VOLUME III: APPENDICES

Appendix A: Colorado Integrated Solid Waste & Materials Management Plan
Appendix B: Final Report – Phase 1 Regional Wasteshed Planning Study
Appendix C: Stakeholder Presentations (1-7)

This page intentionally left blank.

Appendix A

Colorado Integrated Solid Waste & Materials Management Plan

IN ASSOCIATION WITH

SKUMATZ ECONOMIC RESEARCH ASSOCIATES

COLORADO INTEGRATED SOLID WASTE & MATERIALS MANAGEMENT PLAN

PREPARED FOR

Colorado Department of Public Health and Environment

June 2016

June 21, 2016

Mr. Joe Schieffelin
Solid Waste & Materials Management Program Manager
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Re: **Integrated Solid Waste and Materials Management Plan**

Dear Mr. Schieffelin:

The purpose of this Integrated Solid Waste and Materials Management Plan (Plan) is to develop a comprehensive evaluation of the current state of Colorado's waste disposal and materials management practices incorporating a public stakeholder process with feedback and input from regions of the state. This Plan is intended to facilitate the development of disposal, collection and diversion options for geographic regions and help capitalize on a collaborative effort to develop solutions for Colorado's future.

The results and recommendations within the Plan will guide the Colorado Department of Public Health and Environment (CDPHE) and stakeholders to develop short term and long term goals best suited for developing cost effective and environmentally protective waste management and waste diversion systems.

In association with Skumatz Economic Research Associates, Burns & McDonnell appreciates the opportunity to have partnered with the CDPHE to develop a Plan that is intended to serve as a planning resource for the entire state of Colorado. This effort would not have been accomplished without the extensive input and participation by CDPHE, multiple local government and private sector representatives, as well as other community stakeholders.

Should you have any questions regarding this Plan, please contact either Scott Pasternak at (512) 872-7141 or spasternak@burnsmcd.com or Josh Lee at (303) 474-2223 or jllee@burnsmcd.com.

Sincerely,

Scott Pasternak
Senior Project Manager

Joshua Lee, PE
Deputy Project Manager

Enclosure Attachment

EXECUTIVE SUMMARY

LIST OF TABLES

LIST OF FIGURES

APPENDICES:

EXECUTIVE SUMMARY

Introduction

Purpose: The purpose of the Integrated Solid Waste and Materials Management Plan (Plan) is to develop a comprehensive evaluation of the current state of Colorado's waste disposal and materials management practices incorporating a public stakeholder process with feedback and input from regions of the state. This Plan is intended to facilitate the development of disposal, collection and diversion options for geographic regions and help capitalize on a collaborative effort to develop solutions for Colorado's future. The results and recommendations within the Plan will guide the Colorado Department of Public Health and Environment (CDPHE) and stakeholders to develop short term and long term goals best suited for developing cost effective and environmentally protective waste management and waste diversion systems.

Planning History: As declared within the Colorado Solid Waste Act, a statewide system of integrated solid waste management planning is necessary to meet Colorado's solid waste disposal needs, Colorado Revised Statutes (CRS) 30-20-100.5. The most recent solid waste management plan for Colorado was developed in 1992 and was intended to provide a road map for Colorado's waste management future. In 2015, CDPHE requested that the legislature grant additional spending authority for an updated state-wide integrated solid waste and materials management plan. The legislature granted that request for the 2016 state fiscal year. The goals of the Plan are to evaluate the current state of solid waste management practices in Colorado and develop recommendations on strategies that local communities can use to improve waste disposal and recycling activities going forward.

The 2016 Plan describes how CDPHE, local governments, private companies and citizens of Colorado can implement the transition from disposal of waste to sustainable materials management. The Plan also incorporates requirements from C.R.S. 30-20-100.5 (I) - (V), including:

i. How the integrated plan will meet the solid waste disposal needs over the next 20 years

ii. What types of facilities and quantity of facilities are necessary to meet the needs of local governments and citizens

iii. State and local efforts necessary to reduce the volume and toxicity of the waste stream

iv. Realistic waste reduction goals

v. State and local solid waste management goals through source reduction, recycling, composting

vi. Public education concerning solid waste and its impact on public health and the environment

vii. Minimizing illegal disposal of solid waste through the appropriate types of facilities needed to handle solid waste and materials in all areas of the state

Plan Overview: CDPHE retained the services of Burns & McDonnell and Skumatz Economic Research Associates (SERA) as the Project Team to develop the Plan. Burns & McDonnell led the overall project, as well as the transfer and disposal analysis. SERA was responsible for the stakeholder meetings and the solid waste collection and diversion materials management analysis. Table ES-1 summarizes the information that is included in each section of this Plan.

Table ES-1: Plan Organization

Section	Overview
Executive Summary	Provides a stand-alone summary of the Plan, inclusive of key findings, recommendations and conclusions.
1. Introduction	Provides an overview of the purpose of the Plan and history, as well as descriptions of the plan organization and content.
2. Stakeholder Meetings	In an effort to understand a broad range of stakeholder views and perspectives, the Project Team conducted 10 public input meetings across the State utilizing the Appreciate Inquiry technique. Prior to conducting the meetings, participants completed a pre-meeting survey.
3. Transfer and Disposal System	Review of the current transfer and disposal system, including analyses of the wastesheds, landfill adequacy, and overall facility needs. An analysis of costs, case studies and recommendations to improve the transfer and disposal system in Colorado.
4. Solid Waste Collection	Reviews solid waste collection issues for the residential, commercial and multi-family sectors.
5. Diversion Materials Management	Evaluates recycling collection and processing, as well as organics (yard waste and/or food scraps) collection and processing.
6. Collection and Diversion Analysis and Recommendations	Examines strategies for improving the system of collection and diversion in Colorado. The two topics are addressed together, because collections of solid waste and recyclables are delivered jointly. The systems and recommendations for these topics, are inevitably linked.

Using the Plan as a Resource: A key objective for this Plan is for it to serve as working resource guide for the entire state of Colorado. The preceding sections are intended to provide a wide range of guidance – from the cost models for disposal (Section 3) and collection and diversion programs (Section 6 and Appendix E) to resources for local and regional plan development. In addition to the six sections, the Plan includes a number of appendixes focused on providing on-going resources for the state. For example, Appendices C and D provide descriptions of case studies and potential funding sources, respectively.

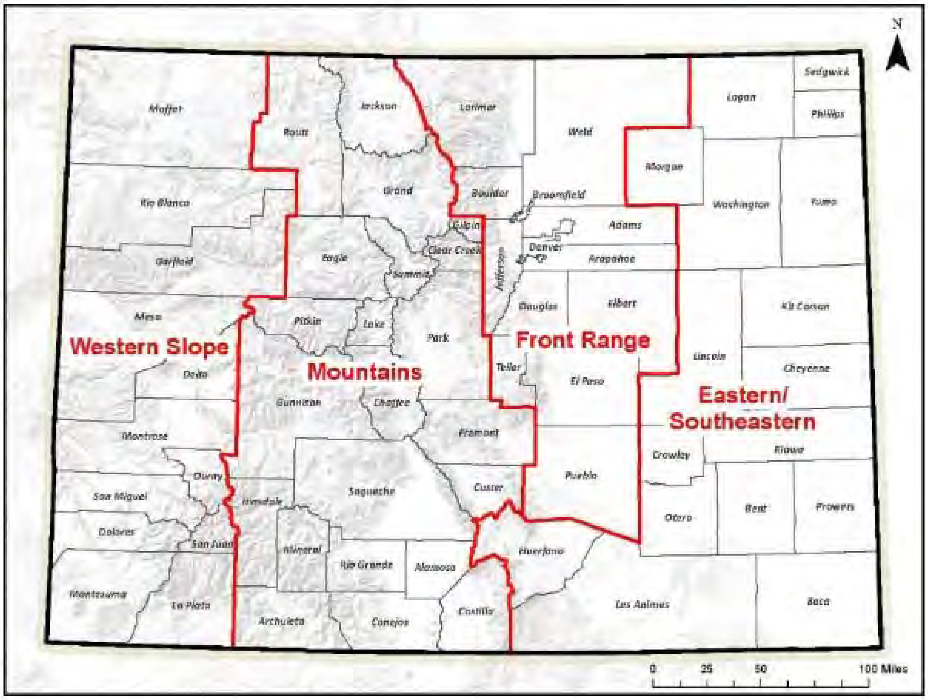


Figure ES-1: Geographic Regions

Communicating Information by Geographic Regions: In order to provide an understanding of disposal and materials management trends within the state, key aspects of the analysis within Sections 3 – 6 of the Plan are organized based on the geographic regions shown in Figure ES-1.

Stakeholder Meetings

The Project Team, at CDPHE's direction, focused on developing a tailored, responsive Plan. Given the diversity of solid waste management within the state of Colorado, it was essential to obtain input from the various areas of the state, to ensure the Plan reflects the range of current characteristics, barriers and opportunities and "acceptability" of potential changes in the different regions.

As described in Section 2, the Project Team organized and facilitated nine regional stakeholder meetings around the state, and one statewide webinar. The statewide webinar was organized for the convenience of stakeholders who could not attend a live meeting or had statewide knowledge that did not fit into a single meeting. Stakeholder meetings were held in the following locations from January – March 2016 (listed in chorological order):

- Alamosa
- Lamar
- Pueblo
- Durango
- Grand Junction
- Denver Metro
- Silverthorne
- Sterling
- Loveland

The feedback from each meeting was extensive and covered a wide array of topics. A selection of results from the stakeholder meetings have been included in Section 2 and the key insights have been integrated into the disposal, collection and diversion sections of the Plan.

Transfer and Disposal System

Having an adequate and cost effective transfer and disposal system in the State of Colorado is important to meet long-term disposal needs. Section 3 evaluates the state's transfer and disposal system in an effort to identify the type and quantity of facilities that are necessary to meet the needs of local governments and citizens.

Current System Review: Section 3 begins with a review of the current transfer and disposal system, including analyses of the wastesheds, landfill adequacy and regional facility needs. Understanding how solid waste moves from communities, via haulers and transfer stations, to landfills is meaningful in evaluating the current transfer and disposal system. Based on input provided by stakeholders via written survey and during the stakeholder meetings, as well as insight from CDPHE and the Project Team (including multiple phone calls to facilities and internet research), Figure ES-2 portrays the disposal wastesheds in the state as they are currently understood.

A key purpose of the Plan is to identify current and future waste management needs and offer recommendations for improvements that can be made to Colorado's waste management system. Central to this objective, is a candid assessment of the current solid waste landfill systems in Colorado. Based on existing federal and state laws and regulations[1], CDPHE assigned each site an adequacy score based on recent inspection information and review of the facility's approved design. Figure ES-2 identifies the levels of adequacy for landfills in the state based on three criteria categories - design and operation, groundwater monitoring, and closure requirements. The figure also defines the landfills by size which

[1] In the Resource Conservation and Recovery Act (RCRA) 1984 Hazardous and Solid Waste Amendments, the U.S. Congress directed the U.S. Environmental Protection Agency (EPA) to develop regulatory authority over landfills and directed the preparation of landfill design and operating criteria that were protective of human health and the environment. The federal regulation is known as Subtitle D. In Colorado, the regulations meeting the minimum requirements in Subtitle D went into effect October 9, 1993 with some exceptions as outlined in 6 Colorado Code of Regulations (CCR) 1007.2 based on the authorities defined and established in the Solid Waste Act, 30- 20-100.5, et seq, Colorado Revised Statutes (C.R.S.).

was determined based on the reported quantity of solid waste disposed of at the landfill in 2014. The following summarizes gaps and opportunities by region:

- **Front Range**: The landfills in the Front Range have been categorized as regional landfills, which is to be expected based on the quantities of solid waste generated throughout this region. Only one of the landfills in the Front Range region has been deemed inadequate by CDPHE. Moving forward it is expected that the haulers and regional landfills on the Front Range will continue to adapt to changing market conditions and provide services. There may be an opportunity for the Front Range regional landfills to expand their wastesheds beyond the highly populated areas of the Front Range.
- **Mountains**: The Mountain region consists primarily of a mix of medium and small landfills, with one regional landfill. Even with the small size of the landfills, regionalization is generally not a good fit for this area because of the difficulty associated with transporting solid waste between the counties. For these central mountain counties, the emphasis will include improvements to the few inadequate landfills to meet regulatory standards or consideration of transferring to a nearby adequate landfill.
- **Eastern/Southeastern:** This region has significant needs regarding the transport and disposal of solid waste. The Eastern/Southeastern region consists of large counties with small towns and a low population density. However, the region has a significant number of small landfills, owned by a combination of counties and towns. The vast majority of these landfills are inadequate with regard to the regulations. From the Project Team's perspective, continuing to operate many of the landfills in this region is a challenge due to the extensive number of facilities that are inadequate, as well as the relatively small solid waste quantities that are unlikely to generate sufficient revenue required to fund facility improvements.
- **Western Slope:** Transfer and disposal of solid waste on the Western Slope are considered medium and regional size landfills supported by a number of transfer stations spread throughout the counties. The system of having one county landfill accepting solid waste from transfer stations situated in the county is the working model for most of the counties. The three landfills inadequate in the groundwater category will need to make adjustments to meet the regulatory requirements. Closure of these landfills would leave large areas unsupported.

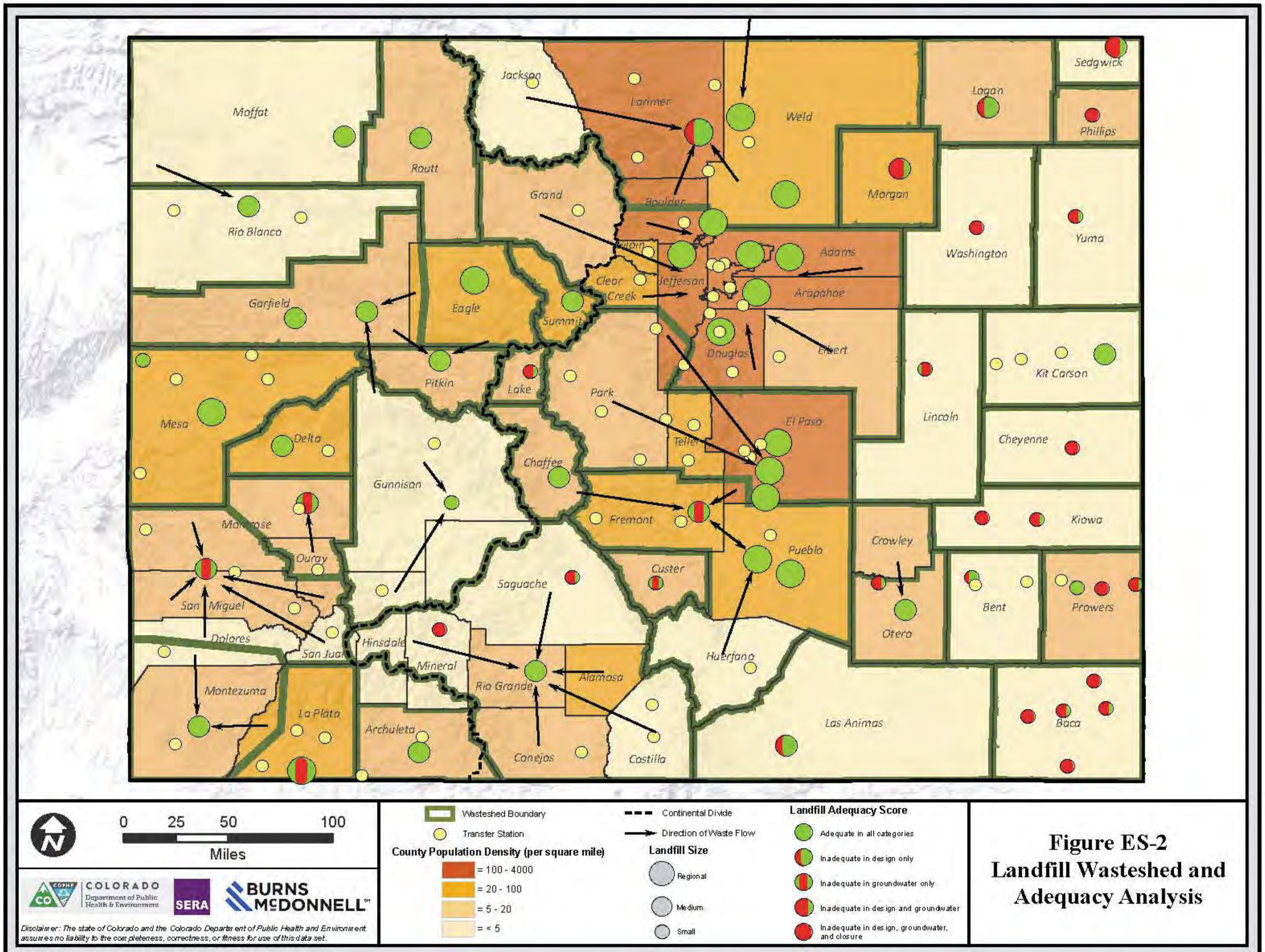


Figure ES-2
Landfill Wasteshed and Adequacy Analysis

Sources: US Census; Burns & McDonnell Engineering; ESRI

Cost Modeling and Conceptual Options Analysis: Based on the review of the current system, Section 3 includes an analysis of typical facility costs for transfer stations and landfills. Based on a range of facility sizes, the cost estimates for the landfills and transfer stations reflect the capital and operating costs associated with the facilities. Section 3 serves as a resource guide for the consideration of owners and operators of transfer and disposal facilities to improve the existing system. As an example of the analysis included in this section, Figure ES-3 summarizes the landfill costs, showing that as landfills increase in size, their costs per ton decrease.

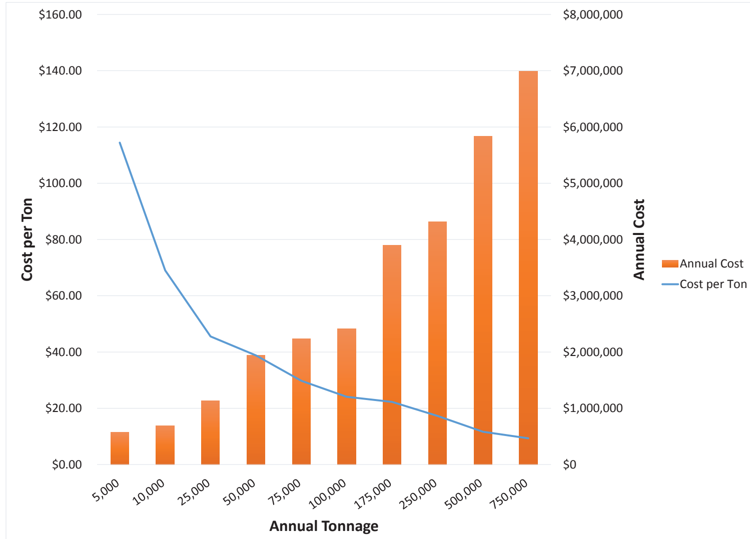


Figure ES-3: Landfill Cost Summary

The Project Team, with input from CDPHE staff, developed six conceptual options that reflect a mix of potential disposal scenarios for a range of community sizes. The purpose of these options is to provide a broad understanding of how costs would compare between different options. Table ES-2 summarizes the six conceptual options included in this section; and Table ES-3 provides a financial summary of the six conceptual options.

Table ES-2: Conceptual Options

Conceptual Option	Overview
Conceptual Option 1	Upgrade Existing Landfill to Current Standards
Conceptual Option 2	Single Drop-off Transfer Station
Conceptual Option 3	Single Compactor Transfer Station
Conceptual Option 4	Multiple Drop-off Transfer Stations Compared to Single Compactor Transfer Station
Conceptual Option 5	Moderate Size Top-Load Transfer Station
Conceptual Option 6	Large Top-Load Transfer Station with and without MRF

Table ES-3: Comparison of Conceptual Options

Conceptual Option	Type	Annual Solid Waste Tonnage	Annual Recycling Tonnage	Total Annual Cost	Cost Per Ton
1	Landfill	1,500	0	$253,462	$168.97
1	Landfill	4,500	0	$439,304	$97.62
2	Drop-off Transfer Station	1,500	0	$118,738	$79.16
3	Compactor Transfer Station	4,500	0	$490,697	$109.04
3	Compactor Transfer Station	15,000	0	$1,275,980	$85.07
3	Compactor Transfer Station	12,500	2,500	$1,222,563	$81.50
4	Three Drop-off Transfer Stations	4,500	0	$356,213	$79.16
4	Compactor Transfer Station	4,500	0	$490,697	$109.04
5	Top-Load Transfer Station	40,000	0	$2,698,545	$67.46
6	Top-Load Transfer Station	175,000	25,000	$11,288,379	$56.44
6	Top-Load Transfer Station	175,000	25,000 [1]	$9,810,890	$49.05

1. Recycling tonnage processed at a local MRF rather than hauled from a transfer station to a third-party MRF.

Transfer and Disposal Key Findings: Section 3 includes key findings on a statewide and regional perspective. Key statewide findings include:

1. Operating landfills outside of the requirements established by the EPA and adopted by the state of Colorado increases the risk to the human health and environment. Bringing landfills in Colorado into compliance with these regulations will help reduce the potential risk to human health and the environment.

2. The absence of adequate groundwater monitoring systems and adequate sampling and analysis of the monitoring systems at landfills in Colorado has the potential to lead to contamination. Capital costs for groundwater monitoring systems and annual costs for sampling and analysis pale in comparison to the cost of remediation necessary to clean up the contamination.

3. In the past the enforcement of the groundwater system and sampling requirements by CDPHE has been inconsistent. This inconsistency has left many owners frustrated with the inspection process and the approach of enforcement by CDPHE.

4. During the review of data provided by CDPHE, it was clear there was a lack of information collected from owners of landfills and transfer stations. As planning for future landfill development and potential partnerships moves forward, the access to total landfill capacity on a county, regional or state basis would benefit the planning process.

The largest need identified for most of the regions is the inadequacy of landfills in one or more categories. Table ES-4 shows the number of landfills by size in each region that are currently considered inadequate by category.

Table ES-4: Count of Inadequate Landfills by Region

Region	Landfill Size	Adequacy Category		
		Design & Operations	Groundwater	Closure
Front Range	Small	N/A [1]	N/A	N/A
	Medium	N/A	N/A	N/A
	Regional	1	0	0
Mountains	Small	3	4	1
	Medium	0	1	0
	Regional	0	0	0
Eastern/Southeastern	Small	15	15	9
	Medium	4	2	0
	Regional	N/A	N/A	N/A
Western Slope	Small	0	0	0
	Medium	0	2	0
	Regional	0	1	0

1. N/A means not applicable and means that there were no landfills of that size in the region.

Table ES-5 shows the capital cost range for each region to maintain the current number and upgrade the landfills. The cost ranges include closing existing disposal areas, constructing new disposal areas and constructing adequate groundwater monitoring systems. The Project Team estimated a statewide cost of $21 – 35 million to achieve adequacy for the landfills in the state. From Table ES-4, there are 23 landfills that are inadequate for design and operations. Correcting this inadequacy requires closure of the unlined areas of the landfill and construction of a new landfill cell. Based on the totals for cell closure and cell construction in Table ES-5, the average cost per landfill is between $875,000 and $1.46 million. For the 25 landfills that are inadequate for groundwater, the average cost per landfill is between $38,100 and $63,500.

Through the analysis provided in Section 3.3 (see Figure ES-3: Landfill Cost Summary), it is shown that the creation of regional landfills will reduce the per ton fees associated with operating landfills. Assuming landfills that are closed can be replaced by drop-off locations or transfer stations, there should minimal inconvenience to the public and may provide savings for the owner. With this in mind, some Colorado communities (refer to case studies for Bent and Hinsdale Counties in Appendix C) previously completed studies to determine costs of building and operating adequate landfills and elected to close landfills and transport waste to other landfills.

Table ES-5: Total Estimated Planning Level Cost of Achieving Landfill Adequacy by Region

Region	Cell Closure [1]	Cell Construction [2]	Groundwater [3]	Total
Front Range	$900,000 - $1,500,000	$1,987,500 - $3,312,500	$0 - $0	$2,887,500 - $4,812,500
Mountains	$562,500 - $937,500	$1,237,500 - $2,062,500	$165,000 - $275,000	$1,965,000 - $3,275,000
Eastern/Southeastern	$4,612,500 - $7,687,500	$10,837,500 - $18,062,500	$487,500 - $812,500	$15,937,500 - $26,562,500
Western Slope	$0 - $0	$0 - $0	$300,000 - $500,000	$300,000 - $500,000
Cost Range[4]	$6,075,000 - $10,125,000	$14,062,500 - $23,437,500	$952,500 - $1,587,500	$21,090,000 - $35,150,000

1. Cell closure using water balance cover (Avg. costs: small - $250,000; medium - $600,000; regional - $1,200,000)
2. Cell construction using geosynthetic liner (Avg. costs: small - $550,000; medium - $1,550,000; regional - $2,650,000)
3. Groundwater wells to create adequate network (Avg. costs: small – $30,000; medium – $100,000; regional – $200,000)
4. Cost range is +/- 25% to account for variations in site conditions

Recommendations: Landfill owners can begin to make decisions regarding the future of the facilities under their care. The key objective is for facilities to begin working towards adequacy with regards to the regulations. The following provides recommendations and strategies for policies at the statewide level and considerations at the regional/local level to improve transfer and disposal of solid waste throughout Colorado.

Statewide recommendations are primarily focused on activities that can be implemented by CDPHE. Given the importance of addressing landfill adequacy issues, the expectation is that these recommendations will be implemented over the next five years. Key statewide recommendations include:

1. **Enforce Current Regulations:** There is a need to clearly and consistently enforce landfill regulations to reduce risk to human health and the environment.
2. **Develop and Implement Policy for Compliance Timeline:** Understanding that multiple landfills have been inadequate for a number of years, the CDPHE should outline the timing and requirements for landfills to improve operations, achieve adequacy or make decisions on future options (such as regionalization).
3. **Provide Technical Assistance:** A suggested key role for CDPHE is to provide technical assistance to cities and counties regarding landfill adequacy and related issues. Technical assistance can be provided through a combination of workshops, guidance documents, one-on-one meetings, etc.

4. **Support Sustainable Funding Strategies for Local Programs:** Through understanding that there is a substantial financial requirement to achieve landfill adequacy or to consider regional options, there is a need to promote funding strategies and sources.

5. **Capture Disposal Facility Data:** While there is an understanding of landfill adequacy in the state, there is a substantial level of additional information that could be tracked by CDPHE that would inform future solid waste planning in Colorado.

Based on the regional analysis included in Section 3, there are a number of recommendations that local communities throughout the state can consider to meet the regulatory requirements for their landfills, as well as to operate in a manner of greater focus on costs and increasing diversion. Key recommendations include:

1. **Consider Regionalization Options:** Given that there are a substantial number of relatively small landfills that are inadequate with regard to the regulations, there could be a substantial benefit for these communities to explore regionalization options.
2. **Evaluate Groundwater Monitoring:** In accordance with state of Colorado and EPA regulations, facility owners need to install, maintain and regularly sample a groundwater monitoring system consisting of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer.
3. **Implement Sustainable Funding Strategies:** Facilities owners need to better understand and pay for the costs of their disposal programs.

Solid Waste Collection

The collection and hauling of solid waste is integral to ensuring that solid waste, recyclables and organics reach their intended destinations for proper management. Due to the variety of collection systems in Colorado, Section 4 begins with a background discussion of existing solid waste collection services. The remainder of the section is organized geographically by the four regions of the state (Figure ES-1). For each geographic region, an evaluation of current regional systems, needs, gaps, support, cooperation and funding opportunities are provided.

Background on Existing Solid Waste Services: Curbside collection service is one of the programs found in Colorado. This is most commonly provided by private haulers for a monthly fee and less commonly provided by municipal staff. Occasionally, communities establish city-wide contracts for service.

In many small, rural communities, drop-off sites either at landfills or transfer station are the most common way to dispose of household solid waste. Pay-As-You-Throw collection systems involve variable rates where customers are charged on the volume of the trash they dispose.

For the commercial sector in Colorado, collection is most prevalent through private haulers. For both commercial collection and large multifamily collection, few municipalities are involved in providing solid waste service. Home owner associations (HOAs) frequently contract for services and can embed the cost in the HOA fees.

Table ES-6 provides the current system for solid waste services in the state.

Table ES-6: Current System Solid Waste Collection Service by Region

Region	Stakeholder Meeting Location	Available Curbside		
		Residential	Commercial	Multifamily
Front Range	Denver	Abundant	Abundant	Abundant
	Loveland	Abundant	Abundant	Abundant
	Pueblo	Abundant	Abundant	Abundant
Mountains	Alamosa	Limited	Common	Limited
	Silverthorne	Abundant	Abundant	Common
Eastern/ Southeastern	Sterling	Common	Abundant	None
	Lamar	Uncommon (self-haul)	Common	None
Western Slope	Durango	Abundant	Abundant	Limited
	Grand Junction	Abundant	Abundant	Limited

Consideration of Solid Waste Collection Gaps and Opportunities: Assessment of gaps are influenced by the requirements of the Plan authorization (see (C.R.S. 30-20-100.5 (I) - (V)). Gaps, as identified in this Plan, relate to realistic opportunities for change in solid waste-related strategies (services, incentives, policies, regulations, and supporting infrastructure). The following tables provide a snapshot of issues and gaps that were gathered through stakeholder meetings, surveys, and research of the four regions of Colorado.

Table ES-7: Collection Needs and Gaps by Region

Front Range	Findings	
Needs/Concerns	• The disposal system received a 3.5 on a scale from 1 to 5, where 5 is working well	• Low landfill tipping fees encourage unlimited disposal
Gaps	• PAYT requirements are in place in many, but not all, areas	• For some municipalities that provide or contract service, residents are not charged for solid waste collection, so do not realize the cost involved
Mountains	**Findings**	
Needs/Concerns	• On a scale of 1-5 (5= working well) the disposal system received a 3.6 • Education is lacking about effects of illegal dumping • Service needs can be inconsistent with large tourist population in northern mountains	• Some transfer stations/drop off sites do not have regular hours • Landfill rates stay low in part to avoid illegal dumping • People are resistant to paying landfill fees where some used to be free
Gaps	• In the southern area, there are fewer drop off sites and illegal dumping is a large problem; transfer stations and drop-off sites are more common in the northern part of the region • Transportation to the landfills are over large distances	• In some areas, regionalization opportunities are not being taken advantage of partly because of landfills being privately owned • State or regional help in identifying and facilitating progress or providing resources would be helpful
Eastern/Southeastern	**Findings**	
Needs/Concerns	• Illegal dumping is common • The sparse rural population necessitates long hauls for collection	• The disposal system received a 3.4 on a scale from 1 to 5, where 5 is working well
Gaps	• Landfills are spread far apart and are often small	• Limited hauling services/options
Western Slope	**Findings**	
Needs/Concerns	• This area of the state has difficulty due to long driving distances • Mountain passes in winter make it difficult for waste collection	• Illegal dumping is an issue • The disposal system received a 4.0 on a scale from 1 to 5, where 5 is working well
Gaps	• Services tend to be in southern and East-Central part of region	

Diversion Materials Management

A critical portion of this Plan involves evaluating how the state can begin to transition away from disposal and toward materials management. Similar to Section 4 on solid waste collection services, Section 5 starts with a background discussion of the types of recycling and organics activities currently found throughout Colorado. Existing condition tables list the services available, but not necessarily how commonly they are used. For each geographic region, this section describes the current system, needs, gaps, support, cooperation and funding opportunities.

Section 5 contains maps depicting the locations of recycling and composting facilities around the state, as well as two additional maps identify the extent to which recycling and organics collection and drop-off programs are available. The majority of the services are located along the I-25 and I-70 corridors of the state.

Background on Existing Recycling Service and Processing: Recycling service is available in most regions of the state. Residential recycling services are provided as curbside pick-up or via drop-off service. The most common form of available recycling in very rural areas is drop-off recycling. There are good examples around the state including hub and spoke programs, which provide a central processing "hub" for multiple drop-off "spokes."

Multifamily recycling in Colorado is not widespread. Some small multifamily buildings may use containers for recycling, but larger buildings are normally treated like commercial buildings and use large dumpster style containers. Challenges include limited space, "split incentives" between generators and bill payers, high resident turnover and contamination due to anonymity and lack of education. HOAs can also be challenging for communities when implementing programs. Often they contract services for their members and do not always include recycling services. Generally, in Colorado, commercial recycling collection is provided by haulers using carts or dumpsters, charging by the number, size and frequency of recycling collection (parallel to commercial solid waste service).

Recycling Processing: Recycling processing facilities (MRFs) are scattered throughout the state, with concentration in both number and size surrounding the densely populated areas of the state, predominately in the Front Range. Colorado has a mix of private and public MRF operations. Single stream MRFs have sorting equipment that can handle incoming recyclable materials that are commingled and sorting is generally automated. There are several dual stream MRFs in Colorado as well as some dump and pick, baling only, or similar small manual operations. The state has numerous low-tech facilities, including hub and spoke, or facilities that conduct basic sorting on a tipping floor followed by baling of separated materials.

Background on Existing Organics Service and Processing: Curbside organic collection service is most commonly limited to yard waste only. However, a combined yard waste and food scraps service is becoming more popular in cities such as Boulder and Longmont. In Colorado, yard waste drop-off sites are available more often than curbside service. Commercial organics consist of food scraps from restaurants, grocery stores and cafeterias (hospitals, long term care, universities, etc.). There are few multifamily organics programs in the state, and HOAs rarely include curbside organics collections. Organics processing facilities, or composting sites, are scattered throughout the state (see Figure 5-1), with concentration in both number and size in the highly populated areas of the state. Tables ES-8 through ES-11 describe both the recycling and organics gaps and opportunities for each of the four regions.

Table ES-8: Diversion Gaps and Opportunities – Front Range

Population (and % of State) (5.2 M)	4,332,041 (83.5%)
Gaps in Recycling Access including Hub and Spoke/Drop-off Recycling	Pueblo area; Colorado Springs area; Western reaches of Larimer, Boulder, & Jefferson Counties; Weld County (except Greeley); parts of Douglas, Adams, Elbert Counties. *Gaps (Colorado Springs 439K; Pueblo 108K;* proxy estimate missing 13%)
Estimated Percent of Population with Coverage	87% of area population (preliminary estimate); 3.8 million
Active Organics Options	Bennet, Aurora, Colorado Springs, Pueblo, Boulder
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Organics siting guidelines
Special Opportunities	Density, facilities, organized collection fairly common, appetite for green and zero waste in areas
Potentially-Acceptable Strategies	Regional planning, hauler licensing, goals, some support for bans, EPR, PAYT, surcharges, mandated diversion, education

Table ES-9: Diversion Gaps and Opportunities – Mountains

Population (and % of State) (5.2 M)	319,969 (6%)
Gaps in Recycling Access including Hub and Spoke/Drop-off Recycling	Grand County; Jackson County; Clear Creek County; Gilpin County Gaps (Grand 15K, Jackson 1K, Clear Creek and Gilpin 15K)
Estimated Percent of Population with Coverage	90% of area population, 290K population covered
Active Organics Options	Milner Landfill, Snowmass Village, Saguache, Center, Hooper, Glenwood Springs, Dillon
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Transient populations/2nd home owners; lack transfer stations/no regionalization, compost processing missing
Special Opportunities	Have MRF; green ethic with interested industry
Potentially-Acceptable Strategies	Planning areas, hub and spoke, recycling goals (2-tiered), landfill surcharges, possibly PAYT, solid waste tax, consideration of waste to energy

Table ES-10: Diversion Gaps and Opportunities – Eastern/Southeastern

Population (and % of State) (5.2 M)	157,455 (3%)
Gaps in Recycling Access including Hub and Spoke/Drop-off Recycling	Plains, in general; Morgan County; Huerfano County. *Gaps (Plains 155K, Morgan 28K, Huerfano 6K)*
Estimated Percent of Population with Coverage	60% of area population (preliminary estimate of 94K)
Active Organics Options	Yuma, Ft. Lupton, Akron, Eaton, LaSalle, Erie, Keenesburg, Hudson, Fort Morgan
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Market access/transportation, want local control and want fewer landfill inspections/enforcement, lack MRFs, low incomes, illegal dumping concerns
Potentially-Acceptable Strategies	2 tier goals, WTE; some support for Hub and Spoke, severance funding, differential taxes by stream; environmental/generator fees, facility co-location incentives, bottle bill, economic development assistance, hauler contract fees, industry funded programs

Table ES-11: Diversion Gaps and Opportunities – Western Slope

Population (and % of State) (5.2 M)	388,115 (7.5%)
Gaps in Recycling Access including Hub and Spoke/Drop-off Recycling	Moffat County (one drop-off); Rio Blanco County; Garfield County; Western Slope, in General Gaps (Moffat and Rio Blanco 19.5K, Garfield 58K, Western Slope most; preliminary estimate missing 100K+)
Estimated Percent of Population with Coverage	75% of area; 288K population covered
Active Organics Options	Austin/Delta County, Grand Junction
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Lack transfer stations, hub and spoke in some areas, lack end markets, significant rural population
Special Opportunities	
Potentially-acceptable strategies	Partial support for regional planning, hub and spoke, two-tiered state goals, reporting, solid waste taxes, landfill surcharges, economic development assistance, industry-supported programs, severance funding, possible waste to energy, possible PAYT, card board bans

Collection and Diversion Going Forward

The current 23% diversion rate (as estimated by CDPHE) in Colorado falls below the national average – compared to 35% nationally (CDPHE reports 11% excluding some C&D, and 23% including more materials). Before appropriate strategies for progress could be considered and crafted, it was necessary to review the authorities that could be used to make recommendations meaningful and enforceable.

- **At the State Level**: The state of Colorado faces an unusual situation in regards to planning and recommendations related to diversion. Under the Colorado Solid Waste Act, CDPHE has authorities almost exclusively in the realm of disposal at landfills. There are resolutions that discuss the state's interest in waste diversion, but generally its **enforceable authorities beyond disposal facilities do not exist**. Given this is a 20-year plan, the study also explores possible avenues for the state to extend existing authorities with and without action by the legislature.
- **At the Local Level**: Many local governments within Colorado have not asserted any of the authorities that are authorized to them in the waste management area. Counties are generally assumed to have waste management authorities; municipalities do as well. However, they do not register firms providing collection or programs, nor do they regulate service, rates or other elements regarding solid waste management, or provide access to solid waste or diversion services or infrastructure. There are notable exceptions provided in Section 6. Most importantly, recycling is hampered because Colorado has low landfill tipping fees and, outside the Front Range, long transportation distances to get recyclables to market.

A majority of the state's population resides in areas with somewhat difficult, but not impossible, waste management economics, and in areas with interest in pursuing diversion as a policy direction. Progress in other regions may be encouraged through the changes in waste management economics, realized from decisions related to landfill closures and compliance issues. Without state authority to mandate or enforce change, and without a dramatic change in actual and relative costs between solid waste disposal and recycling, localities that have not undertaken change will not have specific motivation to do so, and it is unlikely the state will make widespread, meaningful movement toward improved materials management. Local activism, persuasion and local policy leadership may be the main motivators of change.

At the local level, locally-suitable programs are suggested that are as effective and cost-effective as possible. More advanced or aggressive suggestions are suitable in some areas (Front Range and possibly Mountains), but the waste management market economics of the state of Colorado make even basic programs a challenge in other regions of the state. From the state perspective, this is very important, because universal access to programs, and effective programs are certainly attractive goals. From a practical standpoint, it can also be recognized that **truly remote economics, and the challenges they imply, affect about half of the land area of the state, but about 10% of the state's population and waste volumes** (about 7-8% in the Western Slope and 3-4% in the Eastern/Southeastern). Further, these populations are scattered in communities with populations substantially smaller than 7,000-10,000 (about one or two efficient solid waste truck's worth of business).

Mindful of the situation, a menu of strategies and recommendations were developed in this Plan; they are designed to:

- Work within the state's current regulatory and authority structure, but also be suitable if updates in authority arise that would improve the opportunities to drive materials management in the state
- Clearly recognize that there are distinct differences in the feasibility and suitability of strategies in different areas of the state, particularly in the Front Range compared to other areas of the state
- Provide recommendations for local and regional progress, identifying strategies for improving access to recycling and diversion, and also more aggressive strategies for areas of the state with interest in stronger progress
- Serve as a resource for future local or regional planning efforts, should these activities be undertaken as part of local initiatives, or through incentives or initiatives coming from the state

Successful strategies will need to provide access to diversion options, address barriers and motivations, consider economics and tradeoffs, and include enforcement options to make the strategies meaningful. Local acceptability (based on discussions at the stakeholder meetings) was considered in assessing options for recommendations. Recognizing the state's unique authorities situation, four levels of strategies were developed, outlined in Tables below. Level 1 and 2 strategies focus on the state level. Level 3 and Level 4 strategies are locally-focused, and provide guidance for local and regional planning.

- **Level 1 Strategies**: This group includes state strategies that can be implemented in the near term, generally within current authorities.
- **Level 2 Strategies**: These strategies include recommended state activities that would support the achievement of Level 1 recommendations, if additional authorities are assigned to CDPHE.
- **Level 3 Strategies**: Level 3 includes a menu of 12 strategies to be recommended for implementation at the local and regional level, focused on improving access to recycling and diversion by households and businesses across the state. To reflect the varying situations in different parts of the state, the number of strategies recommended for adoption in regions differ: eight strategies in the Front Range, five in the Mountains, and four each in the Eastern/Southeastern and Western Slope.
- **Level 4 Strategies**: This tiered group of progressively more advanced strategies is particularly suited to implementation in areas of the state with reasonably favorable economics and densities, like the Front Range.

Table ES-12: Level 1 Collection and Diversion Recommendations

1. **Adopt Goals**: Adopt the recommended Two-Tier Diversion Goals – Short and Long Term – and Support/Conduct Activities to Achieve the Goals
2. **Improve Tracking**: Improve Performance Tracking and Reporting (to the Legislature)
3. **Training Focus**: Enhance CDPHE Diversion Training/Technical Assistance and Outreach on Collection and Diversion
4. **Inspections & Incentives**: Increase Inspection efforts on non-Adequate Landfills with an Emphasis on Providing Clear and Substantial Economic Incentives for Compliance and Diversion
5. **Regional Planning Initiative**: Establish Regionalized Solid Waste Planning Emphasizing Diversion Alternatives
6. **Supporting Funding**: Support/Fund Regionalized Solid Waste Planning emphasizing Diversion by use of revised RREO grant priorities
7. **Recycling Access Statewide**: Fill Gaps in Recycling Opportunities/Drop-off Networks in the State and Support Existing Infrastructure
8. **Materials Management in CDPHE Operations**: Implement Zero Waste (ZW), Extended Producer Responsibility (EPR), Life Cycle Cost Analysis (LCA), Materials Management (MM), Reduction, and other policies and principles in CDPHE operations
9. **Support MM**: Support ZW, MM and LCA where possible
10. **Supporting Authorities**: Seek additional Supporting Authorities and Identify Collaborative Working Arrangements with Other Agencies/Actors for near/longer term Diversion and Materials Management Progress in Colorado

Table ES-13: Level 2 Collection and Diversion Recommendations[1]

1. **Enforce Goals**: Ability to Enforce Adopted Diversion Goals 2. **Hauler Licensing**: State Licensing of Haulers 3. **Require Regional Planning**: Authority to Require Regional Planning and Establish Planning Authorities 4. **Funding for Planning**: Authority to Provide Designated Funding Source for Regional Planning Activities 5. **Implement/Enforce State-Level Strategies**: Ability to Implement and Enforce Collection and Diversion Strategies Best Applied at the State Level 6. **Landfill Surcharges**: Authority to Increase Landfill Surcharges 7. **Supporting Legislation**: Pursue Legislation to Obtain Authorities 8. **If/as authorities are gathered, establish prescriptive and performance-based strategies:** Recommend flexible, well-suited options for two tiers of prescriptive options[1] for communities in addition to enforceable performance goals.

