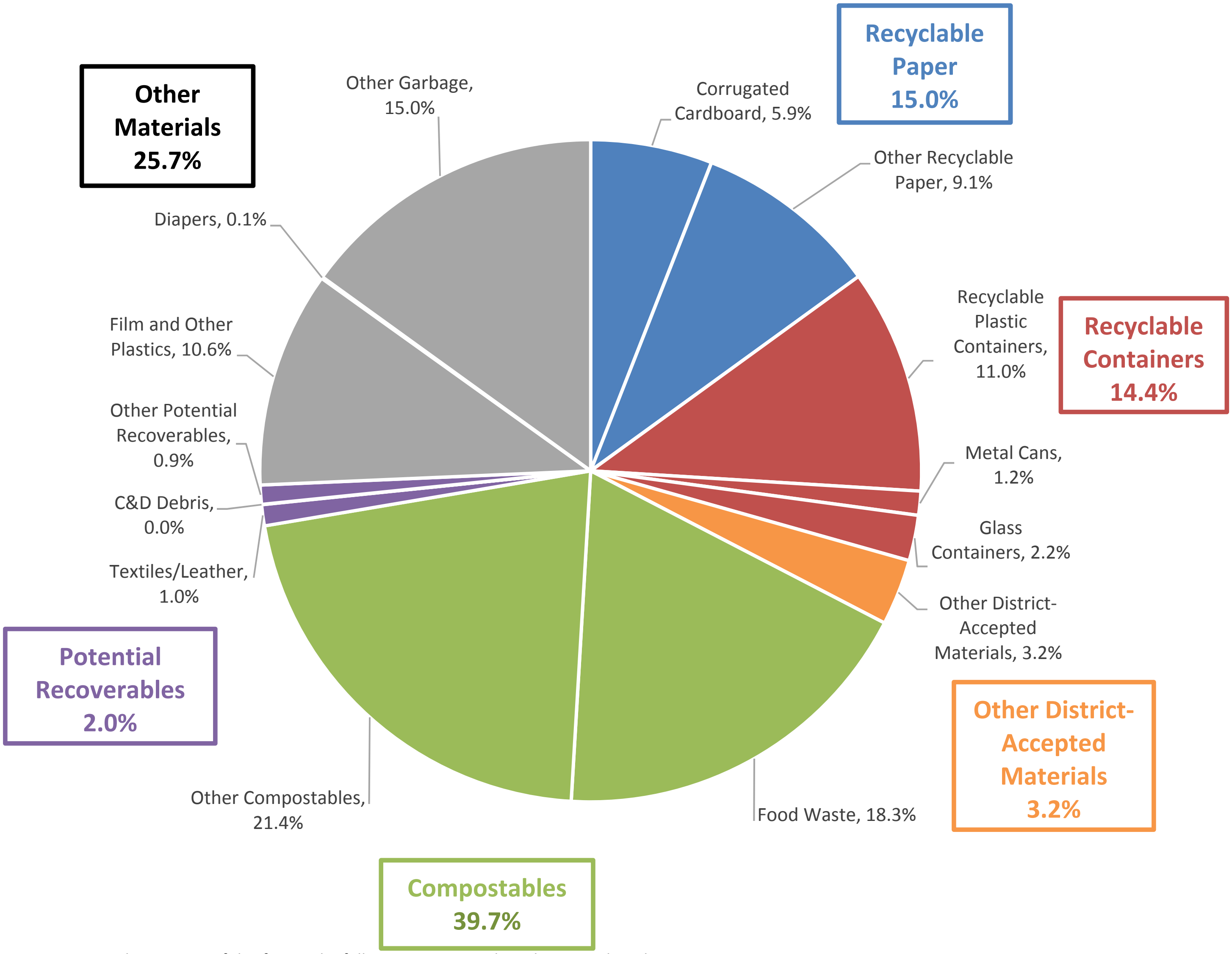
Note: Columns may not appear to calculate correctly due to rounding.

4.3.4 IU Mixed Waste

Figure 4-5 and Table 4-4 depict the composition of IU mixed waste. Below are key findings for the composition of IU mixed waste:

- IU mixed waste is nearly 30 percent recyclable paper and containers. Mixed recyclable paper and corrugated cardboard were the largest components. Additionally, PET bottles were significantly higher (approximately 5 percent) than in any other sector.
- Approximately 3 percent of IU waste was other material accepted by the District and was mostly white goods/small appliances and retail plastic bags.
- Nearly 40 percent of IU waste was potentially compostable materials. While food waste was lower than in the District and City waste, IU had a significantly higher compostable paper composition. This was primarily paper towels and napkins, presumably from restrooms and dining halls.
- IU waste had a lower percentage of other potential recoverables than the other sectors.
- Over 25 percent of IU waste was other materials. As with the other sectors, this was mostly film and all other garbage. IU waste also had an unusually high percentage of liquids, mostly due to water within PET bottles.
- Based on the WCS results and the estimated 6,542 tons of mixed waste collected from IU in 2016, approximately 2,130 tons of recyclable materials (33 percent) and 2,600 tons of compostable materials (40 percent) are being discarded.

Figure 4-5: Composition of IU Mixed Waste (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, office paper, and mixed recyclable paper.
- Recyclable plastic containers include the categories of PET bottles (#1), HDPE bottles (#2), non-bottle #1 and #2 plastic containers, #3-7 plastic containers, and expanded polystyrene (EPS), coded #6.
- Metal cans include the categories of aluminum cans and tin/steel cans.
- Other District-accepted materials include the categories of books, EPS packing peanuts, retail plastic bags, ferrous scrap metal, non-ferrous scrap metal, white goods/small appliances, special wastes, electronics, and electronic media.
- Other compostables include the categories of compostable paper, clean wood waste, yard waste, and other organics.
- Other potential recoverables include the categories of aseptic/polycoated containers, bulky rigid plastics, aluminum foil, and tires and rubber.
- Other garbage includes the categories of EPS not coded #6, other glass, household batteries, treated wood waste, all other garbage, liquids, and grit.

Table 4-4: Composition of IU Mixed Waste (% by weight)

	Material Category	Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Newspaper	1.0%	-0.44%	2.39%
2	Corrugated Cardboard (OCC)	5.9%	3.47%	8.42%
3	Office Paper	1.0%	0.35%	1.59%
4	Mixed Recyclable Paper	7.1%	5.13%	9.12%
	Total Accepted Recyclable Paper	**15.0%**		
8	PET Bottles (#1)	5.1%	3.84%	6.29%
9	HDPE Bottles (#2)	1.0%	0.63%	1.38%
10	Non-Bottle #1 and #2 Plastic Containers	1.0%	0.18%	1.74%
11	#3-7 Plastic Containers	3.5%	2.16%	4.84%
13	Expanded Polystyrene (EPS), Coded #6	0.4%	0.24%	0.63%
19	Tin/Steel Cans	0.4%	0.16%	0.71%
21	Aluminum Cans	0.7%	0.54%	0.94%
25	Glass Containers	2.2%	0.08%	4.36%
	Total Accepted Recyclable Containers	**14.4%**		
5	Books	0.1%	-0.14%	0.44%
15	EPS Packing Peanuts	0.0%	0.00%	0.00%
16	Retail Plastic Bags	1.0%	0.52%	1.54%
20	Ferrous Scrap Metal	0.4%	0.03%	0.68%
23	Non-Ferrous Scrap Metal	0.1%	-0.04%	0.14%
24	White Goods/Small Appliances	1.5%	-1.50%	4.44%
28	Special Wastes	0.0%	0.00%	0.01%
29	Electronics (E-waste)	0.2%	-0.08%	0.40%
30	Electronic Media	0.0%	0.00%	0.00%
	Other District-Accepted Materials	**3.2%**		
6	Compostable Paper	19.4%	16.89%	21.86%
32	Clean Wood Waste	0.2%	-0.07%	0.45%
36	Yard Waste	0.6%	-0.29%	1.50%
37	Food Waste	18.3%	15.12%	21.56%
38	Other Organics	1.2%	-0.65%	3.09%
	Total Potential Compostables	**39.7%**		
7	Aseptic/Polycoated Containers	0.3%	0.19%	0.34%
12	Bulky Rigid Plastics	0.1%	-0.04%	0.32%
22	Aluminum Foil	0.5%	0.10%	0.92%
27	Textiles/Leather	1.0%	0.54%	1.52%
34	C&D Debris	0.0%	-0.02%	0.05%
35	Tires and Rubber	0.0%	-0.01%	0.04%
	Other Potential Recoverables	**2.0%**		
14	EPS, Not Coded #6	0.0%	-0.02%	0.09%
17	Non-Rigid Plastic Film	9.1%	7.82%	10.28%
18	All Other Plastics	1.5%	1.24%	1.80%
26	Other Glass	0.2%	-0.09%	0.46%
31	Household Batteries	0.0%	-0.02%	0.07%
33	Treated Wood Waste	0.2%	0.00%	0.39%
39	Diapers	0.1%	0.02%	0.14%
40	All Other Garbage	7.6%	7.64%	7.64%
41	Liquids	7.0%	2.02%	11.90%
42	Grit	0.0%	0.00%	0.00%
	Other Materials	**25.7%**		

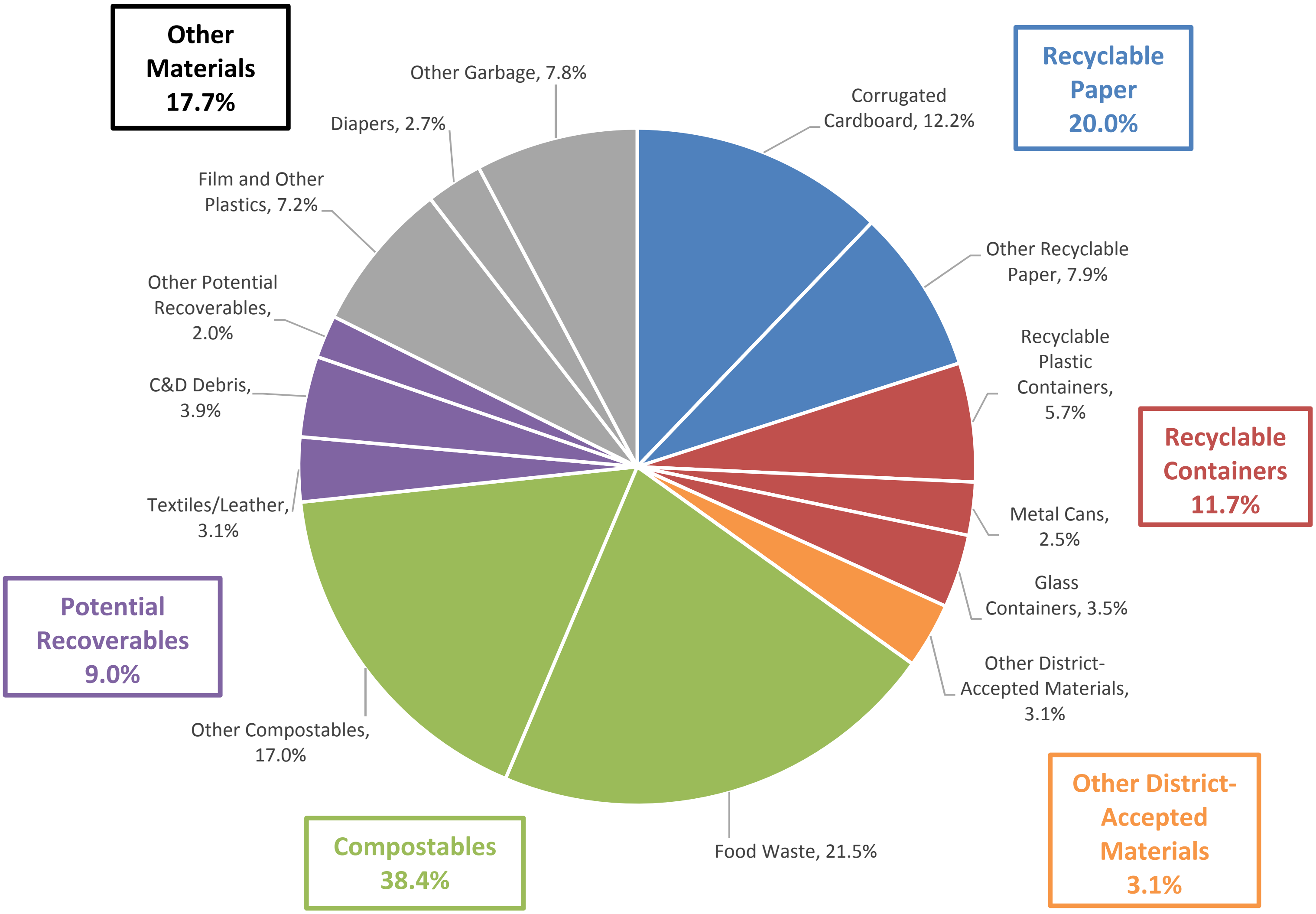
Note: Columns may not appear to calculate correctly due to rounding.

4.3.5 Private Hauler Mixed Waste

Figure 4-6 and Table 4-5 depict the composition of private hauler mixed waste. Below are key findings:

- Privately collected waste had the highest percentage of recyclable paper, at 20 percent, of all the sectors. Combined, recyclable paper and containers were nearly 32 percent. Corrugated cardboard was a major component of this (approximately 12 percent), which was predominantly found in the commercial samples.
- About 3 percent of the private waste was other materials accepted by the District, the largest component was scrap metal.
- Private mixed waste was over 38 percent compostable. About half of this was food waste, but compostable paper and clean wood waste were significant fractions.
- Approximately 9 percent of the private waste was potential recoverables. C&D debris and textiles/leather comprised most of this.
- Private waste had a slightly lower composition of other materials at approximately 18 percent. As with other sectors, film and all other garbage were major components of this.
- Based on the WCS results and the estimated 103,720 tons of mixed waste collected by private haulers in 2016, approximately 33,810 tons of recyclable materials (35 percent) and 39,830 tons of compostable materials (38 percent) are being discarded. Private haulers are by far the largest untapped source of recyclable materials in the County.

Figure 4-6: Composition of Private Mixed Waste (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, office paper, and mixed recyclable paper.
- Recyclable plastic containers include the categories of PET bottles (#1), HDPE bottles (#2), non-bottle #1 and #2 plastic containers, #3-7 plastic containers, and expanded polystyrene (EPS), coded #6.
- Metal cans include the categories of aluminum cans and tin/steel cans.
- Other District-accepted materials include the categories of books, EPS packing peanuts, retail plastic bags, ferrous scrap metal, non-ferrous scrap metal, white goods/small appliances, special wastes, electronics, and electronic media.
- Other compostables include the categories of compostable paper, clean wood waste, yard waste, and other organics.
- Other potential recoverables include the categories of aseptic/polycoated containers, bulky rigid plastics, aluminum foil, and tires and rubber.
- Other garbage includes the categories of EPS not coded #6, other glass, household batteries, treated wood waste, all other garbage, liquids, and grit.

Table 4-5: Composition of Private Mixed Waste (% by weight)

	Material Category	Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Newspaper	0.7%	0.21%	1.10%
2	Corrugated Cardboard (OCC)	12.2%	7.21%	17.15%
3	Office Paper	0.6%	0.21%	1.01%
4	Mixed Recyclable Paper	6.6%	4.66%	8.54%
	Total Accepted Recyclable Paper	**20.0%**		
8	PET Bottles (#1)	1.7%	1.38%	2.04%
9	HDPE Bottles (#2)	0.8%	0.45%	1.08%
10	Non-Bottle #1 and #2 Plastic Containers	0.9%	0.45%	1.38%
11	#3-7 Plastic Containers	1.6%	0.81%	2.35%
13	Expanded Polystyrene (EPS), Coded #6	0.7%	0.44%	0.95%
19	Tin/Steel Cans	1.7%	1.14%	2.20%
21	Aluminum Cans	0.9%	0.51%	1.22%
25	Glass Containers	3.5%	1.65%	5.35%
	Total Accepted Recyclable Containers	**11.7%**		
5	Books	0.1%	-0.03%	0.28%
15	EPS Packing Peanuts	0.0%	0.00%	0.01%
16	Retail Plastic Bags	0.8%	0.53%	1.06%
20	Ferrous Scrap Metal	1.3%	-0.49%	3.19%
23	Non-Ferrous Scrap Metal	0.2%	0.00%	0.41%
24	White Goods/Small Appliances	0.1%	-0.09%	0.31%
28	Special Wastes	0.0%	0.00%	0.00%
29	Electronics (E-waste)	0.5%	-0.08%	1.14%
30	Electronic Media	0.0%	-0.01%	0.05%
	Other District-Accepted Materials	**3.1%**		
6	Compostable Paper	8.8%	7.02%	10.59%
32	Clean Wood Waste	5.5%	-0.42%	11.51%
36	Yard Waste	1.6%	0.03%	3.22%
37	Food Waste	21.5%	15.67%	27.26%
38	Other Organics	1.0%	0.26%	1.73%
	Total Potential Compostables	**38.4%**		
7	Aseptic/Polycoated Containers	0.1%	0.07%	0.18%
12	Bulky Rigid Plastics	1.0%	0.28%	1.77%
22	Aluminum Foil	0.5%	0.13%	0.93%
27	Textiles/Leather	3.1%	1.70%	4.47%
34	C&D Debris	3.9%	-0.75%	8.46%
35	Tires and Rubber	0.4%	0.03%	0.69%
	Other Potential Recoverables	**9.0%**		
14	EPS, Not Coded #6	0.2%	0.06%	0.26%
17	Non-Rigid Plastic Film	6.4%	4.30%	8.50%
18	All Other Plastics	0.8%	0.63%	1.02%
26	Other Glass	0.3%	0.00%	0.62%
31	Household Batteries	0.0%	0.01%	0.06%
33	Treated Wood Waste	1.0%	-0.42%	2.42%
39	Diapers	2.7%	0.77%	4.66%
40	All Other Garbage	4.6%	4.56%	4.56%
41	Liquids	1.7%	1.01%	2.37%
42	Grit	0.0%	0.00%	0.00%
	Other Materials	**17.7%**		

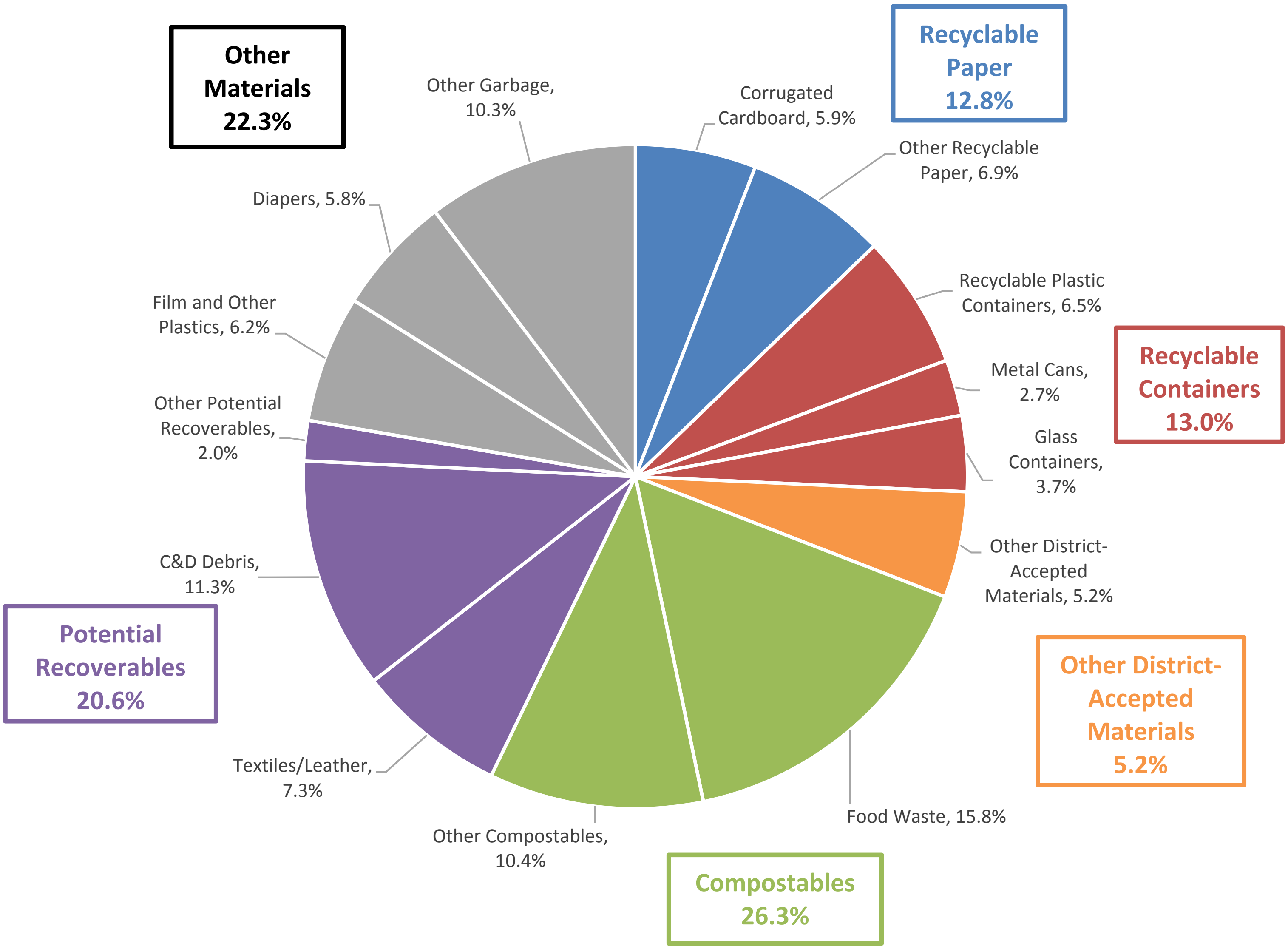
Note: Columns may not appear to calculate correctly due to rounding.

4.3.6 Out-of-County Mixed Waste

Figure 4-7 and Table 4-6 depict the composition of Out-of-County mixed waste. Below are key findings for the composition of Out-of-County mixed waste:

- Over 25 percent of the Out-of-County waste was recyclable paper and containers. Corrugated cardboard and mixed recyclable paper were the largest components of this.
- Approximately 5 percent of the waste was other materials accepted by the District. Ferrous scrap metal was a large component of these materials.
- The Out-of-County waste was significantly lower in organics (about 26 percent). Food waste was still nearly 16 percent of the waste.
- Out-of-County waste had the highest composition of potential recoverables at over 20 percent. Over half of this was C&D debris. This was primarily due to a single sample with a high volume of drywall, and could be considered an outlier. Most C&D debris delivered to the transfer station, based on on-site observations, was in open-top roll-off or hand-unload vehicles.
- About 22 percent of the waste was other materials, again mostly diapers, film, and all other garbage.

Figure 4-7: Composition of Out-of-County Mixed Waste (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, office paper, and mixed recyclable paper.
- Recyclable plastic containers include the categories of PET bottles (#1), HDPE bottles (#2), non-bottle #1 and #2 plastic containers, #3-7 plastic containers, and expanded polystyrene (EPS), coded #6.
- Metal cans include the categories of aluminum cans and tin/steel cans.
- Other District-accepted materials include the categories of books, EPS packing peanuts, retail plastic bags, ferrous scrap metal, non-ferrous scrap metal, white goods/small appliances, special wastes, electronics, and electronic media.
- Other compostables include the categories of compostable paper, clean wood waste, yard waste, and other organics.
- Other potential recoverables include the categories of aseptic/polycoated containers, bulky rigid plastics, aluminum foil, and tires and rubber.
- Other garbage includes the categories of EPS not coded #6, other glass, household batteries, treated wood waste, all other garbage, liquids, and grit.

Table 4-6: Composition of Out-of-County Mixed Waste (% by weight)

	Material Category	Weighted Average	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
1	Newspaper	0.7%	0.27%	1.17%
2	Corrugated Cardboard (OCC)	5.9%	1.50%	10.26%
3	Office Paper	0.2%	-0.02%	0.48%
4	Mixed Recyclable Paper	5.9%	4.39%	7.49%
	Total Accepted Recyclable Paper	**12.8%**		
8	PET Bottles (#1)	2.1%	1.92%	2.25%
9	HDPE Bottles (#2)	1.3%	0.59%	2.07%
10	Non-Bottle #1 and #2 Plastic Containers	0.9%	0.23%	1.64%
11	#3-7 Plastic Containers	1.3%	0.48%	2.17%
13	Expanded Polystyrene (EPS), Coded #6	0.9%	0.34%	1.38%
19	Tin/Steel Cans	2.0%	0.79%	3.19%
21	Aluminum Cans	0.7%	0.47%	1.02%
25	Glass Containers	3.7%	2.31%	5.07%
	Total Accepted Recyclable Containers	**13.0%**		
5	Books	0.9%	-0.82%	2.55%
15	EPS Packing Peanuts	0.0%	0.00%	0.00%
16	Retail Plastic Bags	0.6%	0.17%	0.98%
20	Ferrous Scrap Metal	2.1%	-1.76%	5.88%
23	Non-Ferrous Scrap Metal	0.3%	-0.23%	0.75%
24	White Goods/Small Appliances	0.5%	-0.29%	1.19%
28	Special Wastes	0.1%	-0.07%	0.30%
29	Electronics (E-waste)	0.7%	-0.52%	1.85%
30	Electronic Media	0.2%	-0.22%	0.56%
	Other District-Accepted Materials	**5.2%**		
6	Compostable Paper	7.4%	4.01%	10.77%
32	Clean Wood Waste	0.7%	-0.07%	1.52%
36	Yard Waste	0.1%	-0.01%	0.23%
37	Food Waste	15.8%	5.33%	26.31%
38	Other Organics	2.2%	-2.50%	6.91%
	Total Potential Compostables	**26.3%**		
7	Aseptic/Polycoated Containers	0.4%	-0.01%	0.74%
12	Bulky Rigid Plastics	1.1%	-0.14%	2.39%
22	Aluminum Foil	0.4%	-0.13%	1.03%
27	Textiles/Leather	7.3%	2.04%	12.57%
34	C&D Debris	11.3%	-10.72%	33.32%
35	Tires and Rubber	0.0%	-0.02%	0.05%
	Other Potential Recoverables	**20.6%**		
14	EPS, Not Coded #6	0.3%	0.06%	0.50%
17	Non-Rigid Plastic Film	5.2%	3.01%	7.48%
18	All Other Plastics	0.9%	0.06%	1.84%
26	Other Glass	1.8%	-0.69%	4.36%
31	Household Batteries	0.0%	0.00%	0.01%
33	Treated Wood Waste	0.2%	-0.08%	0.50%
39	Diapers	5.8%	-0.20%	11.77%
40	All Other Garbage	4.7%	2.85%	6.49%
41	Liquids	2.1%	-1.31%	5.52%
42	Grit	1.2%	-0.62%	3.02%
	Other Materials	**22.3%**		

Note: Columns may not appear to calculate correctly due to rounding.