1. These minimum programmatic/opportunity to recycle standards are listed as Level 3 in Section 6

Table ES-14: Level 3 Collection and Diversion Recommendations[1]

1. Enhanced education program by communities or counties or designated actors, annually. 2. Recycling depots/drop-offs with regular, convenient hours, in each town of at least 4,000 population. 3. Curbside recycling offered, single family homes (at least bi-weekly, with minimum requirements for program elements). 4. Curbside recycling, fee embedded in solid waste bill (not separate or options), single family households (at least bi-weekly with minimum requirements for program elements). 5. PAYT rate structure required for single family households (with minimum program elements). 6. Multifamily recycling of at least four materials in buildings with 5+ units, with education provided (minimum program elements), in communities greater than 10,000 population.	7. Yard waste (or yard and food) collection program (single family), at least weekly, or drop-off site open weekends and at least one weekday. 8. Program available for monthly or more frequent on-route collection of yard waste (or food and yard waste) from single family customers, with an education component. 9. Commercial recycling program available for all businesses with 10+ employees or 1,000 square footage, or with 10 CY or greater service per week. 10. Collection and composting program for all businesses generating large quantities or targeted business types (designated by CDPHE Memo, updated). 11. Commercial recycling required for businesses generating large amounts of recyclables. 12. C&D recovery program requiring separate bins at generation or post-separation.

1. Communities in Front Range recommended to implement eight strategies; communities in Mountains recommended to implement five strategies, and the Eastern/Southeastern and Western Slope regions implement four strategies. Number of recommendations increases over time. Communities exempted if they demonstrate they have reached the numeric diversion goals

Table ES-15: Level 4 Collection and Diversion Recommendations

Year 1 • Transfer stations/drop-offs must take recyclables at no fee • Food scrap generators of 104 TPY must divert material to any certified facility within 20 miles **Year 2** • PAYT statewide (volume or weight) • Recyclables banned from landfill • Transfer stations/drop-offs must accept leaf and yard debris • Haulers must offer residential recycling at no extra charge (embedded) • Public buildings must provide recycling containers adjacent to solid waste containers (except restrooms) • Food scrap generators of 52 TPY must divert material to any certified facility within 20 miles	**Year 3** • Leaf, yard and clean wood waste banned from landfill • Haulers must offer leaf and yard debris collection • Food scrap generator threshold at 26 TPY **Year 4** • Transfer stations and drop-offs must accept food scraps • Haulers must offer food scrap collection • Food scrap generator threshold to 18 TPY **Year 5** • Food scraps banned from landfill

Operationalizing the Plan at the State Level: The Plan provides the state and CDPHE with real and positive recommendations on ways to help motivate implementation of these changes (RREO grant incentives, etc.). However, at least in the near term, the ability to drive change is limited in Colorado at the statewide level under CDPHE's current regulatory authority of the Colorado Solid Waste Act. Several specific elements are needed to operationalize the Plan.

- **Regional Partners**: Regional planning is one of the central tenets of the recommendations, but authority to require regional planning does not currently exist. To achieve progress, the Plan suggests that the state may establish partnerships to work with existing regional planning agencies. The state has a number of Councils of Government (COGs) and other agencies spread throughout the state that already conduct regional planning work on other topics (transportation, water, etc.), and have existing working relationships and agreements with counties and communities. A list of candidate regional planning agencies across the state is included within Section 6.
- **CDPHE Work Plan**: Several key CDPHE activities are needed to implement the initial phases of the Plan. The Recycling Resources Economic Opportunity RREO grant program needs revision to focus the funding more on regional plans, and to modify eligibility criteria to incentivize the completion of regional Plans (the recommendation is to phase in a disqualification of submittals from stakeholders outside areas with regional plans). Coordinating with the Environmental Leadership Program (ELP) staff is needed to explore incorporating additional incentives in ELP for completing plans. Developing materials and beginning a series of webinars/outreach/training sessions geared toward diversion is another operationalizing step.

Stakeholder meetings, and meetings with the Solid Waste and Hazardous Waste Commission, to encourage cooperation and support with the Plan's recommendations are key activities in the work plan. Upgrading measurement and data collection efforts, waste composition studies, and improved compliance activities comprise the major steps in the CDPHE near-term work plan.

- **Funding Options**: The Plan lists more than a dozen funding sources that are used by other states. Very few of these funding options are currently available to Colorado, or have the flexibility that would support strong progress. However, the Level 1 strategies do not call for multiple major new efforts by CDPHE staff, partly because there are few available near-term funding sources.

Wasteshed and Local Strategy Recommendations: Level 3 and Level 4 recommendations provide suggestions (or stronger impetus if additional authorities are achieved by CDPHE) for strategies that could, at the local or regional level, provide improved access to recycling (Level 3) or aggressive "next steps" for motivated or advanced jurisdictions (Level 4). These options are suitable for consideration development of comprehensive plans by local communities or regional/waste shed planning agencies. Section 6 provides planning level estimates of the new diversion and the cost per ton to achieve that diversion, applying the Level 3 recommendations. The results are presented in Figure ES-4. These estimates are the sum of the tonnage and cost contributions from the implementation of four strategies in the Eastern/Southeastern Region, four strategies in Western Slope, five strategies in the Mountains and eight strategies implemented in the Front Range. The tonnage and cost results for each of the four Plan regions is provided in Appendix H of the report and the strategies are fully described in Section 6.

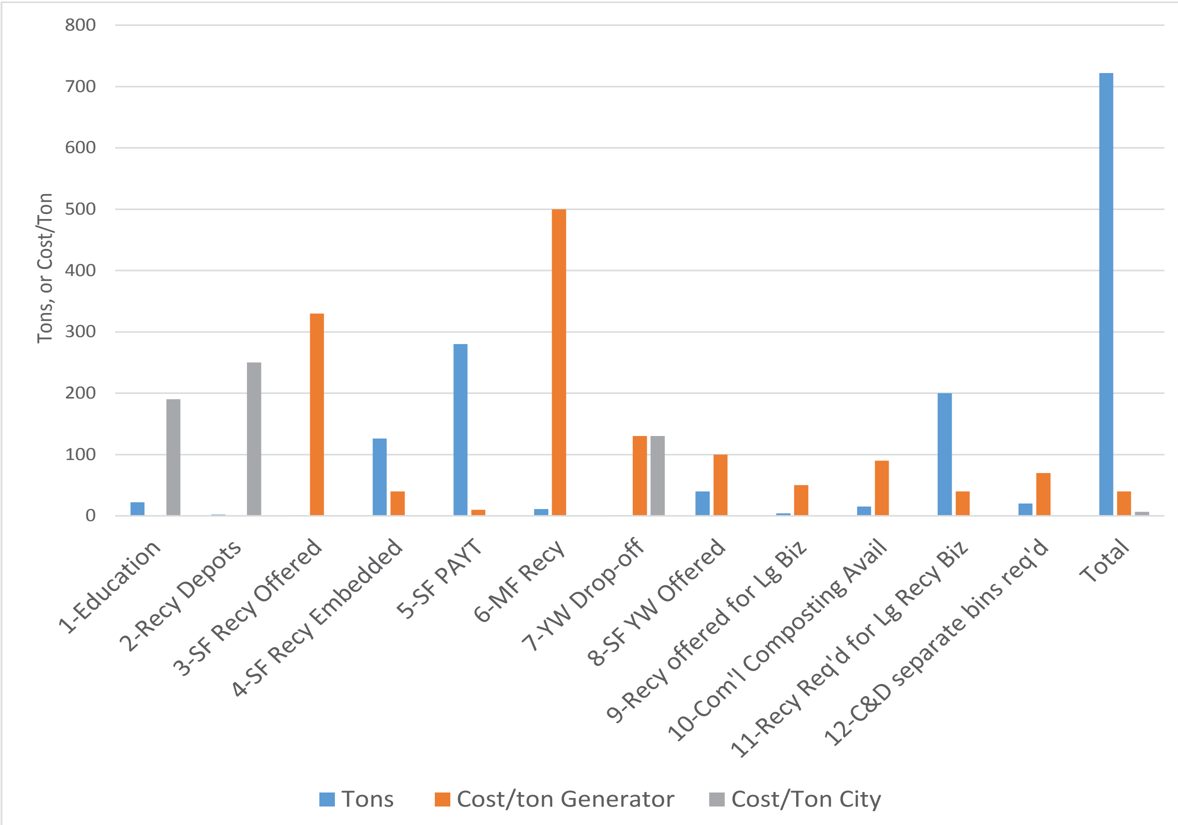


Figure ES-4: Planning Level Estimates of Tonnages and Costs for Selected Level 3 Strategies[2]

The recovered tonnages by region, and the weighted average of achieving that diversion, is presented in Table ES-16. This assumes each region adopts the recommended number of Level 3 strategies. The data show that achieving diversion in the Front Range and Mountains is about $40-60 per ton (recycling and organics), but that costs are more than twice or four times as high to implement fewer (and less-aggressive) strategies in the Eastern/Southeastern and the Western Slope.

[2] Assumes Front Range implements: 1, 4, 5, 6, 8, 10, 11, 12 (8 programs); Mountains implement: 1, 4, 5, 6, 9 (5 programs); Western Slope and Eastern/Southeastern implements: 1, 2, 3, 7 (4 programs)

Table ES-16: Weighted Average Cost per Ton for Level 3 Options by Region[1]

For Selected Subsets of Level 3 Options	Front Range	Mountains	Eastern/ Southeastern	Western Slope	Statewide
Diverted Tons (in thousands)	675	41	2	4	722
Weighted Cost per Ton - Generator	$38	$58	$38	$75	$39
Weighted Cost per Ton - Community	$5	$5	$154	$167	$7
Weighted Cost per Ton - Total	$43	$62	$192	$242	$46

1. (Selected subset of strategies for each region) Assumes Front Range implements: 1, 4, 5, 6, 8, 10, 11, 12 (8 programs); Mountains implement: 1, 4, 5, 6, 9 (5 programs); Western Slope and Eastern/Southeastern implements: 1, 2, 3, 7 (4 programs)

These costs are derived from program design assumptions and detailed cost modeling that is included in the Plan (Appendix E). The costs are presented in contributing "elements" (collection, transport, tip fee, etc.), allowing communities in different regions to adapt the estimates to their local distance and facility characteristics. The results show that, if each region adopts the recommended number of Level 3 ("access to recycling") options, an additional 722,000 tons per year can be diverted statewide at a weighted average cost of about $46-$53 per ton. This is 65% of the cost of implementing all 12 strategies in all areas, and delivers 71% of the tonnage. Table ES-17 presents planning level costs for key collection and diversion options. The ranges reflect differences in assumptions for costs, profits and other inputs.

Table ES-17: Planning Level Estimates: Cost per Ton Options by Region[1]

Total Costs	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Voluntary Residential Collection				
Trash	$70-$80	$80-$100	$90-$110	$90-$110
Recycling	$10-$30	$140-$190	$200-$290	$280-$410
Organics	$90-$110	$100-$110	$110-$130	$110-$130
Mandatory Residential Collection				
Trash	$60-$70	$70-$80	$80-$90	$80-$90
Recycling	$-10-$10	$120-$170	$180-$270	$260-$380
Organics	$80-$90	$80-$90	$90-$100	$90-$100
Every Other Week Residential Collection				
Trash	$50-$50	$60-$70	$60-$70	$60-$70
Recycling	$-20-$-10	$100-$140	$160-$240	$230-$350
Organics	$60-$70	$60-$70	$60-$70	$60-$70
Commercial Collection				
Trash	$60-$70	$70-$90	$80-$100	$80-$100
Recycling	$0-$20	$120-$180	$190-$280	$260-$390
Organics	$80-$90	$80-$90	$90-$100	$90-$100
Drop-off Recycling				
Range	$140-200	$230-$360	$600-$800	$300-$600

1. Includes collection, transport, processing, and tip fees; does not include avoided cost per ton

The figures in Table ES-17 show that:

- Recycling in the Front Range is generally profitable, and the challenges to diversion in the Eastern/Southeastern and Western Slope areas are substantial.
- Organics collection does not appear profitable, especially with zero market value as assumed in this report. Adding in a $30 avoided tipping fee improves the situation relative to trash.
- Every other week collection can help make collection of recyclables more cost-effective, and studies indicate that the loss in tons is relatively minor.

What is not shown in the table is the costs for distant locations could improve by a factor of as much as eight per ton if the transport was made via trailer instead of roll-off. This is relevant in the Eastern/Southeastern and the Western Slope regions, and might attract attention from the RREO grant program. However, determining where best to site such a facility within some of these large geographic regions could be difficult.

The document also provides a list of specific strategy recommendations that could be considered seriously in each region if the state gains authority to require programs, or if regional planning agencies elect to develop plans. The suggestions incorporate the findings from the regional stakeholder meetings on gaps, opportunities, and strategies with potential support in the region. The table includes region-specific recommendations for:

- residential and commercial access, collection and diversion options
- composting and recycling processing and infrastructure needs, including drop-offs
- construction and demolition infrastructure
- longer term sustainable materials management and zero waste strategies
- bans, education and other cross-sector strategies
- state level strategies and their appropriateness within regions

State Tonnages and Performance Goals: Households and businesses within the state generate almost seven million tons of solid waste annually (Table ES-18). Given growth rates projected by the state, this number is expected to grow to more than nine million tons in 20 years – without major changes in upstream waste generation, product stewardship or other structural changes in the market. Table ES-19 shows that current diversion in the state is about 23%, or about 1.6 million tons annually (estimated by CDPHE). If the selected Level 3 strategies are implemented, diversion would be expected to increase to 31% statewide.

Table ES-18: Projected Generation by Region (Tons)

Region	2015	2016	2021	2026	2031	2036
Front Range	5,840,000	5,946,000	6,492,000	7,043,000	7,582,000	8,121,000
Mountains	296,000	301,000	328,000	363,000	396,000	431,000
Eastern/Southeastern	194,000	197,000	215,000	233,000	248,000	263,000
Western Slope	485,000	494,000	545,000	602,000	660,000	717,000
Statewide	6,815,000	6,938,000	7,580,000	8,241,000	8,886,000	9,532,000

Table ES-19: Projected Diversion under Adoption of Selected Level 3 Strategies (Tons)

2014 Total Diversion (per CDPHE)	2,018,264
2014 MSW Generation	8,765,610
2014 Diversion Rate	23%
Additional Generation (1% growth per year)	175,312
Additional Base Diversion (1% growth per year)	40,365
Additional Tons from Level 3 "Access" Strategies	722,000
Diversion Rate including basic access improvements (Level 3)	31%

One of the requirements of the Plan is to set a diversion goal for the state. The Project Team determined that the state would benefit from the use of two metrics.

- Diversion rate is the combination of recycling and organics diversion as a proportion of generation. This is the traditional measurement method used by the state and provides a good comparison to the past and to performance reporting by other states, and nationally.
- Percent recoverables remaining (PRR) uses waste composition studies to identify the percent of recoverable recyclables and organics (separately) that remain in the waste stream. The metric provides a gauge of how well households and businesses are cooperating with the goals of most programs (diverting materials from the trash) and provides information about which programs or materials should be the next target for education or programs in communities.

The Plan develops recommended goals, setting higher recommended goals for the Front Range than for the other regions to recognize the different levels of achievement that are feasible and reasonable to expect. The primary goal for the Plan should be the diversion goal; the PRR goal is secondary.

Setting goals that require legislation changes to be successful would be inappropriate; rather, the goals would be expected to be revised at that time to reflect the actual levels of authority granted. Therefore, the goals presented in Table ES-20 will appear very conservative. The main progress reflected in these goals is continued growth in access and use of organics programs, improved efficiencies in collection, and growth of infrastructure, making programs more feasible and cost-effective. Some of the growth may also occur as landfill compliance is enhanced, and diversion becomes an increasingly attractive alternative. Note that the goals are not intended to limit the achievement of motivated communities.

Should the full range of authorities envisioned in Levels 1-4 of the strategies list be adopted, the state could potentially expect to achieve goals of perhaps 30% by 2021, 35-40% by 2026, and 45%-50% or more by 2026, with higher levels achieved in the Front Range. The secondary PRR goals are presented in Section 6. The recommended goals are presented in Table ES-20.

Table ES-20: Diversion Goals for Recycling in Colorado[1]

Diversion Goals[2]	2016	2021	2026	2036
Front Range	N/A	32%	39%	51%
Rest of State	N/A	10%	13%	15%
Statewide	23% [3]	28%	35%	45%

1. Conservative goals reflecting no new legislative authorities
2. Combines recycling and organics
3. Based on information provided by CDPHE

The study also estimated the value of the unrecovered recyclables being landfilled annually in Colorado. The calculations in Table ES-21 use five-year average market prices. Additional recovery of recyclables can have real value, and a tremendous share of this value is in the Front Range, where economics for recycling and diversion (at least at five-year average recycling market prices) are not unfavorable.

Table ES-21: Buried Value of Recyclables in Colorado[1]

Region	Front Range	Mountains	Eastern/ Southeastern	Western Slope	Statewide
Value of Recyclables Being Landfilled	$218 million	$12 million	$11 million	$26 million	$267 million

1. Using five-year average market revenues

Landfills, Recycling Value and Relative Costs — What the Plan Shows for Colorado

The Plan provides critical information on the economics of sustainable materials management in Colorado. Running a Subtitle D-compliant landfill is expensive, especially for small facilities. Table ES-3 notes these small facilities can cost as much as $170/ton to operate. Furthermore, bringing an inadequate landfill up to compliance is very expensive, and the costs in the Eastern/Southeastern region are estimated to cost between $16 million and $27 million.

The Plan also examined the value of the unrecovered recyclables currently being landfilled, shown in Table ES-21. This value – on order of $267 million statewide (at five-year average market prices). Finally, the Plan estimated the cost of recycling programs. There are “levels” of costs for diversion options, from low-cost PAYT options, to recycling and organics collection options, and more expensive alternatives.

Beyond the planning, programmatic, and policy recommendations, the Plan finds that:

- Running a transfer station can be considerably less expensive than running a small landfill
- The per-ton surcharge needed to transform inadequate landfills into compliant landfills is notably higher than changing operations to a transfer station at the site and moving materials to a larger, compliant site
- The cost per ton of diverting materials from landfills via recycling and other strategies can help mitigate costs in some areas
- Revenues from removing recyclables is a loss; there are dollars to be mined by removing more recyclables, even with processing and transportation costs included

- Recycling and diversion can be a way of avoiding some costs and diverting materials from the facility

Overall, the Plan shows that individual communities, counties, and landfills would benefit by reconsidering the methods of materials management. There are substantial savings to be realized by:

- Closing some compliant landfills and establishing a roll-off collection at the site, transferring materials to a larger, compliant landfill, and making the same change for some inadequate landfills
- Reducing tonnages in some landfills by introducing and promoting low cost recycling and diversion programs

Regional planning will identify additional opportunities and help realize economies that will be win/win – reducing costs and improving the safety of solid waste management in the state.

1.0 INTRODUCTION

1.1 Purpose

The purpose of the Integrated Solid Waste and Materials Management Plan (Plan) is to develop a comprehensive evaluation of the current state of Colorado's waste disposal and materials management practices incorporating a public stakeholder process with feedback and input from regions of the state. This Plan is intended to facilitate the development of disposal, collection and diversion options for geographic regions and help capitalize on a collaborative effort to develop solutions for Colorado's future. The results and recommendations within the Plan will guide the Colorado Department of Public Health and Environment (CDPHE) and stakeholders to develop short term and long term goals best suited for developing cost effective and environmentally protective waste management and waste diversion systems.

1.2 Planning History

As declared within the Colorado Solid Waste Act, a statewide system of integrated solid waste management planning is necessary to meet Colorado's solid waste disposal needs, Colorado Revised Statutes (CRS) 30-20-100.5. The most recent solid waste management plan for Colorado was developed in 1992 and was intended to provide a road map for Colorado's waste management future. Given that the plan was developed more than 20 years ago and substantial changes have occurred in the industry since that time, the 1992 plan no longer fulfills the solid waste and materials management planning needs of the state. In 2015, CDPHE requested that the legislature grant additional spending authority for an updated state-wide integrated solid waste and materials management plan. The legislature granted that request for the 2016 state fiscal year. The goals of the Plan are to evaluate the current state of solid waste management practices in Colorado and develop recommendations on strategies that local communities can use to improve waste disposal and recycling activities going forward.

The 2016 Plan describes how CDPHE, local governments, private companies and citizens of Colorado can implement the transition from disposal of waste to sustainable materials management. The Plan also incorporates requirements from C.R.S. 30-20-100.5 (I) - (V), including:

i. How the integrated plan will meet the solid waste disposal needs over the next 20 years

ii. What types of facilities and quantity of facilities are necessary to meet the needs of local governments and citizens

iii. State and local efforts necessary to reduce the volume and toxicity of the waste stream

iv. Realistic waste reduction goals

v. State and local solid waste management goals through source reduction, recycling and composting

vi. Public education concerning solid waste and its impact on public health and the environment

vii. Minimizing illegal disposal of solid waste through the appropriate types of facilities needed to handle solid waste and materials in all areas of the state

1.3 Plan Overview

1.3.1 Project Team: Burns & McDonnell and SERA

CDPHE retained the services of Burns & McDonnell and Skutmatz Economic Research Associates (SERA) as the Project Team to develop the Plan. Burns & McDonnell led the overall project, as well as the transfer and disposal analysis. SERA was responsible for the stakeholder meetings and the solid waste collection and diversion materials management analysis. Table 1-1 acknowledges key contributors to the Plan.

Table 1-1: Project Team

Burns & McDonnell	SERA
Scott Pasternak Joshua Lee Seth Cunningham Grant Cox Brad Coleman Jenna Barker	Lisa Skumatz Dana D'Souza Dawn BeMent Gary Horton

1.3.2 Plan Organization

Table 1-2 summarizes the information that is included in each section of this Plan. A key objective of this Plan is to make recommendations for an integrated and sustainable materials management system. Toward that end, this Plan has provided a concise and specific set of strategies that communities can consider to help reduce their waste management costs and realize benefits, both in terms of cost savings and liability management, if they implement the Plan recommendations. It is understood that moving toward an effective materials management program will require extensive activity and collaboration among a variety of stakeholders at the state, regional and local levels. Correspondingly, Section 6 of this Plan includes a more in-depth discussion of the collection and diversion strategies and recommendations.

Table 1-2: Plan Organization

Section	Overview
Executive Summary	Provides a stand-alone summary of the Plan, inclusive of key findings, recommendations and conclusions
1. Introduction	Provides an overview of the purpose of the Plan and history, as well as descriptions of the plan organization and content
2. Stakeholder Meetings	In an effort to understand a broad range of stakeholder views and perspectives, the Project Team conducted 10 public input meetings across the state utilizing the Appreciate Inquiry technique. Prior to conducting the meetings, participants completed a pre-meeting survey
3. Transfer and Disposal System	Review of the current transfer and disposal system, including analyses of the wastesheds, landfill adequacy and overall facility needs. An analysis of costs, case studies and recommendations to improve the transfer and disposal system in Colorado
4. Solid Waste Collection	Reviews solid waste collection issues for the residential, commercial and multi-family sectors
5. Diversion Materials Management	Evaluates recycling collection and processing, as well as organics (yard waste and/or food scraps) collection and processing
6. Collection and Diversion Analysis and Recommendations	Examines strategies for improving the system of collection and diversion in Colorado. The two topics are jointly addressed, because collections of solid waste and recyclables are delivered jointly and the systems – and recommendations – are inevitably linked

The Plan also includes the following appendices:

- Appendix A: Terms and Definitions
- Appendix B: Landfill Adequacy Summary
- Appendix C: Case Studies
- Appendix D: Funding Sources
- Appendix E: Cost Models for Collection and Diversion
- Appendix F: Level 1 and Level 2 Collection and Diversion Recommendations – Supporting Rationales and Potential CDPHE Authority Opportunities
- Appendix G: Estimated 2016 Tonnages by Region
- Appendix H: Opportunities and Gaps by Region

1.3.3 Communicating Information by Geographic Regions

In order to provide an understanding of disposal and materials management trends within the state, key aspects of the analysis within Sections 3 – 6 of the Plan are organized based on the geographic regions shown in Figure 1-1. These regions are only intended to communicate information in the Plan in an organized manner, as the analysis and recommendations may involve multiple geographic regions.

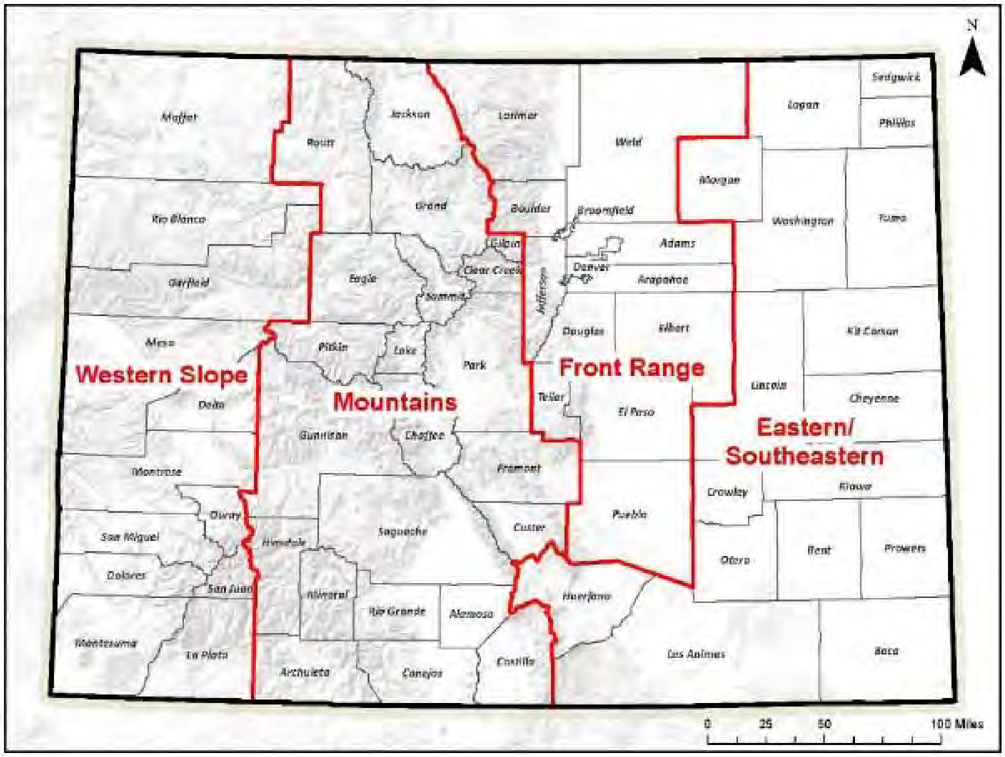


Figure 1-1: Geographic Regions

Front Range: The Front Range includes, for purposes of this Plan, all the counties along the IH-25 corridor from Pueblo County to Larimer County. Generally, the flow of materials within these counties travel toward the major urban areas along IH-25.

Mountains: The Mountain region includes counties along the continental divide and the San Luis Valley. Materials in mountain communities generally are not transported far due to weather induced travel difficulty during much of the year. Therefore, the wastesheds are more localized based on topography. It is understood that, while the San Luis Valley has been included in the Mountains category, the San Luis Valley has very different needs, gaps, demographics, infrastructure and economies. Correspondingly, the needs for the San Luis Valley will be discussed specifically within the Plan as appropriate.

Eastern/Southeastern: The Eastern/Southeastern region consists of the counties along the eastern border of the state and the lower population counties neighboring the Front Range counties. The region also includes Huerfano and Las Animas counties south of Pueblo because they have characteristics similar to the counties in the eastern portion of the state. Due to low population density and large geographic areas in these counties, a relatively high number of landfills exist to service small communities surrounding these respective facilities.

Western Slope: The Western Slope consists of all counties touching the Utah border as well as the counties of Delta, Ouray, San Juan and La Plata. The flow of materials generally stays within each county or is transported in a north/south direction to other counties as opposed to going east.

1.3.4 Conceptual Options

Sections 3 and 6 (as well as Appendix E) of the Plan includes several conceptual options that are intended to provide communities with an understanding of the costs and alternatives to improve their solid waste and/or diversion system. Recognizing that communities may need to consider multiple options, the Plan includes several conceptual options within Sections 3 and 6 and Appendix E that are intended to reflect the various types of options that may be considered. The Project Team organized the conceptual options by types that are representative of the different characteristics of the state. Characteristics may include, but are not limited to, community size, location and proximity to disposal or materials management infrastructure. A conceptual option could be applicable to an individual community or region of the state.

1.4 Plan Limitations

Extensive efforts occurred to develop the facility and service cost estimates and geographic information system (GIS) analysis included in the Plan. However, as with any planning effort, there are limitations to the degree of detail provided and intended use of the information. Facility and collection services probable cost estimates were estimated using construction cost data, bid tabulations from previous projects, price indices and past experiences. Costs are considered high level for use in planning and alternatives comparison, and are not reflective of specific sites or circumstances. Probable costs are used in modeling to provide budgetary estimates for prescribed scenarios with necessary assumptions stated. Prior to implementing any of the recommendations included in this Plan, communities should develop specific and more detailed cost estimates that are focused on their planned activity.

Content for the maps included in the Plan was developed based on extensive collaboration between CDPHE and the Project Team, as well as based on input from multiple stakeholders. Due to the dynamic nature of the solid waste and recycling system in the state, the facilities and services communicated via these maps will change over time. These maps are based on information made available as of March 2016. Recognizing that these maps will change over time, key GIS layers have been provided to CDPHE by the Project Team, which can facilitate future updates.

2.0 STAKEHOLDER MEETINGS

The Project Team, at CDPHE's direction, focused on developing a tailored, responsive Plan. Given the diversity of solid waste management within the state of Colorado, it was essential to obtain input from all areas of the state, to ensure the Plan reflects the range of current characteristics, barriers and opportunities and "acceptability" of potential changes in the different regions.

The Project Team organized and facilitated nine regional stakeholder meetings around the state and one statewide webinar. The statewide webinar was organized for the convenience of stakeholders who could not attend a live meeting or had statewide knowledge that did not fit into any specific region-focused meeting. Figure 2-1 shows the locations of the stakeholder meetings.

To attract diversity in attendees to the meetings, the Project Team reached out through multiple rounds of emails and phone calls to invite the following entities to the meetings:

- landfill recycling and composting facilities
- county commissioners and other elected officials
- city and county officials and staff
- haulers, recycling businesses, brokers
- regional planning agencies
- Colorado/Rocky Mountain Solid Waste Association of North America (SWANA) and Colorado Association for Recycling (CAFR) members
- Recycled Resource Economic Opportunity (RREO) grant applicants/winners

In addition, contacted stakeholders were asked to forward the invitation to appropriate representatives and to other interested parties. The Project Team focused on obtaining information and feedback from each meeting to ensure full understanding of the region's current solid waste systems and future needs. Information gathering occurred via an on-line pre-meeting survey, as well as discussion and voting during each stakeholder meeting. The pre-survey gathered regional data that were used and presented at the stakeholder meetings. The pre-survey asked about the current system for collection services and facilities (trash, recycling and organics) in the area, expansion/contraction plans, prices and costs, material flows, economics of the system and opinions about how well the current systems were working. The pre-survey also solicited information on barriers, options best suited to the area and trends and drivers for change.

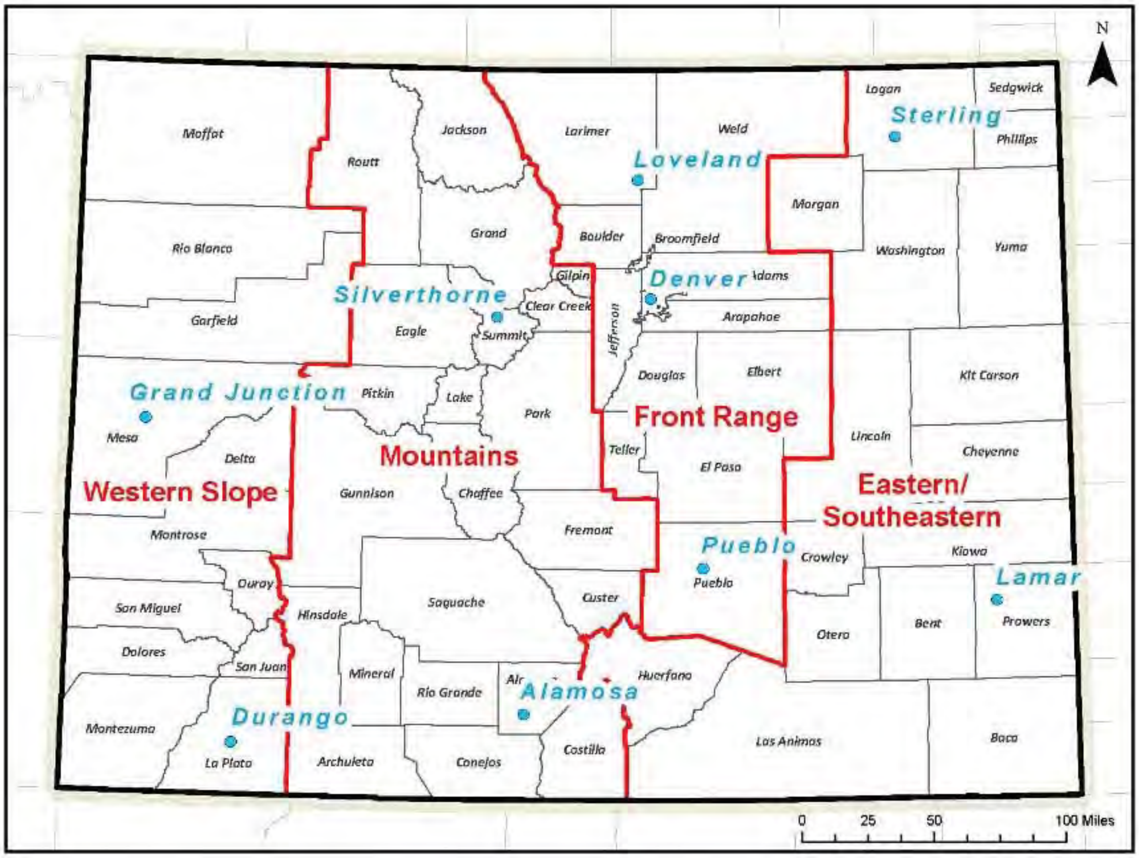


Figure 2-1: Stakeholder Meeting Locations

Maximizing feedback and discussion was the focus of each stakeholder meeting. The meetings included real-time voting using electronic "clickers" on 37 issues related to:

- sector and regions represented
- feedback on maps of regional facility and services
- information on current disposal and diversion systems and how well the systems were working
- regionalization and preferred options for landfills not meeting adequacy requirements
- barriers and opportunities for recycling and composting
- existing and potential funding and regulatory strategies in their area
- level of support for change from local elected officials and planners

As a third avenue for feedback and input, a group work session was conducted allowing participants to discuss needs and gaps, to share successful practices and to identify a potential diversion option that could potentially work in their region. Finally, maps identifying the availability of curbside and drop-off services and locations of facilities for disposal, recycling and composting were posted at each table. Attendees were asked to review and annotate the maps with updates.

The information gathered from the pre-surveys, map corrections, voting results and group table discussions (Figure 2-2) were integrated to identify needs and gaps and potential strategies (as discussed in the subsequent sections of this Plan) reflecting each region's feedback.

Figure 2-2: Regional Stakeholder Meeting Group Work Sessions

The stakeholder groups were facilitated by Project Team staff with training in specialized stakeholder meeting methods, specifically Appreciative Inquiry. This approach focuses on leveraging successes rather than dwelling on barriers. All but one meeting was attended by one or more CDPHE staff. Table 2-1 provides the tally of meetings and attendees by type. The attendee types are listed in order of their relative attendance at each meeting.

The feedback from each meeting was extensive and covered a wide array of topics. Results were summarized in meeting-specific reports that were sent to attendees.[1] Rather than report comprehensive results of the stakeholder meetings in this section, key insight has been integrated into the disposal, collection and diversion sections that follow. To provide perspective on the level of detail addressed in the stakeholder meetings, the remainder of this section provides examples of the type of issues addressed during the meetings. The feedback and input provided by the many meeting attendees representing the variations in factors, situations, suitability and preferences were instrumental in informing the analyses and recommendations developed throughout this Plan.

[1] As of July 2016, these reports are available at: https://www.colorado.gov/pacific/cdphe/integrated-solid-waste-management-plan. If this link does not work in the future, please contact CDPHE at (303) 692-3330 for the updated location.

Table 2-1: Regional Stakeholder Meetings and Attendees

Location	Date	Pre-Survey	Attendees	Attendee Type (Listed in Order of Relative Attendance Numbers)
Alamosa	1/19/16	7	16	Disposal Facilities, City/County Solid Waste/Recycling Staff, Elected Officials, Recycling Businesses, Land Use Enforcement Officers, County Public Health Officials, County Regulators, Local Land Owner
Lamar	1/20/16	11	20	Disposal Facilities, City/County Solid Waste/Recycling Staff, Elected Officials, County Officials, Town Clerk
Pueblo	1/21/16	27	30	Disposal Facilities, City/County Solid Waste/Recycling Staff, Elected Officials, Recycling Businesses, Non-Profit Representatives, County Solid Waste Planner, Citizen Advisory Committee Representative, Haulers
Durango	1/25/16	12	15	Disposal Facilities, City/County Solid Waste/Recycling Staff, Elected Officials, Recycling Businesses, Non-Profit Representatives, County Solid Waste Planner, County Regulators, Regional Council of Government Representatives
Grand Junction	1/26/16	11	14	Disposal Facilities, Recycling/Composting Processing Facilities, City/County Solid Waste/Recycling Staff, Elected Officials, Recycling Businesses
Webinar	2/16/16	6	7	Disposal Facilities, Haulers, Recycling/Composting Processing Facilities, City/County Solid Waste/Recycling Staff, Consultants
Denver Metro	2/17/16	31	22	City Officials, City/County Solid Waste/Recycling Staff, Haulers, Non-Profit Representatives, Disposal Facilities, County Officials, Recycling/Composting Processing Facilities, Recycling Businesses/Brokers, Consultants, Research/Academics, End User Mill/Factory, State Agencies
Silverthorne	2/18/16	24	24	City Officials, City/County Solid Waste/Recycling Staff, Hauler, Non-Profit representatives, Disposal Facilities, County Officials Recycling/Composting Processing Facilities, Recycling Businesses, Consultants, State Agencies, Planning Agency/Regional Groups, Regulators, Restaurant Owners
Sterling	2/25/16	11	16	City Officials, City/County Solid Waste/Recycling Staff, Haulers, Disposal Facilities, County Officials, Recycling Facilities, Recycling Businesses, Planning Agency/Regional Groups
Loveland	3/2/16	39	27	City/County Solid Waste/Recycling Staff, Haulers, Recycling/Organics Processing Facilities, Disposal Facilities, Recycling Businesses, Households/Businesses, Recycling Non-Profit Representative, Elected Official, Broker, City Clerk, Consultant
Total		**179**	**191**	

Table 2-2 summarizes the feedback on the barriers to additional diversion from each meeting. The most commonly stated barrier to increased waste diversion was profitability issues followed by lack of local municipal support. For the regions outside of the Front Range and the more rural areas, transportation and long distances to markets are a significant barrier. Lack of material supply, low program participation, low landfill tipping fees and illegal dumping issues were the next most frequently expressed barriers.

Table 2-2: Barriers to Diversion Programs by Stakeholder Meeting Area

Barriers by Stakeholder Meeting	Alamosa	Lamar	Pueblo	Durango	Grand Junction	Webinar	Denver Metro	Silverthorne	Sterling	Love land
Poor Enforcement of Regulations								RO		
Too Much Regulation		O								
Siting/Permitting Issues	O		O					O		O
Illegal Dumping Concerns	RO		RO		RO					
Contamination Concerns		RO						RO	RO	R
Lack of Municipal Support	RO	O	R				RO	RO	RO	RO
Weak Programs/Few Tons						RO	O			
Low Program Participation			RO	RO		RO				
Transient Tourist Population				RO				RO		
Low Program Profitability	RO	RO	RO	RO		RO	RO	RO		RO
Low Landfill Tipping Fees						O	R	RO		RO
Lack of Material Supply	O		O			RO	O		RO	
Lack of Market Demand		RO					O	R		R
Access to Markets	R		R	RO		R	R	R		R
Transportation Distance	R	RO	RO	RO	R					
Terrain - Winter Passes				RO						
Insufficient Understanding of Technology		O							RO	
Key: R = Recycling; O = Organics										

Another key topic was gathering feedback on the best ways by which CDPHE could improve solid waste management and recycling services that would be protective of human health and the environment. Table 2-3 provides a summary by region of the most common responses to that question. The responses provide suggestions in the areas of recycling, organics, landfills, regulations, education and other topics that move diversion forward and protect the environment.