4.3.7 Comparability of WCS Results

The ability to compare the District WCS results to other jurisdictions is limited because many locality-specific factors influence waste composition, including seasonality, community demographics, the types of diversion programs in place, and performance of those diversion programs. Additionally, the material categories often vary from one WCS to another based on individual jurisdiction's needs and objectives. Nonetheless, comparing the District results to other communities helps provide a frame of reference for assessing the WCS results. Two WCS performed by KCI of relevance to the County are those conducted in Orange County, NC and City of Fayetteville, AR, both of which are also home to a major academic institution. Table 4-7 compares the major category results for the District and the City with the residential WCS results for those two other communities. The District and City had a relatively similar composition to Orange County, NC but Fayetteville, AR had higher recyclables and lower potential compostables.

Table 4-7: District and City Results Compared to Other WCSs

Material Category	District	City	Orange County, NC	Fayetteville, AR
Accepted Recyclable Paper	14%	12%	14%	18%
Accepted Recyclable Containers	11%	10%	10%	12%
Other District-Accepted Materials	6%	3%	5%	4%
Potential Compostables	39%	47%	40%	30%
Potential Recoverables	9%	9%	7%	10%
Other Materials	21%	20%	24%	26%
Total	100%	100%	100%	100%

Note: Figures may not appear to add due to rounding

Section 5
Materials Processing Scenarios: Assumptions and Projections

5.1 Introduction

As part of the feasibility assessment work and as discussed during the strategy session, the District and KCI defined four materials processing facility options for subsequent analysis. These are based on the three physical processing technologies discussed in Section 3 of this report (IPF, MRF, and MWF), as well as an additional scenario evaluating the feasibility of an OCF.

KCI developed a set of assumptions regarding the sources and flow of materials from the County and adjacent counties for each facility. It is important to note that KCI's assumptions are hypothetical for the purpose of conducting the financial assessment (Section 6) and supporting the District's planning process. Without some order of magnitude estimates regarding the capacity and costs of a processing facility, the District, the City, IU, private haulers, and adjacent counties cannot have substantive discussions about whether and how much material they might deliver to a proposed facility. Yet without making preliminary tonnage estimates, it is not possible to develop conceptual designs and cost estimates for processing facilities. Additionally, the District must consider a number of other non-financial factors (including institutional, contractual, regulatory, and political factors) when assessing the feasibility of the four material processing options and associated changes in District collection activities as outlined below.

The feasibility of a District processing facility is highly dependent on whether or not it handles materials from non-District sources. This is a significant challenge given the extensive role the private sector plays in the regional waste management system. At one extreme, it is possible that a District processing facility would be unable to secure waste commitments from any other sources. As noted in Section 3, processing facilities generally need to handle a certain minimum tonnage in order to be financially viable, and the District's own tonnage is not sufficient to achieve those tonnage thresholds.

Therefore, to establish a basis for the feasibility study, KCI developed assumptions for how much material a District processing facility might receive from sources other than the District (i.e., the City, IU, private haulers in the County, and adjacent counties). Assumptions are based on KCI's assessment of the regional solid waste management system's programs and infrastructure and their potential compatibility with each facility option. Also, the assumptions take into consideration the design capacities typically needed for economic viability identified in Section 3. The intent is to identify the approximate amount of material needed in addition to the District's own tonnage and establish a basis for the financial assessment discussed in Section 6.

KCI used the tonnage information in Table 5-1 as the basis for preparing the material flow estimates. Note: for the purposes of the report, total MSW is the total of mixed waste, recyclables, and organics.

Table 5-1: Summary of 2016 Material Generation

Source	Mixed Waste	Recyclables	Organics	Total MSW
District	2,880	2,759	0	5,639
City	4,933	2,609	577	8,119
IU	6,542	1,050	24	7,616
County private haulers	103,720	4,986	0	108,706
Morgan County	38,610	887	0	39,497
Lawrence County	41,728	1,596	0	43,324
Jackson County	35,630	1,042	0	36,672
Green County	12,882	446	0	13,328
Owen County	12,247	0	0	12,247
Brown County	9,216	581	0	9,797
Total	**268,388**	**15,956**	**601**	**284,945**

5.2 Scenario 1: IPF with Additional District Collection Services

Target Sources:

- Source-separated recyclables from the District collection services, IU, and adjacent counties.

Key Features:

- Greater recovery of recyclables in the County through additional permanent drop-off sites, mobile/roving collection, and expanded GBN.
- Handling recyclables from IU and adjacent counties may improve the economic viability of the facility.

Material Flow Assumptions:

- District: Assume the IPF handles all the District segregated recyclables; assume an expanded collection network increases tonnage by 75 percent to 100 percent.
- City: Assume the IPF does not handle single stream recyclables (for estimating the overall County diversion rate, assume that single stream conversion increases recovery by 36 percent to 400 pounds per household per year).
- IU: Assume the IPF handles IU recyclables that are source segregated (i.e., cardboard); assume this equals 10 percent to 20 percent of IU's recovery tonnage.
- County private haulers: Assume the IPF does not handle any private hauler recyclables.
- Other counties:

- Morgan County SWMD: Assume the IPF handles recyclables from the SWMD drop-offs; assume it equals 30 percent to 50 percent of county-wide recycling tonnage.
- Lawrence County SWMD: Assume the SWMD handles its drop-offs at its own processing facility.
- Jackson County SWMD: Assume the SWMD drop-offs go to Rumpke recycling transfer facility.
- Green County SWMD: Assume the SWMD continues to bale its cardboard & ship single stream to Indianapolis.
- Owen County: No organized recycling system, assume nothing handled by the IPF.
- Brown County SWMD: Assume the SWMD continues to handle its drop-offs and curbside at its own processing facility.

Table 5-2 presents a tabulated summary of the assumptions under Scenario 1. Table 5-3 presents the tonnage of County MSW in each category projected through 2034 and potential County recovery rates under Scenario 1 (note: Out-of-County tonnage is not included in this table). Table 5-4 presents the potential material input and output of a District IPF under Scenario 1 (includes both County and Out-of-County tonnage).

Table 5-2: Summary of Material Flow Assumptions – Scenario 1 IPF

Source	Tonnage Flow to District IPF Recyclables
District	All goes to IPF; 75%-100% increase
City	Not handled by IPF
IU	Some goes to IPF; 10%-20% of tons
County private haulers	Not handled by IPF
Morgan County SWMD	Drop-offs go to IPF; 30%-50% of tons
Lawrence County SWMD	Not handled by IPF
Jackson County SWMD	Not handled by IPF
Green County SWMD	Not handled by IPF
Owen County	Not handled by IPF
Brown County SWMD	Not handled by IPF

Table 5-3: Monroe County Tonnage & Recovery Projections – Scenario 1 IPF[12]

	2017	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections					
Source-Separation					
Recyclables	11,520	14,992	15,490	16,076	16,595
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	119,738	123,716	128,394	132,547
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	160	164	169	172
Recovery Rate	9%	11%	11%	11%	11%
High Projections					
Source-Separation					
Recyclables	11,520	15,709	16,231	16,845	17,390
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	119,020	122,974	127,625	131,752
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	220	225	231	235
Recovery Rate	9%	12%	12%	12%	12%

Note: Includes all MSW regardless of whether it is handled by the District or other stakeholders, except for Residue which is based only on the tonnage generated by the IPF.

[12] It is assumed for all scenarios that a facility would open in 2020; 2017 tonnages are provided as a baseline to help assess the facility's recovery rate impact.

Table 5-4: Facility Tonnage Projections – Scenario 1 IPF

	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections				
Facility Input				
Recyclables – Source-Separated	5,404	5,575	5,775	5,951
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	5,404	5,575	5,775	5,951
Facility Output				
Recovered Recyclables	5,243	5,410	5,606	5,778
Recovered Organics	0	0	0	0
Residue & Mixed Waste	160	164	169	172
Total	5,404	5,575	5,775	5,951
High Projections				
Facility Input				
Recyclables – Source-Separated	6,411	6,609	6,842	7,045
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	6,411	6,609	6,842	7,045
Facility Output				
Recovered Recyclables	6,191	6,384	6,611	6,810
Recovered Organics	0	0	0	0
Residue & Mixed Waste	220	225	231	235
Total	6,411	6,609	6,842	7,045

5.3 Scenario 2: MRF with Additional District Collection Services

Target Sources:

- Single stream recyclables from the District collection services, the City, IU, County private haulers, and adjacent counties.

Key Features:

- Greater recovery of recyclables in the County by converting to single stream, additional permanent drop-off sites, mobile/roving collection, and expanded GBN.
- The GBN offers commercial single stream collection service.

- Handling recyclables from the City, IU, and adjacent counties may improve the economic viability of the MRF.

Material Flow Assumptions:

- District: Assume the MRF handles all the District's recyclables; assume expanded collection network and conversion to single stream increases tonnage by 100 percent to 150 percent.
- City: Assume the MRF handles either 0 percent or 100 percent of City-collected recyclables; assume that single stream conversion increases recovery by 36 percent to 400 pounds per household per year.
- IU: Assume the MRF handles either 0 percent or 100 percent of IU recyclables.
- County private haulers: Assume the MRF handles a portion of private hauler recyclables; assume it equals 20 percent to 30 percent of privately collected recyclables.
- Other counties:
    - Morgan County SWMD: Assume the MRF handles recyclables from the SWMD drop-offs; assume it equals 30 percent to 50 percent of county-wide recycling tonnage; assume the MRF enables SWMD to convert to single stream.
    - Lawrence County SWMD: Assume the MRF handles recyclables from Bedford & Mitchel curbside and a portion of the SWMD drop-off recyclables; assume it equals 30 percent to 50 percent of county-wide recycling tonnage.
    - Jackson County SWMD: Assume the SWMD drop-offs go to Rumpke recycling transfer facility.
    - Green County SWMD: Assume the MRF handles single stream recyclables from the SWMD drop-offs; assume it equals 20 percent to 30 percent of county-wide recycling tonnage; assume the SWMD continues to bale its cardboard.
    - Owen County: No organized recycling system, assume nothing handled by the MRF.
    - Brown County SWMD: Assume the SWMD continues to handle its drop-off and curbside at its own processing facility.

Table 5-5 presents a tabulated summary of the assumptions under Scenario 2. Table 5-6 presents the tonnage of County MSW in each category projected to 2034 and a potential recovery rate under Scenario 2 (note: Out-of-County tonnage is not included in this table). Table 5-7 presents the potential material input and output of a District MRF under Scenario 2 (includes both County and Out-of-County tonnage).

Table 5-5: Summary of Material Flow Assumptions – Scenario 2 MRF

Source	Tonnage Flow to District MRF Recyclables
District	All goes to MRF; 100%-150% increase
City	0%-100% goes to MRF; 400 lbs/hhld/yr collected
IU	0%-100% goes to MRF
County private haulers	Some goes to MRF; 20%-30% of tons
Morgan County SWMD	Drop-offs go to MRF; 30%-50% of tons
Lawrence County SWMD	Some goes to MRF; 30%-50% of tons
Jackson County SWMD	Not handled by MRF
Green County SWMD	Some goes to MRF; 20%-30% of tons
Owen County	Not handled by MRF
Brown County SWMD	Not handled by MRF

Table 5-6: Monroe County Tonnage & Recovery Projections – Scenario 2 MRF

	2017	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections					
Source-Separation					
Recyclables	11,520	15,709	16,231	16,845	17,390
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	119,020	122,974	127,625	131,752
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	791	813	838	859
Recovery Rate	9%	11%	11%	11%	11%
High Projections					
Source-Separation					
Recyclables	11,520	17,145	17,714	18,384	18,979
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	117,585	121,491	126,086	130,163
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	2,103	2,165	2,238	2,301
Recovery Rate	9%	12%	12%	12%	12%

Note: Includes all MSW regardless of whether it is handled by the District or other stakeholders, except for Residue, which is based only on the tonnage generated by the MRF.

Table 5-7: Facility Tonnage Projections – Scenario 2 MRF

	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections				
Facility Input				
Recyclables – Source-Separated	7,458	7,684	7,948	8,178
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	7,458	7,684	7,948	8,178
Facility Output				
Recovered Recyclables	6,667	6,871	7,110	7,319
Recovered Organics	0	0	0	0
Residue & Mixed Waste	791	813	838	859
Total	7,458	7,684	7,948	8,178
High Projections				
Facility Input				
Recyclables – Source-Separated	14,629	15,079	15,605	16,066
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	14,629	15,079	15,605	16,066
Facility Output				
Recovered Recyclables	12,526	12,914	13,368	13,765
Recovered Organics	0	0	0	0
Residue & Mixed Waste	2,103	2,165	2,238	2,301
Total	14,629	15,079	15,605	16,066

5.4 Scenario 3: MWF with Additional District Collection Services

Target Sources:

- MSW from District collection services, the City, IU, County private haulers, and adjacent counties.

Key Features:

- The MWF handles both single stream recyclables and mixed waste.
- Greater recovery in the County by recovering recyclable materials from County and the City mixed waste.

- Handling mixed waste from the City, IU, and adjacent counties may improve the economic viability of the MWF.
- Amounts of recyclables and organics in mixed waste are based on the WCS results.