Table 2-3: Common Responses to Solid Waste Suggestions Survey Question

Region	Common Responses
Front Range	**Recycling** - increase and improve recycling programs; mandate recycling; attract recycling businesses; standardize recycling programs; lead by example with recycling; develop recycling educational materials
	Education - increase public solid waste and recycling education; statewide recycling education; develop recycling educational materials; household hazardous waste education; education for regional recycling support
	Funding - develop fair funding model for solid waste; funding for solid waste plan, market and infrastructure development; funding for statewide solid waste initiative; closure and post-closure landfill fund
	Pay as You Throw (PAYT) - need PAYT programs; adopt statewide PAYT; mandate PAYT
	Goals - develop statewide plan with statewide goals; enforce goals
Mountains	**Recycling** - mandate recycling; free/subsidized/incentivized recycling; local/regional recycling; statewide recycling infrastructure; tax relief for recycling equipment; electronics recycling; commercial recycling
	Education - increase recycling education; focus on why recycling makes sense even if it costs more; pay for education; educate on proper methods of disposal to avoid hazards
	Compost - incentivize/subsidize composting; mandate food scrap/compost collection; commercial composting
	Facilities - regionalize recycling and solid waste facilities; foster cooperation between facilities; reduce regulations for composting facilities
	Transfer Stations/Landfills - have regional transfer stations; fund transfer stations for recycling and organics; oversight for landfills; funding for small closing landfills
Eastern/ Southeastern	**Recycling** - state assistance for recycling; incentivized/subsidized recycling or start-up costs; increase recycling awareness and education; takes time for recycling acceptance; fund recycling program through tax, landfill fee or purchase surcharges
	Help/Money - subsidize recycling programs; reduce fees; solid waste assistance; grant money for recycling programs; increase recycling and awareness
	Regulations - make "common sense" regulations; make reasonable regulations; additional regulations are not effective
	Producers - allow for producer input; meet with producers and make "common sense" diversion regulations with risk/reward analysis
Western Slope	**Diversion** - create policies to drive diversion; create diversion templates for easy adoption by local governments; increase funding for diversion programs; require diversion at landfills; landfill diversion should be addressed
	Landfills - have ready access to landfills in this area; landfill diversion should be addressed through a material recovery facility (MRF) or aggregation enterprise; enforce regulations at rural landfills; require diversion at landfills
	Commodities - need favorable market values for commodities; increase the desire for collected commodities; increase options to off-load collected materials
	Recycling - encourage recycling and composting; there is enough interest and willingness to further recycling operations and continue growth; a MRF is needed to address landfill diversion

3.0 TRANSFER AND DISPOSAL SYSTEM

3.1 Introduction

Having an adequate and cost effective transfer and disposal system in the State of Colorado is important to meet long-term disposal needs. This section evaluates the state's transfer and disposal system in an effort to identify the type and quantity of facilities that are necessary to meet the needs of local governments and citizens. This section begins with a review of the current transfer and disposal system, including analyses of the wastesheds, landfill adequacy and regional facility needs. Based on the review of the current system, this section includes an analysis of typical facility costs for transfer stations and landfills. This cost analysis has been included for the consideration of owners and operators of transfer and disposal facilities to improve the existing system. This current system and facility cost review yields multiple conceptual options that could be considered as alternatives to the current transfer and disposal system. The section concludes with a discussion of key findings and recommendations.

3.2 Current System Review

This section provides an analysis of the current transfer and disposal system. The analysis is organized geographically based on four regions of the state (Front Range, Mountains, Eastern/Southeastern and Western Slope) as shown in the Introduction Section (see Figure 1-1 in Section 1.3.3). Figure 3-1 is a map that displays key information regarding the wasteshed analysis and landfill adequacy.

3.2.1 Wasteshed Analysis

Understanding how solid waste moves from communities, via haulers and transfer stations, to landfills is meaningful in evaluating the current transfer and disposal system. Information on the communities and areas where waste is generated is not a requirement of the Engineering Design and Operations Plan (EDOP) for landfills. Correspondingly, there is not an existing data set of wastesheds for the state of Colorado. Based on input provided by stakeholders via written survey and during the stakeholder meetings, as well as insight from CDPHE and the Project Team (including multiple phone calls to facilities and internet research), Figure 3-1 portrays the disposal wastesheds in the state as they are currently understood.

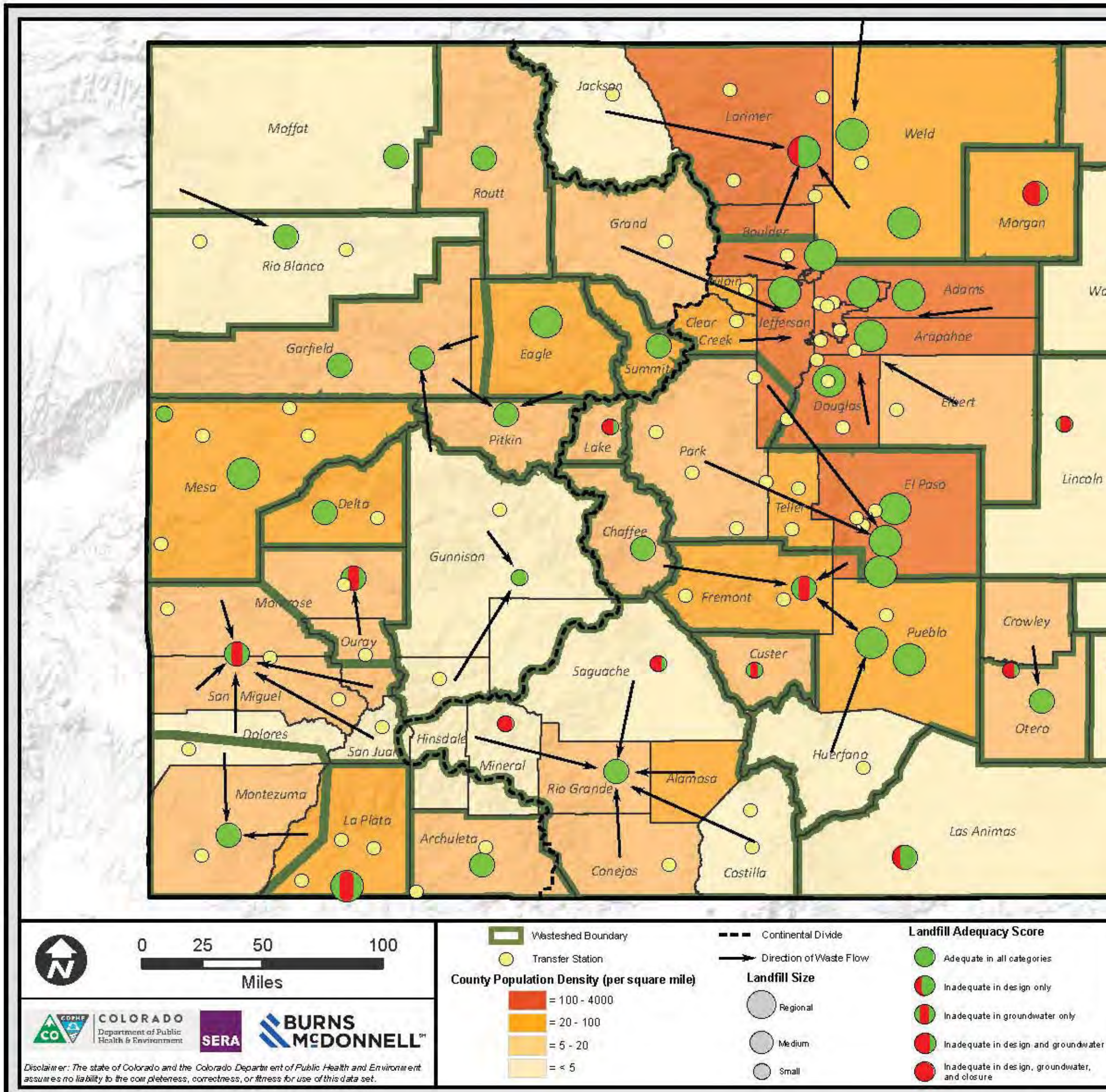


Figure 3-1
Landfill Wasteshed and Adequacy Analysis

Sources: US Census; Burns & McDonnell Engineering, ESRI

The following provides an overview of key information included on the wasteshed map:

- **Population density and landfill size**: The wasteshed map includes information on the population density and landfill size (based on annual quantities received). This detail is helpful to broadly understand the quantities of solid waste that may be generated and disposed on a county by county basis. Landfill size is based on ranges, as follows: small (less than 25,000 cubic yards annually), medium (25,000 to 200,000 cubic yards annually) and regional (greater than 200,000 cubic yards annually).
- **County defined wastesheds**: In many cases, the wasteshed limits were based on the county boundaries, meaning that the vast majority or all of the solid waste generated in the county is disposed at a landfill located within the county. Many of the county defined wastesheds are in the Eastern/Southeastern and Western Slope regions, with several located in the mountains.
- **Limited flows from one county to another county**: In some counties, defined as its own wasteshed, there may be some solid waste that is accepted from an adjacent county. These cases are represented by an arrow.
- **Multi-county wasteshed**: Some counties, typically with small populations, do not operate a landfill but collect solid waste at transfer stations before sending it to an adjoining or nearby county. In some cases, a hauler may directly transport the solid waste to a landfill in an adjacent county. These counties are outlined together with arrows representing the flow of waste.
- **Regional wastesheds**: Regional landfills along the Front Range accept solid waste from multiple areas, most of which overlap with other landfills. These areas are shown as one regional wasteshed with arrows showing the general flow of materials. These areas include multiple wastesheds on the Front Range and a few other areas of the state such as the San Luis Valley area and the Broad Canyon Landfill in San Miguel and Montrose counties.

3.2.1.1 Front Range

The Front Range region generally consists of cities and large towns with high population densities. As a result, the landfills in this region are regional in size. There is also a network of transfer stations where collected solid waste is collected for transport to the landfills. Most of the landfills in the Front Range are private and accept waste from various locations along the Front Range. Many towns and cities have open subscription for hauling where citizens can sign up for service with the company of their choosing (see Section 4.4.1 for further detail). The haulers that collect the solid waste then contract with a landfill for disposal, meaning waste collected from adjoining neighborhoods may be directed to different landfills.

For the purposes of this analysis the Front Range was divided into four regional wastesheds (Northern portion, Denver, Colorado Springs and Southern portion).

With landfills in Larimer and Weld counties, the most northern portion of the Front Range wasteshed accepts solid waste from within their own counties, as well as from Jackson and Boulder counties via transfer stations and direct haul. Additionally, solid waste from the city of Cheyenne, Wyoming is transported and disposed of at a landfill in Weld County.

The Denver wasteshed, which includes the city of Denver, as well as surrounding communities and several nearby counties (such as Adams, Arapahoe, Elbert, Douglas, Grand, Boulder, Gilpin and Clear Creek), has a large network of transfer stations and landfills. Due to the population densities and significant commercial solid waste generated here, waste flows throughout the area.

While not as large as the Denver wasteshed, the Colorado Springs wasteshed also consists of a network of transfer stations and landfills that includes Jefferson, Park, Teller and El Paso counties. The southern portion of the Front Range includes regional landfills in Pueblo County that accept solid waste primarily from Pueblo, Huerfano and Fremont counties.

3.2.1.2 Mountains

Counties in the Mountain region are generally remote with few towns and low population densities. This region is similar to the Eastern/Southeastern region in terms of generally having one landfill in each county. For the most part, solid waste generated in each county is disposed of at a landfill within the same county. Landfill sizes include small, medium and regional facilities. In some cases, solid waste is transported to adjacent counties due to the transportation network and the location of the Continental Divide.

Jackson, Grand, Gilpin, Clear Creek and Park counties do not have landfills but transport their solid waste to landfills on the Front Range. Routt County has one landfill and is assumed to service the entire county. Almost all of the population in Routt County is located along the Highway 40 corridor causing solid waste to be transported directly to the landfill without the need for transfer stations. Eagle and Summit counties are similar in that the majority of the population is along the I-70 corridor; therefore, solid waste can be hauled directly to these landfills from along the corridor.

The wasteshed for the Pitkin County Landfill was described by the operator as equal to the watershed for the Roaring Fork River between Aspen and Glenwood Springs. Assuming this wasteshed, solid waste from parts of Eagle and Garfield County are transported to the Pitkin County Landfill. Figure 3-1 includes arrows showing the areas of other counties that are within the Pitkin County wasteshed.

Based on input from Garfield County landfills, solid waste from portions of Eagle and Gunnison are taken to the South Canyon Landfill located in Garfield County. Based on the topography this is the most feasible option for waste in northern Gunnison County. Lake County functions as a county wasteshed with solid waste staying within the county. Most of the solid waste in Chaffee County also stays within the borders of the county, with the exception that some solid waste from Salida is transported to Fremont County.

Phantom Landfill in eastern Fremont County accepts solid waste from the county, and waste from portions of El Paso and Pueblo counties. The Six Mile Landfill near Gunnison accepts solid waste from Gunnison County and the northern portions of Saguache and Hinsdale counties. The wasteshed for the Custer County Landfill is assumed to be the limits of Custer County.

The San Luis Valley Landfill in Rio Grande County has a large wasteshed that includes most of Saguache and Mineral counties and all of Rio Grande, Alamosa, Conejos and Costilla counties. The San Luis Valley has been organized as a wasteshed and includes transfer stations in Conejos and Costilla counties. Some solid waste is taken to the Mineral and Saguache County landfills, but most of the waste in the area goes to the San Luis Valley Regional Landfill. The wasteshed for the Archuleta County Landfill includes all of Archuleta County and the southern portions of Hinsdale and Mineral counties.

3.2.1.3 Eastern/Southeastern

Counties in the Eastern/Southeastern portion of the state have a relatively low population density and few towns. All of the landfills in this area are either small or medium sized. In all the counties in the northeast and east central portion of the state, the solid waste is hauled to each county's landfill. In the southeastern part of the state, Las Animas has a single Municipal Solid Waste (MSW) landfill servicing the entire county. Bent County and the city of Las Animas operate a Construction and Demolition (C&D) Landfill and haul MSW to the Otero County #2 Landfill.

Kiowa, Prowers, and Baca County all have multiple small landfills within their county boundaries, some owned by the county and some by individual towns. Otero County has one regional landfill and one small landfill. The wasteshed in these areas extends some distance away from the landfill and cannot be effectively shown on a statewide map; therefore, these counties are shown as one county-wide wasteshed.

Solid waste from Crowley County (which does not have a landfill) is typically transported to landfills in Otero and/or Pueblo County; however this was not confirmed. Huerfano County does not have a landfill, as solid waste is collected at a transfer station in Walsenburg and hauled to Pueblo County.

There are only a few counties utilizing transfer stations in this region. Most of the counties are either direct-hauling to landfills by collection trucks or by individual residents. The exceptions are Kit Carson County, which has transfer stations in Flagler, Seibert and Stratton that transfer solid waste to the landfill near Burlington; Bent County, which operates two small transfer stations; and the city of Lamar.

3.2.1.4 Western Slope

The counties on the Western Slope are large with relatively low population densities, with the exception of a few cities. Much of the area is remote and hard to access. Towns are located along highway corridors that cut through the expansive counties. Landfill sizes include small, medium and regional facilities.

In the northwest corner, Moffat County has one landfill that supports the relatively small population along Highway 40. Some of the solid waste in the southwest corner of the county may be transported to Rio Blanco County. Rio Blanco uses transfer stations in Rangely and Meeker to collect solid waste before transport to the Wray Gulch Landfill.

The solid waste in Garfield County is transported to one of two landfills within the county, all of which remains in the county. As stated in the Mountains section, the South Canyon Landfill in eastern Garfield County accepts solid waste from Gunnison and Eagle County. Mesa County has the largest population centered in Grand Junction which utilize transfer stations in the surrounding small towns. The small landfill near the Utah border accepts solid waste from the small towns at the western end of the county but no known delineation has been established, therefore Mesa County in its entirety is considered one wasteshed.

Delta County operates one landfill and accepts solid waste from a transfer station in the eastern portion of the county. Montrose County also operates one landfill, but accepts solid waste from one transfer station within the county and one transfer station in Ouray County, which receives solid waste from the northern portion of Ouray County.

The Broad Canyon Landfill near Naturita (bordering Montrose and San Miguel counties) supports a multi-county wasteshed including the western portion of Montrose County, the southern half of Ouray County, all of San Juan and San Miguel counties and the northern half of Dolores County. The wasteshed for the Montezuma County Landfill includes all of Montezuma County and the southern portion of

Dolores County around Dove Creek and western portion of La Plata County. A transfer station in Towaoc transports solid waste from the southwest corner of Montezuma County to the landfill. The Bondad Landfill in La Plata County accepts solid waste from La Plata County and uses transfer stations to collect solid waste in Marvel, Durango and Bayfield.

3.2.2 Landfill Adequacy Analysis

A key purpose of this plan is to identify current and future waste management needs and offer recommendations for improvements that can be made to Colorado's waste management system. Central to this objective is a candid assessment of the current solid waste landfill systems in Colorado. Without such assessment, the Plan would be unable to make cost-based recommendations for future improvements. Many small landfills initially received waivers from monitoring and design criteria. The state regulations require on-going demonstrations that the technical basis for these waivers remains adequate. However, a significant number of solid waste landfills lack not only the resources to complete the required demonstrations in support of their waivers, but also lack, more fundamentally, the resources to even comply with the reduced set of design, operational and closure requirements contemplated by the waivers. CDPHE believes these facilities will need to make upgrades to their landfill operations in order to achieve compliance with state and federal solid waste regulations. For purposes of estimating the costs associated with these upgrades, CDPHE provided the Project Team with the status of each operating landfill with respect to design and operation, monitoring and closure requirements in the federal and state solid waste regulations.

Toward this end, CDPHE assigned each site an adequacy score based on recent inspection information and review of the facility's approved design. At each stakeholder meeting, participants were provided a draft municipal solid waste landfill map prepared by the Project Team depicting each facility's adequacy score with respect to the above criteria. Some facilities that were rated inadequate in one or more categories had personnel express concern that the stigma attached to such a rating would cause them problems with their local elected officials, management, lessors or the public they serve. Some have interpreted the information on the maps as being pejorative or critical of the facilities or their operators.

Casting facilities in a bad light or reflecting negatively on their owners or operators was not the intent of the adequacy score, nor should the map be interpreted that way. Rather, the adequacy score is simply presented for the purpose of indicating specific costs facilities may need to incur in order to meet all regulatory design and monitoring requirements in the federal and state regulations. Just as CDPHE understands landfill operators are making good faith efforts to achieve compliance with the regulations, it is hoped that readers of the Plan will view the information presented in this section in light of its constructive purpose - to foster dialogue between CDPHE and the owners and operators of these landfills aimed at taking advantage of the recommendations in the Plan. CDPHE looks forward to discussing with each site or region the results of the Plan, its recommendations for improvement and the requirements for achieving regulatory compliance.

In the Resource Conservation and Recovery Act (RCRA) 1984 Hazardous and Solid Waste Amendments, the U.S. Congress directed the U.S. Environmental Protection Agency (EPA) to develop regulatory authority over landfills and directed the preparation of landfill design and operating criteria that were protective of human health and the environment. The EPA responded with a complete set of regulations known as the RCRA Subtitle D. Subtitle D, Part 258 with an emphasis on landfill containment, was proposed in 1988 and became effective in 1991, although various implementation deadline extensions ran through 1997.

The rules established minimum landfill criteria for the location, operation, design, groundwater monitoring, closure and post-closure care and financial assurance. These minimum landfill management requirements had to be met by all landfills in each state. States were allowed to submit their statutes and regulations to EPA establishing that they had statutory and regulatory authority to require that landfills meet the minimum Part 258 requirements. In Colorado, the regulations meeting the minimum requirements in Subtitle D went into effect October 9, 1993 with some exceptions as outlined in 6 Colorado Code of Regulations (CCR) 1007.2 based on the authorities defined and established in the Solid Waste Act, 30- 20-100.5, et seq, Colorado Revised Statutes (C.R.S.). EPA approved Colorado’s solid waste regulatory program as equivalent to Subtitle D and Part 258 requirements in October 1993.

Based on three criteria categories - design and operation, groundwater monitoring and closure requirements - this section summarizes the adequacy of landfills in the state. Each of the three criteria categories are comprised of requirements that are specifically included in Subtitle D and 6 Colorado Code of Regulations (CCR) 1007-2 Part 1. Table 3-1 provides an overview of the individual requirements included in each of the three categories.

Figure 3-1 identifies the levels of adequacy for landfills in the state based on the three categories. The figure also defines the landfills by size which was determined based on the quantity of solid waste disposed of at the landfill in 2014. Appendix B includes a table indicating the current adequacy for each item at every landfill, as well as the annual disposal quantities for the most recent three years.

CDPHE maintains records for each landfill including all design, operation, monitoring and closure components and the adequacy of the landfills for each item. The Project Team requested the adequacy information from CDPHE during the initial document review task, and this information is presented in the following section. The Project Team relied on information provided by the CDPHE regarding the adequacy of each landfill in the state.

Table 3-1: Landfill Adequacy Criteria for Design and Operation, Ground Water Monitoring and Closure Requirements

Design and Operations	Ground Water	Closure Requirements
• Access controls – 6 CCR 1007-2 Part 1 Section 2.1.8 • Adequate hazardous waste screening procedures – 6 CCR 1007-2 Part 1 Section 2.1.2 • Stormwater quality permit - 5 CCR 1002-61 Section 61.3 • Air compliance with open burning permit – C.R.S 25-7-1 • Adequate daily cover – 6 CCR 1007-2 Part 1 Section 3.3.4 • Cover / compaction equipment - 6 CCR 1007-2 Part 1 Section 3.3.2 • Adequate liner - 6 CCR 1007-2 Part 1 Section 3.2.5 • Adequate leachate collection system - 6 CCR 1007-2 Part 1 Section 3.2.5 • Adequate methane monitoring - 6 CCR 1007-2 Part 1 Section 2.3	• Adequate system of ground water monitoring wells - 6 CCR 1007-2 Part 1 Section 2.2 • Adequate ground water sampling - 6 CCR 1007-2 Part 1 Section 2.2 • Ground water impacts from constituents • Ground water waiver granted/current - 6 CCR 1007-2 Part 1 Section 1.5	• Adequate closure cost estimate - 6 CCR 1007-2 Part 1 Section 1.8.2 • Adequate post closure cost estimate - 6 CCR 1007-2 Part 1 Section 1.8.2 • Adequate financial assurance funding mechanism - 6 CCR 1007-2 Part 1 Section 1.8.4

3.2.2.1 Front Range

All but one of the landfills in the Front Range region have been deemed adequate by CDPHE. The only landfill that is rated inadequate is the Larimer County Landfill, which is listed as inadequate due to the lack of a liner and leachate collection system. Similar to the Trinidad Landfill, the Larimer County Landfill operates within a footprint predating the promulgation of the Subtitle D regulations and so a liner and leachate collection system are not required.

3.2.2.2 Mountains

Most of the Mountain landfills have maintained a level of adequacy in regard to the regulations. However, there are several landfills in the region that do not meet adequacy in some or all categories. The Lake County Landfill, Phantom Landfill in Fremont County, Custer County Landfill, Saguache County Landfill and Mineral County Landfill have all been deemed inadequate in one or more categories by

CDPHE. Phantom and Custer County landfills lack adequate groundwater monitoring systems. Lake County and Saguache landfills have several operating and groundwater inadequacies. Mineral County Landfill is considered inadequate in all three categories.

3.2.2.3 Eastern/Southeastern

In the Eastern/Southeastern region there are a number of medium and small landfills. Five of the landfills – East Lamar Municipal, Kit Carson, LABC, Logan County and Otero County – are the only facilities operating in accordance with the regulations. All of the other facilities in the region are inadequate in at least one category with the majority of landfills being inadequate in all three categories. Landfills that are inadequate in all three categories include: Haswell Solid Waste Disposal Site (SWDS), Granada SWDS, Campo SWDS, Prichett SWDS, Two Buttes, Firstview Sanitary and Phillips County. The following landfills were inadequate in design and groundwater: Sedgwick County, Morgan County, Manzanola, Eads SWDS, Holly SWDLF, Yuma County SWDS, Walsh SWDS and Springfield SWDS. Trinidad Landfill was inadequate for design, primarily because it lies within a footprint established prior to the effective date of the current regulations. Washington County Landfill was inadequate for design and closure. The Lincoln County Landfill was inadequate for ground water and closure.

3.2.2.4 Western Slope

There are three landfills on the Western Slope that are in the groundwater monitoring category. These landfills are the Bondad Landfill, Broad Canyon Landfill and Montrose SWDS.

3.2.3 Regional Facility Gaps and Opportunities

For each of the four geographic regions, this section evaluates the gaps and opportunities associated with the transfer and disposal systems in the region, as well as identifies the general investment needs and next step recommendations. Figure 3-1 summarizes the wasteshed analysis and landfill adequacy review referenced in this section.

3.2.3.1 Front Range

All of the landfills in the Front Range have been categorized as regional landfills, which is to be expected based on the quantities of solid waste generated throughout this region. Most of these landfills are privately owned and operated as businesses that have a goal of generating profit. Other landfills owned by counties and municipalities also accept large quantities of solid waste, creating the ability to generate profit. The private landfills for the most part dominate the market and drive the progress through competition, and the public landfills keep pace.

The development of the solid waste transfer and disposal system on the Front Range has evolved over time as markets have changed. As population on the Front Range has increased, the landfills and haulers have adapted by building transfer stations, expanding landfills and/or changing engineering and operational practices to increase airspace. Based on responses from surveys and input at the stakeholder meetings, the current disposal system in the Front Range appears to be working well.

Moving forward it is expected that the haulers and regional landfills on the Front Range will continue to adapt to changing market conditions and provide services. There may be an opportunity for the Front Range regional landfills to expand their wastesheds beyond the highly populated areas of the Front Range. For counties and towns in the Eastern/Southeastern region bordering the Front Range region, challenged to maintain and operate an adequate landfill, construction of a transfer station and hauling to a regional landfill on the Front Range could allow for a viable option. There is also potential for the Front Range landfills to accept additional solid waste from adjacent counties and towns in the Mountain region.

3.2.3.2 Mountains

The Mountain region consists primarily of a mix of medium and small landfills, with one regional landfill in Eagle County. The population of the Mountain counties are much lower than the Front Range, which results in less solid waste generated and less revenue for the operation of the landfill. The transfer of solid waste in the mountains is largely dependent on the topography and road conditions. Most counties have a single county owned landfill that services the entire county, while some counties have only transfer stations. In the northern part of the Mountain region, Routt County operates a landfill, Jackson County does not have a landfill or transfer station and Grand County uses three transfer stations to collect solid waste before transporting it out of the county. The Milner Landfill in Routt County is operating adequately, serving the population around Steamboat Springs. Due to the size of the counties and lack of people living there, the current system seems to be sufficient for the current situation.

The central mountain counties of Gilpin, Clear Creek and Park all utilize transfer stations to collect their solid waste but do not have operating landfills within their respective counties. The rest of the central mountain counties have one landfill each and no transfer stations. These counties include Eagle, Summit, Pitkin, Lake, Gunnison, Chaffee and Fremont. Based on feedback during the stakeholder meetings the system in the central mountains is working well. Even with the small size of the landfills, regionalization is generally not a good fit for this area because of the difficulty associated with transporting solid waste between the counties. For these central mountain counties the emphasis will be to improve the few inadequate landfills to meet regulatory standards or consideration of transferring to a nearby adequate landfill.

In the southern portion of the Mountain region, which includes counties in and around the San Luis Valley, there is need for improvement in the transfer and disposal of solid waste. One clear issue in the region is illegal dumping. This occurs throughout the area and may be related to distance to transfer stations or landfills, but is most likely related to the cost of disposal. From information gathered at the stakeholder meeting in Alamosa, many of the areas in the southern Mountain region are considered impoverished and resort to dumping solid waste in ravines and ditches as opposed to driving to and paying the fees at the landfill. This keeps landfills from raising fees that will sustain operation and provide funding for future expansion or remediation. Voting during the Alamosa stakeholder meeting showed that small landfills not in full adequacy should be upgraded and allowed to continue operation. The responses collected during the meeting also indicate that regionalization of the landfills would not have community support. However, it is the Project Team's perspective that regionalization in the area is feasible with additional transfer stations at small existing landfills or other locations.

3.2.3.3 Eastern/Southeastern

The Eastern/Southeastern region has significant needs regarding the transport and disposal of solid waste. This region consists of large counties with small towns and a low population density. However, the region has a significant number of small landfills, owned by a combination of counties and towns. The vast majority of these landfills are inadequate with regard to the regulations (as discussed in Section 3.2.2.3). Another challenge presented with these landfills includes their extensive disposal capacity, which translates to long lifespans given relatively low incoming solid waste quantities.

Information from the stakeholder input process was insightful. Based on the questions asked during the stakeholder meetings, participants generally think the current solid waste and disposal system is working well. Furthermore, a high percentage of participants from the region said that regionalization of landfills would not make sense for the area. Many of the stakeholders in the Lamar meeting expressed dissatisfaction with the rules and wanted CDPHE to help revise the rules so small rural landfills could continue to operate. Attendees at the stakeholder meeting in Lamar indicated that regionalization would not be supported in the area. Several attendees also noted that closing existing facilities without other convenient and affordable options would likely increase illegal dumping.

Many stakeholder perspectives vary from the opinions of the Project Team relative to potential transfer and disposal solutions for the Eastern/Southeastern region. From the Project Team's perspective, continuing to operate many of the landfills in this region is a challenge due to the extensive number of facilities that are inadequate, as well as the relatively small solid waste quantities that are unlikely to generate sufficient revenue required to fund facility improvements. The lack of funding is a primary reason the small landfills have not been upgraded to adequate regulation standards. This challenge is compounded for counties like Prowers and Baca that have multiple, small landfills. The closure of the small landfills, construction of a regional landfill and transfer stations may provide the optimal service in the area and eliminate the numerous inadequate landfills in this region.

Kit Carson County, located along the Kansas border, is operating an adequate landfill and has three transfer stations in towns along Highway 59. This system may be one that can be duplicated in other eastern counties that have similar size populations. This system would work with more transfer stations positioned throughout multiple counties, directing solid waste to one landfill.

3.2.3.4 Western Slope

Medium size landfills are predominantly on the Western Slope. The small S-Road Disposal Landfill in Mesa County, the regional sized Mesa County Landfill and Bondad Landfill in La Plata County are the only exceptions. Counties on the Western Slope are larger in area and generally have larger populations than the mountain counties, which generates more solid waste and in turn more revenue for the landfills helping to keep the landfills operating within the regulations.

Transfer and disposal of solid waste on the Western Slope are considered medium and regional size landfills supported by a number of transfer stations spread throughout the counties. Based on the wasteshed analysis and the response from the stakeholder meetings in Grand Junction and Durango, the system of having one county landfill accepting solid waste from transfer stations situated in the county is the working model for most of the counties. The number of transfer stations depends mostly on the number and size of towns within each county. Some counties with small populations and only a few towns have only transfer stations and tend to direct solid waste to other counties. Due to the large county sizes, regionalization has occurred to some extent within individual counties or amongst multiple counties.

The three landfills inadequate in the groundwater category will need to make adjustments to meet the regulatory requirements. Closure of these landfills would leave large areas unsupported.

3.3 Cost Modeling Overview

This section provides an overview of the landfill and transfer station financial models developed by the Project Team. These models were utilized to develop the financial comparison of the conceptual options discussed in Section 3.4. **The cost estimates for the landfills and transfer stations reflect the capital and operating costs associated with the facilities and do not include any excess revenue or profit. There are also no expenses for items such as program administration, franchise fees, operating**

reserve contributions and similar expenses. A capital reserve (or debt reserve depending on financing method) of 20% of the amortized capital expenses was included. Only for the purpose of developing the cost estimates, the Project Team also assumed that public sector entities would own and operate the transfer station and landfill facilities. See Section 1.4 related to limitations of the plan and probable cost estimates.

3.3.1 Baseline Landfill Model

The Project Team developed a baseline landfill financial model to which other solid waste disposal options could be compared. The baseline landfill model is based on operating a landfill compliant with state and federal regulations and is based on best management practices, the Project Team's experience in landfill design and operations and regulatory requirements.

Subtitle D defines a small landfill as one receiving less than 20 tons per day, which equates to roughly 25,000 CY per year. For the purposes of this plan, landfills are defined as small, medium or large based on the annual amount of cubic yards (CY) accepted at the landfill. A small landfill is defined as less than 25,000 CY per year, a medium landfill as greater than 25,000 CY but less than 200,000 CY and a large landfill as over 200,000 CY. However, for this analysis, it was necessary for the Project Team to develop additional size segments to adequately capture the cost differences for operating landfills of various sizes. Table 3-2 shows the size categories utilized for the baseline financial model. Table 3-2 also shows the airspace utility factor (AUF) and average vertical column of waste for each landfill size. The vertical column of waste is the sum of the depth of the landfill and the height of the landfill.

Table 3-2: Landfill Size Categories

	Micro	Small	Medium	Medium-Large	Large
Minimum Annual Tonnage	0	10,001	40,001	100,001	500,001
Maximum Annual Tonnage	10,000	40,000	100,000	500,000	1,000,000
Avg. Airspace Utilization (lbs/cy)	800	1,000	1,100	1,200	1,400
Avg. Vertical Column of Waste (ft)	30	60	80	90	110

By using the AUF, vertical column, annual tonnage information and desired site life information, an interested party can estimate the total site size required for the disposal operation. For example, assume a planned landfill has the following characteristics:

- Annual Tonnage: 150,000 tons per year (average)
- Desired Site Life: 50 years

- Airspace Utilization Factor: 1,200 pounds per cubic yard
- Average Vertical Column of Waste: 90 feet (30 yards)

Based on these assumptions, a landfill owner/operator would need to secure at least 86 acres for disposal capacity, as shown by the calculation below. Furthermore, additional land will be needed for buffer areas to the site boundary, entrance roads, site infrastructure, etc. At a minimum, the Project Team would suggest planning on a buffer of 200 feet around the perimeter of the waste footprint, plus an additional 5-30 acres for entrance roads, scale house and other site infrastructure. If there are residences or businesses nearby, the total size may increase to reduce the potential impact on neighbors.

$$Disposal\ Acres = 50\ years\ x\ \frac{150{,}000\ tons}{year}\, x\, \frac{2{,}000\ lbs}{ton}\, x\, \frac{yards^3}{1{,}200\ lbs}\, x\, \frac{1}{30\ yards}\, x\, \frac{1\ acre}{4{,}840\ yards^2} = 86.1\ acres$$

Based on this example and assuming a square waste disposal foot print (approximately 1,937 feet by 1,937 feet), plus an additional 20 acres for other site infrastructure, the landfill operator would need to plan on at least 145 acres (approximately 86 acres for disposal, 39 acres for buffer and 20 acres for other site infrastructure). This number ultimately is dependent on the location and site specific conditions.

3.3.1.1 Personnel

Table 3-3 shows the projected personnel needs for the landfill baseline analysis as well as the assumed base salary for each position. In addition to base salary, the Project Team included an additional 10% of base salary for overtime costs and an additional 35% of base salary for benefits-related costs. The Project Team understands that base salary and benefits will vary based on location, facility ownership (private versus public sector) and other factors. Based on the information presented in Table 3-3, any interested party can estimate the personnel costs based on their specific information.

Table 3-3: Landfill Personnel Requirements

Position	Base Annual Salary	Micro	Small	Medium	Medium-Large	Large
Manager	$75,000	0	0	1	1	1
Supervisor	$50,000	0	1	1	2	2
Heavy Equipment Operator	$40,000	1	1-2	2-3	5-6	7-8
Laborer	$25,000	0	0	1	2	3-4
Gate Attendant/Admin	$30,000	1	1	1-2	3-4	4-5
Total		**2**	**3-4**	**6-8**	**13-15**	**17-20**

In some cases, very small landfill operations may share staff with other non-landfill operations, thereby sharing the costs and lowering the costs allocated to landfill operations.

3.3.1.2 Equipment

Table 3-4 shows the projected equipment needs for the different landfill sizes, including both front-line and back-up units. At the low end of each landfill size, the equipment may not be fully utilized, whereas at the upper end of the range the equipment should be fully utilized. For micro landfills, equipment may be shared with other non-landfill operations. In cases where there is one piece of equipment that plays key role in the operations (e.g., the large dozer for a micro landfill), the landfill operator will need to rely on other non-landfill operations for back-up when there is unanticipated downtime for front-line units.

Table 3-4: Frontline and Back-up Equipment

	Micro	Small	Medium	Medium-Large	Large
Small Dozer	0	1	1 [1]	2 [1]	2 [1]
Large Dozer	1	0	1	1	3
Small Compactor	0	1	2 [1]	1 [1]	1 [1]
Large Compactor	0	0	0	2	3
Motor Grader	0	0	0	1	1
Water Truck	0	0	0	1	1
Excavator	0	0	1	1	1
Haul Truck	0	1	1	2	3
Small Loader	1	0	1 [1]	1 [1]	1 [1]
Large Loader	0	1	1	1	2
Pick-up	1	1	2	3	4
Total	**3**	**5**	**10**	**16**	**22**

1. Includes one back-up unit. In cases where there is one piece of equipment and a back-up is indicated, for the back-up could be a smaller piece of equipment that could be temporarily used for a larger front-line piece of equipment.

Table 3-5 shows typical purchase price and operating and maintenance expenses (including fuel) for the various types of equipment. For the baseline model, the Project Team assumed that the purchase price and annual operating and maintenance expenses of the back-up unit would equal 50% of the purchase price and annual operating and maintenance expenses of the front-line piece of equipment. In some cases, very small landfill operations may share equipment with other non-landfill operations, thereby sharing the costs and lowering the allocated landfill operation costs.

Table 3-5: Frontline and Back-up Equipment Cost

	Purchase Price	Annual Operating and Maintenance
Small Dozer	$300,000	$40,000 - $48,000
Large Dozer	$500,000	$40,000 - $80,000
Small Compactor	$600,000	$40,000 - $60,000
Large Compactor	$1,000,000	$80,000
Motor Grader	$250,000	$20,000
Water Truck	$150,000	$30,000
Excavator	$300,000	$24,000 - $32,000
Haul Truck	$400,000	$20,000 - $28,000
Small Loader	$150,000	$30,000 - $40,000
Large Loader	$350,000	$40,000
Pick-up	$35,000	$6,000

3.3.1.3 Other Operating and Non-Operating Expenses

The Project Team included additional operating and non-operating expenses to the baseline landfill model. Table 3-6 shows annual amounts for professional/engineering fees and environmental monitoring fees. Any one-time or upfront costs for a new landfill are captured in Table 3-7.

Table 3-6: Other Landfill Costs

	Micro	Small	Medium	Medium-Large	Large
Professional/Engineering Fees	$50,000	$75,000	$150,000	$200,000	$250,000
Environmental Monitoring	$15,000	$20,000	$30,000	$50,000	$60,000

Other costs were included as variables that are driven by operating expenses or tonnage. These additional costs are:

- Materials & Supplies: 10% of base salaries
- Insurance: 2.5% of operating and maintenance expenses
- Utilities: $0.05 per ton
- Other/Misc.: 5% of operating and maintenance expenses
- State Solid Waste User Fee: $0.84 per ton

For the purposes of this analysis, the Project Team assumed leachate management costs were minimal and therefore were not included in the model.

3.3.1.4 Capital Costs

The Project Team included non-equipment capital costs for developing landfill cells and closing cells once they reach capacity. Based on discussions with CDPHE staff, the Project Team included two options for both cell development and final cover. For cell development, there are cost options for both a three foot compacted clay liner and one that includes a synthetic liner. For the final cover, there are options for a compacted clay cover (two foot thick layer of protective soil cover over an 18 inch soil barrier layer) and a water balance cover. Water balance covers consist of soil, usually placed as a single loose lift, which provide storage capacity for infiltration from a prescribed annual precipitation. The precipitation is dependent on the ecozone in which the landfill falls and the cover depth is dependent on where the soil plots on the United States Department of Agriculture (USDA) soil texture triangle. For the purposes of this cost modeling, a thickness of 3 feet will be assumed for water balance covers. Water balance covers are generally less expensive as available soil on or near the facility can be used and no special construction labor or equipment is necessary.

In addition to these ongoing capital costs, the Project Team amortized the initial costs of opening a landfill, excluding the land cost, over 20 years. These costs include:

- Permitting
- Scale house
- Scales
- Improvements
- Maintenance
- Environmental monitoring infrastructure

The Project Team did not include the land cost for several reasons. The amount of land needed will vary based on the planned longevity of the landfill. The landfill owner may already own the land that may be utilized for the landfill. Also, land costs can vary greatly depending on location. Table 3-7 lists that initial capital costs and the cost per acre for landfill development and final cover.

Table 3-7: Landfill Capital Costs

	Micro	Small	Medium	Medium-Large	Large
Initial Landfill Costs	$645,000	$1,100,000	$2,000,000	$3,700,000	$5,850,000
Cell Development - Geomembrane (per acre)	$250,000	$225,000	$200,000	$180,000	$160,000
Cell Development - Compacted Clay (per acre)	$230,000	$205,000	$180,000	$160,000	$140,000
Final Cover - Compacted Clay (per acre)	$100,000	$95,000	$90,000	$85,000	$80,000
Final Cover - Water Balance (per acre)	$50,000	$45,000	$40,000	$35,000	$30,000

In addition, the Project Team included a capital reserve (or debt reserve, depending on financing method) contribution that equates to 20% of the annual amortized capital.

3.3.1.5 Total

Using the information presented throughout Section 3.3.1, Figure 3-2 graphically summarizes annual costs and cost per ton for landfills ranging from 5,000 to 750,000 tons per year. Figure 3-2 is based on operating five to six days per week with no sharing of equipment with other departments/entities. The costs for small landfills could be decreased if the number of operating days was reduced and equipment was shared with other departments/entities.

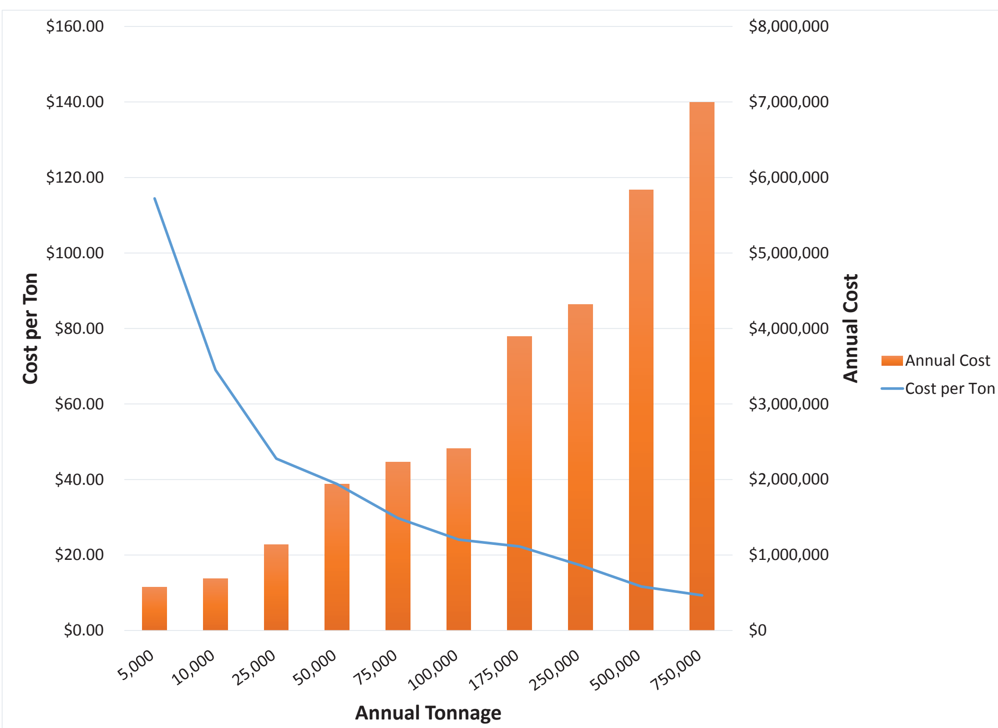


Figure 3-2: Landfill Cost Summary

3.3.2 Transfer Station Models

For the transfer station financial models, the Project Team developed three models based on different styles of transfer stations.