<u>Tonnage Assumptions:</u>

- District:
  - Recyclables: Same as Scenario 2.
  - Mixed waste: Assume the MWF handles all District mixed waste.
- City:
  - Recyclables: Assume the MWF handles 100% of City-collected recyclables; assume that single stream conversion increases recovery by 36% to 400 pounds per household per year.
  - Mixed waste: Assume the MWF handles 100% of City-collected mixed waste.
- IU:
  - Recyclables: Assume the MWF handles 100% of IU recyclables.
  - Mixed waste: Assume the MWF handles 100% of IU mixed waste.
- County private haulers:
  - Recyclables: Same as Scenario 2.
  - Mixed waste: Assume the MWF handles a portion of private hauler MSW; assume it equals 20 percent to 30 percent of privately-collected mixed waste tonnage.
- Other counties:
  - Morgan County SWMD:
    - Recyclables: Same as Scenario 2.
    - Mixed waste: Assume MWF handles all mixed waste from the Martinsville transfer station; assume it equals 20 percent to 30 percent of county-wide mixed waste tonnage.
  - Lawrence County SWMD:
    - Recyclables: Same as Scenario 2.
    - Mixed waste: Assume the MWF handles all mixed waste from the SWMD transfer station; assume it equals 70 percent to 80 percent of county-wide mixed waste tonnage.
  - Jackson County SWMD:
    - Recyclables: Same as Scenario 2.
    - Mixed waste: Assume mixed waste continues to go to the Jackson County transfer station and Medora landfill.
  - Green County SWMD:
    - Recyclables: Same as Scenario 2.

    - Mixed waste: Assume the MWF handles all mixed waste from the SWMD drop-offs, assume it equals 5 percent to 10 percent of county-wide mixed waste.
  - Owen County:
    - Recyclables: same as Scenario 2.
    - Mixed waste: Assume private haulers continue current practices.
  - Brown County SWMD:
    - Recyclables: same as Scenario 2.
    - Mixed waste: Assume the MWF handles all mixed waste from the SWMD drop-offs, assume it equals 5 percent to 10 percent of county-wide mixed waste.

Table 5-8 presents a tabulated summary of the assumptions under Scenario 3. Table 5-9 presents the tonnage of County MSW in each category projected to 2034 and potential recovery rates under Scenario 3 (note: Out-of-County tonnage is not included in this table). Table 5-10 presents the potential material input and output of a District MWF under Scenario 3 (includes both County and Out-of-County tonnage).

Table 5-8: Summary of Material Flow Assumptions – Scenario 3 MWF

	Tonnage Flow to District MWF	
	Recyclables	Mixed Waste
District	All goes to MWF; 100%-150% increase	All goes to MWF
City	All goes to MWF; 400 lbs/hhld/yr;	All goes to MWF
IU	All goes to MWF	All goes to MWF
County private haulers	Some goes to MWF; 20%-30% of tons	Some goes to MWF; 20%-30% of tons
Morgan County SWMD	Drop-offs go to MWF; 30%-50% of tons	Some goes to MWF; 20%-30% of tons
Lawrence County SWMD	Some goes to MWF; 30%-50% of tons	Some goes to MWF; 70%-80% of tons
Jackson County SWMD	Not handled by MWF	Not handled by MWF
Green County SWMD	Some goes to MWF; 20%-30% of tons	Some goes to MWF; 5%-10% of tons
Owen County	Not handled by MWF	Not handled by MWF
Brown County SWMD	Not handled by MWF	Some goes to MWF; 5%-10% of tons

Table 5-9: Monroe County Tonnage & Recovery Projections – Scenario 3 MWF

	2017	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections					
Source-Separation					
Recyclables	11,520	15,709	16,231	16,845	17,390
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	11,223	11,596	12,034	12,423
Organics	0	13,095	13,530	14,042	14,496
Remaining Mixed Waste	119,272	94,702	97,848	101,549	104,833
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	10,966	11,195	11,447	11,648
Recovery Rate	9%	22%	22%	22%	22%
High Projections					
Source-Separation					
Recyclables	11,520	17,145	17,714	18,384	18,979
Organics	607	625	646	671	692
Targeted Materials in Mixed Waste					
Recyclables	0	14,683	15,171	15,744	16,253
Organics	0	16,867	17,428	18,087	18,672
Remaining Mixed Waste	119,272	86,035	88,893	92,255	95,238
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	13,810	14,097	14,414	14,666
Recovery Rate	9%	26%	26%	27%	27%

Note: Includes all MSW regardless of whether it is handled by the District or other stakeholders, except for Residue and Recovery Rate, which are based only on the tonnage handled by the MWF.

Table 5-10: Facility Tonnage Projections – Scenario 3 MWF

	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections				
Facility Input				
Recyclables – Source-Separated	12,237	12,622	13,073	13,469
Recyclables in Mixed Waste	21,492	21,883	22,302	22,619
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	21,343	21,792	22,288	22,685
Mixed Waste	26,435	26,817	27,203	27,463
Total	81,507	83,114	84,866	86,236
Facility Output				
Recovered Recyclables	24,046	24,623	25,273	25,813
Recovered Organics	20,060	20,480	20,943	21,312
Residue & Mixed Waste	37,401	38,012	38,650	39,111
Total	81,507	83,114	84,866	86,236
High Projections				
Facility Input				
Recyclables – Source-Separated	14,629	15,079	15,605	16,066
Recyclables in Mixed Waste	27,546	28,056	28,605	29,024
Organics – Source-Separated	0	0	0	0
Organics in Mixed Waste	27,198	27,777	28,416	28,929
Mixed Waste	33,263	33,746	34,236	34,566
Total	102,635	104,658	106,862	108,586
Facility Output				
Recovered Recyclables	29,992	30,703	31,504	32,167
Recovered Organics	25,571	26,111	26,708	27,186
Residue & Mixed Waste	47,073	47,843	48,649	49,232
Total	102,635	104,658	106,862	108,586

5.5 Scenario 4: Organics Composting Facility

Target Sources:

- Food waste and yard waste from District collection services, the City, IU, County private haulers, and adjacent counties.

Key Features:

- Greater recovery in the County by separating and recovering organic materials from County and City MSW.
- The District adds source-separated organics (food waste and yard waste) to materials accepted at drop-offs.
- The GBN offers a commercial organics collection service.

- Handling organics from the City, IU, and adjacent counties may improve the economic viability of the OCF.

Tonnage Assumptions:

- District: Assume the OCF handles all District organics; assume drop-off and GBN collection recovers 10 percent to 20 percent of food waste and 40 percent to 50 percent of yard waste in County mixed waste.
- City: Assume the OCF handles City-collected organics; assume City implements residential organics collection that recovers 20 percent to 30 percent of food waste and 50 percent to 60 percent of yard waste from City-collected mixed waste.
- IU: Assume the OCF handles IU organics; assume IU implements organics collection that recovers 20 percent to 30 percent of food waste and 50 percent to 60 percent of yard waste in IU mixed waste.
- County private haulers:
  - Organics: Assume the OCF handles a portion of private hauler organics; assume some haulers implement organics collection that recovers 5 percent to 10 percent of food waste and 20 percent to 30 percent of yard waste from the mixed waste they collect.
- Other counties:
  - Organics: Not handled by the OCF.

Table 5-11 presents a tabulated summary of the assumptions under Scenario 4. Table 5-12 presents the tonnage of County MSW in each category projected to 2034 and potential recovery rate under Scenario 4 (note: Out-of-County tonnage is not included in this table). Table 5-13 presents the potential material input and output of a District OCF under Scenario 4 (includes both County and Out-of-County tonnage).

Table 5-11: Summary of Material Flow Assumptions – Scenario 4 OCF

	Tonnage Flow to District OCF Organics
District	All goes to OCF; 10%-20% of FW & 40%-50% of YW in MSW
City	All goes to OCF; 20%-30% of FW & 50%-60% of YW in MSW
IU	All goes to OCF; 20%-30% of FW & 50%-60% of YW in MSW
County private haulers	Some goes to OCF; 5%-10% of FW & 20%-30% of YW in MSW
Morgan County SWMD	Not handled by OCF
Lawrence County SWMD	Not handled by OCF
Jackson County SWMD	Not handled by OCF
Green County SWMD	Not handled by OCF
Owen County	Not handled by OCF
Brown County SWMD	Not handled by OCF

FW = food waste, YW = yard waste

Table 5-12: Monroe County Tonnage & Recovery Projections – Scenario 4 OCF

	2017	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections					
Source-Separation					
Recyclables	11,520	11,866	12,261	12,724	13,136
Organics	607	4,947	5,112	5,305	5,477
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	118,541	122,479	127,111	131,222
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	77	79	82	85
Recovery Rate	9%	12%	12%	12%	12%
High Projections					
Source-Separation					
Recyclables	11,520	11,866	12,261	12,724	13,136
Organics	607	7,915	8,178	8,487	8,762
Targeted Materials in Mixed Waste					
Recyclables	0	0	0	0	0
Organics	0	0	0	0	0
Remaining Mixed Waste	119,272	115,573	119,413	123,929	127,937
Total MSW	131,399	135,355	139,852	145,141	149,834
Residue	0	112	115	120	124
Recovery Rate	9%	15%	15%	15%	15%

Note: Includes all MSW regardless of whether it is handled by the District or other stakeholders, except for Residue which is based only on the tonnage generated by the OCF.

Table 5-13: Facility Tonnage Projections – Scenario 4 OCF

	2020 Year 1	2024 Year 5	2029 Year 10	2034 Year 15
Low Projections				
Facility Input				
Recyclables – Source-Separated	0	0	0	0
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	2,561	2,646	2,747	2,835
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	2,561	2,646	2,747	2,835
Facility Output				
Recovered Recyclables	0	0	0	0
Recovered Organics	2,485	2,567	2,664	2,750
Residue & Mixed Waste	77	79	82	85
Total	2,561	2,646	2,747	2,835
High Projections				
Facility Input				
Recyclables – Source-Separated	0	0	0	0
Recyclables in Mixed Waste	0	0	0	0
Organics – Source-Separated	3,724	3,847	3,993	4,122
Organics in Mixed Waste	0	0	0	0
Mixed Waste	0	0	0	0
Total	3,724	3,847	3,993	4,122
Facility Output				
Recovered Recyclables	0	0	0	0
Recovered Organics	3,612	3,732	3,873	3,998
Residue & Mixed Waste	112	115	120	124
Total	3,724	3,847	3,993	4,122

5.6 Summary

Table 5-14 provides a summary comparison of the four facility options – the tons they would handle based on KCI's material flow assumptions outlined in Section 4 and the percentage impact they would have on the County recovery rate.

Note that the IPF and MRF have similar and minor impacts on the County recovery rate even though the MRF handles significantly more tons. In both scenarios, the major changes in the County's recovery system assumed to occur are modifications in the District collection services. Both facilities handle tons that are already being diverted in the County (e.g., District drop-offs). The MRF tonnage varies significantly depending on how much of the recyclables collected by the City, IU, and private haulers that it receives, however this is not reflected in the recovery rate because it is assumed those non-District tons are recovered regardless of whether the MRF is developed.

Also note that, while it handles comparable tonnage to the IPF, the OCF has greater impact on the County recovery rate than the IPF or MRF. This is because the vast majority of tons diverted to the IPF would be “new” tons of organic materials not previously recovered, whereas the IPF would handle both existing and newly recovered tons.

Table 5-14: Facility Input (Design Capacity) and Impact on County Recovery Rate

	Scenario 1 IPF	Scenario 2 MRF	Scenario 3 MWF	Scenario 4 OCF
Input Materials	Source-segregated recyclables	Single stream recyclables	Single stream recyclables & mixed waste	Food waste
Tons/Year				
Year 1 (2020)	5,400 – 6,410	7,460 – 14,630	81,510 – 102,640	5,430 – 6,590
Year 15 (2034)	5,950 – 7,050	8,180 – 16,070	86,240 – 108,590	6,010 – 7,300
Tons/Day*				
Year 1	21 – 25	29 – 56	314 – 395	21 – 25
Year 15	23 – 27	31 – 62	332 – 418	23 – 28
Increased County Recovery	2% – 3%	2% – 3%	13% – 18%	3% – 6%

* Based on operating 5 days per week.
Note: tonnage data includes all County and non-County sources handled by the facility while Increased County Recovery percentages are based only on County tonnage.

Section 6
Feasibility Assessment

To assess the feasibility of the four materials processing scenarios described in Section 5, KCI completed the following work activities:

- Developed planning-level development and operating cost estimates.
- Projected financial performance over a 15-year time period.
- Assessed non-financial and strategic factors relevant to the District's decision-making process about whether and which kind of processing facility it might implement.

6.1 Scenario 1: IPF

6.1.1 Cost Estimates for Potential New District Collection

The District may wish to consider options to increase recycling by expanding its drop off and collection operations. Options include establishing more recycling drop off sites, establishing a roving drop off (i.e., a trailer mounted recycling roll-off container), and working to increase membership in the GBN.[13]

- Source-segregated recycling drop off: Based on an assessment of the District's existing rural sites and recent expenditures, KCI estimates that the capital cost to establish a recycling drop off for source-segregated recyclables would be in the range of $65,000 to $75,000, not including any required site-specific improvements (e.g., grading, surfacing, and fencing).[14] The estimated annual operating cost for this type of recycling drop off is $90,000 to $100,000, which consists primarily of 55 hours per week staffing, hauling of recyclables, and equipment operating and maintenance.
- Roving source-segregated recycling trailer: Some communities provide roving or mobile drop off recycling services. They can be a cost-effective way to increase recycling access and convenience in rural areas. KCI estimates that the capital cost would be in the range of $40,000 to $45,000 per roving drop off, which includes a pickup truck and large trailer-mounted multi-compartment recycling container. The capital cost could be reduced by purchasing used vehicles or containers. KCI estimates that the annual operating cost would be $65,000 to $70,000 which includes labor and equipment

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[13] It is assumed for this scenario that any new District collection operations are limited to recycling only. The District's 2004 contract with Hoosier states that both parties agree to not open or operate any other solid waste handling facility, otherwise that facility must pay the same host fee as Hoosier or the Hoosier host fee may be eliminated. Additional Orange Bag collection points may or may not be subject to this provision.

[14] The cost estimate includes $15,000 to $20,000 for an office trailer and $50,000 to $55,000 for recycling containers (open top roll offs, closed top roll offs, and compactors).

operating and maintenance. Hauling costs would not need to be added if the trailer is delivered directly to a District facility or a local recycler.