- **Drop-off transfer station:** Small fenced site with roll-off containers and/or front-load dumpster for self-haul customers (i.e., not for collection vehicles). The facility can be staffed or unstaffed.
- **Compactor transfer station:** Allows for use by both self-haulers and collection vehicles. Solid waste is compacted and hauled using roll-off vehicles. Could allow for both solid waste and recycling with the addition of second compactor (for collection vehicles) or roll-off (for recycling drop-off).
- **Top-load transfer station:** Larger transfer stations that allow collection vehicles to unload on a tipping floor before being loaded into transfer trailers for hauling to a disposal location.

Table 3-8 provides a summary of the three styles of transfer stations. While the capacity of a top-load facility could exceed 200,000 tons per year, the Project Team limited it to that amount for this analysis based on the review of the existing facilities and needs in the state.

Table 3-8: Transfer Station Overview

	Drop-off	Compactor	Top-Load
Minimum Annual Tonnage	25	2,500	25,000
Maximum Annual Tonnage	2,500	25,000	200,000
Primary Customer Type [1]	Self-haul	Collection vehicles	Collection vehicles
Site Size (acres)	0.25	0.75	1.5 - 10
Land Cost	$0	$0	$0
Site and Building Costs	$150,000	$300,000 - $350,000	$1.7 - $9.5 million
Hauling Vehicles Utilized	Roll-off and/or Dumpster	Roll-off	Open-top transfer trailer

1. Self-haul refers to individuals hauling waste and manually unloaded. Collection vehicles having compacting dump bodies that collect material from many residential or commercial customers.

3.3.2.1 Personnel

Table 3-9 shows the projected personnel needs for the transfer station models as well as the assumed base salary for each position. For the drop-off transfer station, the facility could be unattended or attended based on specified operating hours. If the drop-off transfer station is open two days per week, for example, it would only require part of one employee's time.

In addition to base salary, the Project Team included an additional 10% of base salary for overtime costs and an additional 35% of base salary for benefits-related costs. The Project Team understands that base salary and benefits will vary based on location, facility ownership (private versus public sector), and other factors. Based on the information presented in Table 3-9, any interested party can estimate the personnel costs based on their specific information.

Table 3-9: Transfer Station Personnel Requirements

Position	Annual Base Salary	Drop-off	Compactor	Top-Load
Manager	$75,000	0	0	0-1
Supervisor	$50,000	0	0-1	1
Heavy Equipment Operator	$40,000	0	1	2
Laborer	$25,000	0	1	2
Gate Attendant/Admin	$30,000	0-1	0-1	2
Total		**0-1**	**2-4**	**7-8**

Figure 3-3: Examples of Drop-off Centers (or Drop-off Transfer Stations)

Figure 3-4: Example of Compactor Transfer Station

Figure 3-5: Example of Exterior and Interior of Top-Load Transfer Station

3.3.2.1 On-Site Equipment

Table 3-10 shows the types of on-site equipment that are typically used at each type of transfer station. This table excludes the equipment utilized to haul the material from the transfer station to the disposal location. Hauling is addressed in Section 3.3.2.4.

Table 3-10: On-Site Transfer Station Equipment

Equipment Type	Purchase Price	Drop-off	Compactor	Top-Load
Open-top Roll-off Containers	$4,500	2	1-2	0
Compactors	$15,000	0	1-2	0
Compactor Receiving Containers	$7,500	0	2-4	0
On-Site Roll-off Vehicle	$125,000	0	0-1	0
Skid Steer	$60,000	0	0-1	0-1
Small Loader	$150,000	0	0	1
Large Loader	$350,000	0	0	0-1
Yard Tractor [1]	$85,000	0	0	1
Material Handler [2]	$200,000	0	0	1-2

1. Used for moving filled transfer trailers to a loading area so that transfer tractor can drop an empty trailer and pick up a loaded trailer without waiting to be loaded.
2. Used for compacting and distributing the material in the transfer trailer.

The Project Team included an annual amount equal to 20% of the purchase price to account for fuel and operating and maintenance expenses.

3.3.2.2 Other Operating Costs

Table 3-11 shows the other operating costs included in the transfer station model.

Table 3-11: Other Transfer Station Operating Costs

Equipment Type	Drop-off	Compactor	Top-Load
Utilities	$0	$7,500	$12,000 - $50,000
Miscellaneous Expenses	$2,500	$5,000	$15,000 - $25,000

3.3.2.3 Total Operating and Amortized Capital

Table 3-12 shows the typical range of operating and amortized capital for the range of transfer stations, including the costs discussed in Section 3.3.2.1 through 3.3.2.3. These costs do not include hauling or disposal.

Table 3-12: Transfer Station Operating and Capital Cost Summary

	Drop-off	Compactor	Top-Load
Minimum Annual Tonnage	25	2,500	25,000
Maximum Annual Tonnage	2,500	25,000	200,000
Typical Range of Total Annual Costs	$21,000 - $54,000	$140,000 - $305,000	$530,000 - $1,650,000
Typical Range of Cost per Ton	$21.60 - $840	$12.20 - $56.00	$8.25 - $21.20

3.3.2.4 Hauling

Hauling costs for the three types of transfer stations will vary and are described in this section.

Drop-off Transfer Station

Hauling for the drop-off transfer station is based on the collection costs discussed in Section 4 and will depend on the number of containers, the collection frequency, the haul distance and the landfill disposal rate.

Compactor and Top-Load Transfer Stations

For both the compactor transfer station and top-load transfer station, the Project Team developed a hauling model to capture the costs for hauling material from the transfer station to a disposal and/or recycling location. Hauling for these transfer stations is based on a number of variables, such as:

- Payload
- Haul distance
- Travel speed
- Time at landfill
- Price for fuel

For the compactor transfer stations, the receiving units or open-top roll-off are hauled by a roll-of vehicle. To increase the payload per trip, the roll-off vehicle can also tow a roll-off trailer so that two containers can be hauled to the landfill at one time. Typical costs for hauling from the compactor transfer stations are $0.25 to $0.40 per ton-mile, depending on the variables discussed and the number of containers (1 or 2 at a time). The Project Team included an example below Table 3-13 to show how a cost per ton-mile can be used to estimate a cost per ton or an annual hauling cost.

Figure 3-6: Example of Roll-off Truck with Roll-off Trailer

Figure 3-7 shows a common example of a transfer tractor and trailer used in top-load transfer station.

Figure 3-7: Example of Top-Load Transfer Tractor and Trailer

For hauling costs associated with top-load transfer stations, the Project Team developed a matrix based on different values for annual tonnage and haul distance. The matrix shows the output of the top-load hauling model based on these two variables. In addition, the following list shows several other key variables that were kept constant for Table 3-13:

- Fuel: $2.50 per gallon
- Payload: 20 tons
- Capital cost for transfer tractor/trailer: $180,000
- Minimum back-up ratio for haul vehicles: 20%
- Annual driver salary: $40,000 (plus 35% benefits)
- Average speed: 50 miles per hour
- Unloading time: 45 minutes

Table 3-13: Hauling Costs for Top-Load Transfer Station ($ per ton-mile)

Annual Tons	One-Way Haul Distance						
	30	40	50	60	70	80	90
40,000	$0.189	$0.186	$0.154	$0.157	$0.160	$0.143	$0.130
60,000	$0.201	$0.157	$0.151	$0.147	$0.144	$0.142	$0.129
80,000	$0.183	$0.162	$0.150	$0.142	$0.146	$0.141	$0.128
100,000	$0.171	$0.165	$0.149	$0.138	$0.139	$0.140	$0.127
120,000	$0.180	$0.154	$0.148	$0.136	$0.142	$0.140	$0.127
140,000	$0.173	$0.157	$0.148	$0.135	$0.138	$0.140	$0.127
160,000	$0.167	$0.160	$0.148	$0.134	$0.140	$0.140	$0.127
180,000	$0.173	$0.153	$0.148	$0.133	$0.141	$0.135	$0.123
200,000	$0.169	$0.155	$0.147	$0.132	$0.138	$0.136	$0.123

To estimate a cost per ton, multiply the cost per ton-mile by the round trip haul distance. For example, if a transfer station needs to haul 60,000 tons per year a one-way distance of 60 miles, multiply $0.147 by 120 miles (60 miles each way) to get $17.64 per ton. For the annual cost, multiply $17.64 per ton by 60,000 tons to get a total of $1.06 million per year, which takes into account operating and amortized capital costs for the hauling operation. As mentioned in the introduction to this section, this amount does not include program administration, franchise fees, operating reserve contributions and similar expenses.

3.3.3 Transfer Station Summary

Table 3-14 provides a general range of total transfer station costs based on constructing and operating the transfer station, hauling the material and disposing of it in a landfill. For this summary table, the assumed haul distance is 75 miles each way and the disposal fee is $30 per ton.

Table 3-14: Summary of Typical Transfer Station Costs

	Drop-off		Compactor		Top-Load	
Tons per Year	25	2,500	2,500	25,000	25,000	200,000
Transfer Station	$21,000	$54,000	$140,000	$305,000	$530,000	$1,650,000
Hauling	$18,000	$128,000	$150,000	$900,000	$615,000	$4,000,000
Disposal	Included in Hauling		$75,000	$750,000	$750,000	$6,000,000
Total Annual	$39,000	$182,000	$365,000	$1,955,000	$1,895,000	$11,650,000
Cost per Ton	$1,560	$73	$146	$78	$76	$58

3.4 Conceptual Options Analysis

The Project Team, with input from CDPHE staff, developed six conceptual options that reflect a mix of potential disposal scenarios for a range of community sizes. The purpose of these options is to provide a broad understanding of how costs would compare between different options. The financial models discussed in Section 3.3 were utilized for the conceptual options as appropriate to determine the cost for each option. However, an interested party could utilize the information presented in this section to develop costs specific to their own situation. Table 3-15 summarizes the six conceptual options included in this section.

Table 3-15: Conceptual Options

Conceptual Option	Overview
Conceptual Option 1	Upgrade Existing Landfill to Current Standards
Conceptual Option 2	Single Drop-off Transfer Station
Conceptual Option 3	Single Compactor Transfer Station
Conceptual Option 4	Multiple Drop-off Transfer Stations Compared to Single Compactor Transfer Station
Conceptual Option 5	Moderate Size Top-Load Transfer Station
Conceptual Option 6	Large Top-Load Transfer Station with and without MRF

3.4.1 Conceptual Option 1

Conceptual Option 1 will evaluate the cost of improvements to two micro landfills (1,500 and 4,500 tons per year) that are currently inadequate in the three categories described in Section 3.2.2.

3.4.1.1 Overview and Key Assumptions

Costs for developing and operating a landfill include design and permitting, capital construction, groundwater monitoring, operations and closure. These costs can vary based on the location and size of the facility. The improvements assumed for this conceptual option will be sufficient to deem the landfill adequate in all categories including the installation of a groundwater monitoring system, completing the necessary sampling and analysis of groundwater, closure of the existing inadequate cell, construction of an appropriately lined cell with leachate collection, and maintaining adequate operations. The assumptions for this conceptual option are based on the lifespan of the new cell and construction materials of the cover and lined cell.

- Annual tons: 1,500 tons or 4,500 tons
- New cell area: one acre for 1,500 tons per year (TPY) and two acres for 4,500 TPY
- New cell lifespan: 13 years for 1,500 TPY and 8.5 years for 4,500 TPY
- Existing cell to be closed: 2.5 acres for 1,500 TPY and 5 acres for 4,500 TPY
- Existing cell will be closed using a water balance cover
- New cell will be completed using a geosynthetic liner and leachate collection system
- Groundwater monitoring system

3.4.1.2 Summary of Financial Model Results

Table 3-16 shows the up-front costs associated with closing an existing inadequate landfill cell and construct a new landfill cell that meets current regulations.

Table 3-16: Landfill Upgrade Costs

	1,500 Tons per Year	4,500 Tons per Year
Additional Permitting	$50,000	$50,000
New Cell Cost	$250,000	$500,000
Existing Cell Closure Cost	$125,000	$250,000
Groundwater Monitoring System Cost	$30,000	$30,000
Total	$455,000	$830,000
Amortization Period (Years)	13.0	8.5
Amortized Capital [1]	$48,437	$122,249

1. Based on funding up-front capital with debt for the amortization period at an annual interest rate of 5%.

Once the upgrades are made, the landfill should be operated based on best management practices and within current regulations. For this conceptual option, the Project Team assumed that all personnel and equipment would be allocated 50% of the time to landfill operations and 50% to non-landfill operations, which reduces the cost of operating the landfill. Table 3-17 summarizes the total projected operating and capital costs based on the landfill model and the amortized upgrade costs from Table 3-16.

Table 3-17: Financial Summary for Conceptual Option 1

	1,500 Tons per Year	4,500 Tons per Year
Personnel Costs	$23,625	$47,250
Equipment O&M	$76,000	$76,000
Other O&M [1]	$52,434	$83,123
Amortized Equipment	$34,132	$62,215
Other Capital Costs	$6,826	$12,443
Amortized Upgrade Costs [2]	$48,437	$122,249
Closure/Post-Closure Contributions	$10,748	$32,244
Solid Waste User Fee	$1,260	$3,780
Total	$253,462	$439,304
Annual Tons	1,500	4,500
Cost per Ton	$168.97	$97.62

1. Includes materials & supplies, professional/engineering fees, environmental monitoring, utilities, insurance, and miscellaneous expenses.
2. From Table 3-16.

Based on the cost estimates from Tables 3-16 and 3-17, the Project Team estimates an average cost of approximately $169 per ton for a 1,500 ton per year landfill and $98 per ton for a 4,500 ton per year landfill operated based on current regulations and best management practices.

3.4.2 Conceptual Option 2

Conceptual Option 2 is based on a drop-off transfer station for a community that has a small landfill that it may choose to close and convert to a transfer station.

3.4.2.1 Overview and Key Assumptions

The primary assumptions for this conceptual option is the amount of tons accepted and the operating hours based on having an attended drop-off transfer station.

- Annual tonnage: 1,500 tons
- Operating hours: 3 days per week, 8 hours per day
- Collection and disposal of roll-off containers and dumpsters provided by private contractor
- Site improvements and containers amortized over 15 years

Table 3-18 shows the number and type of containers and collection frequency for this option. The container mix and collection frequency could vary and still achieve an annual capacity of 1,500 tons per year.

Table 3-18: Containers and Collection Frequency

Container Type	Size (cy)	Number of Containers	Collections per Week	Total Weekly Capacity (cy)	Waste Density (lbs/cy)	Annual Tonnage Capacity
Roll-off	40	2	2	160	300	1,248
Front-Load	8	8	2	128	80	266
Total Annual Tons						1,514

3.4.2.2 Summary of Financial Model Results

Table 3-19 shows the financial summary based on the assumptions discussed, the financial model for drop-off transfer stations, and the collection costs from Section 4.

Table 3-19: Financial Summary for Conceptual Option 2

	Annual Expense
Personnel Costs	$24,300 [1]
On-Site Equipment O&M	$0
Other O&M [2]	$2,500
Collection Cost	$81,601
Disposal Cost	Included with Collection
Amortized Equipment	$0
Amortized Site/Facility Capital	$10,337 [3]
Total	$118,738
Annual Tons	1,500
Cost per Ton	$79.16

1. Based on 0.6 of a full-time equivalent gate attendant, plus 35% of base salary for benefits.
2. Includes miscellaneous supplies and expenses.
3. Includes $150,000 in site costs amortized over 15 years using a 5% cost of debt.

3.4.3 Conceptual Option 3

Conceptual Option 3 addresses a community with greater capacity needs than can be addressed with a drop-off transfer station. Conceptual Option 3 includes two sizes of a compactor transfer station, one that can manage 4,500 tons per year and one that can manage 15,000 tons per year. In addition, the Project Team included a version of the 15,000 tons per year transfer station with an additional compactor for accepting recyclables from collection vehicles.

3.4.3.1 Key Assumptions

The key assumptions for Conceptual Option 3 include:

- Annual tonnage: 4,500 tons or 15,000 tons
- Operating hours: 5 days per week, 8 hours per day
- One solid waste compactor plus one open-top container for bulk items or self-haul
- Option for recycling compactor at 15,000 ton per year transfer station (2,500 tons per year recycling and 12,500 tons per year refuse)
- Haul distance: 75 miles (one way) for refuse, 125 miles (one way) for recycling
- Disposal fee: $30 per ton
- Net processing fee: $0 per ton
- Site capital amortized over 15 years
- Equipment amortized over 7 years

3.4.3.2 Summary of Financial Model Results

Table 3-20 summarizes the results of the financial models for the scenarios discussed for Conceptual Option 3.

Table 3-20: Financial Summary for Conceptual Option 3

	4,500 Tons per Year	15,000 Tons per Year	15,000 Tons per Year with Recycling
Personnel Costs	$87,750	$166,750	$166,750
On-Site Equipment O&M	$7,800	$44,800	$50,800
Other O&M [1]	$12,500	$12,500	$12,500
Amortized Equipment	$6,740	$38,712	$43,896
Amortized Site/Facility Capital	$27,460	$27,460	$30,046
Hauling Cost	$213,447 [2]	$535,758	$543,571
Disposal Cost ($30 per ton)	$135,000	$450,000	$375,000 [3]
Processing Cost ($0 per ton)	$0	$0	$0 [3]
Total	$490,697	$1,275,980	$1,222,563
Annual Tons	4,500	15,000	15,000
Cost per Ton	$109.04	$85.07	$81.50

1. Includes utilities and miscellaneous supplies and expenses.
2. While one vehicle is sufficient to meet the hauling needs for this transfer station, the Project Team assumed the operator would purchase one used vehicle as back-up to the one front-line vehicle.
3. Based on collecting 12,500 for disposal and 2,500 tons for recycling.

As expected the larger transfer station (15,000 tons per year) benefits from some economies of scale and is less expensive on a per-ton basis than the small transfer station (4,500 tons per year). Adding the capability to accept recyclables to the 15,000 tons per year transfer station results in higher capital costs (additional compactor and larger building to accommodate the compactor), but by diverting material from the landfill, the operation as a whole was less expensive than hauling only solid waste.

3.4.4 Conceptual Option 4

Conceptual Option 4 utilizes the results of Conceptual Options 2 and 3 to compare the cost of operating three independent drop-off transfer stations (each accepting 1,500 tons per year) to one regional compactor transfer station accepting 4,500 tons per year.

3.4.4.1 Key Assumptions

The key assumptions are consistent with those listed in Section 3.4.2.1 and 3.4.2.1.

3.4.4.2 Summary of Financial Model Results

Table 3-21 summarizes the results of the financial models for the scenarios discussed for Conceptual Option 4.

Table 3-21: Financial Summary for Conceptual Option 4

	Three 1,500 Tons per Year Drop-off Transfer Stations	One 4,500 Tons per Year Compactor Transfer Station
Personnel Costs	$72,900	$87,750
On-Site Equipment O&M	$0	$7,800
Other O&M	$7,500	$12,500
Amortized Equipment	$0	$6,740
Amortized Site/Facility Capital	$31,010	$27,460
Hauling/Collection Cost	$244,804	$213,447
Disposal Cost ($30 per ton)	Included in Collection	$135,000
Processing Cost ($0 per ton)	$0	$0
Total	$356,213	$490,697
Annual Tons	4,500	4,500
Cost per Ton	$79.16	$109.04

Table 3-21 shows that the three smaller drop-off transfer stations could be operated less expensively than the one 4,500 ton compactor transfer station, the key difference is that the compactor transfer station can accept material from collection vehicles while the drop-off transfer stations allow for self-haulers that must manually unload the material.

3.4.5 Conceptual Option 5

Conceptual Option 5 includes a top-load transfer station with the capacity to accept 40,000 tons per year. This conceptual option may be applicable for a smaller-size landfill that may be reaching capacity in the future and the community or landfill operator may be interested in building a transfer station and hauling to a larger, regional landfill.

3.4.5.1 Key Assumptions

The key assumptions for Conceptual Option 5 include:

- Annual tonnage: 40,000 tons
- Operating hours: 5 days per week, 8 hours per day
- Building size: 8,000 square feet
- Site size: 1.8 acres

- Scale house: 1 scale, small scale house, scale management software
- Disposal fee: $30 per ton
- Net Processing fee: $0 per ton
- Site and building capital amortized over 20 years
- Equipment amortized over 7 years

3.4.5.2 Summary of Financial Model Results

Table 3-22 summarizes the results of the financial models for the scenarios discussed for Conceptual Option 5.

Table 3-22: Financial Summary for Conceptual Option 5

	Annual Cost
Personnel Costs	$210,250
On-Site Equipment O&M	$87,000
Other O&M [1]	$27,031
Amortized Equipment	$75,177
Amortized Site/Facility Capital	$193,073
Hauling Cost	$906,014
Disposal Cost ($30 per ton)	$1,200,000
Processing Cost ($0 per ton)	$0
Total	$2,698,545
Annual Tons	40,000
Cost per Ton	$67.46

1. Includes utilities and miscellaneous supplies and expenses.

The transfer station operating costs from Table 3-22 total approximately $15 per ton, while the hauling adds approximately $23 per ton and the disposal, $30 per ton. If the hauling distance were increased or decreased, the transfer station and disposal costs would remain the same and the hauling cost would increase or decrease.

The operator of a transfer station of this size could choose to dedicate a small portion of the tipping floor to recyclables and haul loads of recyclables to a Material Recovery Facility (MRF) in the region. Conceptual Option 6 includes a transfer station that accepts solid waste and recycling.

3.4.6 Conceptual Option 6

For Conceptual Option 6, the Project Team developed a comparison of two large scale transfer station operations. The first scenario is based on a transfer station that accepts a total of 200,000 tons per year, with 175,000 tons being solid waste and the remaining 25,000 tons being recyclables. The solid waste is long-hauled to a landfill and the recyclables are long-hauled to a MRF.

For the second scenario, the transfer station takes 175,000 tons of solid waste and the 25,000 tons of recyclables are direct-hauled to a local single-stream MRF for processing. The cost for the local MRF is based on the analysis in Section 5.

3.4.6.1 Key Assumptions

The key assumptions for Conceptual Option 6 are summarized in Table 3-23. The model assumes processing costs of $70 per ton, which (similar to the other costs developed for this analysis) excludes program administration costs, overheads, excess revenue/profit and similar costs. The model also includes an average revenue of $90 per ton, meaning there is a net revenue of $20 per ton for the local MRF.

Table 3-23: Key Assumptions for Option 6

	Scenario 1	Scenario 2
Annual tonnage at transfer station	200,000	175,000
Annual tons of solid waste accepted at transfer station	175,000	175,000
Annual tons of recyclables accepted at transfer station	25,000	0
Annual tons diverted to local MRF	0	25,000
Operating hours	5 days per week, 8 hours per day	5 days per week, 8 hours per day
Building size	40,000 square feet	35,000 square feet
Site size	9.2 acres	8.0 acres
Scales	2	2
Haul distance (one way)	75 miles for refuse 125 miles for recycling	75 miles
Disposal fee	$30 per ton	$30 per ton
Net Processing fee	$0 per ton	($20 per ton) [1]
Site and building capital amortization	20 years	20 years
Equipment amortization	7 years	7 years

1. Based on a processing cost of $70 per ton and revenue of $90 per ton.

3.4.6.2 Summary of Financial Model Results

Table 3-24 summarizes the results of the financial models for the scenarios discussed for Conceptual Option 5.

Table 3-24: Financial Summary for Conceptual Option 6

	Scenario 1	Scenario 2
Personnel Costs	$456,750	$456,750
On-Site Equipment O&M	$209,000	$209,000
Other O&M [1]	$72,913	$67,306
Amortized Equipment	$180,597	$180,597
Amortized Site/Facility Capital	$768,931	$678,953
Hauling Cost	$4,350,188	$3,468,284
Disposal Cost ($30 per ton)	$5,250,000	$5,250,000
Processing Cost	$0	($500,000)
Total	$11,288,379	$9,810,890
Annual Tons	200,000	200,000
Cost per Ton	$56.44	$49.05

1. Includes utilities and miscellaneous supplies and expenses.

Based on this analysis, it would less expensive for an entity to process the recyclables locally rather than to long-haul recyclables to a third-party MRF. However, this scenario will depend on current market conditions for recyclable materials and the types of contracts that third-party MRF operators are willing to offer to outside customers.

3.4.7 Comparison of Conceptual Options

Table 3-25 provides a summary of the six conceptual options discussed.

Table 3-25: Comparison of Conceptual Options

Conceptual Option	Type	Annual Solid Waste Tonnage	Annual Recycling Tonnage	Total Annual Cost	Cost Per Ton
1	Landfill	1,500	0	$253,462	$168.97
1	Landfill	4,500	0	$439,304	$97.62
2	Drop-off Transfer Station	1,500	0	$118,738	$79.16
3	Compactor Transfer Station	4,500	0	$490,697	$109.04
3	Compactor Transfer Station	15,000	0	$1,275,980	$85.07
3	Compactor Transfer Station	12,500	2,500	$1,222,563	$81.50
4	Three Drop-off Transfer Stations	4,500	0	$356,213	$79.16
4	Compactor Transfer Station	4,500	0	$490,697	$109.04
5	Top-Load Transfer Station	40,000	0	$2,698,545	$67.46
6	Top-Load Transfer Station	175,000	25,000	$11,288,379	$56.44
6	Top-Load Transfer Station	175,000	25,000 [1]	$9,810,890	$49.05

1. Recycling tonnage processed at a local MRF rather than hauled from a transfer station to a third-party MRF.

3.5 Key Findings

The regional analysis of the transfer and disposal system in the state of Colorado presented in this section identified needs and opportunities for the regions. Below are the key findings for each of the regions and the costs associated with upgrading the landfills in each region to full adequacy.

3.5.1 Statewide Key Findings

The minimum landfill requirements established in Subtitle D of the federal regulations and 6 CCR 1007-2 of the state regulations were created for the protection of the human health and environment, with an emphasis on containment. The state of Colorado, as an EPA approved Subtitle D program, is required to maintain and enforce state regulations that meet the minimum criteria outlined in Subtitle D and the federal regulations. Operating landfills outside of the requirements established by the EPA and adopted by the state of Colorado increases the risk to the human health and environment. Bringing landfills in Colorado into compliance with these regulations will help reduce the potential risk to human health and the environment. By reducing the potential of contamination from landfills, owners can avoid remediation which involves expensive investigations and cleanups.

The state of Wyoming, in an effort to bring landfills into compliance, created a groundwater monitoring program to investigate the presence of contamination from landfills. The program was successful in determining the presence of contaminants in groundwater as a result of unlined landfills. However, this created the need for a remediation program to remediate impacted groundwater sites at a statewide cost of several hundred million dollars (as discussed in Appendix C). The absence of adequate groundwater monitoring systems and adequate sampling and analysis of the monitoring systems at landfills in Colorado has the potential to lead to contamination similar to Wyoming. Capital costs for groundwater monitoring systems and annual costs for sampling and analysis pale in comparison to the cost of remediation necessary to clean up the contamination.

In the past the enforcement of the groundwater system and sampling requirements by CDPHE has been inconsistent. Many groundwater waivers were granted without proper demonstration and were not properly renewed. Other issues with regard to the regulations were sometimes noted in landfill inspection reports and sometimes not. This inconsistency has left many owners frustrated with the inspection process and the approach of enforcement by CDPHE.

During the review of data provided by CDPHE, it was clear there was a lack of information collected from owners of landfills and transfer stations. Other than waste quantities derived from solid waste user fee amounts, there is not landfill capacity information available for any of the landfills. As planning for future landfill development and potential partnerships moves forward, the access to total landfill capacity on a county, regional or state basis would benefit the planning process.

3.5.2 Regional Findings

The largest need identified for most of the regions is the inadequacy of landfills in one or more categories. Table 3-26 shows the number of landfills by size in each region that are currently considered inadequate by category.

Table 3-26: Count of Inadequate Landfills by Region

Region	Landfill Size	Adequacy Category		
		Design & Operations	Groundwater	Closure
Front Range	Small	N/A [1]	N/A	N/A
	Medium	N/A	N/A	N/A
	Regional	1	0	0
Mountains	Small	3	4	1
	Medium	0	1	0
	Regional	0	0	0
Eastern/Southeastern	Small	15	15	9
	Medium	4	2	0
	Regional	N/A	N/A	N/A
Western Slope	Small	0	0	0
	Medium	0	2	0
	Regional	0	1	0

1. N/A means not applicable and means that there were no landfills of that size in the region.

3.5.2.1 Front Range

With the landfills present in the region being regional in size, they accept large quantities of solid waste. Effectively, this creates enough revenue to maintain adequacy and make improvements as needed. The landfills in the Front Range are expected to continue to expand to meet the needs of the growing population in the region. The Larimer County Landfill is scheduled to reach capacity in the near future and will construct a new fully adequate landfill at that time.

3.5.2.2 Mountains

The small landfills in the Mountains, generally serving small seasonal populations, were initiated before the promulgation of Subtitle D. They receive waste quantities too small to generate the funds required, using current tipping fees, to operate adequately or upgrade the facilities. Significant increases to the tipping fee would likely result in illegal dumping. There is a need for adequate groundwater monitoring systems at a few of the landfills to aid in protecting human health and the environment. Some counties and municipalities in the Mountain region have closed landfills and switched to transfer stations to collect waste before transporting it to other medium or regional sized landfills. The San Luis Valley uses a regional disposal system that services multiple counties surrounding the landfill located in Rio Grande County. Hinsdale County operates a transfer station in Lake City that collects and transports waste to the Six Mile landfill in Gunnison County.

3.5.2.3 Eastern/Southeastern

The Eastern/Southeastern region has large needs for their landfills that are currently inadequate. There is a necessity for these facilities to upgrade infrastructure and improve operations to be deemed adequate with regards to the current regulations. While many of the landfill owners in this region oppose regionalization and prefer to continue operating as is, continuing with the current system may pose a risk to the human health and environment. Based on the quantity of waste received at the inadequate landfills, generating the revenue necessary to upgrade and operate the landfills would require a significant increase in tipping fees. This would most likely cause hardship for residents and increase illegal dumping in the region. This region of the state would benefit from exploring options for regionalization.

3.5.2.4 Western Slope

Installing adequate groundwater monitoring networks and completing groundwater analysis is needed at three landfills in the Western Slope. Towns and counties in the Western Slope have provided a network of transfer stations to collect and transport waste to medium and regional landfills. This allows service to reach the small communities in the region while providing enough waste to landfills to generate funds necessary to maintain operations and expand as needed. Mesa County operates four transfer stations in small communities within the county to provide service to all residents.

3.5.2.5 Regional Costs

Funding for landfills in Colorado has been and will continue to be the responsibility of the owner. It is evident that inadequate funding exists in multiple communities across the state, resulting in landfills that are not financially able to maintain adequate operations or make plans for adequate expansion or closure. Landfills are expensive to build, operate and close in compliance with the regulations. As shown in this section, the expense of operating a compliant landfill can result in very large per ton costs when spread across a small amount of waste.

Based on the stakeholder meetings, there are different appetites for closing local landfills and creating regional facilities. Many of stakeholders opposed regionalization based on the convenience that would be lost by closing small local landfills. However, the small local landfill owners also stated that there was a lack of funding available to upgrade their landfills to an adequate rating. Table 3-27 shows the capital cost range for each region to maintain the current number and upgrade the landfills. The cost ranges include closing existing disposal areas, constructing new disposal areas and constructing adequate groundwater monitoring systems. The Project Team estimated a statewide cost of $21 – 35 million to achieve adequacy for the landfills in the state. This estimated cost does not include sampling of the groundwater network. From Table 3-26, there are 23 landfills that are inadequate for design and operations. Correcting this inadequacy requires closure of the unlined areas of the landfill and construction of a new landfill cell. Based on the totals for cell closure and cell construction in Table 3-27, the average cost per landfill is between $875,000 and $1.46 million. For the 25 landfills that are inadequate for groundwater, the average cost per landfill is between $38,100 and $63,500.

Table 3-27: Total Estimated Planning Level Cost of Achieving Landfill Adequacy by Region

Region	Cell Closure [1]	Cell Construction [2]	Groundwater [3]	Total
Front Range	$900,000 - $1,500,000	$1,987,500 - $3,312,500	$0 - $0	$2,887,500 - $4,812,500
Mountains	$562,500 - $937,500	$1,237,500 - $2,062,500	$165,000 - $275,000	$1,965,000 - $3,275,000
Eastern/Southeastern	$4,612,500 - $7,687,500	$10,837,500 - $18,062,500	$487,500 - $812,500	$15,937,500 - $26,562,500
Western Slope	$0 - $0	$0 - $0	$300,000 - $500,000	$300,000 - $500,000
Cost Range[4]	$6,075,000 - $10,125,000	$14,062,500 - $23,437,500	$952,500 - $1,587,500	$21,090,000 - $35,150,000

1. Cell closure using water balance cover (Avg. costs: small - $250,000; medium - $600,000; regional - $1,200,000)
2. Cell construction using geosynthetic liner (Avg. costs: small - $550,000; medium - $1,550,000; regional - $2,650,000)
3. Groundwater wells to create adequate network (Avg. costs: small – $30,000; medium – $100,000; regional – $200,000)
4. Cost range is +/- 25% to account for variations in site conditions

Through the analysis provided in Section 3.3 (see Figure 3-2: Landfill Cost Summary), it is shown that the creation of regional landfills will reduce the per ton fees associated with operating landfills. Assuming landfills that are closed can be replaced by drop-off locations or transfer stations, there should minimal inconvenience to the public and may provide savings for the owner. With this in mind, some Colorado communities (refer to case studies for Bent and Hinsdale Counties in Appendix C) previously completed studies to determine costs of building and operating adequate landfills and elected to close landfills and transport waste to other landfills.

Regardless of whether a facility decides to close existing inadequate cells and build an adequate cell or transfer station, installation of groundwater monitoring networks or receptor analysis will be required for all facilities. By installing adequate groundwater monitoring systems or performing receptor analysis for closing facilities, the landfill owner and CDPHE will have the necessary information on the potential risk to the human health and environment. To this point, determination of adequacy is based on compliance with the regulations and does not reflect an evaluation of individual sites. Consequentially, the capital costs shown above do not include potential remediation costs. However, the state of Wyoming has concluded in the past several years that many landfills set for closure were contaminating groundwater. Appendix C includes a case study of the Wyoming program.

3.6 Recommendations

The preceding portions of Section 3 have summarized the current state of the transfer and disposal systems in Colorado, as well as the financial costs for constructing, operating, upgrading and transitioning facilities. With this information, landfill owners can begin to make decisions regarding the future of the facilities under their care. The key objective is for facilities to begin working towards adequacy with regards to the regulations. The following provides recommendations and strategies for policies at the statewide level and considerations at the regional/local level to improve transfer and disposal of solid waste throughout Colorado. Several of these recommendations should be coordinated with the recommendations included in Section 6 of the Plan, which focuses on collection and diversion issues.

3.6.1 Statewide Recommendations

The following statewide recommendations are primarily focused on activities that can be implemented by CDPHE. Given the importance of addressing landfill adequacy issues, the expectation is that these recommendations will be implemented over the next five years.

3.6.1.1 Enforce Current Regulations

There is a need to clearly and consistently enforce landfill regulations to reduce risk to human health and the environment. As an EPA approved state program, Colorado is required to maintain and enforce regulations that meet the minimum criteria set forth in Subtitle D. In order to maintain the EPA approved program, CDPHE should enforce the regulations. Key strategies include:

1. CDPHE should provide written notices to each of the inadequate landfills in the state, specifically identifying the reason for an inadequate status.
2. CDPHE should conduct individual meetings with applicable landfills to discuss the timeline to achieve adequacy, as well as identifying available resource assistance.

3.6.1.2 Develop and Implement Policy for Compliance Timeline

Understanding that multiple landfills have been inadequate for a number of years, the CDPHE should outline the timing and requirements for landfills to improve operations, achieve adequacy or make decisions on future options (such as regionalization). Key strategies include:

1. Establish a one year period for landfill owners to review options and make decisions on future operations.
2. While decisions are being made by landfill owners, facility operations will need to improve and achieve operational-adequacy within one year. Adequate facility operations include maintaining access controls, completing hazardous waste screening, compacting waste, installing daily cover, removing litter and other nuisances and maintaining stormwater facilities.
3. If a landfill owner decides to close its facility within one year, CDPHE should streamline the closure process as allowed under state law and regulations. For example, the CDPHE could require only a receptor analysis for groundwater instead of a full monitoring network.
4. For landfills that decide to continue operating, CDPHE should provide three years for the landfill to plan and implement the needed changes to achieve full adequacy.
5. If a landfill has not agreed to a compliance or closure plan with CDPHE after four years, the CDPHE should take enforcement actions for inadequate landfills.

3.6.1.3 Provide Technical Assistance

A suggested key role for CDPHE is to provide technical assistance to cities and counties regarding landfill adequacy and related issues. Technical assistance can be provided through a combination of workshops, guidance documents, one-on-one meetings, etc. An initial list of technical assistance to be provided includes:

1. Assist landfill owners on interpretation of regulations and how best to comply.
2. Streamline approval process for owners that want to close inadequate landfills.
3. Guidance/workshops on regionalization opportunities and how to develop necessary facilities and arrangements.
4. Guidance/workshops on how local governments procure and contract for transfer and disposal services if a decision is made to close a landfill and the local government needs to contract for services.[1]
5. Develop statewide contract(s) for cooperative purchasing for landfill rates at transfer stations and landfills in the state in an effort to provide cities and counties with negotiated rates.

[1] For example, the Houston-Galveston Area Council conducted a Solid Waste and Recycling Procurement Workshop, which is available at: https://www.h-gac.com/community/recycling/workshops/documents/2015-08-19-SWandRecyclingProcurementPresentation.pdf

3.6.1.4 Support Sustainable Funding Strategies for Local Programs

Through understanding that there is a substantial financial requirement to achieve landfill adequacy or to consider regional options, there is a need to promote funding strategies and sources. Activities to be considered by CDPHE could include the following:

1. As another form of technical assistance, CDPHE could conduct workshops on how local governments can track costs and revenue on a full-cost accounting basis for their solid waste systems.
2. CDPHE should serve as a resource to identify and assist local governments with potential funding sources and strategies, such as the ones identified in Appendix D and Section 6.4.6 of this Plan.
3. Understanding that no state funding mechanism currently exists for closure or upgrading landfills, the state could evaluate the feasibility for a statewide funding source. If this option is considered, funding could be prioritized for facilities that are willing to close inadequate facilities and move toward regionalization. Including diversion capabilities (recycling and organics transfer or processing) within future disposal facilities could also be a basis for prioritizing the use of state funds.

3.6.1.5 Capture Disposal Facility Data

While there is an understanding of landfill adequacy in the state, there is a substantial level of additional information that could be tracked by CDPHE that would inform future solid waste planning in Colorado. This issue will become more important over time as additional landfills in the state begin to reach capacity. Specific activities include:

1. Continue to update the wastesheds for transfer stations and landfills (as shown in Figure 3.1).
2. Improve already-required landfill reporting requirements by having landfills report on annual waste quantities/types, origin of waste and remaining airspace.

3.6.2 Regional/Local Recommendations

Based on the regional analysis included in this section, there are a number of recommendations that local communities throughout the state can consider to meet the regulatory requirements for their landfills, as well as to operate in a manner of greater focus on costs and increasing diversion. While these recommendations are primarily focused on facilities that need to achieve adequacy status, there are other landfills in the state that will reach capacity. Over the long-term, these adequate landfills would benefit from starting to evaluate future disposal options.

3.6.2.1 Consider Regionalization Options

Given that there are a substantial number of relatively small landfills that are inadequate with regard to the regulations, there could be a substantial benefit for these communities to explore regionalization options. The intent of this Plan is not to prescribe which local governments should regionalize, but to provide an understanding of the benefits and costs associated with regionalization, as compared to continuing to operate existing facilities. While this is primarily an issue for communities located in the Eastern/Southeastern region, there are some landfills in other regions of the state that may also consider regionalization now or over time as their landfills reach capacity. Key activities can include the following:

1. Determine the full-cost for existing landfills to continue operating based on achieving adequacy status.
2. Coordinate with other local communities that may also have similar landfill adequacy issues and identify regionalization scenarios to evaluate.
3. Determine the costs for the regionalization scenarios and compare those costs to the current operation (based on achieving adequacy).
4. Utilize the cost analysis included in this section of the Plan to assist with the financial analysis.
5. Develop and implement the preferred scenario.

3.6.2.2 Evaluate Groundwater Monitoring

In accordance with state of Colorado and EPA regulations, facility owners need to install, maintain and regularly sample a groundwater monitoring system consisting of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer. Facilities considered inadequate in groundwater can become fully adequate by taking the following steps:

1. Consult with a geologist/hydrogeologist to develop a plan indicating location and depth of wells to be installed at the facility.
2. Coordinate with CDPHE to obtain approval of planned installation as adequate monitoring network.
3. Complete installation of groundwater monitoring wells and begin monitoring program.
4. Utilize results of monitoring program to identify additional areas where groundwater wells can be placed to provide a complete picture of groundwater on the site and help determine any risk to human health and the environment.

3.6.2.3 Implement Sustainable Funding Strategies

Facilities owners need to better understand and pay for the costs of their disposal programs. Specific activities can include the following:

1. Local governments should track costs and revenue on a full-cost accounting basis (with potential technical assistance from CDPHE).
2. Local governments should primarily utilize tipping fees and other local funding strategies (as discussed in Section 6.4.6) as the primary method for funding disposal systems.
3. While the Local Government Test is an allowable method for accounting for closure and post closure costs, local governments should establish and fund dedicated reserves each year based on the incoming tonnage.
4. Local governments should evaluate alternative funding strategies and sources (which are discussed in Appendix D).

4.0 SOLID WASTE COLLECTION

4.1 Introduction

The collection and hauling of solid waste is integral to ensuring that solid waste, recyclables and organics reach their intended destinations for proper management. Due to the variety of collection systems in Colorado, this section begins with a background discussion of existing solid waste collection services. The remainder of the section is organized geographically on the four regions of the state (Front Range, Mountains, Eastern/Southeastern and Western Slope) as shown in the Introduction Section (see Figure 1-1 in Section 1.3.3). For each geographic region, this section evaluates the current system, as well as needs, gaps, support and cooperation and funding opportunities. Due to the linkages between collection and diversion issues, solid waste collection recommendations are included in Section 6 of this Plan. This section also includes brief case studies in "text boxes." The detailed case studies are included in Appendix C.

4.1.1 Background on Existing Solid Waste Services in Colorado

Residential solid waste service: Colorado residential solid waste collection service consists of several main options.

Curbside collection: Curbside service is most commonly provided by a private hauler or by city staff. Billing methods for solid waste collection include a monthly fee for unlimited waste collection or the less common billing method which is based on the size of container collected (e.g. Boulder, Fort Collins).

- In most of the state, haulers are in a **free-market system**, with minimal municipal control or authority over solid waste collection. Contracts are established between a hauler operating in a community and the individual resident. The household is direct billed by the hauler for the collection service. In many communities, multiple haulers operate within a single area.

City of Longmont's Municipal Collection System

- The City of Longmont began providing residential solid waste and recycling collection in 1948.
- Funded through user fees, the service allows residents to select either a 48 or 96 gallon container with embedded single stream curbside recycling.
- A waste management fee charged to all participating residents funds the operation of the waste diversion center, special collection events, household hazardous waste and waste disposal at all city facilities and parks.
- The city collects 29,000 tons of solid waste and 12,000 tons of recyclables annually, maintaining a 30% diversion rate.
- Longmont is planning to launch a voluntary curbside organics collection program with enhanced pay-as-you throw rates. If approved, the new rates would include a reduced volume every-other-week solid waste collection option.