- GBN: The District's GBN program serves approximately 60 members with service ranging from once monthly to twice weekly.[15] Fees are in the range of $15 to $17 per pick up with no limit on the amount of material or number of containers a member places out for that pick up. The current fee structure does not cover the cost of providing the service. KCI did not develop a cost estimate to expand the GBN beyond its current base, which we recommend begins with considering changes in the service and fee structure, such as making the fee based on a combination of the frequency and level (e.g., number of carts) of service.

6.1.2 IPF Design Capacity

KCI generally recommends that facility design capacity is sized to accommodate growth within the reasonable life expectancy of the facility without building too much excess capacity that would go unutilized. Facilities can plan to accommodate significant future growth by either expanding the facility when it becomes necessary or operating the facility more hours per day.

Based on the material flow assumptions, the IPF would handle approximately 21 to 25 tons per day initially, increasing to 23 to 27 tons per day (see Table 5-14). Based on a single shift, this equates to a current and future range of 2.6 to 3.4 tons per hour.

6.1.3 IPF Design and Operating Features

For the purpose of this assessment, KCI established a series of assumptions regarding basic IPF design and operating parameters, which were used to establish planning-level cost estimates.

- Overview of IPF operations: The IPF's core function is to consolidate source-segregated recyclables, inspect and remove contaminants, bale the recyclables, store them, and then load them for shipment to end use markets.
- Site requirements: Key features of the IPF site include perimeter fencing and gate, truck scale, and pre-engineered building to house all IPF materials handling activities. A 1.5-acre site can provide sufficient space.
- Building requirements: The IPF building's major functional areas include tipping floor, space for a horizontal baler and feed conveyor, space for materials storage, loading docks for outbound recyclables, and office and employee facilities. KCI estimates that a 9,000 to 10,000 square feet building would be suitable.[16]

[15] Based on discussions with District staff, membership has been declining due to members switching to private service providers who provide more convenient (e.g., single stream) service that requires less effort by the member to recycle.
[16] As a point of reference, the building located at the District landfill is 4,800 square feet. The IPF is larger in order to provide sufficient tipping and bale storage areas.

- Equipment and rolling stock: the IPF's central piece of processing equipment would be a horizontal baler designed to handle the full range of recyclables (e.g., paper, metal, and plastic). Rolling stock required for materials handling include a skid steer with clamshell bucket, forklift with bale-grabber, and several roll-off containers.
- Staffing: Based on the IPF's design capacity, KCI estimates that it will require up to 3 full-time equivalent material handlers plus an equipment operator/facility manager.

6.1.4 IPF Cost Estimate and Financial Projection

KCI developed planning-level capital and operating cost estimates based on the design and operating features outlined above combined with unit cost factors (e.g., building cost per square foot) derived from local construction cost factors and financial analyses performed by KCI for other facilities (see Table 6-1).[17]

- Capital cost: $3.1 to $3.2 million.
- Total annual cost (annualized capital and operating costs): $573,000 to $597,000.
- Commodity revenue from sale of recyclables: $532,000 to $631,000.
- Net annual cost (revenue): ($35,000) to $41,000, or $5 per ton revenue to $8 per ton cost.[18]

Labor and benefits costs are based on the District's hourly wages and overhead. Maintenance and repair costs include allowances for site, building, processing equipment, and rolling stock. Electricity is based on general building requirements and estimated demand to operate the baler. Other direct costs include residue disposal, supplies, utilities and other general services. A cost allowance is also provided for increased G&A expenses for the District.

Revenue is generated from the sale of recyclables to end use markets, which is different than the District's current practice of hauling unprocessed recyclables. It is assumed that the IPF would be marketing truckload quantities of recyclables to end users such as paper mills, plastic recyclers, and scrap metal buyers. It is assumed that color-sorted glass continues to be marketed as it is now.

Table 6-2 provides a 15-year financial projection for the IPF which indicates that the IPF's financial performance would be relatively consistent based on the tonnage assumptions and the projection that population will not increase much in the next 15 years. Please note that this and subsequent financial projections are stated in current dollars and not adjusted for inflation.

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[17] Site development costs include land purchase ($80,000 to $130,000 per acre), grading, storm water structures and paving. Long-term lease is an option to land purchase that would reduce total capital cost; however, the annualized capital cost would be reduced because this includes the annualized cost of land whether it is loan/debt repayment or lease.

[18] Note that the $45,000 net revenue or $7 per ton is associated with the high tonnage range, while the $33,000 net cost is for the low tonnage range. This is due to the economies of scale, i.e., higher tonnage throughput achieves better utilization of capital and operating costs.

Table 6-1: Cost Estimate for IPF

Item	Cost Range	
	Low Estimated Tons	High Estimated Tons
Capital Cost		
Site Development	$645,000	$645,000
Buildings	$1,388,000	$1,450,000
Processing Equipment	$425,000	$425,000
GC, Engineering & Contingency	$515,000	$532,000
Sub-Total Facility Development	$2,972,000	$3,052,000
Rolling Stock	$134,000	$134,000
Total Capital Cost	$3,106,000	$3,186,000
Annualized Capital Cost	$229,000	$234,000
Per Inbound Ton	$42	$37
Annual Operating Cost – Year 1		
Labor & Benefits	$213,000	$213,000
Maintenance & Repair	$49,000	$59,000
Electricity	$4,000	$4,000
Residue Disposal	$7,000	$9,000
Other Direct Costs	$26,000	$29,000
Sub-total Direct Cost	$300,000	$315,000
General & Administrative	$45,000	$47,000
Profit	$0	$0
Total Annual Operating Cost	$345,000	$362,000
Per Inbound Ton	$64	$56
Total Annual Cost	$573,000	$597,000
Per Inbound Ton	$106	$93
Revenue – Year 1		
Commodity Sales	($532,000)	($631,000)
Revenue Share	$0	$0
Total Net Revenue	($532,000)	($631,000)
Per Inbound Ton	($99)	($98)
Net Annual Cost (Revenue)	$41,000	($35,000)
Per Inbound Ton	$8	($5)

Table 6-2: 15-Year Financial Projection for IPF

Item	2023 Year 1	2027 Year 5	2032 Year 10	2037 Year 15
Low Estimated Tons				
Annualized Capital Cost	$229,000	$229,000	$229,000	$229,000
Annual Operating Cost	$345,000	$359,000	$377,000	$394,000
Total Annual Cost	$573,000	$588,000	$606,000	$622,000
Total Annual Cost Per Ton	$106	$105	$105	$105
Annual Revenue	($532,000)	($549,000)	($569,000)	($586,000)
Net Annual Cost (Revenue)	$41,000	$39,000	$37,000	$36,000
Net Annual Per Ton	$8	$7	$6	$6
High Estimated Tons				
Annualized Capital Cost	$234,000	$234,000	$234,000	$234,000
Annual Operating Cost	$362,000	$378,000	$397,000	$415,000
Total Annual Cost	$597,000	$612,000	$631,000	$649,000
Total Annual Cost Per Ton	$93	$93	$92	$92
Annual Revenue	($631,000)	($651,000)	($674,000)	($694,000)
Net Annual Cost (Revenue)	($35,000)	($39,000)	($43,000)	($44,000)
Net Annual Per Ton	($5)	($6)	($6)	($6)

6.2 Scenario 2: MRF

6.2.1 Cost Estimates for Potential New District Collection

Integral to the MRF scenario is the assumption that District drop off and collection operations would be able to convert to single stream. Dedicated containers are no longer required for each material type and the level of staffing at the South Walnut facility can be reduced. Conversion to single stream collection provides an opportunity for the District to reduce unit operating costs. The District may also wish to consider expanding these operations, e.g., drop off locations, roving drop off collection, and GBN.

- Single stream recycling drop off: KCI estimates that the capital cost to establish a single stream recycling drop-off would be in the range of $40,000 to $50,000, not including any required site-specific improvements. The estimated annual operating cost for a single stream drop off is $70,000 to $80,000, which consists primarily of 55 hours per week staffing, hauling of recyclables, and equipment operating and maintenance.[19]
- Roving single stream recycling trailer: Such a mobile collection would be set up similarly to Scenario 1 with the sole difference that the trailer would have only one compartment rather than separate ones for each material type. Consequently, it is assumed that planning-level capital and operating cost would be comparable, i.e.,

[19] The District can expect that converting to single stream will enable cost savings at South Walnut as well.

$40,000 to $45,000 capital cost and $65,000 to $70,000 annual operating cost per roving drop off.

- GBN: Conversion to single stream can make collection more convenient for members and thus provide an opportunity for more businesses and institutions to join the network. It would also potentially reduce the District's cost per customer to provide collection service by reducing the effort to handle and store segregated materials individually, with single stream materials being delivered directly to the MRF for processing.

6.2.2 MRF Design Capacity

Based on the material flow assumptions, the MRF would handle approximately 29 to 56 tons per day initially, increasing to 31 to 62 tons per day (see Table 5-14). The wide range in these estimates is due primarily to whether the MRF receives the City's and IU's recyclables. Based on a single shift, this equates to a current and future range of up to 4 to 8 tons per hour. As noted in Section 3, single stream processing systems provided by equipment vendors typically have a minimum design capacity of approximately 10 tons per hour because smaller systems become difficult to justify economically. The current industry trend is toward large capacity regional MRFs to achieve economies of scale.

6.2.3 MRF Design and Operating Features

KCI established a series of design and operating assumptions for the MRF based on general industry best practices which were then used to establish planning-level cost estimates.

- Overview of MRF operations: The MRF's core functions are to receive single stream recyclables, sort them into marketable commodities using mechanical and manual means, bale the recyclable commodities, store them, and then load them for shipment to end use markets. It is also envisioned that the MRF would be able to receive source segregated materials that can be directly baled.
- Site requirements: Key features of the MRF site include perimeter fencing and gate, truck scale, and a pre-engineered building to house all material handling activities. A 2.5-acre site can provide sufficient space.
- Building requirements: The MRF building's major functional areas include tipping floor, space for the single stream processing system, space for a horizontal baler and feed conveyor, space for materials storage, loading docks for outbound recyclables, and office and employee facilities. KCI estimates that a 24,000 to 27,000 square foot building would be suitable.
- Equipment and rolling stock: A typical small-scale single stream processing system incorporates equipment to perform the following major functions: Infeed conveyor, manual pre-sorting stations, screen(s) to separate 2-dimensional and 3-dimensional materials; post-screen manual sort of paper grades, magnetic ferrous separator, eddy current aluminum separator; and manual sort of plastics. Optical sorters are generally

not financially justified at this scale of throughput. Rolling stock required for materials handling include a small articulated loader, skid steer with clamshell bucket, forklift with bale-grabber; and several roll-off containers.

- Staffing: Based on the MRF's design capacity, KCI estimates that it will require 10 to 20 full-time equivalent material handlers, 2 equipment operators, plus a mechanic/millwright and a facility manager.[20]

6.2.4 MRF Cost Estimate

KCI's capital and operating cost estimate for a District MRF is provided in Table 6-3.

- Capital cost: $10.3 to $10.9 million.
- Total annual cost (annualized capital and operating costs): $1.4 to $1.9 million.
- Commodity revenue from sale of recyclables: $711,000 to $1.4 million.
- Net annual cost (revenue): $616,000 to $712,000 or $42 to $95 per ton.

The low net annual cost is associated with the high tonnage estimate, while the high net annual cost is associated with the low tonnage estimate, which is due to the economies of scale achieved by having higher MRF throughput.

The MRF is projected to operate below its design capacity and, as a result, its net annual cost is higher than what could be achieved if it handled more tons. The significant range in the estimates is due to whether the MRF does or does not handle recyclables from the City and IU. Based on the material flow assumptions, these two potential sources of recyclables account for approximately 50% of MRF tonnage.

Table 6-4 provides a 15-year financial projection that indicates the MRF's financials will remain relatively consistent over time based on the assumptions that tonnage growth is limited by the amount of recyclables received from other stakeholders in the region and low projected overall population growth.

[20] The range of material handlers is wide because of the wide range of tonnage projections. A 10-ton per hour design capacity MRF can operate at lower throughput with slightly reduced staffing. However, the ratio of staffing to throughput is not linear; certain positions must be staffed regardless of the lower throughput.