Refer to Appendix C for further details.

- A few communities in Colorado (e.g. Longmont, Thornton) use **municipal staff** for solid waste collection. The collection service is usually mandatory (or mandatory pay) and funded by community taxation, billed directly to the household or combined with other community utility service charges.
- Occasionally, communities establish **city-wide contracts for service** – issuing an Request for Proposal (RFP) where one hauler (or a limited number of haulers, with geographically distinct service areas) is selected to provide waste collection services community-wide (e.g. Louisville, Lafayette). Communities that select a city-wide contract for solid waste collection do so for the benefit of lower costs to residents, (assumed on economies of scale and geographic clustering) and for the decreased impact of having a single waste collection vehicle on the streets.

City of Lafayette's RFP and Collection Contract

- An audit of Lafayette's solid waste in 2013 determined that yard waste and food scraps made up 42% of the landfilled materials from the City.
- Lafayette posted a RFP for the addition of organics collection for single-family households that do not receive solid waste service from home owners associations (HOAs) in April of 2014.
- Single family residents already had recycling with a Pay-As-You-Throw (PAYT) program.
- A curbside organics program is now provided at no cost to residents and began in 2015. In the first four months of the program, with half the community outside HOA, the city collected 235 tons of organics.

Refer to Appendix C for further details.

Drop-off: In some small, rural communities, household solid waste collection services may primarily be provided via a drop-off option either at landfills or broadly distributed transfer stations. Drop-off collection is typically billed by the quantity of containers, by weight, or sometimes embedded in municipal utility rates or taxes. In many communities, households may have access to both curbside collection and drop-off services.[1]

Commercial solid waste collection in Colorado is almost universally provided by private haulers using carts or dumpsters, charging by the number, size and frequency of collection – a volume indicator. Some businesses "self-haul", transporting solid waste independently to transfer stations or landfills[2]. Local

[1] Hub and spoke: In a few areas of the state, a "hub and spoke" system is in place. While predominately a program for recycling, a few communities indicated their solid waste collection system might be considered hub and spoke, with households using distributed drop-off centers, where the material is accumulated and brought to a landfill. This is a kind of refinement to a transfer station system. This Plan generally defines hub and spoke for recycling operations.

[2] No community in the state of Colorado has opted to contract for commercial solid waste collection, a system that is in place in a limited number of communities nationwide.

governments in Colorado are almost never involved in providing waste hauling services for multifamily or commercial (or most mixed-use) buildings due to state law. To provide a statutory reference, CRS § 30-15-401 states: "The governing body may not compel industrial or commercial establishments or multifamily residences of eight or more units to use or pay user charges for waste services provided by the governmental body in preference to those services provided by a private person".

In Colorado, **solid waste collection for multifamily** establishments generally depend on container type. If the multifamily building is similar to single family dwellings (four-plexes, etc.), solid waste is collected via containers using rear load or automated trucks. Solid waste pick-up is arranged on an individual basis or on a pre-determined schedule. Small multifamily buildings are generally treated parallel to single family service. If the multifamily building is similar to an apartment complex, or mixed use, waste collection services are completed by detachable containers (dumpsters), and these multifamily locations are treated by haulers as a commercial customer[3].

Home Owner Associations (HOAs), most commonly found in the Front Range region of Colorado have commonly taken on the responsibility for arranging residential solid waste collection services. In these cases, the collection service for member households is contracted and the cost embedded in the HOA fees. This service tends to involve solid waste collection and single stream recycling in large containers.

City of Golden's Approach to Include HOAs in PAYT

- In 2014, the city of Golden passed an ordinance requiring all haulers to offer PAYT to HOA's with embedded recycling.
- Larger HOA's anticipate lower prices than the city program or wanted to maintain existing service and control their own options resulting in legal action against the city.
- Lessons learned include implementing Phase 2 within one year and allowing three years for compliance. Additional outreach would have improved acceptance within the community.
- The city of Golden should have had "star" resident examples and suggested the HOAs become leaders as "Green Adopters".

Refer to Appendix C for further details.

[3] University housing and building service is most commonly arranged as a contract by the university or by university staff and trucks. School collection service is commonly treated as a commercial account by haulers, as is government office service. Occasionally government account service is included as part of a municipal contract.

PAYT Ordinances in Golden, Vail, and Fort Collins

- Golden, Fort Collins, and Vail are examples of communities in Colorado that have passed ordinances that resulted in implementation of PAYT services indirectly through hauler licensing.
- Curbside recycling must be offered and the cost embedded in the solid waste costs.
- Solid waste costs are based on container size.
- Haulers shall not collect recyclable materials co-mingled with solid waste.
- Golden's ordinance covers single and multi-family, HOA's and businesses.
  Fort Collins ordinances have changed over time and require unlimited recycling with carts provided by haulers. Vail's ordinance requires PAYT for the commercial sector.

Refer to Appendix C for further details.

Pay As You Throw (PAYT): In Colorado, fees for solid waste collection have traditionally been charged as a fixed fee for unlimited collection. The PAYT system is based on the amount of solid waste being collected, where an additional charge is issued based on a higher volume of solid waste generated. Solid waste quantity measurements are completed based on the size of collection containers. There are certain elements associated with best practices in the design of these programs such as threshold levels of price increments between cans, embedded recycling and at least one smaller size container. Multiple studies suggest PAYT is one of the most cost-effective programs available, encouraging recycling, composting and source reduction. A growing number of communities in Colorado have initiated the residential[4] PAYT system in one of three ways:

- As an ordinance, requiring PAYT rate design by haulers operating in a community or unincorporated county (e.g. Vail, Boulder, Boulder County)
- As a practice by the municipal solid waste service (e.g. Longmont, Thornton)
- As a requirement of the selected contracted service provider (e.g. Lafayette)

Funding for solid waste collection services is provided by fees paid directly to haulers, or through community taxation paid to cities when the waste collection is a municipal or contracted service.

Table 4-1 provides the current system for solid waste services in the state; each geographical region is discussed individually throughout the following sections. Many of the regions may have curbside services available, however, curbside services are limited in rural areas.

[4] Commercial PAYT requires haulers to provide recycling service with the costs embedded in the trash charge. Rather than unlimited recycling, as the residential PAYT usually offers, commercial PAYT provides a "multiple" of the trash volume in recycling (e.g. 50%, 100%, 150%). This program is in place in Vail.

Table 4-1: Current System Solid Waste Collection Service by Region

Region	Stakeholder Meeting Location	Available Curbside		
		Residential	Commercial	Multifamily
Front Range	Denver	Abundant	Abundant	Abundant
	Loveland	Abundant	Abundant	Abundant
	Pueblo	Abundant	Abundant	Abundant
Mountains	Alamosa	Limited	Common	Limited
	Silverthorne	Abundant	Abundant	Common
Eastern/ Southeastern	Sterling	Common	Abundant	None
	Lamar	Uncommon (self-haul)	Common	None
Western Slope	Durango	Abundant	Abundant	Limited
	Grand Junction	Abundant	Abundant	Limited

The collection actors and situations around the state are quite varied. They include mostly private hauling, some municipal collection, and some contracting, and include service providers ranging from independent "man and a truck" firms and small haulers, medium-sized regional firms, and the largest firms in the nation. Solid waste and recycling progress has been made in areas with small firms and with large firms – but nearly always when licensing and service requirement ordinances, or contracts have been implemented by local jurisdictions, staff, and decision-makers that are interested in more organized collection or recycling progress. These strategies, when present, have moved the state's recycling performance forward. However, local requirements are less likely to be invoked in areas that lack at least minimal supporting infrastructure, or where distances cause clear barriers.

4.1.2 Consideration of Solid Waste Collection Gaps and Opportunities

Assessment of gaps are influenced by the requirements of the Plan authorization (see C.R.S. 30-20-100.5 (I) - (V)). The language requests a plan that addresses:

- safe service to Colorado residential and non-residential customers
- reduction and diversion of solid waste
- reduction of toxics
- education of the public
- other considerations

Gaps, as identified in this Plan, relate to realistic opportunities for change in solid waste-related **strategies** (services, incentives, policies, regulations, and supporting infrastructure) that relate to the elements requested in the Plan. Strategies also relate to services offered or expected in similar regions nationally.

Strategies List: There are a number of strategies related to solid waste collection that have been implemented within Colorado, and in other states, counties and communities. A list of strategies from SERA's "Comp Plan in a Box" program with potential suitability to different communities and counties in Colorado has been developed, identifying strategies, their pros and cons and their general suitability for rural verses urban communities. Further information is provided in Section 6.2.3.

4.2 Front Range

4.2.1 Current Solid Waste Collection System

The Front Range contains the largest population concentration in the state of Colorado and is centered along the I-25 corridor, from Fort Collins to south of Pueblo. Solid waste collection services for the Front Range are readily available along the western portion of the region and becomes limited in the southern and eastern portions. Results of survey data obtained from the stakeholder meetings in this region indicate that regional planning is supported along with hauler licensing and reporting for both residential and commercial haulers. PAYT type programs for residential solid waste service, while common in this region, are not universal.

4.2.2 Needs, Gaps, Support and Cooperation and Funding Opportunities

Table 4-2 summarizes current needs, gaps and opportunities identified for the Front Range.

Table 4-2: Needs, Gaps, Opportunities and Funding for Solid Waste Collection — Identified by Front Range Stakeholders

Issues	Findings	
Needs/Concerns	• The disposal system received a 3.5 on a scale from 1 to 5, where 5 is working well	• Low landfill tipping fees encourage unlimited disposal
Gaps	• PAYT requirements are in place in many, but not all, areas	• For some municipalities that provide or contract service, residents are not charged for solid waste collection
Want/Support	• There is general support in this region for hauler licensing and reporting for both residential and commercial haulers	• Majority would support mandatory PAYT type programs • Landfill and materials management plans/regulations/ funding
Cooperation	• Many facilities exist; expertise and passion in the disposal/diversion industries • Opportunity for sharing best management practices, coordinating, collaborating, • Use of equipment and staff	• Public events/publicity • Educational resources • Scheduling and transportation network
Funding in Place	• Collection fees are in place for roughly 25% of the region	• Commercial fees or taxes are established
Funding would Support	• Economic development	• Litter taxes • Landfill surcharges

The main considerations underlying the assessment of next steps in trash collection-related recommendations in this region include:

- The underlying trash collection and disposal infrastructure is quite mature.
- The region has two main areas – the I-25 corridor ("I-25 Front Range" or Metro Front Range) and the areas east and the areas at the north and south ends of the wasteshed area. The access to landfills and transfer stations – and the appetite for more requirements (including those that will move to higher recycling and diversion) is different between the areas – as are the population densities, which have implications for suitability of some strategies.
- For this region, aggressive requirements are potentially suitable, and given the population density, practices here have dramatic effects on the overall state performance.

4.3 Mountains

4.3.1 Current Solid Waste Collection System

This region runs north to south, the length of the state and includes communities situated in the major mountain ranges with the exception of the San Luis Valley. Mountain passes are especially difficult in winter for solid waste collection services. Populations tend to be spread out - along areas of high transient tourist populations. Waste collection services in this region range from non-existent to PAYT and other mandatory programs for both residential and commercial. Services are centered on the I-70 corridor and the southern section of the region. Each of these areas face unique challenges, besides long distances, illegal dumping is one of the main issues making it difficult for landfills to consider any price increase, especially in the southern part of the region.

4.3.2 Needs, Gaps, Support and Cooperation and Funding Opportunities

Table 4-3 summarizes current needs, gaps and opportunities identified for the Mountains.

Table 4-3: Needs, Gaps, Opportunities and Funding for Solid Waste Collection — Identified by Mountain Region Stakeholders

Issues	Findings	
Needs/Concerns	• On a scale of 1-5 (5= working well) the disposal system received a 3.6 • Education is lacking about effects of illegal dumping • Service needs can be inconsistent with large tourist population in northern mountains	• Some transfer stations/drop off sites do not have regular hours • Landfill rates stay low in part to avoid illegal dumping • People are resistant to paying landfill fees where some used to be free
Gaps	• In the southern area, there are fewer drop off sites and illegal dumping is a large problem; transfer stations and drop-off sites are more common in the northern part of the region • Transportation to the landfills are over large distances	• In some areas, regionalization opportunities are not being taken advantage of partly because of landfills being privately owned • State or regional help in identifying and facilitating progress or providing resources would be helpful
Want/Support	• Some support for hauler licensing and reporting	• Enforcement and measurement of landfill materials • Training and outreach
Cooperation	• San Luis Valley Ecosystem Council is a potential source for sharing information and coordinating programs	
Funding in Place	• User fees are the most common source of funding	• There are some landfill surcharges and litter taxes
Funding would Support	• User fees and Enterprise fund arrangements • Some support for generator fees up to $2/month /household • PAYT would be supported only in certain cases	• Trash tax if at a regional or state level • Planning areas • Requirements for plans with authorization for funding

The main considerations underlying the development of next steps in trash collection recommendations in this region include:

- This region has two main areas – the I-70 Mountain areas with a tourism and recreation focus (and some population density) and the Alamosa area. Landfill and transfer station access is greater in the I-70 Mountain corridor – and transfer stations are relatively far apart in the Southern part of the region. The southern area has some similarities to the mountain areas (some mountain-related barriers and transport distances). However, they differ significantly in that they are substantially more likely to transport materials to facilities across state lines (for example, New Mexico) than are communities in the northern part of this wasteshed. Illegal dumping and income issues are of greater concern in the southern part of this wasteshed. For these reasons, this part of the region has greater affinity with the Eastern/Southeastern or Western Slope regions than the Mountain region. However, the mountain barriers and some isolation issues argue for its inclusion in the Mountain grouping.
- It is important to have landfills and solid waste management up to regulations in this area because groundwater is an issue here and the water from this area ends up as a key water source for other areas of the state.
- For the southern part of the region, exemptions have been suggested because of the lower population density and low-income communities.

4.4 Eastern/Southeastern

4.4.1 Current Solid Waste Collection System

This region is located in the eastern plains in the south and southeastern sections of the state. Communities consist of smaller populations; however, most residents and businesses have access to adequate solid waste collection services. There are a few communities with PAYT programs, but they are less common. Tipping fees tend to be low.

4.4.2 Needs, Gaps, Support and Cooperation and Funding Opportunities

Table 4-4 summarizes current gaps and opportunities identified for the Eastern/Southeastern region.

Table 4-4: Needs, Gaps, Opportunities and Funding for Solid Waste Collection — Identified by Eastern/Southeastern Region Stakeholders

Issue	Findings	
Needs/Concerns	• Illegal dumping is common • The sparse rural population necessitates long hauls for collection	• The disposal system received a 3.4 on a scale from 1 to 5, where 5 is working well
Gaps	• Landfills are spread far apart and are often small	• Limited hauling services/options
Want/Support		• There was strong input against landfill regionalization in this region
Cooperation	• The region contains spread out communities which creates difficulty when sharing resources	• There is some interest in creating public/private facility partnerships
Funding in Place	• User fees	• Enterprise funds
Funding would Support	• Economic development assistance • Incentives/tax benefits for facilities and co-location of facilities	• Requirements for plans with authorization for funding • Landfill assistance

The main considerations underlying the assessment of next steps in trash collection recommendations in this region are:

- The area has just a few population concentrations. Beyond those areas, populations are sparse, distances are long, and there is a lack of transfer station distribution.
- No recommendations for required bundled recycling should be created in this region due to the typical distance to facilities and the rural and remote conditions present in this region.

4.5 Western Slope

4.5.1 Current Solid Waste Collection System

The Western Slope shares similar characteristics with the Mountain region. These include the spread out population densities and the difficulty involved in collecting materials due to mountain passes and winter conditions. Solid waste collection services are centered on the southern and central areas of this region. Facilities out of state may be closer to collection points in the northern area of this region, than those in state. The southern area of this region has a large tourist population, and local collection services support this area. Most of the residential curbside services are located in incorporated communities, and many counties have some form of volume based trash service (PAYT) available to residents. However, it is unclear how many select this option, and many of the available systems have small differentials in PAYT prices, which limits the diversion incentive provided.

4.5.2 Needs, Gaps, Support and Cooperation and Funding Opportunities

Table 4-5 summarizes current gaps and opportunities identified for the Western Slope.

Table 4-5: Needs, Gaps, Opportunities and Funding for Solid Waste Collection — Identified by Western Slope Stakeholders

Issue	Findings	
Needs/Concerns	• This area of the state has difficulty due to long driving distances • Mountain passes in winter make it difficult for waste collection	• Illegal dumping is an issue • The disposal system received a 4.0 on a scale from 1 to 5, where 5 is working well
Gaps	• Services tend to be in southern and East-Central part of region	
Want/Support	• PAYT with bundled recycling and organics services • For landfills, support for some facility closures and for the conversion of some to transfer stations should be based on location	• There is some support for waste-to-energy facilities
Cooperation	• There is potential for a regional education outlet where groups share education resources within the region	
Funding in Place	• User fees • Landfill surcharges	• Enterprise funds • Litter taxes
Funding would Support	• Economic assistance • Landfill surcharges	• Solid waste taxes at local level • Taxes on oil/gas

The main considerations underlying the assessment of next steps in trash collection recommendations in this region are:

- The area has relatively few population concentrations. Beyond those areas, populations are sparse, distances are long, and there is a lack of transfer station distribution.
- The mountains are a barrier to transport.
- Recommendations for required bundled recycling would probably be unsuitable in this region due to traveling distances to facilities and the rural and remote conditions present in this region.

5.0 DIVERSION MATERIALS MANAGEMENT

5.1 Introduction

A critical portion of this Plan is evaluating how the state can begin to transition away from disposal and toward materials management. Similar to Section 4 on solid waste collection services, Section 5 starts with a background discussion of the types of recycling and organics activities currently found in Colorado. Existing condition tables list the current situation of services available, but not necessarily how commonly they are used. The remainder of the section is organized geographically based on the four regions of the state (Front Range, Mountains, Eastern/Southeastern and Western Slope) as shown in the Introduction Section (see Figure 1-1 in Section 1.3.3). For each geographic region, this section evaluates the current system, as well as needs, gaps, support and cooperation and funding opportunities. Due to the linkages between collection and diversion issues, collection recommendations are included in Section 6 of the Plan. This section also includes brief case studies. Detailed case studies are included in Appendix C.

This section includes three maps relating to waste diversion, intended to provide context for the discussion of the current system, gaps and options moving forward. Figure 5-1 (on page 5-5) identifies the locations of recycling and composting facilities around the state. Two additional maps identify the extent to which recycling (Figure 5-2) and organics (Figure 5-3) collection and drop-off programs are available. The highly populated areas of the state reflect a higher concentration of facilities and services. Not surprisingly, the bulk of the facilities, in particular, are located along the I-70 and I-25 corridors.

5.1.1 Background on Existing Recycling Service and Processing

Residential recycling: Recycling service is available in most regions of the state. Residential recycling services are provided as curbside pick-up or via drop-off service.

Drop-off recycling: In most small, rural communities, recycling may primarily be available solely as a drop-off option, either at landfills or broadly distributed at transfer stations or convenience centers – usually unstaffed with no fee, but occasionally staffed, with or without a fee. In many communities, households may have access to both recycling collection service and drop-offs.

Fort Collins' Glass Recycling - Drop-off and Curbside

- Roughly 30% of glass from single-stream recycling is eligible for glass-to-glass recycling due to breakage.
- The city would like to move glass from its mixed recycling materials collection to clean glass drop-offs to increase its value, but does not wish to reduce recovered glass tonnage.
- Collection services in Fort Collins vary and allow choices; the city is educating residents about the nuances about glass recovery and the issues surrounding recycling.
- The city of Fort Collins offers two options, including curbside single stream programs or self-haul to facilities, and encourages use of the non-single stream alternative.

Refer to Appendix C for further details.

- **Hub and spoke:** A subset of drop-off recycling, this service consists of distributed drop-off or convenience centers for recycling, with some level of processing at a centralized "hub". Some of the hub and spoke facilities are established by non-profit organizations. In this service subset, trucks can circulate among the spokes collecting individual materials; at other spokes the material is single stream and is collected at one time. Usually, processing involves baling of separated materials. In other cases, processing involves light baling of the aggregated single stream materials with transport to a single stream Material Recovery Facility (MRF) located in the Front Range, New Mexico, or elsewhere, for processing and marketing.

Recycling Hub and Spoke - Clean Valley Recycling (CVR)

- Started in 2011, CVR is the "Hub" of the recycling system in the Arkansas Valley.
- The CVR baler was purchased through a grant.
- Collection sites are located in a 30-mile radius.
- At each drop-off site, recyclables go into large 40 gallon "potato sacks" sold for $3.
- Baled materials are stored at their site, located in an old sugar mill, to await a full load for transportation to Denver or elsewhere.
- CVR works with The Lamar Partnership which sells bags at the Chamber of Commerce and donated site containers.

Hub and Spoke - Angel of Shavano

- Located in Poncha Springs, Angel of Shavano took over recycling for Chaffee County in 2012.
- Angel of Shavano tripled the amount of material at the drop-off sites and created jobs for five employees. Waste Management's curbside recycling is processed by Angel of Shavano.
- Recycled material is sent directly to mills, manufacturers or exporters and 5% of the total material sales is reimbursed to the county and local government.

Refer to Appendix C for further details.

Multifamily recycling: In Colorado, recycling services for multifamily establishments are rare. When provided, the type of recycling service generally depends on the type of container. If the building is most like single family dwellings (four-plexes, etc.), collection is via containers (collected via rear loader or automated truck) and arranged on an individual basis or on a pre-determined schedule. If the multifamily building is similar to an apartment complex, or mixed use, recycling services are commonly delivered by detachable containers (dumpsters) and treated by haulers as a commercial customer.[1] Multifamily recycling is available in Boulder, however many communities in the state are not considering multifamily recycling until after they capture the residential and potentially commercial sectors. Some communities such as the Town of Superior have "space for recycling" ordinances in place for the commercial and multifamily sector. Historically, the multifamily sector has been complicated. This challenge is also seen

[1] University housing and building recycling services are most commonly arranged as a contract by the university or by university staff and truck owners.

in leading communities nationally (e.g., Seattle, San Jose, etc.). Challenges include limited space, “split incentives” between generators and bill payers, high resident turnover and contamination due to anonymity and lack of education.[2]

City of Boulder: Mandatory Commercial Recycling Ordinance

- The city of Boulder recently passed a new ordinance requiring all business owners (including multi-family residences) to provide recycling and organics service.
- Helping to ease the transition, a previous ordinance required all haulers to provide multifamily housing with free containers for recycling or composting with recycling costs embedded in the solid waste collection billing.
- This pre-existing ordinance creates an incentive for multi-family building owners to encourage their tenants to recycle.
- The city of Boulder will not begin issuing notices of violation until June 17, 2017.
- The penalties are $500 for a first offense, $1,000 for a second and $2,000 thereafter.

Refer to Appendix C for further details.

Home owner association (HOA) recycling: Generally, when recycling is included as part of the HOA services, it is contracted across member households and the cost is embedded in the HOA fees. Joint solid waste and recycling collection contracts for HOAs are most prolific along the Front Range and the collection tends to include solid waste and single stream recycling in separate containers. In some Colorado jurisdictions, HOAs are covered and called out by residential ordinances; in other areas, the coverage for HOAs is unclear.[3]

Commercial recycling: In Colorado, commercial recycling collection is almost universally provided by haulers using carts or dumpsters, charging by the number, size and frequency of recycling collection (parallel to commercial solid waste service). The service is a separately paid option service (with two exceptions – Vail and recently, Boulder). Some businesses “self-haul” their recycling to a MRF or other sites, or contract directly with brokers. A few large chains have separate arrangements (e.g. Walmart) for their own recycled commodities.

Commercial PAYT with Embedded Recycling

- A city wide ordinance was passed in Vail in 2014.
- As a resort/tourist community much of their waste came from businesses providing services to guests such as condos, restaurants and hotels.
- Owner(s)/occupant(s) of all premises and commercial establishments are responsible for ensuring that no recycling goes into their solid waste collection containers, contracting recycling services, ensuring delivery of recyclables to a MRF.
- To accommodate additional containers, the city of Vail waived building permit fees if a new solid waste structure had to be built and offered a rebate up to $750 for building and/or signage.

Refer to Appendix C for further details.

[2] Some strategies that have included bounties to haulers for building participation, “champions” for recycling in buildings (who encourage and educate residents and keep materials clean), provision of household containers and many other strategies. More recently, after 20-plus years of trying different approaches, San Jose elected to deliver its multifamily materials to a MRF. This controversial strategy boosted recovery of their multifamily sector.
[3] HOAs can require compliance at contract expiration or with some lead time to avoid interfering in contractual relationships.

Funding: Funding for recycling collection services is provided through fees paid directly to private haulers, or community taxation paid to cities when recycling collection is municipal. When contracted, the cost can also be embedded in the complete solid waste collection service fee.

Table 5-1 provides a summary of the currently offered recycling options in the state. Figure 5-2 provides a statewide map of recycling services. Each region is discussed individually in the following sections.

Table 5-1: Current Recycling Collection Services by Region

Region	Sector		
	Residential	Commercial	Multifamily
Front Range	Abundant	Abundant	Common
Mountains	Common	Common	Limited
Eastern/ Southeastern	Limited	Limited	None
Western Slope	Common	Common	None

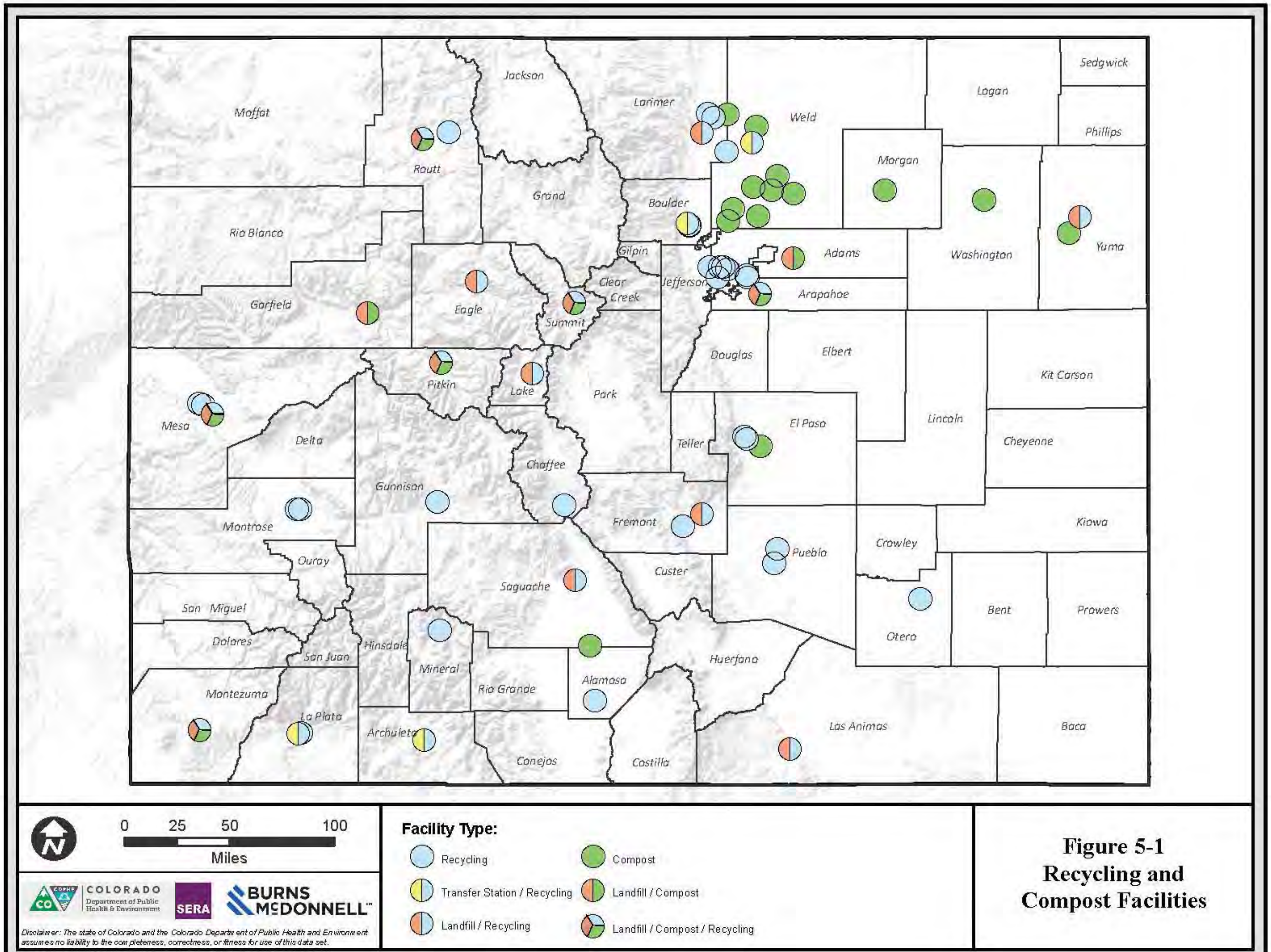


Figure 5-1
Recycling and Compost Facilities

Sources: Burns & McDonnell Engineering, ESRI

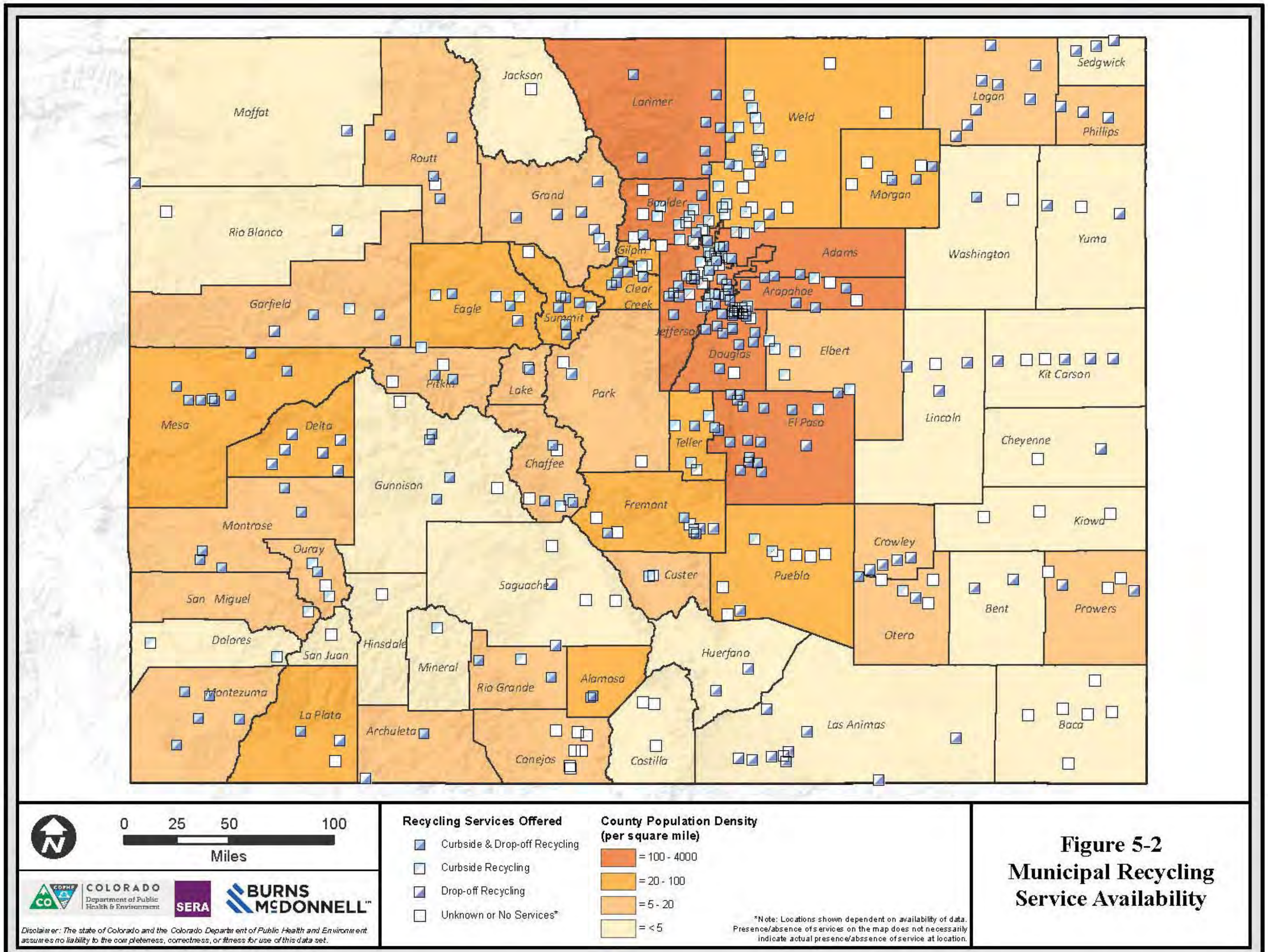


Figure 5-2
Municipal Recycling Service Availability

Sources: US Census, Burns & McDonnell Engineering, ESRI

Recycling processing: Recycling processing facilities (MRFs) are scattered throughout the state, with concentration in both number and size surrounding the densely populated areas of the state, predominately in the Front Range. Colorado has a mix of private and public MRF operations. Types of MRFs present in Colorado are described below.

- **Single stream MRFs**: Facilities in the Front Range tend to be more highly-automated single stream facilities that accept materials from both residential and commercial sources. Sorting equipment at these facilities can handle incoming recyclable materials that are commingled. Sorting at single stream MRFs is generally automated and not manual.
- **Dual stream MRFs:** Although single stream is the norm, some dual stream MRFs exist in Colorado, including the Eagle County MRF. These facilities do not include the extra equipment and labor needed to sort containers from paper. However, the focus is on reducing the chances for contamination by keeping glass and plastics from the paper stream to try to capture higher market prices.
- **Small scale manual operations**: Dump and Pick, baling only, or similar small manual operations: The state has numerous low-tech facilities, including hub and spoke or facilities that conduct basic sorting on a tipping floor followed by baling of separated materials. Facilities bale pre-sorted materials that are accepted from drop-off facilities. Low-tech facilities with a basic manual sorting line along a conveyer belt also exist. In some cases, haulers run informal operations to accomplish basic sorting which they then sell directly to brokers for higher revenues. They often accompany this process with specialized routes, running their recycling trucks to focus on offices and avoid restaurants, for example, to help provide cleaner, higher-saturation input materials.

Boulder County Publicly Owned and Privately Operated MRF

- The Boulder County Recycling Center (MRF), owned by the county and operated via county contract by Eco-Cycle, was built after a ballot initiative approved a recycling sales tax.
- The facility is roughly 50,000 square feet and processes an average of 48,000 single-stream tons per year (an estimated 38,880 tons residential, 5,280 tons commercial and 3,840 tons source-separated materials from drop-offs). The maximum capacity of the facility is 75,000 tons annually.
- The MRF originally accepted dual-stream materials, but in 2008 began accepting single-stream materials.
- The facility utilizes environmentally sustainable practices such as daylighting, use of recycled/sustainable materials, water reuse from roofs for irrigation and others.

Refer to Appendix C for further details.

Alpine Waste Privately Owned and Operated MRF

- Alpine Waste and Recycling is the largest privately held commercial solid waste collection company in Colorado.
- The recycling sorting facility is roughly 50,000 square feet and has the capacity to processes 30 tons/hour. The facility processes more than 6,000 tons per month and processed an average of 80,000 single-stream tons in 2015.
- Alpine was the first facility in Colorado to accept expanded polystyrene (EPS) and has a dedicated line with an EPS condenser to form “bricks” for recycling.

Refer to Appendix C for further details.

Additional case studies of MRFs are included in Appendix C, including Eagle County's Multi-material MRF and Altogether Recycling's large scale private MRF.

Table 5-2: Current Recycling Processing System by Region

Region	Stakeholder Meeting Location	Transfer Stations	Recycling Facilities	Recycling Facilities with On-Site Processing
Front Range	Denver	Common	Abundant	4
	Loveland	Common	Limited	2
	Pueblo	Common (most by Colorado Springs)	Common	3
Mountains	Alamosa	Limited (especially in rural areas)	Limited	2
	Silverthorne	Common	Common	4 to 5
Eastern/ Southeastern	Sterling	Common	Limited	1 (small scale)
	Lamar	Limited	Limited	1 (small scale)
Western Slope	Durango	Common	Common	2
	Grand Junction	Limited	Common	3

5.1.2 Background on Existing Organics Service and Processing

Residential organics service: Some communities along the Front Range offer combined yard waste and food scraps collection. Yard waste service is generally provided via drop-off service.

Curbside organics: Curbside organics service is most commonly provided by a private hauler or by city staff. The service is occasionally "embedded" and charged as part of a combined solid waste and recycling bill. In Colorado this service is not often available to residents. Yard waste service is the more common option for communities in the state, however a combined yard waste and food scraps service is becoming a more popular option in cities such as Boulder and Longmont. When provided, the material is usually collected in a lidded 96-gallon wheeled cart funded through a separate fee (e.g. Superior's Rock Creek HOA), or sometimes the fee is embedded in the solid waste collection bill (e.g. Lafayette, Boulder). A few communities, like Lafayette and Louisville, allow the generator to choose the size of organics container and charge based on the size. In most of the programs, service is year-round.

- **Drop-off organics**: In all sizes of communities in Colorado, yard waste drop-off sites are available. Facilities have year round and seasonal options, located at landfills, or more broadly, transfer stations or convenience centers. These centers are usually unstaffed with no fee. However, some are occasionally staffed, with or without a fee. Some facilities make the compost product available to residents for free or reduced fees. Drop-off programs in Colorado generally do not accept food waste. An additional case study of Summit County's drop-off organics program is included in Appendix C.
- **Seasonal/special and clean-ups**: It is common for communities to have special yard waste events, including holiday tree chipping events, a leaf drop-off or street side collection or "spring

Denver's Residential Curbside Organics Pilot Program

- A 2008 waste composition revealed that over 50% of the residential waste stream was compostable.
- Solid waste services are paid through property taxes and general funds.
- Through grant funding, the pilot program began in 2008 as a single route.
- With a funding shortfall in 2010, to continue program residents paid $9.75/HH/month.
- In 2012 Denver SWM was able to secure a $2 million inter-agency loan from the Denver Department of Environmental Health.
- The grant paid for the purchase of new carts and trucks, and collection and processing costs.

Refer to Appendix C for further details.

City of Louisville: Contracted Solid Waste, Recycling, and Organics Collection

- Through a contract with a private hauler, the city of Louisville provides solid waste, recycling and organics collection services to its residents.
- Solid waste is collected weekly, single stream recyclables and organics collection (food and yard waste) alternates every-other-week.
- The hauler provides the carts and customers can choose a 96-gallon, 64-gallon or 32-gallon cart for each separate service.
- A 64-gallon cart for solid waste, recycling and organics costs approximately $24.64 per month.
- The cost of recycling and the first 32-gallons of organics is covered in the fee for solid waste collection.

Refer to Appendix C for further details.

Superior's Drop-off Organics Program

- In 2005, the Town of Superior opened a 3,000 square foot seasonal yard waste drop-off site, open weekend days and one weekday evening, and staffed by a greeter (closed in winter).
- The facility has two concrete pads for 30 cubic yard roll-offs.
- In 2015, 101 tons of yard waste were collected.
- The largest challenge faced by the facility has been to balance increased usage and availability of service while minimizing contamination.

Refer to Appendix C for further details.

clean-up" programs that include significant yard/green materials. A few communities have included the costs in the structure of their hauling contracts, thought usually the costs of these services are embedded in taxation[4].

City of Boulder: Mandatory Commercial Recycling Ordinance & Food Mandates

- As part of Boulder's recently passed commercial ordinance - all business owners must separate recyclable and compostable material.
- They must also provide recycling and compost containers anywhere they have solid waste containers for employees or customers.
- This ordinance becomes effective on June 17, 2016.

Refer to Appendix C for further details.

Commercial organics: Commercial organics consist of food scraps from restaurants, grocery stores and cafeterias (hospitals, long term care, universities, etc.). Service for food organics collection is not commonly provided in large dumpsters because the material can be too heavy for transportation. The service is provided frequently in smaller containers to also reduce common odor issues associated with this material. The service is billed by the number, size and frequency of collection, parallel to commercial solid waste collection service. The service is almost universally a separately-paid, optional service (with two exceptions: Boulder implemented a mandate for some business types and Fort Collins is considering a Universal Recycling Ordinance that may require the same for commercial organics). Some businesses "self-haul" their food scraps to the landfill; some businesses have invested in "Earth Tubs™" as part of a farm-to-table ethic to bring organic waste materials to their farm to be used as nutrient rich soil additives.

Multifamily organics: Generally, there are not organic collection services provided for the multifamily sector in the state.

Home owner association (HOA) organics service: Unless required by local ordinance, HOAs rarely opt to include yard waste or food waste collection services. If the service is provided, it is generally contracted across member households and the cost is embedded in the HOA fees. There are a few HOAs that provide information to residents on how to separately contract for organics service (e.g. Superior's Rock Creek HOA). The service is generally expensive and in some cases may be separately collected and incorrectly delivered to the landfill and disposed of as solid waste rather than composted. If communities intend to include HOAs in their ordinances related to organics, they tend to call them out in ordinance text to ensure compliance.

[4] Communities that are considering PAYT programs often discontinue these "clean-ups" to avoid having people use it as garbage day.

Funding: Funding for organics service is provided through user fees paid directly to haulers, by user fees or community taxation paid to cities when collection is municipal, or contracted, or the cost is embedded in the solid waste collection fee (e.g. Boulder, Louisville, Lafayette). Table 5-3 provides the current availability of offered organics service in the state. Figure 5-3 provides a statewide map of organics services.

Table 5-3: Current Organics Collection Service by Region

Region	Sector		
	Residential	Commercial	Multifamily
Front Range	Limited	Common	Limited
Mountains	Limited	Limited	Limited
Eastern/ Southeastern	None	None/Limited	None
Western Slope	Limited	Limited	None

Table 5-4: Current Organics Processing System by Region

Region	Stakeholder Meeting Location	Compost Processing
Front Range	Denver	Limited
	Loveland	Common
	Pueblo	Limited
Mountains	Alamosa	Limited-None
	Silverthorne	Common
Eastern/ Southeastern	Sterling	Limited
	Lamar	None
Western Slope	Durango	Limited
	Grand Junction	Limited

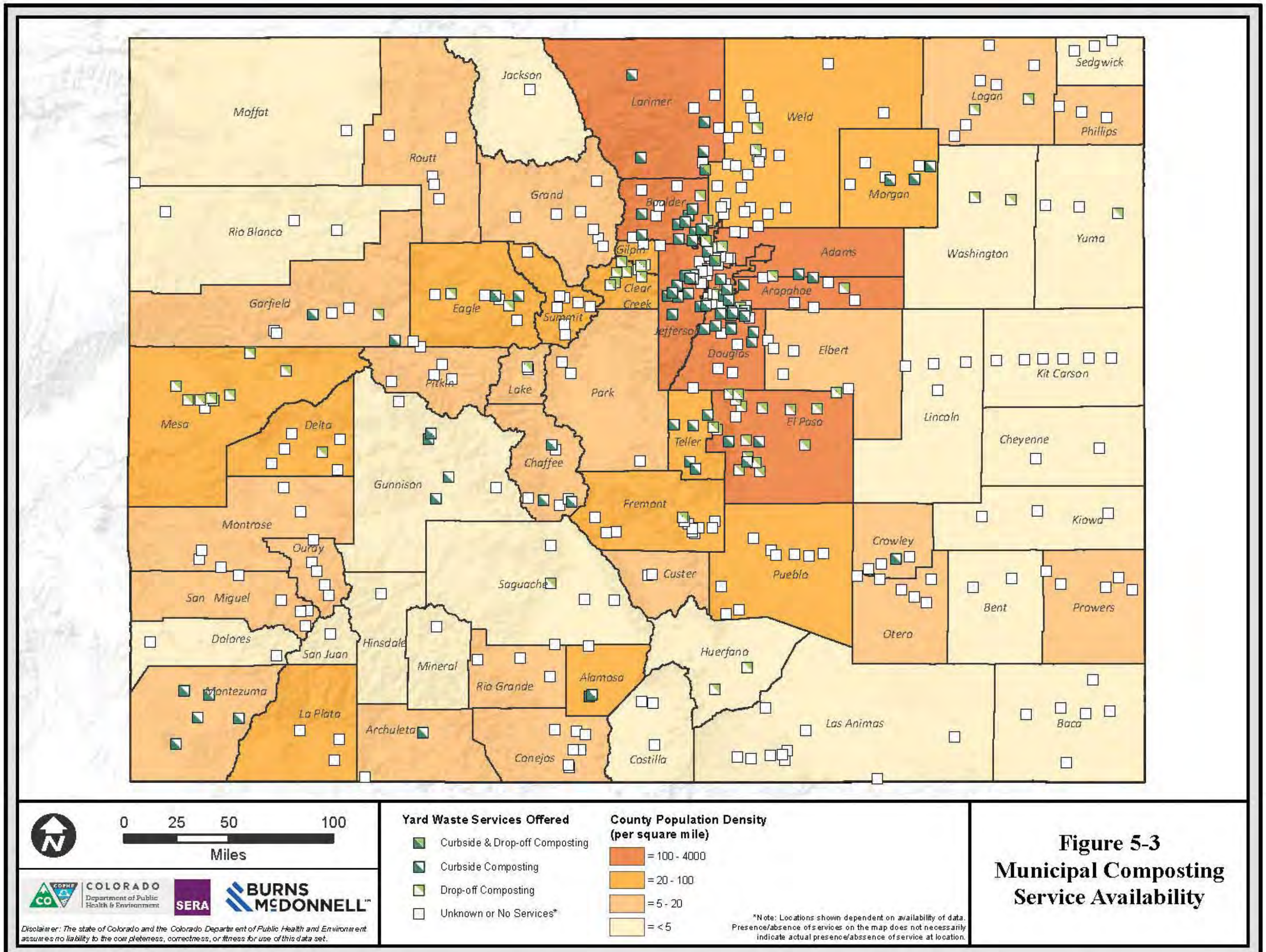


Figure 5-3
Municipal Composting Service Availability

Sources: US Census, Burns & McDonnell Engineering, ESRI

Organics processing: Organics processing facilities, or composting sites, are scattered throughout the state (see Figure 5-1), with concentration in both number and size in the more populated areas of the state. The organic processing facilities include both public and private operations. Windrow-based composting facilities are most common in Colorado. While compositing facilities are scarce in many rural areas of Colorado for residential and commercial organics, agricultural composting, where material is processed for use on agricultural land, is common.

Private Sector Organics Processing: A1 Organics

- A-1 Organics is Colorado's largest composter.
- Their facilities are located in rural areas to eliminate complaints about odor from neighbors.
- Curbside organics average $35.00 per ton.
- Remote locations require additional costs.
- A-1 Organics accept food and yard waste, manure, leaves and branches and more.

Private Sector Organics Processing-Western Disposal, Boulder

- Western Disposal is a privately owned collection company that services primarily Boulder County.
- Their Class II Compost facility processes source separated organic and food-waste materials, both residential and commercial.
- For over 10 years they have had a static pile compost facility on a nineteen-acre site within the City of Boulder without odor complaints.
- Western's Organics accept residential organics from other haulers at a price of $77.00 per ton.

Refer to Appendix C for further details.

On-Farm Composting/Farm Siting

- Under the National Organic Program Rule, organic producers have limited choices on what products can be used for crop production.
- Materials must be managed in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.
- Due to the heavy regulation and specific criteria involved in compost production, many facilities do not function as a public organics drop-off site for fear of a contaminated and unusable compost product.

Refer to Appendix C for further details.

Pitkin County: Compost Program and Processing

- Looking forward to the end of the landfill life in Pitkin County, a study revealed 40-60% of the landfill material was comprised of food waste and waste related paper.
- A yard waste ban was passed. Through a grant from the state, they purchased a compost mixer and began accepting food scraps.
- Pitkin County's compost site currently accepts roughly 781 tons of food waste and 6,442 of general compostables.

Refer to Appendix C for further details.

5.1.3 Consideration of Gaps, Opportunities, and Potential Strategies

Gaps are influenced by the requirements of the Solid Waste and Integrated Materials Management Plan empowering language (see (C.R.S. 30-20-100.5 (I) – (V)). The language requests a Plan that addresses:

- safe and cost effective services to Colorado residents
- maximizing waste reduction and recycling programs
- reduction of volume and toxicity of the waste stream
- education of the public
- other considerations

Gaps as identified in this Plan are related to realistic opportunities for changes in solid waste-related **strategies** (services, incentives, policies, regulations and supporting infrastructure) that relate to the elements requested in the Plan. Strategies also relate to services offered or expected in similar regions nationally.

5.2 Front Range

5.2.1 Current Diversion System

The Front Range is where many communities have high diversion rates and are moving beyond basic collection programs. Most residents have access to recycling either through curbside or drop-off programs (Table 5-5) and organics programs are becoming more available (Table 5-7). It is common for the cost of recycling to be embedded in the cost of waste collection services. Low landfill tipping fees are one of the most commonly cited barriers to increase diversion. For recycling, low market prices and contamination are also common issues (Table 5-9). While commercial recycling and organics programs are available, participation is often lacking. This region has the most recycling processing facilities (MRFs) and these facilities accept materials from the other regions (Table 5-8)[5]. Recycling processing in the southern portion of this region is limited. There are collection hubs, however materials are often transported north. Table 5-5 summarizes recycling programs available for the Front Range region based on the stakeholder meeting location.

[5] Source: Composting operations tables based on information from Eric Heyboer, Marjie Griek, and SERA

Table 5-5: Existing Recycling Availability – Front Range

Stakeholder Meeting Location	Residential		Commercial		Multifamily		Available Recycling Processing	Transfer Stations
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off		
Denver	Abundant	Common	Abundant	Limited	Common	Common	Abundant	Common
Loveland	Abundant	Abundant	Abundant	Limited	Common	Common	Common	Common
Pueblo	Common	Common	Common	Limited	Limited	Limited	Common	Common

Table 5-6: Recycling Processing Facilities – Front Range

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Denver Metro	Numerous throughout	Alpine W&R, Waste Management, Boulder County	Curbside, DOCs,[1] residential/commercial	Denver metro, north Front Range
Pueblo	Swink, Trinidad, others	Roots Recycling (formerly WE Recycle)	Curbside, DOCs, residential/commercial	South east central
Larimer	Throughout Larimer County	Larimer County	Curbside, DOCs, residential/commercial	Larimer, some Weld
Colorado Springs	El Paso, Pueblo and some Mountain counties	Bestway Recycling	Curbside, DOCs, residential/commercial	El Paso, Teller, Pueblo, Fremont

1. DOC = Drop off center

Most organics collection programs target yard waste only, but food waste programs are becoming more available. There are several large composting facilities in the eastern central portion of this region, but there is a scarcity of programs and facilities in the southern portion of the region. Table 5-7 summarizes current organics programs available for the Front Range region and each of the stakeholder meeting locations. Table 5-8 summarizes the known composting operations.

Table 5-7: Existing Organics Programs – Front Range

Stakeholder Meeting Location	Residential		Commercial		Multifamily	
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off
Denver	Common	Common	Common	Abundant	Common	Common
Loveland	Limited	Limited	Common	Limited	Limited	Limited
Pueblo	Limited	Limited	Limited	Limited	Common	Common

Table 5-8: Known Composting Operations – Front Range [1]

Location	Operator	Service Area/Type	Class
Bennet	Alpine East Regional Landfill	Front Range Residential and commercial drop off	2
Aurora	Waste Management (DADS)	Front Range Residential and commercial drop off	1
Colorado Springs	Don's Garden Shop	Southern Front Range Residential	3
Pueblo	Midway Organic	Southern Front Range Residential and commercial drop off	1
Erie	PermaGreen	Statewide Distribution through retailers	3
Eaton	A1 Organics	Eastern, Front Range Residential and commercial drop off	1
La Salle	Heartland BioDigester	Statewide Commercial only	None listed
Keenesburg	A1 Organics	Wholesale only	1

1. Does not include Class V agricultural or on-farm only facilities

5.2.2 Needs, Gaps, Support, Cooperation and Funding Opportunities

Table 5-9 summarizes current needs, gaps, support and funding opportunities identified for the Front Range.

Table 5-9: Needs, Gaps, Opportunities and Funding for Diversion – Front Range

Issues	Findings	
Needs/Concerns	• Weak municipal support • Market prices are low and access is difficult, creating unprofitable economics • Issues arise from contamination • Low landfill fees create an atmosphere where it is easy to discard rather than recycle • Siting and permitting issues for organic facilities	• Lack of local program demand and supply for organic facilities • Low landfill prices and unlimited solid waste collection services make it unprofitable to operate organic sites • The diversion system received a 4.0 on a scale from 1 to 5, where 5 is working well
Gaps	• Biggest gap is private industry profitability, which is currently being publicly subsidized • Diversion industry lacks participation as well as material market value and proximity needed to be independently profitable	• Siting guidelines for organics make it difficult to establish facilities
Want/Support	• Regional planning districts • Hauler licensing for residential and commercial services • State diversion goals- two tiers (lower goal for smaller population or rural areas) with measurement • Contamination control • Some support for landfill bans on cardboard, bottles and cans	• Producer responsibility • State level PAYT • Hub and spoke programs • Landfill surcharges • Mandates for diversion • State should do more measuring/ reporting of materials • More recycling education
Cooperation	• There is expertise and passion in the disposal/diversion industries • Opportunity for sharing best management practices, coordinating and collaborating resources is available. • Educational resources and environmental groups (CAFR, RMOC, RCAB, CML) can help share education and resources • Co-locating recycling remanufacturing at MRFs and transfer stations to improve synergy	• Bridging I-25 divide to help spread services and share resources • More sharing of systems, community gardens and reuse areas • Provide city models with strong programs • More directed meetings /communication • Marketing materials, coordinating transportation, scheduling and transportation network • Collaboration, with consideration of waste shed authority • Share public events and publicity
Funding in Place	• Advance Disposal Fees (ADFs) such as those for bags and paint • Litter taxes	• User fees • Landfill surcharges • A few areas do not have taxes on certain material streams
Funding would Support	• Economic development assistance • Tax incentives for facilities and programs • No taxes on some material streams	• Strong support for a solid waste tax, most common support is for between $0.10 - $2.00 per household/month • Producer responsibility programs

Feedback was also gathered on strategies that might be suitable and supported by the stakeholders. The strategies with wide support by stakeholders within this region include:

- State level goals, two-tiered
- Associated measurement and reporting
- Licensing for residential and commercial haulers, with reporting
- Establishing regional planning districts (with funding authority)
- Two of the three sub-areas strongly supported PAYT mandates, potentially at the state level
- Two of the three subareas supported landfill bans, mentioning OCC and bottles/cans
- User fees and solid waste taxes/fees (in the $0.10-$2.00 range/household/month)
- Landfill surcharges to modify recycling economics
- No taxes on recycling and organics streams (to modify recycling economics)
- Hub and spoke in outlying areas
- Producer responsibility initiatives/industry supported programs
- Economic development assistance
- CDPHE release the landfill and materials management plan soon
- CDPHE finish siting guidelines for organics
- CDPHE provide local planning assistance

The main driving forces underlying the recycling and organics collection/facility-related recommendations in this region are:

- There are substantial diversion programs in place within this region, but there remains additional regional appetite to divert more recycling from outside of the region.
- Programs and facility access are well established in the Metro/I-25 Front Range areas (e.g. Boulder's and Denver's access, densities and transportation distances are substantially less than rural/Northern Weld County, Elbert, Southern Pueblo County, etc.).
- There are hub and spoke programs in place in the outside of the I-25 Front Range Areas that fit well into the respective communities.

Stakeholder Insight -
Front Range Plastics Recycler

"Build programs that connect processors with their end-users in more of a partnership than a transactional way. At the moment, each individual business seems to either sink or swim based on how well they can sell their product. This is a short-term, not a long-term way, of dealing with fluctuating commodity prices, which often make it hard for these businesses to stay swimming. Partnerships with buyers (who aren't simply brokers) will permit less fluctuation in the prices, which will allow recycling/composting business to be more attractive to get into and to stay in."

Inappropriate Programs:

- For this region there are few programs that would be inappropriate. Aggressive requirements set by the state are suitable and given the population and facility densities, practices in this region have dramatic effects on the overall state performance.

5.3 Mountains

5.3.1 Current Diversion System

Several cities and counties in this region are committed to significantly increasing diversion and have dedicated resources to programs and facilities. Recycling is included in the cost of residential solid waste service for many areas along the I-70 corridor. There is also an active hub and spoke program throughout the region. High tourist populations bring in funding, but also cause consistency issues. Processing facilities are available; however, participation rates are low. There are limited recycling options in the southern portion of the region (Table 5-10), many drop off sites are run by volunteers and no major MRF or single stream processing facilities are present within the region, which cause higher transportation costs for collection systems. Insufficient demand and access to markets are reported as significant barriers. Table 5-10 summarizes recycling programs available for the Mountain region based on stakeholder meeting location.

Table 5-10: Existing Recycling Availability – Mountains

Stakeholder Meeting Location	Residential		Commercial		Multifamily		Available Recycling Processing	Transfer Stations
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off		
Alamosa	Limited	Limited	Limited	Common	Limited	Limited	Limited	Limited
Silverthorne	Abundant	Abundant	Abundant	Common	Common	Abundant	Multiple	Multiple

Table 5-11: Recycling Processing Facilities – Mountains

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Canon City	Fremont and Custer counties	Phantom LF (Twin Enviro), Howard Disposal	Curbside, DOCs[1], Residential/Commercial	Fremont and Custer
Salida	Buena Vista, Poncha Springs	Angel of Shavano	DOCs	Chaffee; also accepts from Park, Hinsdale
Archuleta	Pagosa Springs	Archuleta County	DOCs	Archuleta (takes to Durango)
Creede/Del Norte	Crestone, Monte Vista, South Fork	MDS Waste [2]	DOCs	Hinsdale, Mineral, Rio Grande, Alamosa
Gunnison	Crested Butte	Gunnison County	DOCs	Gunnison
Leadville	Leadville	Lake County	DOCs	Lake
Breckenridge	Summit County	Summit County, Waste Management	DOCs, some curbside by Waste Management, Residential/Commercial	Summit
Wolcott	Vail, Red Cliff, Eagle, Edwards, Gypsum	Eagle County	DOCs, some curbside by Waste Management	Eagle
Pitkin	Basalt, Carbondale, Snowmass	Pitkin County	DOCs, some curbside (by Waste Management)	Pitkin
Steamboat	Hayden, Oak Creek	Twin Enviro, Waste Management	DOCs, some curbside	Routt

1. DOC = Drop off center
2. Previously was Recycle Creede, now being serviced by a small local hauler

Table 5-12 summarizes organics programs available for the Mountain region based on the stakeholder meeting location.

Table 5-12: Existing Organics Programs – Mountains

Stakeholder Meeting Location	Residential		Commercial		Multifamily	
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off
Alamosa	Limited	Limited	Limited	Limited	None	None
Silverthorne	Limited	Abundant	Limited	Limited	Limited	None

Table 5-13 summarizes the known composting operations.

Table 5-13: Known Public Composting Operations – Mountains

Location	Operator	Service Area/Type	Class
Milner	Milner Landfill (Twin Enviro)	Routt County Residential and commercial drop off	1
Snowmass Village	Pitkin County	Pitkin County Residential and commercial drop off	1
Saguache	Colorado Natural Compost		None listed
Center	Compost Technologies		None listed
Hooper	Soil Solutions	South central mountains (sell nationally)	5
Glenwood Springs	South Canyon Disposal Site (City of Glenwood Springs)	Glenwood Springs Residential and commercial drop off	1
Dillon	Summit County	Summit County Residential and commercial drop off	1

1. Does not include Class V agricultural or on-farm only facilities

5.3.2 Needs, Gaps, Support, Cooperation and Funding Opportunities

Table 5-14 summarizes current gaps and opportunities identified for the region. The northern area along the I-70 corridor has more services and facilities and a higher tourist population. In the southern portion of the region, the City of Alamosa has most collection services available, while there are few of the available services in the rural areas.

Table 5-14: Needs, Gaps, Opportunities and Funding for Diversion – Mountains

Issues	Findings	
Needs/Concerns	• Recycling is unprofitable due to market access and prices • Organics is unprofitable due to operating costs and permitting **Both** recycling and organics: • Lack municipal commitment • Economics hurt by low landfill prices	• Contamination issues are present in recycling and organics • Poor enforcement of regulations • Northern area is hampered by a large transient tourist population (education, convenience for them, etc.) • The diversion system received a 2.8 on a scale from 1 to 5, where 5 is working well
Gaps	• Transfer stations • Hub and spoke model • Education and outreach • Grants and subsidies for infrastructure • Regionalization/collaboration	• Funds/money/resources – including RREO/grants/subsidies • State level policy with goals • Bottle bill • Regional leadership and sharing of resources • Composting processing
Want/Support	• Some support for planning areas with funding • User fees • Enterprise funds • Training and outreach • Planning assistance • Landfill surcharge • Some support for generator fees or environmental fees up to $2/household/month	• Regional/state level solid waste tax • Waste to energy • Hauling licensing/reporting • Economic development assistance • Bottle Bills (traditional and Delaware-type) • Recycling goals • Planning districts • PAYT only in certain cases • Hub and spoke
Cooperation	• San Luis Valley Ecosystem Council • USDA Recycling Group • Waste tire inspection grant • Entities with solid waste grants work together • Safety First Fund Summit - shared resources/facilities.	• Recycling infrastructure is available with room for improvement • Share compost facility and related expertise as a hub • Those with PAYT share best practices with other cities • Recycling goals and planning districts
Funding in Place	• User fees • To a lesser extent, landfill surcharge	• Advanced disposal fees or litter fees • Enterprise funds
Funding would Support	• Bottle bill • Strong support for producer responsibility	• Landfill surcharge • Tax benefits for investments • Environmental fees

Feedback was gathered on strategies that might be suitable and supported by the community. The support for strategies has been split in this region by areas, as follows:

Alamosa and Silverthorne meetings stakeholders supported

- Planning areas (with funding authorization)
- Planning assistance

- Hub and spoke
- User fees and environmental or generator fees (up to $2/household/month)

In addition, Silverthorne meeting stakeholders supported

- Recycling goals
- Bottle bills
- Landfill surcharges

In addition, Alamosa meeting stakeholders supported

- Hauler licensing and reporting
- PAYT only in certain areas
- State level solid waste tax
- Waste to energy
- Enterprise funds

From CDPHE, Alamosa meeting stakeholders wanted:

- Training and outreach

The main driving forces underlying the recycling and organics collection/facility -related recommendations in this region are:

- There is a strong interest in sustainability along the I-70 Mountain corridor due to a high tourist population.
- The tourist and second-home nature of the I-70 Mountain communities complicates programs, especially in terms of education. Overall performance for the communities is hampered because if residents recycle, but tourists do not, the high percentage of tourists hurts the numbers.

Stakeholder Insight -
Recycling Processor and Collection Company

"In the future closer facilities need to pop up that accommodate smaller amounts of materials - this will reduce transportation costs and capital costs, while the material can ultimately go to a transfer station". (Recycling Processor)

"Compost is a work in progress so we are getting closer to a good system. Our local MRF has outdated technology that can only take duel stream but our residents and businesses are demanding single stream so we have to ship many recyclables to the Front Range. It's very cheap to bury everything in the landfill and that seems very short sighted". (Recycling Collection Company)

- Transportation distances between generators and facilities and getting materials across the mountains during the winter months makes collection services difficult.
- The southern portion of the Mountain region is substantially different from the rest of the region having lower population densities, lower incomes, fewer second homes and tourism and a greater likelihood to be transporting materials to neighboring states.

Inappropriate Programs:

- Provide reduced requirements for the rural areas of the region; very aggressive programs would not be appropriate.
- However, more aggressive options are suitable in the I-70 corridor because of facility access and strong interest in sustainability.

5.4 Eastern/Southeastern

5.4.1 Current Diversion System

Profitability and insufficient demand for products are the top barriers to recycling in this region. There are some successful hub and spoke programs, but full processing facilities are not present in this region (Table 5-16). Hub and spoke programs are limited by the distance between communities. Few areas within the region offer recycling as a subset cost to solid waste service. Table 5-15 summarizes current recycling programs available for the Eastern/Southeastern region based on stakeholder meeting location.

Table 5-15: Existing Recycling – Eastern/Southeastern

Stakeholder Meeting Location	Residential		Commercial		Multifamily		Available Recycling Processing	Transfer Stations
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off		
Sterling	Limited	Common	Common	Limited	None	None	None	Common
Lamar	Limited	Limited	Limited	Limited	None	None	Limited	Limited

Table 5-16: Recycling Processing Facilities – Eastern/Southeastern

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Denver	Sterling	Waste Management	Curbside (Sterling, other), DOC, Residential and Commercial	Julesburg, Sterling, other towns in NE (Northeast)
Yuma (new)	Keenesburg, Hillrose, Eckley	Quest Services	DOCs, Commercial Curbside	NE and East Central
Bent	Numerous	Southeast and East Central Recycling	DOCs	14 counties in east central and southeast, 1 in Kansas
Swink	La Junta, Rocky Ford, Manzanola, Fowler, Ordway, Ead	Clean Valley Recycling	DOCs	Southeast – 7 counties
Trinidad		TerraFirma	DOCs	Las Animas County

1. DOC = Drop off Center

Lack of financing and participation are cited as the main barrier to promoting growth in organics programs within the region. This is a high agricultural region and people compost on their own property. The composting sites listed by the state in this region were identified to no longer accept organics. Table 5-17 summarizes organics programs available for the Eastern/Southeastern region based on the stakeholder meeting location.

Table 5-17: Existing Organics Availability – Eastern/Southeastern

Stakeholder Meeting Location	Residential		Commercial		Multifamily	
	Curbside	**Drop-off**	**Curbside**	**Drop-off**	**Curbside**	**Drop-off**
Sterling	None	Limited	None	None	None	None
Lamar	None	None	None	None	None	None

Table 5-18 summarizes the known composting operations.

Table 5-18: Known Composting Operations – Eastern/Southeastern [1]

Location	Operator	Service Area/Type	Class
Yuma	Ace Composting	Rendering	1
Ft. Lupton	BOSS Compost	Front Range for sales, unknown for intake (manure, definitely)	None listed
Akron	Colorado Compost	Unknown	3
Fort Morgan	Teague Enterprises	Not for public (commercial machinery)	2

1. Does not include Class V agricultural or on-farm only facilities

5.4.2 Needs, Gaps, Support, Cooperation and Funding Opportunities

Table 5-19 summarizes gaps and opportunities identified for the region. This region is fairly homogenous in types of facilities and the distances traveled for services.

Table 5-19: Needs, Gaps, Opportunities and Funding for Diversion – Eastern/Southeastern

Issues	Findings	
Needs/Concerns	Lack of the following for recycling and organics: • Material supply • Municipal commitment • Program participation • Finances/profitability • Market access and demand • High costs to operate	• Contamination issues • Insufficient understanding of some technologies • Too much regulation • Transportation distances • The diversion system received a 2.8 on a scale from 1 to 5, where 5 is working well
Gaps	• Better (more accessible) markets • Better/more accessible sources of funding • Improved education • Reasonable beneficial use permitting	• Reduced state regulation • More local control • Need more education • There are no public organic composting sites or full scale MRFs
Want/Support	• Hub and spoke • Waste to energy • Two-tier state recycling goals (lower goals for rural or certain regions) • Local planning assistance and training • Regional planning districts	• Bottle bill (traditional type and Delaware model) • Community members would like more burning to be allowed within the region • CDPHE technical assistance in lieu of fines
Cooperation	• Coordinated strategies among CDPHE divisions for overall benefit to public health, which might instigate some very innovative projects • Hub and spoke • volunteer-run facilities	• Public/private partnerships and collaboration • Some concerns that distances are too great out on the plains for effective sharing opportunities
Funding in Place	• User fees are by far the most commonly reported form of funding • Landfill surcharges	• Much less common: fees on hauler contracts
Funding would Support	• Economic development assistance • Environmental fee • Oil and gas tax • Incentives/tax benefits for facility co-location	• User fees • Fees on hauler contracts • Industry funded programs • No taxes on some streams

Feedback was gathered on strategies that might be suitable and supported by the community. The support for strategies has been communicated in this region by areas, as follows:

Sterling and Lamar meetings stakeholders supported:

- State level goals, two-tiered
- Possible waste to energy

In addition, Sterling meeting stakeholders supported:

- Hub and spoke
- Allotments from oil/gas tax
- No taxes on recycling and organics streams
- Environmental fees
- Facility co-location incentives

In addition, Lamar meeting stakeholders supported:

- Bottle bill
- Economic development assistance
- Fees on hauler contracts
- Industry-funded programs/producer responsibility

From CDPHE, Lamar and Sterling meeting stakeholders are looking for:

- Organics siting guidelines
- Local planning assistance
- Training

The main driving forces underlying the recycling and organics collection/facility-related recommendations in this region are:

- There is interest in hub and spoke and it is a suitable option for the area.
- On-site agricultural composting exists throughout the region.
- There are PAYT options; however, few have recycling options.
- Interest in economic development assistance and co-location of facilities was conveyed during stakeholder meetings.

Stakeholder Insight -
Town Administrator and Public Works Director

"One concern we do have for future budgeting concerns is the Town and surrounding area are seeing a declining population". (Town Administrator)

"The state needs to make composting more operator friendly, less regulation. Smaller communities don't have a lot of revenue for staff and permit or annual fees. Tax payers shoulder too much cost now". (Public Works Director)

Inappropriate Programs:

- For this region, mandates and bans will not be well-received and the lack of access to organics processing limits program initiatives in the near term.
- Low incomes and the anticipation of illegal dumping are a concern.
- Low population densities (along with mountain barriers) affects economics of diversion.

5.5 Western Slope

5.5.1 Current Diversion System

Curbside recycling is embedded in about half of the communities where curbside recycling is available. Processing is limited and is complicated by mountain passes. Much of the material is transported out of state to New Mexico or Utah. There is regional cooperation in the southern portion of the region and interest in improving the collection systems. Residents within the region are reluctant to contribute any additional monetary resources for recycling services. Table 5-20 summarizes recycling programs available for the Western Slope region and based on the stakeholder meeting location.

Table 5-20: Existing Recycling Availability – Western Slope

Stakeholder Meeting Location	Residential		Commercial		Multifamily		Available Recycling Processing	Transfer Stations
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off		
Durango	Common	Common	Abundant	Limited	Limited	Limited	Limited	Common
Grand Junction	Abundant	Abundant	Common	Common	Limited	Limited	Limited	Limited

Table 5-21: Recycling Processing Facilities – Western Slope

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Grand Junction	Locations in Mesa and Delta Counties	Mesa County, Grand Junction Curbside Recycling Indefinitely (with City), Waste Management	Curbside, DOCs[1]	Mesa and Delta
Montrose	Paradox, Gateway, Ouray, Nucla	Bruin Waste	DOCs	Montrose, Ouray and San Miguel (some Delta/San Juan)
Durango	La Plata, Montezuma, San Juan, Dolores	City of Durango, Phoenix Recycling	Curbside, DOCs	La Plata, Montezuma, San Juan, Dolores

1. DOC = Drop off Center

There are few areas that offer organics service and processing. It can be difficult in this region due to geography and climate. Some areas offer drop off yard waste areas, but the material, rather than being composted, is sent to a landfill classified as solid waste. Table 5-22 summarizes current organics programs available for the Eastern/Southeastern region.

Table 5-22: Existing Organics Availability – Western Slope

Stakeholder Meeting Location	Residential		Commercial		Multifamily	
	Curbside	Drop-off	Curbside	Drop-off	Curbside	Drop-off
Durango	Limited (outside City)	Limited	Limited	Limited	Limited	Limited
Grand Junction	Limited (outside City)	Limited	Limited	Limited	Limited	Limited

Table 5-23 summarizes the known composting operations.

Table 5-23: Known Composting Operations – Western Slope [1]

Location	Operator	Service Area/Type	Class
Austin (Delta County)	CB Industries	Western Slope	1
Grand Junction	Mesa County Landfill	Mesa County Residential and commercial drop off	3
Cortez	Montezuma County Landfill	Montezuma County	1

1. Does not include Class V agricultural or on-farm only facilities

5.5.2 Needs, Gaps, Support, Cooperation and Funding Opportunities

Table 5-24 summarizes gaps and opportunities identified for the region. Montezuma County, in the southern portion of the region, has programs and facilities available for the services discussed and has five county's cooperating. There are few services and facilities between Durango and Grand Junction and in the northern area of this region.

Table 5-24: Needs, Gaps, Opportunities and Funding for Diversion – Western Slope

Issues	Findings	
Needs/Concerns	For recycling and organics: • Lack profitability • Lack market access • Have low participation • Other issues are a large tourist population	• Long distances to MRF (from 60-180 miles one way) and markets • Transportation especially difficult negotiating winter passes • Illegal dumping if costs increase • The diversion system received a 3.1 on a scale from 1 to 5, where 5 is working well.
Gaps	• Transfer stations • Hub and spoke • Local end use markets • Market development assistance	• Education (especially K-5) • Access to recycling for rural customers • Enhanced organics (especially food scraps) for commercial and multi-family
Want/support	• Some support for siting guidelines for organics • Regional planning districts • Local planning assistance • Small support for bans on cardboard • PAYT bundled with recycling and organics service (residential) • Strong support for hub and spoke • Waste to Energy	• Two-tier state recycling goal • More policy (not material bans which lead to illegal dumping of tires and electronics) • Require commercial recycling • More construction and demolition and household hazardous waste programs
Cooperation	• The Southwest Regional Council of Governments collaborates for increased diversion • Regional education outlet would be helpful Suggest landfill owners to provide space for composting	• Regional MRF and regional collaboration • Some facilities have 50/50 cost share with municipalities
Funding in Place	• User fees • Landfill surcharge	• Enterprise funds • Limited support for advanced disposal fees and litter fees
Funding would Support	• Local solid waste tax (between $1-5/household/month) • Economic (development) assistance • Allocation from the oil/gas tax • Landfill surcharge to improve economics of recycling/diversion • Producer responsibility programs • Implement stewardship bills to tire and electronic purchases to offset the cost for recycling	• Market development assistance • Local use requirements (require local use of locally-recovered recycled content products) • Local recycling and organics processing • Grant opportunities (to improve infrastructure in particular)

Feedback was gathered on strategies that might be suitable and supported by the community. The support for strategies has been split in this region by areas, as follows:

Grand Junction and Durango meeting stakeholders supported:

- Establishing regional planning districts (with funding authority)
- Hub and spoke
- Economic development assistance

In addition, Grand Junction meeting stakeholders supported:

- State level goals, two-tiered
- Associated measurement and reporting
- Solid waste taxes/fees (in the $1-$5 range/household/month)
- Producer responsibility/industry-supported programs
- Landfill surcharges to modify recycling economics
- Support from oil and gas funds
- Waste to Energy

In addition, Durango meeting stakeholders supported:

- PAYT mandates, potentially at the state level
- Cardboard bans

From CDPHE, Durango meeting stakeholders are looking for:

- Organics siting guidelines
- Local planning assistance

The main driving forces underlying the recycling and organics collection/facility-related recommendations in this region are:

- Limited areas with high population density
- Interest in collaboration
- Mountain passes pose significant issues for transportation of materials
- Hub and Spoke programs are a good fit for areas of this region

Stakeholder Insight -
County Landfill Manager

"Curbside in the county involves very long hauls with very few stops because of low participation. We have long distances to end markets. Nothing is sustainable if it cannot be kept local, because you end up having to depend upon others. (i.e. when the ports were on strike last year). Composting on the other hand is great. When we keep organics out of the landfill we begin to eliminate problems like leachate and methane production. We can produce a product that people want and need locally. We can begin to fix our areas over tilled, nutrient depleted, over mono-cropped soil. The problem with local composting is that the super markets, casino, hospital, will have to get separate compactor style roll-offs and retrain their employees to source separate the materials."

Inappropriate Programs:

- For this region, mandates and bans will not be well-received and the lack of access to organics processing, limits program initiatives in the near term
- Low income communities and the anticipation of illegal dumping are a concern
- Low population densities (along with mountain barriers) effects the economics of diversion

5.6 Summary of Diversion and Materials Management Sector

This section discussed diversion and materials management as it currently exists in Colorado, and identifies needs, gaps, and opportunities in the four regions of the state.

5.6.1 Summary of Needs and Gaps and Challenges Commonly Found Statewide

The challenges and gaps for solid waste diversion in Colorado vary substantially between the regions. There are examples of extremely successful diversion programs, but many areas face significant difficulties due to logistics, cost, and lack of local volumes and interest. Recycling and organics processing facilities infrastructure is still needed, especially in the rural areas of the state. Common barriers are the low cost received for recycled materials, long hauling distances to recycling markets, and low tip fees at landfills making disposal more economically attractive. Although availability to recycling services is common through all but the most rural areas of the state, usage varies greatly. Rural areas tend to rely more on drop-off recycling and participation is generally lower than with curbside systems. Commercial recycling and organics services are becoming more available, but few communities have addressed the significant gains in diversion that could be made in this sector. Organics diversion especially, with food waste included, is limited. Facility siting issues is one commonly stated barrier from stakeholders. Most of the existing programs are along the I-25 and I-70 corridors.

5.6.2 Summary of Programs Supported/Wanted by Stakeholders and Inappropriate Programs Statewide

Levels of diversion considered necessary, practical, and achievable differ between regions and even within regions. Generally, there is support for establishing a statewide diversion goal, especially if it is less stringent for areas with less access to recycling and organics. Landfill surcharges or environmental fees are also widely supported, though there is some concern that any additional charges to landfill fees may lead to illegal dumping. Local planning and economic assistance received statewide support and for the most part hub and spoke programs did as well. Hauler licensing or reporting Pay-As-You-Throw were frequently supported, and Waste to Energy also had support. More aggressive programs such as bans on certain materials would be more appropriate for the larger urban areas of the state, but not well received in most rural areas, where transporting materials to viable markets would be costly.

6.0 COLLECTION AND DIVERSION ANALYSIS AND RECOMMENDATIONS

6.1 Introduction

Sections 4 and 5 provided a summary of the status quo and gaps in the collection system and the diversion system (programs and facilities/infrastructure), respectively. Section 6 examines strategies for improving the system of collection and management of waste diversion in Colorado, identifying and assessing potential strategies and their costs toward providing recommendations for the near term and 20 year horizon. The two topics are jointly addressed because collection of solid waste and recyclables are often delivered simultaneously and the systems and recommendations are inevitably linked.

6.2 Considerations for this Section

6.2.1 Colorado's Unique Situation of Authorities and Implications for Diversion Elements of the Plan

Before appropriate strategies could be considered and crafted, it was necessary to review the authorities that could be used to make recommendations meaningful and enforceable. Strong limitations were noted, which dramatically affected the types of recommendations. However, it is also noted that progress can be made in the state because a majority of the state's population resides in areas with somewhat difficult, but not impossible, waste management economics.

State Level: The state of Colorado faces an unusual situation in regard to planning and recommendations related to diversion. **Under the Colorado Solid Waste Act, CDPHE has authorities almost exclusively in the realm of disposal at landfills. Generally, its enforceable authorities beyond disposal facilities do not exist.** There are assorted resolutions and proclamations that discuss the state's (and legislature's) interest in recognizing waste diversion and recycling. Furthermore, CDPHE is tasked with developing a Plan that provides recommendations on how to transition from disposal of waste to sustainable materials management. However, the lack of direct authority in the area of materials management, requires a Plan for collection and diversion options that:

- Speaks separately at the state level and the local level
- Develops strategies that can work because they are practical, suitable and beneficial for Colorado, and have the potential to improve waste management if the state or locality does not acquire additional authorities
- Recognizes that the recommended strategies work even better if the agencies are allowed additional authority

Local Level: Many local governments within Colorado have not asserted any of the authorities that are authorized to them in the waste management area. Counties and municipalities are generally assumed to have waste management authorities. However, as mentioned in Sections 4 and 5, the majority of jurisdictions in Colorado assert no authorities in this area. They do not register firms providing collection or programs, nor do they regulate service, rates or other elements regarding solid waste management.

Important exceptions exist – particularly the communities and counties along the Front Range and some in the Mountains that have initiated strong diversion services requirements, invested in diversion infrastructure, passed strong ordinances and fostered private business partnerships in diversion. Outside this area, few counties or local jurisdictions have gotten involved in waste management. There are exceptions. There are noteworthy individual communities along the Western Slope that have elected to initiate recycling service such as Grand Junction and Durango. Some other outstanding examples have sprung from the regional level – including pioneering hub and spoke efforts by the Upper Arkansas Area Council of Governments (UAACOG). However, most of the hub and spoke and other non-urban progress has been by non-profits or motivated individuals or groups (in a number of cases, aided by state grant funds) without strong local government/county mandates or drivers. Some jurisdictions have taken responsibility to the degree of municipally-provided service, and others have enacted ordinances or other authorities toward advancing recycling and diversion. However, by and large, in this state, the drivers have been interested councils, citizens and/or staff.

For the most part, without state authority to mandate change, and without a dramatic change in actual and relative costs between solid waste and recycling (see Section 3's recommendations that may change relative disposal costs at the local level) localities that have not undertaken change will not have specific motivation to do so. For that reason, this section's recommendations cannot have the force that they have in some other states. Until and unless the state acquires the authority to enforce change, the economics of waste management in this state are unlikely to result in widespread, meaningful movement toward improved materials' management. As a consequence, this Plan provides "best fit" strategies toward advancement, but until regulatory authority is authorized– at the state or local level – local activism and persuasion may be the main motivators of change, if any change is to happen.

This section identifies potential state and local strategies that leverage existing authorities. Suggestions are made for ways to leverage for authorities that may motivate some change. At the local level, locally-suitable programs are suggested that are as effective and cost-effective as possible. More advanced or aggressive suggestions are suitable in some areas (Front Range and possibly Mountains), but the waste management market economics of the state of Colorado make even basic programs a challenge in other regions of the state. From the state perspective this is very important, because universal access to programs, and effective programs is certainly an attractive goal. However, from a practical standpoint, it can also be recognized that **truly remote economics, and the challenges they imply, affect about half of the land area of the state, but only about 10% of the state's population** (about 7-8% in the Western Slope and 3-4% in the Eastern/Southeastern). Further, these populations are scattered in communities with populations substantially smaller than 7,000-10,000 (about one or two efficient solid waste truck's worth of business). This provides further challenges to the economics.

Therefore, the recommendations for potentially-suitable strategies for the state regions are very divided in nature, with more advanced strategies in consideration for the Front Range and potentially Mountains, but substantially less aggressive recommendations for other areas. The Plan provides the state and CDPHE with real and positive recommendations on ways to help motivate implementation of these changes (RREO grant incentives, etc.). However, at least in the near term, the ability to drive change is limited in Colorado at the statewide level under CDPHE's current regulatory authority of the Colorado Solid Waste Act.

6.2.2 Organization of the Section

Because the state of Colorado's "authorities" situation regarding collection and diversion is unique, this section is organized differently than many solid waste and materials management plans, and differently than the preceding Transfer and Disposal Section. Section 6.3 addresses the state-level situation. It provides:

- assessment considerations for state-level recommendations for Colorado
- development of recommended state-level strategies for Colorado, with an accompanying assessment of the program and funding options available at the state level
- recommendations for strategies and an "action plan" for the state
- comparisons to recommendations from other states, and effective state-level strategies elsewhere
- statewide performance estimates (tons and costs) based on recommendations
- recommended set of goals and associated measurement methods, tailored to the local/regional level for three periods: 5 years, 10 years and 20 years from now
- resource lists for potential partner agencies for connecting at the local and planning area level

Section 6.4 examines the local/regional elements of the Plan. The results are presented jointly for comparison and analysis purposes, and then broken out into sections for each of the four regions of the state. Section 6.4 provides:

- Inventory and high level ranking assessment of higher – and lower – performing strategies available at the local level
- Local program recommendations for the four regions of the state
- Planning agencies in each area of the state that may be candidates for area-wide planning if counties prefer not to establish new agencies for integrated planning
- Potential funding sources for planning, service, and programmatic initiatives

Additional supporting tables and information are provided in Appendix G and Appendix H. Section 6.5 presents a summary and implications from the work in the Plan.

6.2.3 Recommendations and Resources

This Plan, and in particular this section, serves two main purposes:

- Develops recommendations and a Plan for the state guiding progress over the next 20 years in the areas of collection and diversion
- Serves as a resource document for the communities, counties, stakeholders and regional planning agencies considering change as a result of the state's adoption of the Plan and its collection and diversion goals and recommendations. The resources are designed for urban/ suburban and rural areas of the state

As a resource document for collection and diversion in communities, this section of the Plan includes:

- **Cost models**: This section refers to the results of cost models, to generate costs for the recommended strategies at the local levels (Sections 6.3 and 6.4). Template cost models, providing ranges of costs for collection and diversion in urban, suburban and rural areas of the state are provided in Appendix E
- **Tables of high impact/low cost initiatives and inventories of programs and funding options**: Tables of recommendations for effective and cost-effective collection and diversion programs and initiatives suitable for different state regions –illustrating programs that are high impact/low cost and identifying other strategies that are less effective and more costly (Section 6.4). The Plan also provides an inventory of "typical" recommendations in zero waste plans (Section 6.4), and next stage product stewardship and market development options for the state and for communities considering advanced options (Section 6.3). Funding strategies suitable for the local and state level area also described and assessed.

- **Access to "Comp Plan in a Box©"**: Opportunities for Colorado Community staff, county staff or planning agency staff to obtain a list of tailored community-specific strategies because CDPHE has contracted for one year's worth of results from SERA's "Comp Plan in a Box©" for community staff requesting the service.[1] This is accessed through the web link www.surveymonkey/r/SERAcompplaninabox.[2]
- **Collection and diversion case studies:** The Plan also contains many case studies in Appendix C of communities and programs that illustrate how various strategies work in real-world communities, with a focus on Colorado examples. These case studies are referenced throughout this Plan.