Table 6-3: Cost Estimate for MRF

Item	Cost Range	
	Low Estimated Tons	High Estimated Tons
Capital Cost		
Site Development	$1,200,000	$1,200,000
Buildings	$3,213,000	$3,625,000
Processing Equipment	$4,300,000	$4,300,000
GC, Engineering & Contingency	$1,145,000	$1,260,000
Sub-Total Facility Development	$9,857,000	$10,385,000
Rolling Stock	$477,000	$477,000
Total Capital Cost	$10,334,000	$10,862,000
Annualized Capital Cost	$687,000	$721,000
Per Inbound Ton	$92	$49
Annual Operating Cost – Year 1		
Labor & Benefits	$482,000	$802,000
Maintenance & Repair	$68,000	$134,000
Electricity	$17,000	$34,000
Residue Disposal	$33,000	$88,000
Other Direct Costs	$40,000	$60,000
Sub-total Direct Cost	$640,000	$1,117,000
General & Administrative	$96,000	$168,000
Profit	$0	$0
Total Annual Operating Cost	$736,000	$1,285,000
Per Inbound Ton	$99	$88
Total Annual Cost	$1,423,000	$2,005,000
Per Inbound Ton	$191	$137
Revenue – Year 1		
Commodity Sales	($711,000)	($1,389,000)
Revenue Share	$0	$0
Total Net Revenue	($711,000)	($1,389,000)
Per Inbound Ton	($95)	($95)
Net Annual Cost (Revenue)	$712,000	$616,000
Per Inbound Ton	$95	$42

Table 6-4: 15-Year Financial Projection for MRF

Item	2023 Year 1	2027 Year 5	2032 Year 10	2037 Year 15
Low Estimated Tons				
Annualized Capital Cost	$687,000	$687,000	$687,000	$687,000
Annual Operating Cost	$736,000	$764,000	$797,000	$827,000
Total Annual Cost	$1,423,000	$1,450,000	$1,483,000	$1,514,000
Total Annual Cost Per Ton	$191	$189	$187	$185
Annual Revenue	($711,000)	($733,000)	($758,000)	($780,000)
Net Annual Cost (Revenue)	$712,000	$718,000	$726,000	$734,000
Net Annual Per Ton	$95	$93	$91	$90
High Estimated Tons				
Annualized Capital Cost	$721,000	$721,000	$721,000	$721,000
Annual Operating Cost	$1,285,000	$1,334,000	$1,394,000	$1,450,000
Total Annual Cost	$2,005,000	$2,055,000	$2,114,000	$2,170,000
Total Annual Cost Per Ton	$137	$136	$135	$135
Annual Revenue	($1,389,000)	($1,432,000)	($1,482,000)	($1,525,000)
Net Annual Cost (Revenue)	$616,000	$623,000	$633,000	$645,000
Net Annual Per Ton	$42	$41	$41	$40

6.3 Scenario 2 Hybrid

Given the fact that Hoosier Disposal currently has capacity to accept single stream recyclables and transfer them to Republic's in Indianapolis, the option exists for the District to convert to single stream collection and continue with its current hauling arrangement with Hoosier rather than developing a District MRF. The current agreement with Hoosier entails a fee of $100 per load to transfer recyclables from District facilities and a 45% revenue share for fiber and plastic materials.

The cost estimates provided above for District-operated single drop off and roving collection include the cost to transfer materials to a facility, whether that be a District MRF or Hoosier's transfer station. Using the tonnage estimates for District single stream collection, an assumed processing fee of $80 per ton for single stream recyclables, and a 45% revenue share, KCI estimates the Year-1 net annual cost for utilizing Hoosier to provide single stream processing services would be in the range of $37 per ton or $277,000 to $545,000 based on the low and high tonnage estimates.

6.4 Scenario 3: MWF

6.4.1 Cost Estimates for Potential New District Collection

It is assumed that District collection and drop off operations for Scenario 3 would be the same as Scenario 2, namely existing operations would convert to single stream recycling, and that

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the MWF would have the capability to receive and process both recyclables and mixed waste. Conversion to single stream would provide opportunities for the District to reduce the cost of operating its existing drop off collection. If the District were to expand single stream recycling collection activities beyond its current programs and facilities, the cost estimates provided previously for Scenario 2 would be applicable to Scenario 3.

6.4.2 MWF Design Capacity

Based on the material flow assumptions described in Section 5, the MWF would handle in the range of 314 to 395 tons per day initially, increasing slightly to 332 to 418 tons per day after 15 years (see Table 6-1). Based on a single operating shift per day, this translates to approximately 40 to 50 tons per hour. This throughput is somewhat low for a MWF, as discussed in Section 3.

The primary reason for the range of tonnages has to do with how much tonnage the MWF receives from in-County private haulers. Also, it is important to note that the tonnage estimates are based on an assumption that the facility receives all the City's and IU's mixed waste. This assumption was made to achieve a throughput in the range of what is generally regarded as a minimum for a financially viable MWF.

6.4.3 MWF Design and Operating Features

Design and operating assumptions for the MWF were made based on current MWF processing technologies and general industry practices.

- Overview of MWF operations: The MWF would be designed to receive mixed waste and single steam recyclables separately. Mixed waste is processed through the entire system separating recyclables, organics, and non-recoverable materials. Single stream recyclables would be fed into the processing system at a point after recyclables are separated from mixed waste. The MWF then sorts recyclables into marketable commodities, bales and stores them, and then loads them for shipment to end use markets. The MWF also separates and processes organic materials (i.e., food waste, yard waste, wood, and non-recyclable paper) to be a composting feedstock.
- Site requirements: Key features of the MRF site include perimeter fencing and gate, truck scales, and a pre-engineered building to house all material processing activities. KCI also assumes that the site includes a windrow composting operation for the organics separated from mixed waste.[21] KCI estimates that a 16-acre site would provide sufficient area for the MWF and composting operation.

[21] For the purpose of the financial assessment, KCI assumed that organics would be windrow composted rather than anaerobically digested because anaerobic digestion requires significantly more capital investment and higher operating costs than windrow composting. Windrow composting is assumed rather than in-vessel or static pile because of the capital-intensive nature of those options. If the District were to conclude that higher financial investment in MWF was feasible, then these higher technology options could be considered at a later date.

- Building requirements: The MWF building's functional areas include tipping floor with segregated areas for mixed waste and recyclables, space for the mixed waste processing system, space for two horizontal balers and feed conveyors, space for materials storage, loading docks for outbound recyclables, loadout bunkers for organics, and office and employee facilities. KCI estimates that a 60,000 to 70,000 square foot building would be suitable.
- Composting area requirements: A composting site of approximately 7 acres would provide the necessary area for windrow composting of the organic fraction of mixed waste. Turned windrow composting requires an impermeable surface capable of supporting heavy equipment operations. The composting area also includes a storm water retention basin for reuse in the compost operation or transport for off-site treatment.
- Equipment and rolling stock: a typical MWF incorporates equipment to perform the following major functions: infeed conveyor, trommel screen to perform initial size classification and separation, manual pre-sorting stations; screen(s) to separate 2-dimensional and 3-dimensional materials, density and air classifiers, post-screen manual sort of paper grades; magnetic ferrous separator, optical sorters for plastic or other material separation, eddy current aluminum separator; and manual sort of plastics. Rolling stock required for materials handling include articulated loaders, skid steers, forklifts, and roll-off containers.
- Staffing: Based on the MWF's design capacity, KCI estimates that it will require a full-time staff of approximately 28 per shift (24 material handlers, 4 equipment handlers, 3 mechanics/millwrights, and a plant manager). A MWF with design capacity for 40 tons per hour may need to operate for up to 1.5 shifts per day if tonnage received is at the high end of projections.[22]

6.4.4 MWF Cost Estimate

KCI's capital and operating cost estimate for a MWF is provided in Table 6-5.

- Capital cost: $38.8 to $39.9 million.
- Total annual cost (annualized capital and operating costs): $6.3 to $7.1 million.
- Commodity revenue from sale of recyclables: $2.8 to $3.4 million.
- Net annual cost (revenue): $3.5 to $3.7 million or $36 to $43 per ton.

While the net annual costs are relatively close for both low and high tonnage estimates, the net cost per ton is lower for the high tonnage scenario due to economies of scale. It is important to note that this cost estimate is highly dependent on the assumptions regarding how much tonnage the facility receives. For example, if it were to receive mixed waste only from the District, City, and IU, the next annual cost per ton would likely be greater than $100 per ton.

[22] MWFs that run more than one shift per day can achieve higher utilization of capital expense and potentially a better return on investment.

As with the preceding 15-year financial projections, future financial performance of the MWF (Table 6-6) is expected to be relatively consistent provided that the sources of waste handled by the facility do not change significantly and population does not grow significantly.

Table 6-5: Cost Estimate for MWF

Item	Cost Range	
	Low Estimated Tons	High Estimated Tons
Capital Cost		
Site Development	$5,955,000	$5,955,000
Buildings	$8,678,000	$9,528,000
Processing Equipment	$17,000,000	$17,000,000
GC, Engineering & Contingency	$4,348,000	$4,586,000
Sub-Total Facility Development	$35,980,000	$37,068,000
Rolling Stock	$2,861,000	$2,861,000
Total Capital Cost	$38,841,000	$39,929,000
Annualized Capital Cost	$3,132,000	$3,209,000
Per Inbound Ton	$38	$31
Annual Operating Cost – Year 1		
Labor & Benefits	$1,243,000	$1,534,000
Maintenance & Repair	$632,000	$795,000
Electricity	$158,000	$199,000
Residue Disposal	$459,000	$578,000
Other Direct Costs	$365,000	$450,000
Sub-total Direct Cost	$2,857,000	$3,557,000
General & Administrative	$286,000	$356,000
Profit	$0	$0
Total Annual Operating Cost	$3,143,000	$3,913,000
Per Inbound Ton	$39	$38
Total Annual Cost	$6,274,000	$7,122,000
Per Inbound Ton	$77	$69
Revenue – Year 1		
Commodity Sales	($2,765,000)	($3,446,000)
Revenue Share	$0	$0
Total Net Revenue	($2,765,000)	($3,446,000)
Per Inbound Ton	($34)	($34)
Net Annual Cost (Revenue)	$3,509,000	$3,676,000
Per Inbound Ton	$43	$36

Table 6-6: 15-Year Financial Projection for MWF

Item	2023 Year 1	2027 Year 5	2032 Year 10	2037 Year 15
Low Estimated Tons				
Annualized Capital Cost	$3,132,000	$3,132,000	$3,132,000	$3,132,000
Annual Operating Cost	$3,143,000	$3,249,000	$3,377,000	$3,497,000
Total Annual Cost	$6,274,000	$6,380,000	$6,509,000	$6,629,000
Total Annual Cost Per Ton	$77	$77	$77	$77
Annual Revenue	($2,765,000)	($2,829,000)	($2,901,000)	($2,961,000)
Net Annual Cost (Revenue)	$3,509,000	$3,551,000	$3,607,000	$3,668,000
Net Annual Per Ton	$43	$43	$43	$43
High Estimated Tons				
Annualized Capital Cost	$3,209,000	$3,209,000	$3,209,000	$3,209,000
Annual Operating Cost	$3,913,000	$4,045,000	$4,206,000	$4,357,000
Total Annual Cost	$7,122,000	$7,255,000	$7,415,000	$7,566,000
Total Annual Cost Per Ton	$69	$69	$69	$70
Annual Revenue	($3,446,000)	($3,525,000)	($3,613,000)	($3,686,000)
Net Annual Cost (Revenue)	$3,676,000	$3,730,000	$3,802,000	$3,880,000
Net Annual Per Ton	$36	$36	$36	$36

6.5 Scenario 4: OCF

6.5.1 Cost Estimates for Potential New District Collection

Scenario 4 would require modifying existing District sites to accept source-separated organics, i.e., adding dedicated collection containers such as roll carts or small (e.g., 1 to 2 cubic yard) sealed collection bins. Additionally, the District would need to arrange for collection and delivery of organics to a composting site. Box trucks like those used for the GBN collection can be used to collect roll carts, however, a front or rear loading garbage truck would be more efficient and also able to service larger collection bins.

In order to provide a planning-level estimate of the cost for organics collection, KCI assumed that the District's five existing sites could be outfitted with an inventory of 65-gallon roll carts and the District would contract with a private hauler for collection. Based on an inventory of 100 carts (20 per site), twice weekly collection, a fee of $100 per site per collection, plus plastic liners for carts, the estimated annual cost would be in the range of $55,000 to $60,000. This estimate assumes no additional District staffing would be required when adding organics collection at the District sites.

6.5.2 OCF Design Capacity

The material flow assumptions are that organics collection programs are implemented by the District, the City, and IU which recover a portion of the organics currently in their mixed waste.

Also, it is assumed some organics are collected by private haulers (e.g., restaurants, grocery stores, etc.) and brought to the composting facility. Based on the assumptions, the OCF would handle approximately 10 to 14 tons per day initially, increasing to 11 to 16 tons per day (see Table 5-14) of organics consisting of food waste and yard waste.

Food waste needs to be combined with other materials to achieve proper conditions for composting. These materials are generally referred to as bulking agents and they provide a lower density, drier, and more porous source of carbon. Yard waste and ground wood waste can be good bulking agents and are the most commonly used materials at food waste composting facilities. Based on the results of the waste characterization study, most of the organics in mixed waste is food waste. So, an OCF would need an additional bulking agent, and it is assumed that this could be obtained from existing recovery activities in the County, e.g., landscape contractors, arborists, and land clearing activities.

6.5.3 OCF Design and Operating Features

- Overview of OCF operations: The OCF's core function is to receive organic materials, quickly blend them to achieve proper conditions for composting, form the materials into large windrows, manage and monitor the composting process, test compost, screen finished compost, store it, and then load it for transport off site.
- Site requirements: Key features of the IPF site include the following: Perimeter fencing and gate, truck axle scale, impermeable compost pad suitable for heavy equipment operations, storm water retention basin, and an office trailer. Given the limited design capacity, KCI estimates that a 2.5- to 3-acre site can provide sufficient space.
- Equipment and rolling stock: The OCF primary materials handling equipment would be an articulated wheel loader with large capacity bucket. The loader performs multiple functions including mixing, windrow construction, windrow turning, etc. Other equipment would be needed such as a grinder for processing any large woody materials for the bulking agent and a trommel screen for screening the compost prior to marketing and distribution. Because these pieces of equipment would only be needed occasionally (e.g., quarterly), it is assumed they would be rented, the cost for which is included in other direct costs.
- Staffing: Given the relatively small scale of the OCF, the OCF can be operated with a single, part-time equipment operator/facility manager with proper composting facility operator training.

6.5.4 OCF Cost Estimate

KCI's capital and operating cost estimate for an OCF is provided in Table 6-7.

- Capital cost: $992,000 to $1.1 million.
- Total annual cost (annualized capital and operating costs): $213,000 to $251,000.
- Commodity revenue from sale of compost: $9,000 to $12,000.

- Net annual cost (revenue): $204,000 to $239,000 or $41 to $48 per ton.