6.3 Introduction and Summary of State Level Recommendations

6.3.1 Overarching Considerations

In addition to the content for the Plan that is required on the collection and diversion side, several additional overarching considerations are being considered in the development of recommendations and program elements.

- **Opportunities to divert**: To achieve diversion, the opportunity to recycle must be available. Having some minimum access to at least drop-off options within some reasonable distance of population centers is a core principle in this Plan. This is consistent with 30-201-101.5 CRS, which suggests that reducing waste is a community ethic that CDPHE should promote. It is also a principle of state-level recycling legislation around the US since at least Oregon's "Opportunity to Recycle" legislation dating back to 1991.
- **Barriers**: The Plan recognizes barriers; in fact, a substantial effort on the project was to conduct 10 stakeholder meetings in very different areas of the state to identify the priority barriers for each region of the state – as well as for the CDPHE. The Plan addresses a number of key barriers, but also notes others that are not easily "addressable," and that must be recognized short or longer term, and that drive the expectations and recommendations at the local and state level.
- **Motivations**: Without motivations, status quo will prevail and virtually no change will occur. In the real world, actors act in their best interests, according to markets and to rules that are set out

[1] Up to two requests per agency, from July 1, 2016 through July 15, 2017. Agency staff respond to 25 questions on a Survey Monkey form, and the inputs are used in the model to generate a tailored list of residential and commercial program recommendations for that community using SERA's "Comp Plan in a Box" program. Contact SERA at 303/494-1178 or Skumatz@serainc.com to use this resource.
[2] No additional discussion of this topic is included in the Plan; the web link explains the resource.

(and enforced). The Plan works to integrate motivations into the recommendations where possible.

- **Diversification**: Work on previous plans has made it abundantly clear that the burden of responsibilities for solid waste strategies should be spread across many actors. Concentrating too much responsibility on one actor (e.g. haulers, etc.) does not recognize that changes need to occur at all levels, leads to resentment and lack of cooperation from affected actors and does not well-leverage the change. Spreading responsibility around recognizes the responsibility all had in the *status quo* and that all have in moving toward a solution.
- **Information**: Information alone is not motivational, but the right information can be leveraged with self-interest to effect change, and can provide foundational information (costs, impacts, program ideas) useful for communities and stakeholders to develop plans that are well-informed.
- **Enforcement**: For those strategies that need enforcement, enforcement should be the expectation. Without enforcement, changes and new rules are legally meaningless, are ineffective in motivating change in the market, and are unfair to those following the new rules. Enforced rules represent a "level playing field." If new rules are understood and reasonably enforced, stakeholders will generally follow the new rules. Without enforcement, those complying will face economic disadvantage, and their businesses will be hurt, which would not be the intent of any new initiatives.
- **Economics and tradeoffs:** There are economic issues at play. Stated landfill tipping fees do not, in many cases, fully cover the cost of compliance and closure, leading to understatement of costs. Very inexpensive diversion programs could help reduce costs, and extend lifetimes of landfills. Most areas of the state face unfavorable economics between landfilling, recycling and composting, with tipping fees and combined out-of-pocket collection/transport/management costs favoring disposal. However, near-term economics is not the entire picture. A tipping fee for an "almost full," or "about to close" or "out of adequacy" landfill is not truly the low tipping fee most sites charge in Colorado – it is much higher (as discussed in Section 3). This also extends to small landfills, where the costs of adequacy (and potentially coming into compliance) along with the highly fixed costs of running the landfill are spread over relatively few tons.[3] There are diversion options that are very inexpensive to implement; they can also substantially extend the lifetime of existing landfills, with potential savings, depending on the cost of running and replacing the landfill. Implementing some of these initiatives, and regionalizing landfills can be a cost effective set of strategies, and can lead to savings for communities and landfills.

[3] And the market is not perceived to be able to bear the landfill tipping rates that would result.

- **Economic development and wasted value**: There is potentially as much as $150 per ton in profit (and additional job creation benefits) to be realized by diverting and recovering more of Colorado's "single stream mix" recyclables from the waste stream – and more per-ton value from specific materials. A high percentage of materials disposed in Colorado have market value if they were recycled instead of disposed. A 2015 study[4] found that 27% of the disposal stream, or about 1.2 million tons per year was currently recyclable (not including "advanced" recyclables) and the buried value was between $145 and $170 million annually. The value (at 2015 prices) was about $120 per ton gross, and about $60 per ton net. Disposal costs range from about $15-$60 per ton in the state or about $30 per ton average. This leaves a considerable margin to work with - on the order of $150 net per ton gross revenue (and more for individual materials) to cover collection, transport, processing and marketing.

6.3.2 Level 1 and Level 2 State Level Collection and Diversion Recommendations

6.3.2.1 Level 1 Recommendations

In this section, the state-level recommendations for the collection and diversion sections of the Plan are summarized. **These Level 1 recommendations are almost universally items that CDPHE can introduce and act on, at least to some degree, immediately, with its existing authorities and funding sources**. These recommendations are presented in Table 6-1.

[4] Skumatz and D'Souza, "Colorado's Wasted Value: Recyclables Discarded in the Front Range and Rest of the State and their Dollar, Job, and GHG Impacts," Skumatz Economic Research Associates, Superior, Colorado, May 2015.

Table 6-1: Level 1 Collection and Diversion Recommendations

1. **Adopt Goals**: Adopt the recommended Two-Tier Diversion Goals – Short and Long Term – and Support/Conduct Activities to Achieve the Goals
2. **Improve Tracking**: Improve Performance Tracking and Reporting (to the Legislature)
3. **Training Focus**: Enhance CDPHE Diversion Training/Technical Assistance and Outreach on Collection and Diversion
4. **Inspections & Incentives**: Increase Inspection efforts on non-Adequate Landfills with an Emphasis on Providing Clear and Substantial Economic Incentives for Compliance and Diversion
5. **Regional Planning Initiative**: Establish Regionalized Solid Waste Planning Emphasizing Diversion Alternatives
6. **Supporting Funding**: Support/Fund Regionalized Solid Waste Planning emphasizing Diversion by use of revised RREO grant priorities
7. **Recycling Access Statewide**: Fill Gaps in Recycling Opportunities/Drop-off Networks in the State and Support Existing Infrastructure
8. **Materials Management in CDPHE Operations**: Implement Zero Waste (ZW), Extended Producer Responsibility (EPR), Life Cycle Cost Analysis (LCA), Materials Management (MM), Reduction, and other policies and principles in CDPHE operations
9. **Support MM**: Support ZW, MM and LCA where possible
10. **Supporting Authorities**: Seek additional Supporting Authorities and Identify Collaborative Working Arrangements with Other Agencies/Actors for near/longer term Diversion and Materials Management Progress in Colorado

For each of these 10 Level 1 diversion recommendations, Table F-1 in Appendix F provides a detailed discussion of:

- Specific **action elements** under each of these recommendations
- **Why** these strategies are high-level recommendations for CDPHE under this new 20-year plan
- Notes on **existing authorities/funding sources** that can support these activities

Given that there is always concern about the degree to which CDPHE (an agency with a primarily regulatory focus and very limited funding) can act on various recommendations, **notes are also provided identifying the source of the authority for these items, and the funding sources** – with a **strong emphasis on existing authorities and funding sources**.

Level 2 "Supporting" Recommendations. It is likely that CDPHE will find that substantial, on-going change in this state of the types envisioned by the Level 1 recommendations is hampered somewhat by CDPHE's current limited arsenal of available authorities. The Project Team examined additional authorities that CDPHE may find helpful in realizing the full intent of the Level 1 collection and diversion recommendations. These additional Level 2 recommendations are presented in Table 6-2; details are presented in Table F-2 in Appendix F. Note that as CDPHE adopts and begins to act on the 10 Level 1 recommendations, it may find some of the existing authorities or cooperative arrangements with other agencies are sufficient into the future, reducing the need for some Level 2 items. For example, a strong network of regional COG planning agencies may adopt the regional solid waste planning responsibilities readily, with cooperation by the counties involved, reducing the need for Item 2 in Table 6-2. In addition, funding for additional CDPHE staff would be necessary to fully implement the Level 2 strategies, and to oversee implementation of the Plan, should the authority and funding be granted. Also, as it undertakes Level 1 efforts, CDPHE may also find this list is insufficient and add other items as priority barriers/needs for authority.

A review of Appendix F is important to gain an understanding of the elements and steps included in the recommendations in Levels 1 and 2, and the rationale for their priorization as recommendations. The details in Table F-2 include:

- Why the additional authority would be beneficial in assisting CDPHE in achieving the objectives of the Plan;
- The perceived and real barriers to flexing this type of authority; and
- Possible avenues to pursue for gaining or leveraging toward the desired authority.[5]

Table 6-2: Level 2 Collection and Diversion Recommendations[1]

1. **Enforce Goals**: Ability to Enforce Adopted Diversion Goals
2. **Hauler Licensing**: State Licensing of Haulers
3. **Require Regional Planning**: Authority to Require Regional Planning and Establish Planning Authorities
4. **Funding for Planning**: Authority to Provide Designated Funding Source for Regional Planning Activities
5. **Implement/Enforce State-Level Strategies**: Ability to Implement and Enforce Collection and Diversion Strategies Best Applied at the State Level
6. **Landfill Surcharges**: Authority to Increase Landfill Surcharges
7. **Supporting Legislation**: Pursue Legislation to Obtain Authorities
8. **If/as authorities are gathered, establish prescriptive and performance-based strategies:** Recommend flexible, well-suited options for two tiers of prescriptive options[1] for communities in addition to enforceable performance goals.

1. These minimum programmatic/opportunity to recycle standards are listed as Level 3 in Section 6.3

To support the last element of these recommendations, this section includes “minimum access standards” (designated Level 3 strategies) and more advanced standards (Level 4 options) later in this section. These recommendations provide a prescriptive approach for communities, which may be attractive to communities that feel a performance goal is not specific enough. The Level 3 options approach, adapted from the state of Oregon’s Legislation, recognizes that different requirements are suited to urban/metropolitan/central locations than for more distant and less densely populated areas. The number of recommendations for the two areas differ (fewer in more rural areas). The Level 4 options adapt the new standards instituted in Vermont. Level 4 recommendations differ from the previous

[5] Source: Based on analysis by the diversion project team, after discussions regarding existing legal authorities between diversion Project Team and legal counsel for CDPHE.

recommendations in that they are more aggressive, and ratchet up access, incentives and program minimums in recycling and organics over time. These strategies may be best suited as a guideline for the more densely populated areas of the state and those with better market access. All four “levels” of strategies are designed to prefer reuse, recycling, composting, and diversion over landfilling and disposal.

Other strategies stakeholders were interested in seeing the state work on included:

- Release streamlined compost siting standards, include options with food
- Break down silos/barriers in CDPHE/collaboration
- Statewide level market analysis study
- Bottle bill
- Work toward possibly transforming curbside recycling into an industry-supported programs. Examples include the Blue Box program in Canada, in which the municipal recycling programs are now funded by contributions from the paper/fiber and container industries whose products make up the materials collected.[6]

Longer Run Strategies. Finally, note that these strategies are not associated with a timeline. If the state does not acquire additional authorities, there is little it can do beyond the Level 1, or possibly some Level 2 recommendations. Acquiring additional strategies can be a very long process, but this is a 20-year plan. The state may be successful in gaining some (currently unknown) set of strategies beyond its current purview. To provide for this situation, the Plan provides Level 2, 3, and 4 recommendations, a list of potentially-appropriate strategies in the realm of product stewardship and materials management, and a list of zero waste strategies for consideration at the local level for advanced areas of the state (Section 6.4).

Support for the Strategies. The top three strategies receiving the highest votes by stakeholder meeting participants per question are included in Table 6-3 and Table 6-4. For example, in the question that included as one of the choices whether the state should adopt a 2-tier goal, in the Western Slope region that choice received the first and second highest scores out of approximately 10 choices. Not all the recommended strategies were voted on during the stakeholder’s meetings.

[6] Industry contributes to a non-profit which distributes the funds, and/or contracts for service, depending on the location. One example is found at: http://stewardshipontario.ca/service-providers-municipalities-bluebox/the-blue-box-program-plan/. Other examples of industry-funded programs are paint care programs, e-waste takeback, and mercury thermostat collection programs.

Table 6-3: Top Ranking Regional Support for Level 1 State-Level Collection and Diversion Strategies

Level 1 Strategy	Front Range	Mountains	Eastern/ Southeastern	Western Slope
1. Adopt 2-tier Goals	1*	1~	1	1-2
2. Improve Tracking	1*	1~	2-3	2
3. Training Focus	1-3	1-3	1-2	1-3
4. Inspection/Incentives				
5. Regional Planning Initiative	2-3**	2-3	3~~	
6. Supporting Funding	2-3 **	2-3	3~~	
7. Recycling Access Statewide (hub/ spoke & drop-off)	2-3	2-3	1-2	
8. MM in CDPHE Operations				
9. Support MM				
10. Supporting Authorities				

* Not including Pueblo; **Not including Denver; ~Not including Silverthorne; ~~Not including Sterling
This table shows the participant voting ranking results of the top three strategies per question

Table 6-4: Top Ranking Regional Support for Level 2 State-Level Collection and Diversion Strategies

Level 2 Strategy	Front Range	Mountains	Eastern/ Southeastern	Western Slope
1. Enforce Goals				
2. Hauler Licensing	1*	1~	2-3	2
3. Require Regional Planning	2-3**	2-3	3~~	
4. Funding for Planning	2-3 **	2-3	3~~	
5. Implement/Enforce State-Level Strategies				
6. Landfill Surcharges	2-3*		3	3
7. Supporting Legislation				
8.MM in CDPHE Operations				
9.Establish Performance & Prescriptive Strategies				

*Not including Pueblo; **Not including Denver; ~Not including Silverthorne; ~~Not including Sterling
This table shows the participant voting ranking results of the top three strategies per question

Funding Options at the State Level. State-level funding authority is a critical component of a Plan, both to fund state activities related to planning and oversight, and delivering the state-level Plan's elements. A review of the variety of funding options available in many states around the country is provided in Table 6-5[7], along with an assessment of their suitability for the state level[8] in Colorado.

[7] Adapted from Skumatz, "Footing the Bill for Diversion Programs: Funding Options", Skumatz Economic Research Associates, 2007.
[8] Local funding options are discussed later in the section.

Table 6-5 shows that current authorities for funds for CDPHE – and for passing funding to local efforts – is very limited. Disposal fee surcharges, which form a significant funding source for CDPHE, would take some change for the CDPHE to be able to take on substantial new activities. Other options, although limited, are also available, including supplementation environmental project (SEP) funds.[9] Industry funded programs are not in place in the US, and are most appropriate to the local level. Authorities that form the core of revenues for other states, disposal fee surcharges, newly authorized planning fees, fees on various products (not allowed), bottle bill escheats (not in place), and other sources, cannot be counted on to fund new efforts in the state. To the extent the state requests new authorities (from the legislature), it would need to request funding associated with the authorities. Barring that, appeals for greater efforts that are construed as under current authorities, will need to be made to the Solid Waste and Hazardous Waste Commission, in order to affect the funding situation both to CDPHE and the RREO – a critical near-term link in being able to motivate change in the state.

Table 6-5: Potential Funding Sources and Colorado "Fit"

Source	State/ Local	Available Now?	Priority	Discussion for Colorado
Disposal Fee Surcharge	Both	Yes	High	Increase existing surcharge to provide economic incentive and use funds for planning, grants, programs, enforcement
Differential Disposal Fee Surcharge	Both	No	High	Charge a higher surcharge for communities not meeting goals or without regional plan in place. Provides economic incentives to save money by meeting goals. Use funds for planning, grants, programs, enforcement
Hauler Registration or Licensing Fees	Both	No	High	Introduce a statewide (or local) fee for hauler registrations, related to oversight, data collection, enforcement, etc.
Fines	State	Yes	High	Fines for non-compliance or enforcement actions used to fund monitoring; difficult to reassign to recycling
SEP Funds	Local	Yes	High	SEP funding is available to recyclers/composters, but is not well known. Incentivizes diversion
Planning Fee Authorization	Local	No	High	State authorizes ongoing funding source for regional planning and/or programs. Often on per-ton basis or population based
Tax on first Sale of Toxics in the State	State	No	Medium	Incorporate a dedicated tax on wholesale sale of toxics in the state with funds used for proper management
Industry-funded Recycling and EPR Programs	Both	Not used	Medium	Industry contributes to e.g. going to EPR can reduce the revenue requirements at least at the local level

[9] Fines were mentioned in stakeholder meetings, but they are limited in level and use. However SEP funds could potentially be better advertised and used to support diversion. CDPHE could advertise SEP funding to recyclers/composters, as there is currently limited knowledge of these funds. https://www.colorado.gov/pacific/cdphe/supplemental-environmental

Table 6-5: Potential Funding Sources and Colorado "Fit"

Source	State/ Local	Available Now?	Priority	Discussion for Colorado
Severance, Lottery, Marijuana Tax, Hunter License	Both	No	Low	Allocations from specialized funds. Needs work at the legislative or other level. Easier links could potentially be drawn to severance, hauler license, or hunter license fees because of environmental or service links
Traditional Bottle Bills with Escheats	Both	No	Low	Collect small fees for container sales, rebated when returned through system. Funds not reclaimed (escheats) can be used for recycling/solid waste management at state level. Must be separately accounted to designate to specific purposes and the program designed to not impact TABOR revenues
Bottle Bills Revenues – without Rebates for Returns	Both	No	Low	One bottle bill system specifically did not rebate funds to returnees, and instead endowed a grant program to fund needed state infrastructure, with grants to cities or haulers
Litter Fees/Advanced Disposal Fees	Both	No	High	Product-based fees that are used toward the appropriate management of targeted waste streams. Examples include litter fees, single use bag fees, and others. Requires a nexus study to draw link and establish appropriate/justifiable fee. Rarely raise significant funds beyond the limited product management
Single Purpose Fees/Taxes for Recycling	Both	No	Low	With TABOR, this might be feasible to the extent a service is associated/rendered
Environmental Revenues	Both	No	Low	Carbon or emissions credits can be difficult to assign uniquely, and the State may not be first in line for the allocation, favoring local program deliverers. Air space guarantees are not very valuable in Colorado, not facing significant landfill space shortfalls

6.3.3 Operationalizing the Level 1/Level 2 Recommendations – a Near-Term Recommended State "Work Plan"

There are several steps that will help operationalize the recommendations in the short- to medium-term – without any changes to legislation.

- **RREO grant program revisions**: Revise the solicitation to communicate the target is regional planning; award higher points to regional planning efforts rather than small planning projects and non-regional plan projects; phase in revised eligibility criteria, making ineligible grant requests from any actors in those areas without completed (or in-progress) regional plans. Work with RREO to develop minimum content of the Plan, with guidance from the recommendations in this document.

- **RREO rebate program revisions**: Revise the criteria for the RREO rebate funds to allow application to broader diversion activities.
- **Meetings to revise/partner with Environmental Leadership Program (ELP)**: Meet with the ELP staff to explore the potential of adding “community is part of completed or in-progress regional plan” to their criteria for ELP status. The goal is to provide additional pressure to regional plan development. If this is not possible, develop a similar program, providing benefits of discounted or streamlined inspections or permitting, or similar benefits.
- **Meet and explore partnerships with regional planning agencies (e.g. COGs)**: Set up meetings with COGs around the state (or a series of group meetings) to explore their interest in expanding their scope of planning to include integrated solid waste and diversion/materials management planning. Mention RREO grant, ELP and other benefits to regional actors. Provide information on potential reduced waste management costs from regionalizing landfills, and from high impact/low cost diversion strategies. In short term (before new funding options arrive) mention funding source of RREO grant funds, and explore shared savings models to fund planning. Where possible, help organize/designate single or group planning agencies as appropriate. An initial list of candidate agencies is provided in Table 6-6.
- **Disseminate Plan information widely**: Disseminate Plan information widely across the state on the Plan, and on the economics of landfill operation, closure and disposal alternatives. Discuss and explain the goals, the recommendations, regionalization and planning, associated grants and incentives and the resource aspects of the document. Emphasize the 10 regional stakeholder meetings, and the regional design of the Plan. Focus on near term, but discuss longer-term directions as well.
- **Begin webinars, stakeholder meetings and outreach**: Prepare a series of training webinars open to state stakeholders, communities, counties, consultants, landfills, elected officials and others. Topics to consider: 1) outreach on the completed Plan and its recommendations and implications; 2) regional recommendations, program strategies and costs (for each of the four regions); 3) educational sessions on integrated planning, rural strategies, PAYT, cost-effective strategies, more effective citizen outreach programs; composting; EPP strategies; strategies for commercial and multi-family sectors; 4) the workings of the “Comp Plan in a Box” model to get participation; and 5) other topics requested by state communities or stakeholders. Position CDPHE staff as experts who use information from the Plan and available publications to work one-on-one with communities/counties/planning agencies. Continue the series of stakeholder meetings to periodically re-engage the regional stakeholders with CDPHE in this broader (non-enforcement) light.

- **Consider instituting periodic regional (and state-level) stakeholder meetings going forward**: At least two of the 10 Stakeholder meetings conducted as part of this project requested the meetings be held periodically – one suggested quarterly because they valued the networking and ability to learn about successful programs, market issues, collaboration opportunities and other issues in the region and state-wide. CDPHE staff should consider convening meetings at least annually (potentially every six months) to provide these opportunities – and to position CDPHE as an agency that provides information and training, addresses prevention and other issues and does more than enforce.
- **Meetings/informational sessions with Solid Waste & Hazardous Waste (SW&HW) Commission**: Prepare and deliver briefings for the SW&HW commission on the Plan, including industry stakeholders interested in revisions to the landfill tipping fee and making credible case for CDPHE and RREO allocation increases. Present information on successes in other states. The goal is to create an environment friendlier to increases in the tipping fee for CDPHE and RREO, and potentially to allow incentive-based differentials in the tipping fee's design based on progress toward goal.
- **Encourage development of regional 'eco-parks' located at or near landfills/transfer stations**: As landfills close or are converted into transfer stations, not only should recyclables and compostables be collected there, but also processed/reused/remanufactured/composted at these locations.[10] This creates local job development, reduced transportation costs and regional cooperation.
- **Improve compliance**: Work within the CDPHE to refine the rationale for non-compliance. In addition, prepare short documents on the costs of compliance, and the most cost-effective diversion options and policies, and the effect on landfill lifetimes.
- **Ramp up measurement efforts**: Ramp up measurement efforts and plan for the next round of improved measurement, introducing the new metric.
- **Waste composition study**: Identify cities or counties in the state that have conducted waste composition studies in the last one or two years, and compute Percent of Recoverable Remaining (PRR) for those areas. Use to refine the definition. Then identify cities or counties in the state planning waste compositions in the near future, and work with them to assure PRR can be computed from their results. Work with them to identify whether there are economies from adding simplified waste compositions (able to support PRR computations) for a few outlying areas of interest. Then identify (regional planning) areas of the state that need waste composition

[10] This strategy was suggested and supported by CAFR's 2015 Summit triumvirate work and is based on successful programs being piloted around the country.

studies that will provide a reasonable baseline for the PRR for the state and allocate funds for that work. Work with the regional planning agencies to develop a PRR monitoring protocol going forward, including periodicity of the measurements.

- **Pilot test draft hauler data collection form:** Find partners around the state (communities/counties or haulers) willing to pilot test a recommended reporting form and use the feedback to 1) solicit comments and work on improvements to the reporting form and procedures; and 2) use the new (partial state) information to prepare an improved next Legislative Tracking Report.
- **Backhauling**: CDPHE work with CDOT on relaxing fees/regulations to back haul recyclables to markets, especially from rural areas.[11]
- **Design/adopt/implement MM principles and practices at CDPHE**: Contact communities and counties with strong waste diversion and materials management practices to identify strategies suitable for integration into CDPHE operations. Examples include San Francisco, Boulder, Alameda StopWaste and others. Work toward incorporating Sustainable Materials Management (SMM) into policy and program development.
- **Meet with CDPHE attorneys and others to explore potential strategies for achieving authorities (or "authorities – light"):** Work with the attorneys and others (heads of other departments/agencies, etc.) to identify strategies for achieving additional capabilities related to the Plan's recommendations.

Of course, adding new authorities considerably expands CDPHE's ability to implement and enforce changes that encourage recycling and diversion in the state – and the progress toward recommended goals over time. The vast majority of the state already has regional bodies conducting planning work on issues of concern. Most of the agencies address transportation, housing and aging population, with other topics also addressed. Currently few of the COGs address solid waste in Colorado; however, Tri-County Health and Northeast County Health Department address solid waste to some degree and may also be considered as potential partners. Table 6-6 also lists the areas of the state without known COGs.

[11] A particularly good model is ALPAR in Anchorage, which established a non-profit to organize the efficient gathering and preparation/scheduling of recyclables, using backhaul space donated by major industries bringing materials into the state (beverage manufacturers, etc.)

Table 6-6: Potential CDPHE Planning Agency Partners for Regional Planning

Topic	Front Range	Mountains	Eastern/Southeastern	Western Slope
Presence of Potential Regional Planning Agencies	Pike Peak COG (PPCOG), Denver Regional (DRCOG), Pueblo Area (PCOG), North Front Range Transportation & Air Quality Planning Council; East Central Council of Local Governments (ECCOG, shared with Eastern/Southeastern)	Upper Arkansas Area (UAACOG), Northwest Colorado (NWCCOG) San Luis Valley Council of Governments/Development Group	Northeastern Colorado Association of Local Governments (NECALG); South Central Council of Governments (SCCOG); East Central Council of Local Governments (ECCOG, shared with Front Range)	Southwest Colorado (SWCCOG); Mesa County Regional Transportation Planning Organization; Associated Governments of Northwest Colorado (AGNC)
County Gaps in Potential Planning Agency Partners	No gaps	Gunnison, Hinsdale, Saguache, Mineral, Rio Grande, Alamos, Conejos, Costilla	Crowley, Kiowa, Otero, Bent, Prowers, Baca	Delta, Montrose, Ouray, San Miguel

6.3.4 Colorado’s Recommendations in Context – Other States’ Plans and Implications for Level 3/Level 4 “Next Generation” Recommendations

The recommendations summarized above can be put into context relative to the content and recommendations for plans in other states. Five selected examples are provided to show the range. Because Colorado is rather behind in the area of legislation on diversion, previous-generation/replaced legislation is provided (and in some cases, focused on) in some state cases. In short:

- Oregon’s Original 1983 “Opportunity to Recycle” Plan had several attractive features that have been incorporated in the Diversion recommendations in this Colorado Plan. It established **two-tier goals** that recognized the differences between **urban/suburban and rural** conditions **(with performance and prescriptive elements)**. It established both a numeric goal (performance), and lower vs. higher numbers of prescriptive elements that were required for large/urban vs. small/rural communities. The law listed 12 fairly basic strategies or best management practices, and the 1997 update required cities with populations greater than 4,000 to provide at least three strategies from the list, and towns of 10,000 or more must provide “an additional one or two, depending on the activities chosen.” The menu of strategies included:

1. Weekly single family curbside recycling program, same day as trash, with container provided
2. Enhanced education/outreach program

3. Multifamily recycling of at least four materials for buildings with five or more units with education
4. Effective yard waste collection (monthly or more frequent) or drop-off program (open at least once weekly) composting program, also promoting Back yard composting (BYC)
5. Commercial recycling program with weekly on-site collection for businesses with 10+ employees or 1,000 square feet or more, with associated education, and optionally, waste assessments and recognition programs. Commercial goal should be to strive for 55% diversion
6. Recycling depots for recycling the "principal recyclable materials" with regular/convenient hours, open on weekend days, and collect additional recyclables when convenient/possible
7. PAYT rates for households
8. Collection and composting program for commercial/institutional businesses that generate large volumes
9. Commercial recycling program that requires commercial generators of large amounts of recycling to recycle
10. Program for monthly or more frequent on-route collection of food and compostables from residential service customers, including an education component
11. Recovery program for construction and demolition (C&D) that requires C&D separated at generation site or sent to facility for separation; includes an education component
12. A food waste collection program requiring non-residential generators that generate large amounts of food to source separate food for recovery

- California's AB939 Legislation (1989) established a wide array of changes designed to motivate intensive recycling, diversion and waste reduction program development across the state. It authorized regional planning agencies, and gave them substantial new funding sources to support the planning. It required the regional planning agencies to conduct planning work/documents including SRREs (Source Reduction and Recycling Elements – a comprehensive planning document) and conduct detailed waste composition studies in their territory to inform the plans. They established a measuring method with rules – "landfill diversion" (selected because it also addressed source reduction). The state set goals for landfill diversion, relative to a 1990 baseline, of 25% by 1995 and 50% by 2000. Results were posted by area and community on a website for comparison; plans were also posted. The state set substantial financial penalties for not reaching goals.[12]

- Iowa's original 1990s legislation established a 50% diversion goal. Communities not meeting goals must advertise the failure to meet goal to its residents; must put in a PAYT program; must pay higher landfill surcharges that achieving communities, along with other enforcement elements. The difference in surcharge is $3.75 per ton for communities with 25% diversion or more, and $4.75/ton for those not reaching the 25% goal. The state retained $0.95 per ton for implementation/planning, and $0.50 for environmental protection.
- New York's 2010 plan includes a number of recommendations and strategies. Most noteworthy is the recommendation of a numeric goal. The state's plan is a **generation** goal – not diversion. The state goals are phased-in reductions of generation per capita that began with the 2010 goal of 4.1 lbs. solid waste/day/capita, to 2016's 2.9 lbs. solid waste/day/capita, to 2030's 0.6 lbs. solid waste/day/capita. This is a reduction of 85% in <u>generation</u> over a 20 year period. Aggressive is not a strong-enough term for this goal.
- Vermont has a very straightforward prescriptive-approach plan (Act 148, passed 2012), which is being used as a model in several other states. It is based on three tenets for increasing recycling – convenience, incentives and mandates. It focuses on a phased implementation assuring access and eliminating (economic) barriers. The phase-in of program requirements includes (July 1 for all years):
    - 2014: Transfer stations and drop-offs must accept recyclables at no fee; Food scrap generators of 104 TPY must divert material to any certified facility within 20 miles
    - 2015: PAYT statewide (volume or weight); recyclables banned from landfill; Transfer stations/drop-offs must accept leaf and yard debris; haulers must offer residential recycling at no extra charge (embedded); public buildings must provide recycling containers adjacent to solid waste containers (except restrooms); food scrap generators of 52 TPY must divert material to any certified facility within 20 miles
    - 2016: Leaf, yard and clean wood waste banned from landfill; haulers must offer leaf and yard debris collection; food scrap generator threshold at 26 TPY
    - 2017: Transfer stations and drop-offs must accept food scraps; haulers must offer food scrap collection; food scrap generator threshold to 18 TPY

[12] The stated penalties were fines of $10,000 per day for not reaching goals (very substantial for large or small communities, dramatically changing the economics of recycling). Ultimately communities were not fined, with "best efforts" being recognized.

  - 2020: Food scraps banned from landfill
- New Oregon Legislation: Given that the state's original plan has led to substantial program development around the state, PAYT statewide (through hauler rate design requirements in regulations), and universal access, this new plan goes to the next step. It works to increase research and information, and works to integrate consideration of materials management more widely into waste management.

In crafting the collection and diversion recommendations for Colorado, lessons from other states' plans were considered.

- Oregon's **two-tier** goal-setting approach is extremely well-suited to Colorado; it has a "Front-range-like" area with denser populations and access corridors, and a "rest of state" that is more rural and has mountains and distance issues.
- Oregon and Iowa have elements of a **performance and prescriptive** approach – reach the goal using programs the town selects, but if goals are not achieved, some prescriptive elements come into play. This has attractive aspects, allowing creativity, but also ultimately forcing progress and change if it is not achieved without intervention.
- **Financial incentives** are important to gaining compliance. California's aggressive approach absolutely spurred market change and action, but this approach would not be acceptable in Colorado (and ultimately was not enforced in California). **Iowa's two-tier tip fee surcharge may be a more suitable approach in Colorado, but the dollar differences per ton must be large enough to incentivize action, or they are not worth the administrative and enforcement efforts**.
- **Funding the planning and programs** is important; avoiding unfunded mandates is critical. Each state had an array of funding sources; California and Iowa's are quite clear.
- New York's **goal is not practical or realistic**. Goals should be set that 1) are potentially achievable, 2) relate to the behaviors being sought, and 3) measurable. New York is highly unlikely to be able to reduce generation by such a huge percentage; regulating demand is extremely difficult in a world of Amazon.com, and considering supply/demand lessons like Prohibition and the War on Drugs. Given Colorado's situation – measurement and recycling maturity – two performance metrics are recommended. The first recommendation is the traditional diversion rate goal (including recycling and organics[13]); and secondly, introduction of another metric is recommended that directly reflects the behavior being requested, PRR. Major

[13] Tracked potentially through hauler reporting or a continuation of current facility-based efforts.

advantages of this metric include clear source of information, simplified waste characterization, and actionable results (indicates what is under-performing). Finally, the Project Team also recommends tracking additional information that can be easily calculated from these data, including generation per capita and other similar "normalized" metrics.

- California's landfill diversion measurement metric was fraught with **problems and too complex** and did not provide actionable information. Establishing a baseline requires identifying where all local haulers go with their waste in some base year, and then requires tracking over time – as haulers change and as they change where they bring materials.
- There is **clarity and enforceability** in Vermont's goal; either a program is in place or it is not. This is attractive – should CDPHE gain the authority to make similar requirements.

Each of these considerations is recognized and incorporated into the Level 1 and Level 2 statewide collection and diversion recommendations for Colorado, to the extent the current CDPHE authorities allow.

Note that in some states and communities, higher diversion is the goal, without strong regard for the cost of those diverted tons. The analyses in this report very strongly considered the near- and longer-term costs in developing the goals and strategies, and the cost-effectiveness of "upstream" initiatives (including reduction/prevention, EPP and other strategies). Given that it is a 20 year plan, the Project Team also tries to address marketplace changes that may occur or we may be able to help make happen with strategies in the Plan.[14]

Finally, the review of selected state legislation and plans also highlights strategies that would be suitable for Colorado, should greater authority be granted. These are identified as Level 3 and Level 4 strategies in the following section, and are provided as recommendations suited to the medium and longer term, as authorities allow.

[14] Sustainable programs are marked not just by their "green-ness" but by their ability to be sustainable in the market – or if you are lucky or deliberate or persistent enough to substantially transform the market, then in the transformed market. A no-longer-functioning or unfundable program is not sustainable.

6.3.5 Materials Management and Other State-Level Recommendation Options – Level 3 and Level 4 Strategies

6.3.5.1 Level 3 Strategies – Publish "Standards" on Minimum Program Recommendations for Communities

Given that the state may not acquire additional authorities, and that regional planning cannot, at this point, be guaranteed, one additional step the state can take is to widely publish a list of "expected" program access options for statewide communities. Taken from the Oregon legislation (although Oregon had enforcement powers), this approach will suggest a list of reasonable and flexible program/access options to decision makers and staff at the community and county level. This list could be considered the "minimum expected" for recycling access for communities around the state, and potentially guide governments with a concrete list of minimum expectations. In addition, the list in Table 6-7 recognizes that requirements can be made in some communities, but in others, the strategies are suitable for community or county implementation.

This list has the advantage of being relatively easily "counted," and the state could gather information on the number of communities/counties in the state conforming to the list. Should the communities in the state decide to move forward on these programs, progress would be realized in some areas of the state; presumably those communities that have adopted more aggressive options would not backslide because the drivers for their performance lie elsewhere. Finally, these Level 3 strategies allow communities and regions to increase access to diversion opportunities for residents, businesses, visitors, and others, and move toward goals with a set of strategies tailored to their region.

The recommendation is that:

- the Front Range area of the state should implement at least eight of the following strategies (Table 6-7),
- The Mountain areas should adopt five strategies
- Other areas of the state (more rural areas) should adopt at least four strategies

Additional state "heft" behind the goals may be implemented by coupling the list with access to RREO grants. Communities not adopting the minimum number are not eligible for RREO funds, and lose out on the other benefits noted in the state level recommendations (ELP, etc.). If the community or its county meet the area recycling goal (low or high), they are exempted from this "count."

Table 6-7: Level 3 Prescriptive Menu Strategies – Minimum State Recommendations for Publication (Near-Term and/or if State or Regional Authorities are not Achieved) [1]

1. Enhanced education program by communities or counties or designated actors, annually. 2. Recycling depots/drop-offs with regular, convenient hours, in each town of at least 4,000 population. 3. Curbside recycling offered, single family homes (at least bi-weekly, with minimum requirements for program elements). 4. Curbside recycling, fee embedded in solid waste bill (not separate or options), single family households (at least bi-weekly with minimum requirements for program elements). 5. PAYT rate structure required for single family households (with minimum program elements). 6. Multifamily recycling of at least four materials in buildings with 5+ units, with education provided (minimum program elements), in communities greater than 10,000 population.	7. Yard waste (or yard and food) collection program (single family), at least weekly, or drop-off site open weekends and at least one weekday. 8. Program available for monthly or more frequent on-route collection of yard waste (or food and yard waste) from single family customers, with an education component. 9. Commercial recycling program available for all businesses with 10+ employees or 1,000 square footage, or with 10 CY or greater service per week. 10. Collection and composting program for all businesses generating large quantities or targeted business types (designated by CDPHE Memo, updated). 11. Commercial recycling required for businesses generating large amounts of recyclables. 12. C&D recovery program requiring separate bins at generation or post-separation.

1. Communities in Front Range recommended to implement eight strategies; communities in Mountains recommended to implement five strategies, and the Eastern/Southeastern and Western Slope regions implement four strategies. Number of recommendations increases over time. Communities exempted if they demonstrate they have reached the numeric diversion goals

6.3.5.2 Level 4 and Advanced Materials Management Strategies – Considering More Aggressive Directions in the Medium- to Longer Run

Finally, this is a 20-year Plan. In the foreseeable future, there are few enforcement options available to the state -- and by the time authorities are available for a zero waste plan, the situation in each region of the state will likely have changed. However, if the state acquires real authority in materials management: beyond disposal, there are a number of suitable directions that can be studied, considered and pursued.

- The most direct, and first set of items the state can and should consider, is an adaption of the Vermont scheduled roll-out of direct program requirements for the Front Range. These recommendations are provided in Table 6-8.[15]
- The second set of recommendations that the state should consider and research is a set of product stewardship and market development suggestions that follow in Table 6-9.
- Note that, in addition, a list of typical recommendations from zero waste plans is provided in Section 6.4, as most of these recommendations are targeted more at the local program level.

[15] Note, of course, a different rollout time frame could be used.

Table 6-8: Level 4 Recommendations

Year 1 • Transfer stations/drop-offs must take recyclables at no fee • Food scrap generators of 104 TPY must divert material to any certified facility within 20 miles **Year 2** • PAYT statewide (volume or weight) • Recyclables banned from landfill • Transfer stations/drop-offs must accept leaf and yard debris • Haulers must offer residential recycling at no extra charge (embedded) • Public buildings must provide recycling containers adjacent to solid waste containers (except restrooms) • Food scrap generators of 52 TPY must divert material to any certified facility within 20 miles	**Year 3** • Leaf, yard and clean wood waste banned from landfill • Haulers must offer leaf and yard debris collection • Food scrap generator threshold at 26 TPY **Year 4** • Transfer stations and drop-offs must accept food scraps • Haulers must offer food scrap collection • Food scrap generator threshold to 18 TPY **Year 5** • Food scraps banned from landfill

Table 6-9 includes product stewardship and market development strategies. This list excludes traditional recycling and diversion program access, program mandates and material ban strategies that increase supply – and which are well-demonstrated by the strategies in the previous Vermont-inspired strategies. It is possible that, despite the statutory focus on disposal and disposal facilities, the CDPHE may be able to undertake action in a few of these stewardship or market development strategies, including, but not restricted to:

- Working to incorporate recycling and composting into the state's climate change report, especially given the existing work demonstrating the effectiveness and cost-effectiveness of recycling, composting, PAYT and other strategies in reducing GHG and in job-creation.[16] A strong case can be made in favor of considering SMM options in climate change plans. Using EPA's WARM Model, moving 100 tons of mixed recyclables from trash to recycling leads to greenhouse gas reductions of 86 metric tons of carbon equivalent (MTCE) or 315 metric tons of carbon dioxide equivalent (MTCO2E). The same model assigns 12 MTCE or 42 MTCO2E reductions from diverting mixed organics. The research also indicates SMM options are more

[16] McKinsey & Company, "Pathways to a Low Carbon Economy, Version 2 of the Global Greenhouse Gas Abatement Cost Curve, 2009. For comparisons of cost (cost per MTCE) and job-creation performances for US recycling, composting, PAYT waste management strategies compared to energy efficiency and generation strategies, see: Skumatz, Lisa A., "Biggest Bang for GHG Reduction", *Proceedings of the AESP Conference*, 2009; Skumatz, "Do Energy Efficiency Strategies Outperform Recycling in GHG Mitigation and Job Creation?", Proceedings of the IEPEC Conference, Portland, August 2009; Freeman and Skumatz, "A kWh Is Not Just a kWh: Comparing Various Energy Efficiency Programs in Terms of GHG, Job Impacts, and Policy Achievements (NEBs and Beyond)", Proceedings of the ACEEE Summer Study of Buildings", Asilomar, CA, August 2010 and others.

readily available to communities than are energy options, and many SMM options can be implemented quickly.

- Establishing procurement preferences, at least within CDPHE and publishing the standards for use by other state agencies and communities.
- Supporting tax benefit/exemption legislation proposal that may be brought by industry that provides incentives for expanded diversion and materials management infrastructure.
- Providing useful information and support to local and state economic development staff if they undertake efforts to work to attract recycling/waste management industries to communities, counties or the state.
- Keeping tabs on research at the national and international level to help inform interested communities, counties and stakeholders in the state as part of the CDPHE's revised "information and training" activities.

Table 6-9: Other Advanced Materials Management Strategies - State-Level Product Stewardship and Market Development Options[17]

Diversion Programs	• Have market development priorities • Statewide policies for funding • Local recycling market development zones	• Tying recycling and composting to climate change
Mandates	• Minimum content standards	• Procurement mandates/preferences
Sustainable Materials Management	• Including recycling and composting in climate change plan/tying to climate change	• Support for low carbon fuels and electricity generation
Funding Assistance	• Traditional (disposal surcharges, grants, product fees, product deposits, ADFs) • Bottle bills • State tax exemptions for major recycling facilities • Property tax exemption for specified criteria	• Sales tax exemptions/credits/tax incentives • Coordination with other government or private financing programs • Loan programs (RMDZ, GHG reduction loan programs) • GHG Grants
Extended Producer Responsibility	• Many products (packaging, paint, carpet, mattresses, fluorescents, pesticides, etc.)	• Industry –funded programs (full cost EPR, like British Columbia, etc.)
Market Assistance	• Local market development assistance staff • Technical support and research	• Dedicated recycling industry experts/networking
Other	• Research and development	• Regional cooperation

Again, zero waste strategies the state may consider – or consider requiring at the local level, should the authority become available – are listed in Section 6.4.