Table 6-8 provides a 15-year financial projection indicating that future costs and revenues are expected to be relatively consistent based on the material flow assumptions and population projections.

Table 6-7: Cost Estimate for OCF

Item	Cost Range	
	Low Estimated Tons	High Estimated Tons
Capital Cost		
Site Development	$503,000	$600,000
Buildings	$51,000	$51,000
Processing Equipment	$0	$0
GC, Engineering & Contingency	$64,000	$73,000
Sub-Total Facility Development	$617,000	$724,000
Rolling Stock	$375,000	$375,000
Total Capital Cost	$992,000	$1,099,000
Annualized Capital Cost	$90,000	$97,000
Per Inbound Ton	$21	$17
Annual Operating Cost – Year 1		
Labor & Benefits	$40,000	$43,000
Maintenance & Repair	$30,000	$39,000
Electricity	$0	$0
Residue Disposal	$0	$3,000
Other Direct Costs	$42,000	$54,000
Sub-total Direct Cost	$112,000	$139,000
General & Administrative	$11,000	$14,000
Profit	$0	$0
Total Annual Operating Cost	$124,000	$153,000
Per Inbound Ton	$29	$27
Total Annual Cost	$213,000	$251,000
Per Inbound Ton	$50	$44
Revenue – Year 1		
Commodity Sales*	($9,000)	($12,000)
Revenue Share	$0	$0
Total Net Revenue	($9,000)	($12,000)
Per Inbound Ton	($2)	($2)
Net Annual Cost (Revenue)	$204,000	$239,000
Per Inbound Ton	$48	$41

*The duration of the compost process (from receiving material to sale of finished compost) could require 45-120 days depending on the compost method used, operating conditions, and amount of food waste, among other factors.

Table 6-8: 15-Year Financial Projection for OCF

Item	2023 Year 1	2027 Year 5	2032 Year 10	2037 Year 15
Low Estimated Tons				
Annualized Capital Cost	$90,000	$90,000	$90,000	$90,000
Annual Operating Cost	$124,000	$128,000	$132,000	$137,000
Total Annual Cost	$213,000	$217,000	$222,000	$226,000
Total Annual Cost Per Ton	$50	$50	$49	$48
Annual Revenue	($9,000)	($9,000)	($10,000)	($10,000)
Net Annual Cost (Revenue)	$204,000	$208,000	$213,000	$217,000
Net Annual Per Ton	$48	$48	$47	$46
High Estimated Tons				
Annualized Capital Cost	$97,000	$97,000	$97,000	$97,000
Annual Operating Cost	$153,000	$158,000	$164,000	$170,000
Total Annual Cost	$251,000	$256,000	$262,000	$267,000
Total Annual Cost Per Ton	$44	$43	$42	$42
Annual Revenue	($12,000)	($12,000)	($13,000)	($13,000)
Net Annual Cost (Revenue)	$239,000	$243,000	$249,000	$254,000
Net Annual Per Ton	$41	$41	$40	$40

6.6 Assessment of Strategic Factors

In addition to the financial assessments presented above, the District needs to consider strategic and non-financial factors to fully assess the feasibility of the four waste processing scenarios (IPF, MRF, MWF, and OCF). The District's assessment and decision-making process needs to include consideration of potential impacts on itself and other stakeholders, whether to proceed further with planning and development, what waste processing scenario(s) is(are) most viable given the full local context, what scale of development is suitable, and identification of the potential roles of stakeholders in a future waste processing system. Based on discussions with District staff and KCI's independent assessment of the regional solid waste management system, we have identified a series of major factors that impact the overall feasibility and potential framework for an enhanced waste processing system to achieve higher diversion rates in the County.

6.6.1 Design Capacity, Available Tonnage and Financial Viability

The financial assessment demonstrates that economies of scale are an important component of assessing material processing facilities' viability for the District and the County. An IPF is generally well suited for comparatively small throughput, comparable to what is currently managed by the District and other entities that recover source segregated recyclables in the County and Region. Based on the financial assessment, an IPF designed to handle the District, a fraction of IU, and a small amount of recyclables from adjacent counties could be developed and operated in the range of an $8 per ton net annual cost to a $5 per ton net annual revenue.

Single stream MRFs entail significantly more capital and operating costs than IPFs. Their typical minimum design capacity is in the range of 10 tons per hour. To attain this scale of operation, a District-initiated MRF would need to handle tonnage from the City, IU, and adjacent counties in addition to District-collected materials. In particular, the financial assessment demonstrates that operating a single stream MRF without material from the City and IU may be difficult to justify strictly from a financial perspective based on avoided disposal costs: $35 per ton net annual cost with the City and IU versus $95 per ton without them.

MWFs require capital expenditures for more complex, robust machinery and have higher total operating costs than MRFs. Most MWFs currently operating in the U.S. handle 75 tons per hour or more and most have been developed in parts of the country with high waste diversion mandates and high avoided disposal costs. Mixed waste processing systems offered by equipment vendors have minimum design capacity in the range of 35 tons per hour. The MWF considered in the financial assessment would handle 40 to 50 tons per hour consisting of all District, City, and IU; 20% to 30% of County private haulers; and a portion of adjacent counties' recyclables and mixed waste. Such a MWF could be financially viable (i.e., comparable to current disposal costs) with an estimated net annual cost of $36 to $43 per ton. However, a MWF handling only District, City, and IU mixed waste would handle less than 15 tons per hour. This would not be sufficient to financially justify the capital investment in mixed waste processing technology. Therefore, it appears that tonnage from private haulers (in addition to the City and IU) would be needed for a financially viable MWF.

OCFs that utilize windrow composting methods are readily scalable and generally well suited for small design capacity. The scale of facility considered in this assessment is relatively small and would have a net annual cost of $41 to $48 per ton. While the material flow assumptions include tonnage from private haulers, financial viability is not dependent on it given the scalability of windrow composting.

6.6.2 Legal and Contractual Matters

Indiana Code 13-21-3-14.5 limits the ability of solid waste districts to provide waste management services either by themselves or through contracted services. The District would have to demonstrate there is a need for the service and that the service is not already available at reasonable cost in the County or Region. Without meeting these standards, the District is constrained in the types of material processing initiatives it can undertake. Given the presence of MRF services in the Region, it is unlikely the District could successfully demonstrate the need for developing one. It is also possible that development of a District IPF could be challenged, although the District may be able to claim that an IPF is not a significant departure from the activities it already performs.

The Code does not clearly define the standards for demonstrating need and absence of existing service. Consequently, it is possible that any initiatives the District undertakes could be open to challenge. For example, the Code does not make clear whether mixed waste processing is distinct from waste transfer and disposal and thus a type of service not currently available in the Region.

The District's 2004 agreement with Hoosier contains provisions that also impact the District's ability to develop materials processing infrastructure. Article 7 of the agreement states that neither party "…will own, open, operate, encourage, support or otherwise establish the opening or operating of another landfill, transfer station, incinerator, or similar facility for the management and/or disposal of MSW in Monroe County…." Exceptions to this are allowed on a case-by-case basis by mutual consent. Further, it stipulates that the District will seek to impose the host fee on any facility that does open, and if it is unable to do so, then the parties are obligated to negotiate adjustment or elimination of the host fee being paid by Hoosier. Lastly, if the parties are unable to reach agreement, then either one may terminate the agreement.

Article 7 has several potential implications that should be noted. First, interpretations of it may vary, e.g., whether it applies to a District IPF, MRF, or OCF, but it appears that a MWF would likely be considered to be within its intent. Second, the host fee currently paid by Hoosier represents a significant source of revenue to the District (approximately $250,000 annually), the loss of which may have negative impact on the District's current operations. Loss of this revenue or the need to pay a matching host fee would in effect place an additional financial burden on any material processing project the District implements, if it is deemed subject to the terms of the contract. Third, termination of the agreement would eliminate the need for Hoosier to pay the host fee.

It is also important to note that the 2004 agreement's 20-year term ends in 2023. One year prior to that in 2022, the District's agreement with Hoosier for recyclable materials and mixed waste management come to an end. The status of any possible District plans to develop a materials processing facility must take into account how the District intends to manage waste transfer and disposal in the future.

Given these issues, it may be in the District's best interest to postpone any active development of a processing facility that would invoke Article 7 until after the current Hoosier agreements reach their term in 2022 and 2023. Prior to that time, the District may want to initiate planning activities to more fully understand its options for the County's future materials recovery and waste transfer and disposal system. Options may include negotiating with Hoosier to extend similar terms or releasing a general request for proposals to solicit offers from service providers for either waste transfer and disposal only or for a combination of materials processing, waste transfer, and disposal.

6.6.3 Financing Facility Development

Financing the development of a material processing facility typically requires a predictable and reliable future revenue stream in order to validate or obtain the commitment of capital. Development can be financed many ways – debt financing (e.g., bonds or borrowing) and equity financing (cash reserves or stock issuance in the case of the private sector). Both require demonstration that a reliable source of revenue will be available to repay that investment.

In the case of material processing facilities initiated by the public sector (e.g., the District), potential sources of revenue include taxes, special assessments, utility service fees, and tip fees.[23]

Financing capacity needs to match the scope of a project. The District has limited financing capacity beyond the revenue it generates from the tax levy and vehicle excise taxes. The financial assessment presented in this Section indicates that a MRF or MWF has significant development costs ($10.3 to $10.9 million and $38.8 to $39.9 million, respectively), which are expected to be well beyond the capability of the District to finance by relying on its existing sources of revenue.[24] Consequently, additional revenue streams would need to be guaranteed to obtain financing. Options include tip fees and long-term tonnage commitments from potential sources of material or new sources of tax-based financing.

Based on KCI's assessment of the solid waste system stakeholders in the County, the District would likely face major challenges securing either tonnage commitment or new tax-based revenue. Both the City and IU have historically managed their materials processing and waste disposal through short-term agreements with the private sector. Private haulers generally do not enter into long term waste supply agreements with public entities in large part to maintain competitive flexibility. Given these challenges, public entities like the District have the option to extend their ability to develop materials processing infrastructure by accessing private sector capital through PPP. The District's 20-year agreement with Hoosier which was originally designed to help finance landfill closure was an example of this type of PPP.

6.6.4 Public-Private Partnerships

PPPs can take many different forms and full review of them, their applicability to the District, advantages, and disadvantages was not in the scope of this project. However, a general discussion is important to understanding the strategic and non-financial factors related to a possible District processing facility. Two common types of PPPs are publicly owned and privately-operated facilities and contracting with privately-owned and operated facilities. Table 6-9 summarizes some of the advantages and disadvantages of each. Please note that regulatory and contractual matters discussed above are not included in the table.

[23] Revenue from commodity sales is another source of revenue which may or may not be considered as a basis for project financing.
[24] The lower capital expense required for an IPF or OCF may be within the District's financial capability.

Table 6-9: Advantages and Disadvantages of PPP Options

Publicly owned and privately operated	
Advantages	**Disadvantages**
District has long-term control of its processing needs	Requires public-sector funding
Allows for private sector competition for operations	Operator focus on profit vs. customer service
Taps into private-sector operating expertise	Potential impacts of mergers or acquisitions
Private-sector focus on cost efficiency	Profit margin may offset operating cost savings
Guaranteed priority to handle public tonnage	A portion of revenue retained by operator
Privately owned and operated	
Advantages	**Disadvantages**
Enables use of private-sector capital	District does not have long-term control of its processing needs
Allows for private sector competition	Operator focus on profit vs. customer service
Places less risk on the District (tonnage flow, commodity markets, & equipment problems)	Potential impacts of mergers or acquisitions
Taps into private-sector development and operating expertise	Profit margin may offset operating cost savings
Private-sector focus on cost efficiency	A portion of revenue retained by operator

A PPP between the District and a private company may provide an option for achieving the District's goal of increasing recovery rates. For example, a company such as Hoosier, Ray's, or Rumpke may be potential partners for developing a MRF or MWF. Given the relatively small amount of projected organics recovery, partnering with an existing yard and vegetative waste composting facility like Good Earth to incorporate organics may be another potential option for the District to consider.

Also, as noted in the MRF financial assessment above, because single stream processing services are already available in the area, the District has the option to convert its collection system to single stream, potentially increase recovery, reduce unit operating costs, and transfer single stream recyclables to an existing MRF rather than develop a MRF in the County.

6.6.5 Stakeholder Impacts

In addition to the District, County citizens and businesses, the other major stakeholders who would be impacted by a possible District processing facility include the City, IU, Hoosier, and private haulers.

The City has historically preferred short term or verbal agreements for materials management services and has made such arrangements with Hoosier. A District processing initiative would potentially offer the City another alternative that enables it to achieve its material recovery and waste management goals. However, given its historical practices, the city may have concerns about making a long-term commitment to a processing facility whether or not it is developed by the District or a private company.

IU has also historically managed its materials processing and waste transfer and disposal through short term agreement primarily with Hoosier. Like the city, a District processing facility would provide more options and opportunities for waste recovery than are currently available. However, it too may have concerns with regards to making a long-term commitment to a processing facility.

A District processing facility could possibly divert materials that are currently handled by Hoosier, which could potentially impact the company's revenue. Hoosier has a number of options for how it might respond to a District materials processing initiative. For the remainder of the current 20-year contract, specific provisions limit the ability of any one to develop other waste management facilities. Indiana code also provides a strong foundation for Hoosier and other private waste companies to limit District activities. As the major player in the County, it is also able to influence the marketplace through its agreements with other stakeholders that bring materials to its facility.

Private haulers in the County span a wide range from large vertically integrated companies like Hoosier and Rumpke to small "mom and pop" companies with limited capital assets. Given the fact that Hoosier has the only large transfer facility in the County, much of the waste collected in the County flows through it. It is likely that most major haulers operating in the County have an agreement with Hoosier that includes a tip fee discount off of the posted gate rate. It is possible that private haulers would express concern about participation in a District materials processing initiative if it would lead to them receiving less favorable terms with Hoosier.

Section 7
Summary and Conclusions

Being the major center of population and economic activity in the Region, the County generates 44 percent of the mixed waste and nearly 75 percent of the recyclables in the Region (see Figures 7-1 & 7-2). Most of the mixed waste generated in the Region is collected and controlled by private haulers. Recyclables recovered in Monroe County and the Region are handled primarily by Hoosier and Ray's.

Figure 7-1: Source of Regional Mixed Waste

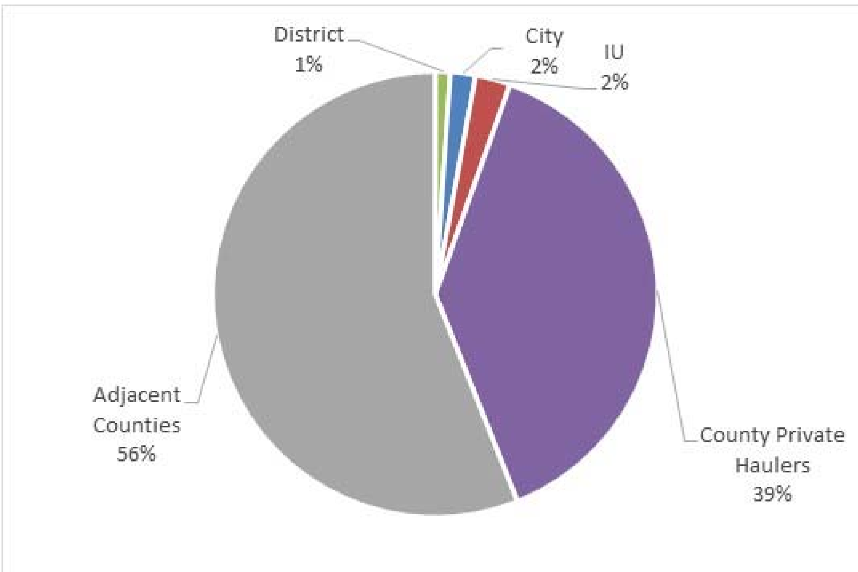
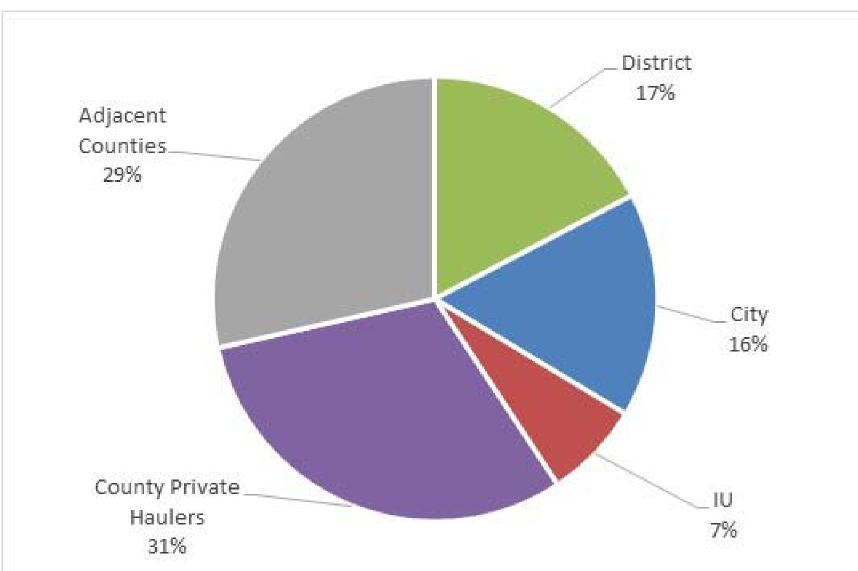
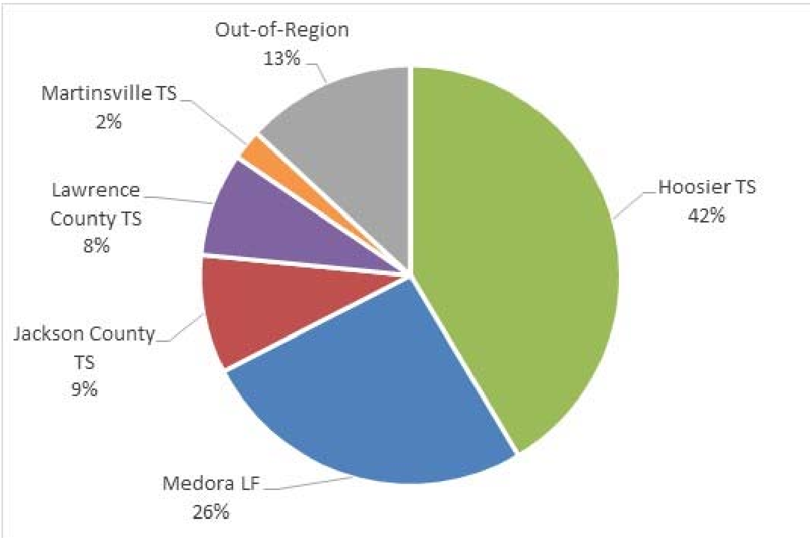


Figure 7-2: Source of Regional Recyclables



The Hoosier transfer station, Rumpke's Medora landfill, and the Jackson County transfer station together handle 77 percent of mixed waste in the Region (see Figure 7-3). Prevailing tipping fees for mixed waste are in the range of $40 to $50 per ton in Monroe County while tipping fees in neighboring counties are as low as $32 per ton at the Medora landfill.

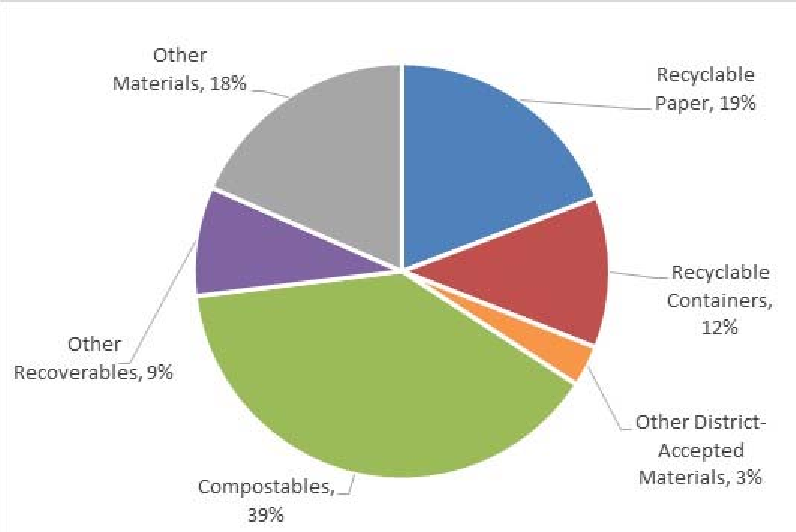
Figure 7-3: Facilities Receiving Regional Mixed Waste



Waste Composition Study

The waste composition study conducted for this project provides the District with an understanding of the composition of mixed waste disposed by the primary generator sectors within and around the County. The results indicate that 34 percent of the County's mixed waste is recyclable paper and containers that are currently accepted in the existing City and District recycling programs. In addition, 39 percent of the County's waste stream consists of compostable materials (see Figure 7-4).

Figure 7-4: Composition of County Mixed Waste



Given the amount of recyclable materials found in the County's mixed waste, the District may want to consider implementing a redesigned comprehensive outreach and education program regardless of whether the District expands its materials recovery infrastructure or not. The goal of such a program would be to improve participation by County residents in the whole range of materials separation opportunities available to them.

Material Processing Facility Options

Four types of materials processing facilities were selected for assessment in this study: IPF, MRF, MWF, and OCF. A set of assumptions was established regarding the sources and flow of materials from the County and adjacent counties for each facility. It is important to note that the assumptions are hypothetical for the purpose of conducting the financial assessment and supporting the District's planning process. Table 7-1 summarizes each facilities' estimated tonnage and impact on the County recovery rate.

Table 7-1: Facility Tonnage and Impact on County Recovery Rate

	Scenario 1 IPF	Scenario 2 MRF	Scenario 3 MWF	Scenario 4 OCF
Tons/Year – Year 1	5,400 – 6,410	7,460 – 14,630	81,510 – 102,640	2,560 – 3,720
Tons/Day – Year 1*	21 – 25	29 – 56	314 – 395	10 – 14
County Recovery Rate	11% – 12%	11% – 12%	22% – 27%	12% – 15%
Recovery Rate Increase	2% – 3%	2% – 3%	13% – 18%	3% – 6%

* Based on operating 5 days per week.
Note: tonnage data includes all County and non-County sources handled by the facility while County Recovery percentages are based only on County tonnage.

- **IPF and MRF:** An IPF or MRF is estimated to have minor impact on the County's total recovery rate. The primary reason for this is that the only major change in the County's recovery infrastructure would be an expanded District collection network. Based on the assumptions made, a County recovery rate in the range of 11 to 12 percent is projected (2 to 3 percentage points higher than the current 9 percent recovery rate).

Furthermore, even though a MRF would handle significantly more material than an IPF, a much higher proportion of this tonnage would be from out-of-county sources compared to Scenario 1, which does not increase the recovery rate of Monroe County.

- **MWF:** A MWF would represent a major change in the County recovery infrastructure that recovers recyclables and organics from mixed waste with the potential to boost the County recovery rate to 22 to 27 percent based on the assumptions made (13 to 18 percentage points higher than the current recovery rate). This impact is highly dependent on whether a MWF can secure tonnage from sources other than the District.
- **OCF:** An OCF would also represent a major change in the County's infrastructure targeting source-separated food waste and yard waste with the potential to increase County recovery to 12 to 15 percent based on the assumptions made (3 to 6 percent greater than the current recovery rate). Even though potentially compostable materials are the largest material category (approximately 40 percent of the mixed waste stream), the OCF's impact is limited due to the assumptions regarding how much organic material is actually diverted by various generator categories. It should be noted that development of an OCF with either an IPF or MRF is a hybrid option that could have the combined impact of increasing the County recovery rate 5 to 9 percent.

Financial Assessment

The financial assessment indicates that the cost per ton of an IPF and/or OCF may be less than or comparable to prevailing disposal costs when relying primarily on materials collected by the District. And it may be possible for the District to pursue either or both without needing to receive significant amounts of material from other sources.

On the other hand, the assessment indicates that a MRF or MWF would require a significant amount of tonnage from non-District sources to be financially comparable to regional disposal costs. As an alternative to developing a MRF, the District may want to consider converting to single stream collection and delivering recyclables to Hoosier for processing. This option would require limited capital investment and could achieve a similar impact on the County recovery rate as developing a MRF.

Table 7-2: Summary of Financial Assessment

Capital Cost	Annual Cost	Annual Revenue	Net Annual	Net Per Ton
		IPF		
$3,100,000 - $3,200,000	$573,000 - $597,000	$532,000 - $631,000	($35,000) - $41,000	($5) - $8
		MRF		
$10,300,000 - $10,900,000	$1,400,000 - $2,000,000	$711,000 - $1,400,000	$616,000 - $712,000	$42 - $95
		MWF		
$38,800,000 - $39,900,000	$6,300,000 - $7,100,000	$2,800,000- $3,400,000	$3,500,000 - $3,700,000	$36 - $43
		OCF		
$992,000 to $1,100,000	$213,000 - $251,000	$9,000 - $12,000	$204,000 - $239,000	$41 - $48

Notes:
Annual cost includes annualized capital and operating cost.
Revenue is in parentheses, e.g., ($35,000) is revenue of $35,000.

Financing the development of either a MRF or MWF would require some kind of guarantee that the facility would receive enough material to justify its development. One potentially viable approach would be to coordinate a multi-stakeholder initiative (i.e., District, City, and IU) to establish a PPP for developing a MRF or MWF. It is also important to note that an OCF can be compatible with either a MRF or MWF.

Indiana law and existing District contracts also place certain constraints on the District's ability to undertake materials processing initiatives. Because of the Code's restrictions and lack of clearly defined standards, the District may want to undertake a legal review of various materials processing initiatives vis a vis the Code to support its review and decision-making process.

In a similar vein, with the results of the financial assessment to provide context, the District may also want to have some preliminary discussions with various stakeholders, which may provide further insight into the feasibility and conceptual framework for a materials processing system focused on achieving the District's goals.

As noted above, the timing of the existing agreements with Hoosier should be considered as well. As the end of their terms approach, the District may be in a better position to consider materials recovery and waste transfer and disposal options. At that time, the District may be able to leverage private sector competition with the option to negotiate with Hoosier to extend similar terms or release a request for proposals to solicit offers from service providers for either waste transfer and disposal only or a combination of materials processing, waste transfer and disposal.

Conclusion

In conclusion, it appears that potentially financially viable options for new materials processing infrastructure in Monroe County include an IPF, MWF and OCF based on the material flow assumptions developed for this study (financial viability being based on prevailing costs of disposal). But financial viability depends in large part on how much material is actually handled by a facility. Given the fact that the private sector manages a significant amount of the recyclables and mixed waste in the County and Region, it can be expected that the possible development and operation of a materials processing facility in the District will depend to a large degree on the private sector's role in it. Existing statutory and contractual limitations also pose a challenge to a possible District material processing facility which may possibly be addressed through some kind of public-private partnership.

Moving forward, the District can use the information analysis provided in this feasibility study as a starting point for further internal discussions possibly followed by discussions with other key stakeholders with the goal of determine whether and how the District can facilitate the growth of enhanced recovery programs and practices, and the infrastructure to support them, in Monroe County.