[17] Adapted/Selected from Skumatz and Boisson "State of Connecticut DEEP: Strategies for Modernization of the State's Solid Waste Management Infrastructure," 2015. Key chapter on this topic developed by Boisson.

6.3.6 Establishing a "Goal" – and the Role of the PRR Metric

The authorization language for the Plan states that it should establish a "Goal." In addition, the state Legislature also requires CDPHE to report on the state's performance in waste management and diversion, which the CDPHE has been providing for several years. Neither source requires a specific form for the goal or tracking, but tracking and monitoring is an important part of the Plan and monitoring progress toward improvement.

There has been extensive work, and formal work in many states, on the best form for tracking, metrics and goals. The main options have traditionally been variations on the following:

- Diversion rate, or percent of materials diverted (recycled or composted), calculated as recycling tons as a percent of tons "generated" (solid waste plus recycling plus organics tons), or organics tons as a percent of generation, or the combined diversion rate (recycling plus organics divided by generation). Also referred to as a program, recycling, or organics diversion rate.
- Landfill diversion rate, a calculation that compares the number of tons of MSW brought to any and all disposal facilities from a community today, compared to the total MSW tons brought to facilities in a designated "base year." Decreases reflect diversion from programs and source reduction in the community.
- Per-capita generation or diversion tonnages, computed as recycling, organics, or solid waste tonnages divided by population.

Each has pros and cons and vary in their data and reporting needs. The diversion rate attributes progress to recycling and organics, as illustrated in Table 6-10.

The difficulty of the traditional programmatic diversion rate figure is that it does not tell the state what to do next. It tracks progress relative to the previous year (assuming consistent definitions and measurements are used), and allows geographic comparisons, but it does not inform the state about which materials are recycled well or poorly (and which should be the focus of education and recovery efforts), does not allow separate computations of residential vs. commercial performance, and varies with economic conditions. The addition of a new metric PRR – provides the state with a new metric that addresses these concerns. PRR metric tracks the percent of recyclables and compostables still remaining in the disposal stream. The PRR metric uses simplified waste composition studies on the solid waste stream only to identify these percentages. The metric is computed using simplified waste composition sorts from tons at transfer stations or landfills, or from sorts from samples of individual residential and commercial collection trucks. The composition studies are substantially less expensive than traditional waste composition studies (which commonly sort solid waste into 30+ categories) because the waste needs only to be sorted into “current recyclables,” “current compostables” and “all else.”

Table 6-10: Pros, Cons and Data Considerations for Measurement Metric Alternatives

	Major Pros	Major Cons	Data Needs
Diversion Rate	Traditional, easily understood, attributable to programs and sectors	Does not reflect source reduction, varies with economic conditions, variations in what is included in different communities	Current program or facility tonnages on solid waste, recycling and organics
Landfill Diversion Rate	Addresses source reduction	Does not attribute progress to specific programs or sectors, must track multiple haulers and facilities, varies with economy, requires ad hoc adjustments; data intensive	Landfill data covering materials attributable to community for current and base year
Per Capita Generation	Simple, normalized metric	No attribution to programs	Current program or facility tonnages on solid waste, recycling and organics and population
Percent Recoverables Remaining (PRR)	Limited data requirements, attribution to general program activities, measures customer behaviors requested, “actionable,” relatively invariant to economic cycles	Requires waste compositions but only of the solid waste stream	Simplified solid waste composition study; in simplest form it does not require total tonnages

Some California communities have established goals of 10% (starting at 30% with an extensive list of “recoverables”). A recent publication[18] indicates the Front Range is currently at about 21% based on an intentionally very conservative (short) list of single stream recyclables, and rest of the state (ROS) is about 45%; statewide figures are about 27%. The metric directly tracks the desired behavior – diversion of materials from the disposal stream – without having to worry about variations in economic conditions and their effects on the overall generation stream. The PRR metric requires periodic waste sorting or waste composition studies of the solid waste stream, either at the landfill/transfer station streams, or from trucks or containers. However, again, the costs of the sorts are low because data on only three or four material streams are needed. The total solid waste remaining also needs to be weighed to compute the percent recyclables, and percent compostable (and the combined PRR) still left in the disposal stream.[19]

The recommendations to the state in regard to measurement and goals include:

[18] Skumatz and D’Souza, “Colorado’s Wasted Value: Recyclables Discarded in the Front Range and Rest of the State and their Dollar, Job, and GHG Impacts”, Skumatz Economic Research Associates, Superior, Colorado, May 2015. The only recyclables included were: cardboard, aluminum cans, HDPE, PET, high grade office paper, ONP, and mixed paper.

[19] A version of the PRR approach is in place in communities in California, with good success. PRR alone does not measure waste reduction. Tracking generation data and program data can help reflect these “upstream” effects.

- Continue **tracking the traditional "diversion rate**" and its constituents, the "recycling rate" and "organics rate" and the combined "diversion rate" as core metrics. These are calculated as percentages of these streams divided by "generation" (solid waste plus recycling plus organics tonnages). Current facility-centric data sources should continue to be used. When hauler reporting is instituted, the state should consider separately tracking results for the **residential and commercial** sectors, and improve regional tracking.
- Add tracking of the **Percent Recoverables Remaining** (PRR) for the state, potentially reporting information separately for residential and commercial streams, and for different regions of the state. In the short run, work with communities and counties conducting studies, and report out the implications of the information identified. If and when authorities are acquired, a periodic system of waste composition studies – or sampling of random trucks – should be implemented, at the state level or as a requirement of waste shed agencies.
- Add **tracking of additional information** that can be easily calculated from these data, including generation per capita and other similar "normalized" metrics.

Deriving the Goals for Colorado: The Plan's goals come from the derivation of practical and, in appropriate areas, more aggressive (stretch) diversion levels in the four designated regions in the state in the near, medium and longer term. These goals are calculated as diversion and PRR goals for consideration and benchmarking by state regions and communities.[20]
The Plan develops recommended goals, setting higher recommended goals for the Front Range than for the other regions to recognize the different levels of achievement that are feasible and reasonable to expect. The primary goal for the Plan should be the diversion goal; the PRR goal is secondary.

Setting goals that require legislation changes to be successful would be inappropriate; rather, the goals would be expected to be revised at that time to reflect the actual levels of authority granted. Therefore, the goals presented in Table 6-11 will appear very conservative. The main progress reflected in these goals is continued growth in access and use of organics programs, improved efficiencies in collection, and growth of infrastructure, making programs more feasible and cost-effective. Some of the growth may also occur as landfill compliance is enhanced, and diversion becomes an increasingly attractive alternative. Note that the goals are not intended to limit the achievement of motivated communities.

[20] CDPHE may elect to continue to report and track other metrics for its own uses and legislative purposes CDPHE tracks and reports on 'recycling' (2 numbers) and 'diversion'. 'Recycling' is generally more similar to EPA's method but usually includes scrap metal. Therefore CDPHE removes that and reports 'recycling' both with and without scrap metals. They also measure and report 'diversion' which includes both MSW and industrial/institutional/commercial.

The near term goals focus on achievements that are possible with continued improvement in access across the state, and a continuation of the trend in the Front Range and elsewhere for PAYT, added organics, contracting, universal recycling ordinances, and other programs. The figures represent a combination of residential and non-residential performance; residential figures would be expected to be higher, and non-residential would likely be lower than the goal presented. The figures assume that the current low market prices for recyclables would rebound somewhat over the period, or progress will likely stagnate. The calculations of the goal are based on computations in Section 6.4.1 (state tonnages and composition), and Section 6.4.2 (analysis of specific strategies). Note that the nationwide average for diversion is currently about 35%, based on EPA figures.

Table 6-11: Diversion Goals for Recycling in Colorado[1]

Diversion Goals (recycling and organics combined)	2016	2021	2026	2036
Front Range	NA	32%	39%	51%
Rest of State	NA	10%	13%	15%
Statewide	23% [2]	28%	35%	45%

1. Conservative Goals reflecting No New Legislative Authorities; includes recycling and organics
2. From CDPHE

Table 6-12: Secondary Goals for Recycling in Colorado – Percent Recoverables Remaining (PRR)

Diversion Goals (recycling and organics combined)	2016	2021	2026	2036
Front Range	21%	17%	14%	10%
Rest of State	45%	40%	34%	28%
Statewide	27%	21%	17%	13%

Should the full range of authorities envisioned in Levels 1-4 of the strategies list be adopted, the state could potentially expect to achieve goals of perhaps 30% by 2021, 35-40% by 2026, and 45%-50% or more by 2026, with higher levels achieved in the Front Range. This is because it is expected that many communities in the Front Range of Colorado can achieve long-term performance levels that come close to those included long-term plans for other major metropolitan areas of the nation. The rural areas will be expected to achieve lower goals, given their economic, density, and transportation challenges. The higher goals for the Front Range as a whole would not be expected to discourage some communities within the area from exceeding these performance levels. The Zero Waste goals in place in some Boulder County and Larimer County communities may be able to lead the Front Range to achievement beyond these goals.

Other metrics to consider tracking over time include generation per capita, important source reduction programs at state level, and indicators related to toxics, among others.

The Plan also estimated the value of the unrecovered recyclables being landfilled annually in Colorado. The calculations in Table 6-13 use five-year average market prices. Additional recovery of recyclables can have real value, and a tremendous share of this value is in the Front Range, where economics for recycling and diversion (at least at five-year average recycling market prices) are not unfavorable.

Table 6-13: Buried Value of Recyclables in Colorado[1]

Region	Front Range	Mountains	Eastern/ Southeastern	Western Slope	Statewide
Value of Recyclables Being Landfilled	$218 million	$12 million	$11 million	$26 million	$267 million

1. Using Five-Year Average Market Revenues

6.4 Diversion Potential at the Local/Wasteshed Level

Increasing diversion and recycling in the four regions of Colorado requires improved access, and regional planning, with the ability to enforce requirements and program initiatives. The economics of low landfill tipping fees, low population density and high transportation costs results in low existing and economic potential for diversion in the regions outside the Front Range. However, the previous section identified strategies designed to improve access to diversion, and suggested that fewer strategies could be "required" outside the Front Range, and additional elements could be required in the populated areas of the Front Range. To estimate the potential from these strategies, three analytical steps were taken:

- Estimate the tonnages available to be diverted in each region, including residential, commercial, and construction and demolition (C&D) and a proxy waste composition for the area.
- Develop regionally-appropriate assumptions about the tonnage totals that would be diverted from each of the 12 - Level 3 strategies in the four regions.
- Develop models and regionally-appropriate cost information for each of the strategies in the region.

6.4.1 Deriving Regional and Statewide Tonnage Estimates

Table 6-14 used assumptions about generation and disposal rates for the various regions of the state[21] and waste composition studies from Mesa County, Boulder County, Larimer County, Southwest Colorado

[21] 7 pounds per capita per day in the Front Range (from SERA Front Range research), 5.9 in the Eastern/Southeastern and Western Slope (from Gillow-Wiles and Trujillo, "Southwest Colorado Council of

Council of Governments, El Paso County and other sources to generate a proxy waste composition for the four areas of the state. Some of these studies provided data on the proportion of materials disposed by residential and commercial sources separately. Using data from each region on population and employment, ratios were developed on the estimated total tonnages of residential vs. commercial sector approximations. Finally, information from a study conducted in Larimer County[22] provided useful information to apportion elements from the residential and commercial sectors into a separate construction and demolition (C&D) sector stream.

Additional information was derived from the state, which provided forecasts of population and employment figures by county in five year increments, beyond 2035. The ratios developed as part of the projections and apportionments for 2016 were then extrapolated to provide projections for five-year increments for the next 20 years. The results at the state level are presented in Table 6-12. The results for each of the four regions are presented in Appendix G. The overall totals and results compared well with the last reports filed by the CDPHE. Table 6-15 presents the portions of the total disposal streams disaggregated into residential, commercial and C&D streams. Finally, Table 6-16 presents the breakdown by material type, summed up from the estimates for the four geographic regions of the state with their regional waste compositions.

Households and businesses within the state generate almost seven million tons of solid waste annually. Given growth rates projected by the state, this number is expected to grow to more than nine million tons in 20 years – unless major changes in upstream waste generation, underlying consumption trends, product stewardship or other structural changes occur in the market.

Governments Southwest Colorado Waste Study", 2015), and a blended rate of 75% Front Range and 25% non-Front Range for the Mountain area. EPA's national figures (of about 4.5 pounds per capita per day) are significantly exceeded by the tonnages in Colorado.

[22] Sloane Vasquez, 2012, "Waste Stream Analysis and Waste Conversion Technologies Review" provided useful ratios and translations to support separation of the C&D stream. Note that the C&D stream is assumed to be similar across the state, for lack of more refined information.

Table 6-14: Projections of Colorado MSW Disposal Tonnages

Region	2015	2016	2021	2026	2031	2036
Front Range	5,840,000	5,946,000	6,492,000	7,043,000	7,582,000	8,121,000
Mountains	296,000	301,000	328,000	363,000	396,000	431,000
Eastern/Southeastern	194,000	197,000	215,000	233,000	248,000	263,000
Western Slope	485,000	494,000	545,000	602,000	660,000	717,000
Statewide	6,815,000	6,938,000	7,580,000	8,241,000	8,886,000	9,532,000
Growth Rate	1.0%	1.8%	1.7%	1.6%	1.4%	1.4%

Table 6-15: Disaggregation of Disposed by Region and Sector (2016)

Region	% Tons Residential	% Tons Commercial	% Tons C&D	Total
Front Range	47%	26%	27%	100%
Mountains	39%	37%	23%	100%
Eastern/Southeastern	41%	38%	21%	100%
Western Slope	40%	38%	22%	100%
Statewide	46%	28%	26%	100%

Table 6-16: State-level Waste Composting Proxy and Associated Tonnages by Material Type, 2016

Material Type	Waste Composting 2016			Tons 2016			Total Tons 2016
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Paper	20.3%	28.2%	1.0%	648,900	542,400	18,300	1,209,600
Cardboard/bags	3.7%	12.4%	0.0%	118,900	238,900	-	357,800
Newspaper	3.9%	3.2%	0.0%	124,600	61,300	-	185,900
Office Paper	1.2%	2.5%	0.0%	37,100	48,900	-	86,000
Paperboard	2.5%	2.0%	0.0%	78,300	38,600	-	116,900
Junk Mail	2.3%	2.3%	0.0%	74,900	44,400	-	119,300
Magazines/Catalogues	1.9%	1.5%	0.0%	61,200	28,400	-	89,600
Dairy/Juice	0.3%	0.2%	0.0%	8,700	4,100	-	12,800
NonRecyclable Paper	4.6%	4.0%	0.0%	145,300	77,700	-	223,000
Plastic	12.4%	12.6%	0.0%	394,200	242,700	-	636,900
Plastics 1&2	7.2%	2.0%	0.0%	229,900	37,500	-	267,400
Rigid Plastics 3-7	0.5%	0.6%	0.0%	15,800	11,800	-	27,600
Polystyrene	0.3%	1.0%	0.0%	10,600	19,100	-	29,700
Other Rigid Plastics	1.8%	3.6%	0.0%	56,000	69,500	-	125,500
Plastic Bags/Film/Wrap	2.6%	5.5%	0.0%	81,800	104,800	-	186,600
Other Plastics	0.0%	0.0%	0.0%	-	-	-	-
Metal	3.9%	5.2%	2.0%	124,200	100,800	36,500	261,500
Aluminum Cans	0.6%	0.5%	0.0%	20,600	9,000	-	29,600
Tin Cans+AG19	1.2%	0.5%	0.0%	37,800	8,900	-	46,700
Other Ferrous	0.6%	1.0%	0.0%	19,200	19,200	-	38,400
Other Aluminum	0.4%	0.3%	0.0%	13,700	6,100	-	19,800

Table 6-16: State-level Waste Composting Proxy and Associated Tonnages by Material Type, 2016

Material Type	Waste Composting 2016			Tons 2016			Total Tons 2016
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Other Non-Ferrous	0.4%	0.6%	0.0%	13,700	11,100	-	24,800
Appliances	0.6%	0.4%	0.0%	19,200	8,100	-	27,300
Other Metal	0.0%	2.0%	0.0%	-	38,500	-	38,500
Glass	3.2%	3.5%	1.2%	101,200	66,600	21,600	189,400
Organics	40.1%	32.3%	5.1%	1,279,100	620,500	93,200	1,992,800
Yard Waste	8.4%	6.0%	5.1%	267,300	116,200	93,200	476,700
Food Scraps	17.6%	16.8%	0.0%	563,000	322,700	-	885,700
Textiles/rubber/Leather	3.7%	2.0%	0.0%	119,300	37,700	-	157,000
Wood	2.9%	5.4%	0.0%	91,000	104,400	-	195,400
Diapers	4.8%	0.6%	0.0%	153,800	12,000	-	165,800
Other Organics	2.7%	1.4%	0.0%	84,700	27,400	-	112,100
E-waste	2.1%	0.6%	0.0%	67,700	11,500	-	79,200
Problem Wastes	17.1%	13.9%	4.7%	545,400	266,800	85,900	898,100
HHW	0.1%	0.1%	0.0%	3,000	2,100	-	5,100
C&D	0.4%	1.1%	78.6%	13,800	22,100	1,436,200	1,472,100
Rock/Concrete/Brick	0.0%	0.0%	31.2%	-	-	570,000	570,000
Asphalt Shingles	0.0%	0.0%	18.0%	-	-	328,900	328,900
Wood (treated)	0.0%	0.0%	11.1%	-	-	202,800	202,800
Wood Dimensional	0.0%	0.0%	10.0%	-	-	182,700	182,700
Drywall – Clean	0.0%	0.0%	5.1%	-	-	93,200	93,200
Drywall – Paint	0.0%	0.0%	10.3%	-	-	188,200	188,200
Other	0.8%	3.5%	1.3%	26,100	67,800	24,100	118,000
Total 2016	100.0%	100.0%	101.0%	3,189,700	1,921,200	1,827,000	6,937,900
Total 2021	-	-	-	3,484,900	2,099,000	1,996,100	7,580,000
Total 2026	-	-	-	3,788,800	2,282,000	2,170,200	8,241,000
Total 2036	-	-	-	4,382,300	2,639,500	2,510,100	9,532,000

6.4.2 Achieving Minimum Progress - Estimated Impact of Basic “Access-Oriented” Strategies

The state Level 1 and Level 2 goals are very state-focused, and are crafted in a way that works around the lack of current authorities. The first level of achievement for state progress should be regional planning. Short of that, substantial progress is made if access to recycling and diversion in the state is improved. This section provided an analysis (in Section 6.3) that assessed goals and recommendations collaborated from other states. Leveraging off the approach taken in Oregon, this section suggested a two-level approach to minimum recycling access strategies (Level 3 recommendations). These recommendations represent minimum requirements that allow flexibility for communities and are easily quantifiable.

Access to recycling is a core principle of this Plan, and strategies geared toward greater access are the underpinnings of the strategies summarized in Table 6-7.

This Plan recommends that the Front Range implement no fewer than eight of the Level 3 strategies identified in Table 6-6 (abbreviated below in Table 6-17), where the Mountains should adopt five, and four in the remaining regions. Communities not adopting the minimum number recommended are not eligible for RREO funds, and lose out on the other benefits noted in the state level recommendations (ELP, etc.). If the community or its county meet the area recycling goal (low or high), they are exempt from this recommendation.

Table 6-17: Level 3 Prescriptive Approach - State Recommendations for Publication (Near-Term, and/or if State or Regional Authorities are not Achieved)

Number of recommendations increases over time. Communities exempt if they demonstrate they have reached these Numeric Diversion Goals.	
1. Enhanced education program 2. Recycling depots/drop-offs in towns with population of at least 4,000. 3. Curbside recycling offered to single family homes (at least bi-weekly) 4. Curbside recycling for single family households (at least bi-weekly), cost fully embedded in solid waste bill 5. PAYT rate structure for single family trash service 6. Multifamily (MF) recycling of at least four materials in 5+ unit buildings in communities with a population greater than 10,000.	7. Yard waste (or yard and food) drop-off site 8. Organics (yard waste with or without food scraps) collection program for single-family customers 9. Commercial recycling program available for larger businesses 10. Commercial composting collection program for targeted businesses 11. Commercial recycling required for businesses generating large amounts of recyclables. 12. C&D recovery program requiring separate bins at generation or post-separation.
Recommendation: Front Range – Adopt 8 strategies; Mountains – 5 strategies, Rest of State - 4 strategies.	

The 12 - Level 3 strategies, designed to increase access to diversion in the regions are modeled in the tables below. The results are used to estimate the diversion potential that can be realized at the state level from basic access-related strategies implemented at the local level. The revised diversion quantities, presented in Table 6-17, show that diversion can be increased to 31% if the Front Range implements eight strategies, and the Mountains, Eastern/Southeastern and Western Slope implement four to five strategies.

To estimate the quantity of potentially recovered waste, the Project Team reviewed the presence of various programs and the relevant available waste by tons for each region and the likely involvement in the program (where voluntary). An estimate of the quantities that could be recovered if each program were implemented in each region is summarized in Figure 6-1. Individually selected programs and the quantity of waste collected if implemented in each region are summarized in Figure 6-2. The program assumptions are included in the table heading. To estimate the costs, a variety of assumptions were used, derived from the cost modeling in Appendix E:

- For drop-off programs, the cost of the operation of the drop-off center was incorporated, tipping fees were included and the relevant hauling distances were added for each region.
- For residential and commercial collection service strategies, the cost per ton for the service was developed and included.
- For education, a simplistic approach of expenditures of $2 per household per year was assumed.

Given that most programs were service-oriented, most of the costs accrued are charged to the generators. The cost to agencies or the state are minimal, covering only the drop-off centers, where relevant, and education initiatives. The assumption during this exercise is that households and businesses would absorb the cost of collection services in user fees. Further, because profit figures vary substantially based on local conditions (competition included), per the convention of this report, profit is excluded from the cost computations.

Table 6-18 presents planning level costs for key collection and diversion options. The ranges reflect difference in assumptions about elements comprising the costs.

Table 6-18: Planning Level Estimates: Cost per Ton Options by Region[1]

Total Costs	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Voluntary Residential Collection				
Trash	$70-$80	$80-$100	$90-$110	$90-$110
Recycling	$10-$30	$140-$190	$200-$290	$280-$410
Organics	$90-$110	$100-$110	$110-$130	$110-$130
Mandatory Residential Collection				
Trash	$60-$70	$70-$80	$80-$90	$80-$90
Recycling	$-10-$10	$120-$170	$180-$270	$260-$380
Organics	$80-$90	$80-$90	$90-$100	$90-$100
Every Other Week Residential Collection				
Trash	$50-$50	$60-$70	$60-$70	$60-$70
Recycling	$-20-$-10	$100-$140	$160-$240	$230-$350
Organics	$60-$70	$60-$70	$60-$70	$60-$70
Commercial Collection				
Trash	$60-$70	$70-$90	$80-$100	$80-$100
Recycling	$0-$20	$120-$180	$190-$280	$260-$390
Organics	$80-$90	$80-$90	$90-$100	$90-$100
Drop-off Recycling				
Range	$140-200	$230-$360	$600-$800	$300-$600

1. Includes collection, transport, processing, and tip fees; does not include avoided cost per ton

If the recommended number of strategies in the Front Range, Mountains, Eastern/Southeastern and Western Slope are implemented, the state achieves 722,000 additional diverted tons (71% of the potential from implementing all options). These tons are achieved at about 65% of the per-ton costs to generators (customers) or governments/non-profits that would have arisen if all of the strategies had been implemented in all four regions. Table 6-19 shows that diversion statewide from improving access, with sensitivity to regional situations, is expected to increase to approximately 31%. Note that these strategies include both residential and commercial sector outreach and programmatic initiatives, in recycling and organics.

Table 6-19: State Recycling Performance with Basic Minimum Access Strategies (Tons)

2014 Total Diversion (per CDPHE)	2,018,264
2014 MSW Generation	8,765,610
2014 Diversion Rate	23%
Additional Generation (1% growth per year)	175,312
Additional Base Diversion (1% growth per year)	40,365
Additional Tons from Level 3 "Access" Strategies	722,000
Diversion Rate including basic access improvements (Level 3)	31%

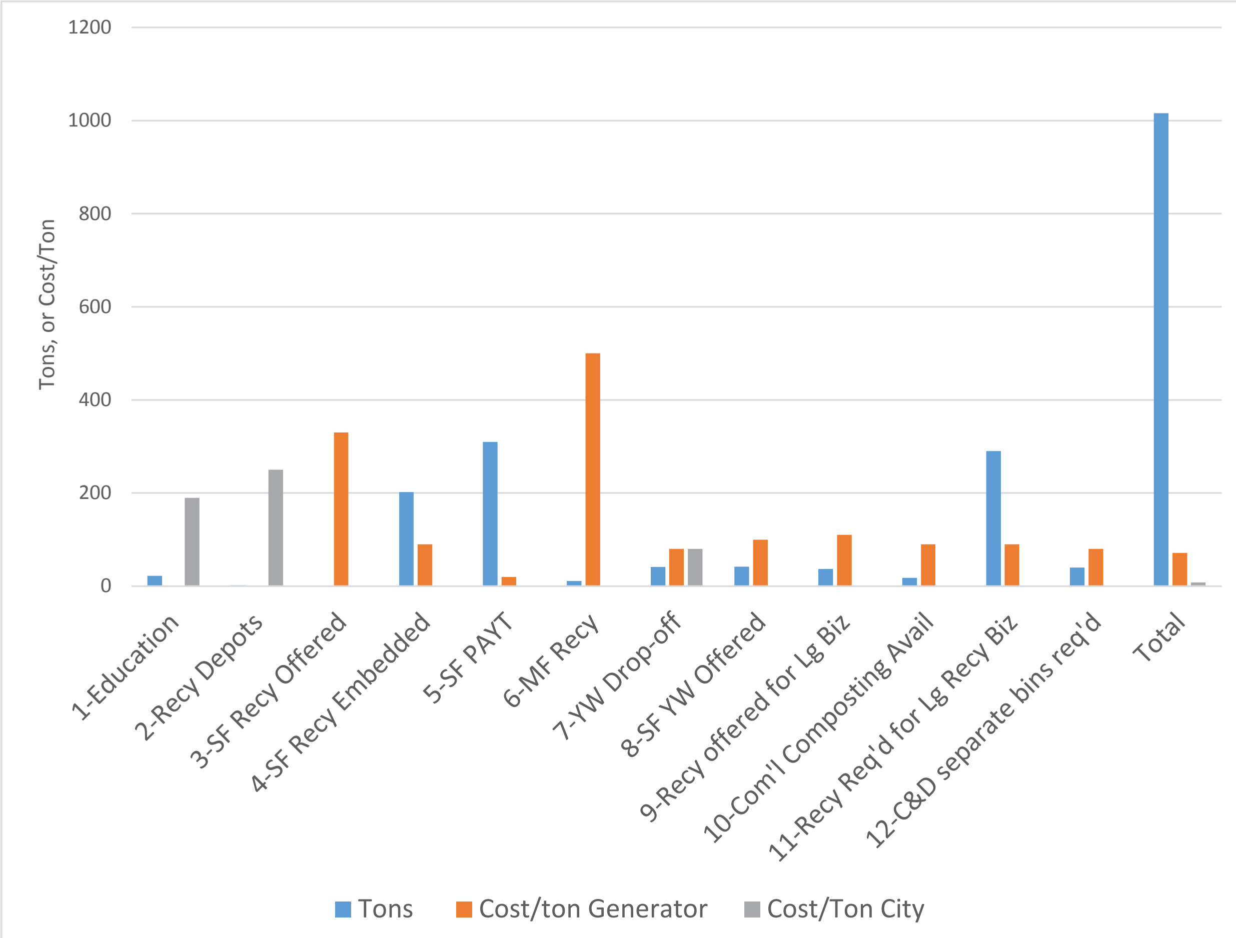


Figure 6-1: State Level Summary Diversion Performance – If All 12 Strategies Invoked in Each Region

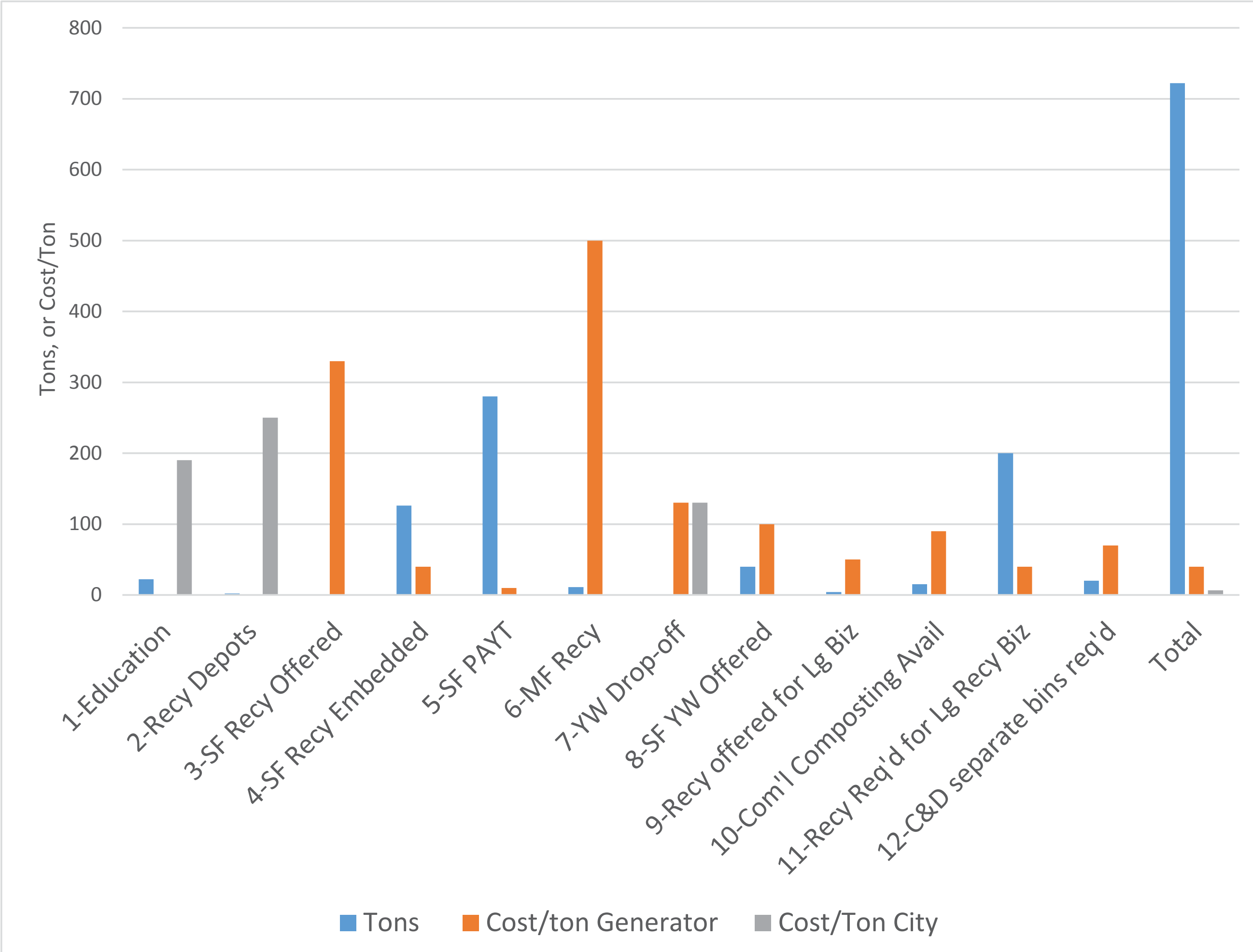


Figure 6-2: State Recovery with Selected Programs for Each Region[23]

These figures show that:

- Education is relatively costly per ton to the community, but delivers more tons that some of the voluntary service options modeled
- Embedded recycling and PAYT are strong performers; optional recycling for a separate fee delivers few tons
- Multifamily recycling is expensive and not very effective
- Offering households organics service is relatively expensive, but would deliver substantially more tons if the program was mandatory or "embedded" rather than optional as modeled
- Requiring recycling in the commercial sector is effective at diverting tons

[23] Assumes Front Range implements: 1,4,5,6,8,10,11,12 (8 programs); Mountains implement: 1,4,5,6,9 (5 programs); Western Slope and Eastern/Southeastern implements: 1,2,3,7,(4 programs)

- Even simple C&D recycling strategies have the potential to deliver noticeable tons

Similar figures for the selected Level 3 programs in each of the regions are provided in Appendix H.

The results from Figure 6-2 can also be summarized in tabular form, including the results from each of the regions. Table 6-18 details the tons (in thousands) and the costs (in cost per ton) associated with the implementation of between four and eight strategies in each region. The costs are derived from the program design assumptions and detailed cost modeling in Appendix E. The results show:

- An additional 722,000 tons per year can be diverted statewide if the "access to recycling" recommendations (Level 3) are implemented in the regions. The weighted average cost of achieving this diversion is about $46-$53 per ton
- Most of the tons are generated in the Front Range, which is also reflected in the low statewide costs for the set of programs
- The costs in the Eastern/Southeastern and in the Western Slope are 2.5-3.7 times the cost per ton found in the Front Range, identifying the influence that travel distance and low densities have on the affordability of diversion in those regions
- The cost to implement programs from the community perspective are quite low in the Front Range and Mountains; they consist of the education and drop-off programs. The drop-off option (with the associated transportation) is more expensive in the Eastern/Southeastern and Western Slope regions. The remainder of the programs are assumed to be directed by the communities or counties through ordinance or other method, with the cost borne by the generator
- These costs assume a five-year average of $140 per ton in single stream mix revenues, and zero revenues for organics. To the extent the market prices differ from those values, these weighted average costs would need to be adjusted

Table 6-20: Weighted Average Cost per Ton of Level 3 Options by Region[1]

For Selected Subsets of Level 3 Options	Front Range	Mountains	Eastern/ Southeastern	Western Slope	Statewide
Diverted Tons (in thousands)	675	41	2	4	722
Weighted Cost per Ton – Generator	$38	$58	$38	$75	$39
Weighted Cost per Ton - Community	$5	$5	$154	$167	$7
Weighted Cost per Ton - Total	$43	$62	$192	$242	$46

1. Selected subset of strategies for each region

6.4.3 Beyond the Minimum in Colorado – Strategy Options Inventory

There are a number of strategies that are well-suited to the various regions of the state and should be considered for implementation if and when planning agencies and funding are achieved. The first section lists traditional strategies (programs, mandates/bans, incentives, etc.). A list of zero waste and market development options is also included in this section.

Programs and Strategies List Ranked by Relative Cost-Effectiveness: The Project Team considered the array of effective and cost-effective diversion strategies available. These options are presented in Table 6-21. The table provides a relative ranking of a variety of diversion program alternatives available for the residential and commercial sectors.

- The first row reflects the best performance ― high impact/low city cost strategies
- The second row represents the alternatives related to medium cost and low to high impact; and the medium impact with low to high cost
- The third row reflects low impact/higher cost strategies
- The last row reflects strategies that do not have direct tonnage quantities assigned

Note that some important strategies (toxicity reduction, etc.) may be ranked low in this table because the criteria is based on quantity in tons and cost to city. In other cases, the cost to city may be low, although the cost to the generator may be high (higher bills for recycling), because the cost to the city is simply an ordinance or similar. The list is a general guide on the most effective and cost-effective strategies for communities to consider.

Table 6-21: Major Diversion Strategies Ranked by General Performance Category[24]

Single Family	Multifamily (MF)	Commercial
High Impact/Low (City) Cost		
• PAYT with cost for organics and recycling embedded; better with small solid waste cans, aggressive rates, every other week (EOW) solid waste • PAYT with recycling embedded • Organics – Mandatory or embedded in solid waste rate • Recycling – Mandatory or embedded in solid waste rate • Add food waste to organics • Add materials to recycling • Reduce recycling frequency to EOW and introduce organics	• All new or improved properties must have generator fee to fund recycling • PAYT bag program for MF and small businesses • City-wide ordinance requiring all large	• Recycling and organics embedded in solid waste rate a la PAYT for residential • Recycling embedded in solid waste • Material disposal bans • Mandatory recycling for all or targeted businesses • Mandatory organics for specific business types • Education on bidding for service and right-sizing; require clear invoicing and incentives on bills

[24] Program list developed/subsetted from SERA's "Comp Plan in a Box" and supporting publications.

Table 6-21: Major Diversion Strategies Ranked by General Performance Category[24]

Single Family	Multifamily (MF)	Commercial
• Material disposal bans – organics, recyclables, individual materials • EOW solid waste collection with organics • Larger recycling bins required • ADF legislation/fees on certain products (depends on product)	MF to provide recycling	• Differential taxes or tipping fees on some material streams (if substantial) • Add small businesses to residential curbside program • Require incentive rates for recycling and/ or organics
Middling Impact/Middling Cost		
• Drop-off recycling program, hub and spoke • Drop-off organics program • Offer curbside organics • Offer curbside recycling EOW • Offer curbside recycling weekly • Contract incentive to haulers to meet goals • Enhanced drop-off recycling stations • Taxes on some material streams • Require incentive rates for composting service • Recycling rebate program • Enforcement of non-compliance in programs, incentives	• Clear bags for recycling • ADF legislation on products • Enforcement of noncompliance	• Differential tip fee or contract incentives for haulers meeting goals • Technical assistance for businesses • Encourage cooperative agreements to share recycling service in neighborhoods or for small businesses • Require recycling (and composting) containers next to solid waste containers at businesses • Enforcement of non-compliance • Neighborhood sweeps – advising businesses door to door in a neighborhood
Low Performance (high cost/low impact)		
• E-waste events; HHW events • Reuse events promotion • Social Marketing education/outreach • Education/outreach • Backyard composting education	• Promote reuse programs • Education/outreach • Social marketing	
Unclear tonnage impact		
• Reporting required as part of hauler license • Contracting for collection (reduces cost) • Lobby for better organics permitting • Zero waste branding	• Space for recycling/organics ordinance (new or remodel)	• Space for recycling/organics ordinance (new or remodel) • Business recognition program • Require business recycling plans • Procurement guidelines • Require leases with recycling clauses • Work with industry groups to promote sustainable/green business practices

Note: Ranking within groups is not meaningful

Zero Waste, Extended Producer Responsibility, and Market Development Options: Finally, as communities and regions of the state consider options as part of regional planning work, zero waste options, environmentally-preferred packaging strategies (EPP) and market development approaches should be included in the mix. SMM encompasses integrated management of materials, considering a systemic approach to using and reusing materials more productively over their entire lifecycles. Zero waste, product stewardship, and traditional reduction/reuse/recycling strategies are all parts of an SMM strategy. SMM leads to greater consideration of "upstream" management of materials; rather than focusing on recycling what the market generates, SMM informed by life cycle assessment (LCA) studies[25] may argue for changes in material usage in the products to facilitate recycling.

Table 6-22 presents a list of sustainable materials management options that are frequently considered in more aggressive plans, and which should be seriously considered, at least by the agencies that may be ultimately tasked with developing the waste shed comprehensive plans in the Front Range. The optimal plan would encourage diversion, protect the environment, but also support industry growth and innovation. The large majority of these options are elements of traditional integrated, or comprehensive Plans as well (PAYT, education, program expansions/service options, facility recommendations); however, as a resource, the list of zero waste, SMM, and market development program recommendations beyond those often included in traditional comprehensive solid waste management plans are italicized and are also included in Table 6-22. The strategies include economic development, packaging strategies, product stewardship, and other initiatives. Note that the state has already introduced some other programs from this list, including strategic bans (tires, E-waste), and individual communities have undertaken many other elements.

[25] LCA Studies are generally fairly expensive, but can lead to important and unexpected suggestions for changes in the hierarchy for treatment of materials. Work by Allaway at Oregon's Department of Environmental Quality found shipping in plastic bags led to lower impacts than cardboard boxes. Recent work by Franklin Associates found that overall environmental impacts were lower from ground coffee purchased in bags than in plastic or metal cans.

Table 6-22: Options for Sustainable Materials Management - ZW, EPP, Market Development and Traditional Strategies – Typical Zero Waste Plan Options[26]

Topic	Options for ZW, EPP, and Market Development Strategies	
Outreach/Education (mostly traditional strategies)	Social marketing Sustained Public relations outreach Focus on source reduction Technical assistance & awards/recognition Media, regional, and retailer partnerships City staff education Train the trainer	*Develop and communicate to residents the highest priority materials for recovery*, and where to recycle/drop-off Publicize take back locations Reuse/repair directories on websites, etc. Research
Programs/Services (mostly traditional strategies)	Universal recycling ordinances (residential, commercial, recycling, organics) PAYT incentives; more aggressive incentives, smaller solid waste container options Embedded recycling – no extra fee Embedded organics – no extra fee Every other week solid waste to drive use of organics Highest use hierarchy (and research on topic) Maintain one or more recycling drop-offs in the community; potentially work with local non-profits as appropriate Bottle bill/collection sites Single stream recycling Schools programs Multifamily sector gets access to, or required recycling Reduce garbage volume exemptions for commercial or multifamily buildings Support multifamily compost programs/collection system Business technical assistance, waste audits, recognition programs	Develop/expand materials to recycling programs as markets develop Improve efficiencies in recycling collection Develop/expand organics materials to food, compostable paper; drop-offs or curbside as appropriate; increase curbside collection frequency *Encouraging use of in-sink garbage disposers in areas with appropriate waste water treatment and other conditions* Expand materials at drop-offs (e.g. metals) Expanded access to programs Mandatory/embedded programs for some sectors/targeted materials Material bans for high value materials/landfill bans Increase electronics collection Work with independent recyclers to help the community recycle their waste Support at-home composting programs Opportunities for tree limb management Outreach program and work with individual firms on expanding food waste reuse/composting/diversion (technical assistance, etc.); similar for recycling

[26] Source: Skumatz, "Zero Waste Planning: Unlocking the Next 30% - Tips for Balancing Near and Long Term Strategies for Fundamental Change" Skumatz Economic Research Associates, 2013. Note that some recommendations "cross" classification lines and are listed multiple times in the table.

Table 6-22: Options for Sustainable Materials Management - ZW, EPP, Market Development and Traditional Strategies – Typical Zero Waste Plan Options[26]

Topic	Options for ZW, EPP, and Market Development Strategies	
Collection//Haulers (mostly traditional strategies)	Provide financial incentives for diversion and against landfilling Considerations of contracting, franchising, regulations, requirements for economies and authorities Diversion requirements in contracts/agreements	Reporting and measurement Require haulers to offer or provide diversion services (recycling and/or organics) *Ensure that recyclable materials collected at curbside or drop-offs are actually recycled and that operations are effective*
Requirements/Ordinances (mostly traditional strategies)	Recycling plans, space for recycling in commercial/multifamily Support/establish material bans (food, yard waste, separated recyclables, etc.) Required services, embedded, mandates Require embedded recycling for commercial sector (commercial PAYT) Require city recycling and composting ordinance compliance as part of city leases, zoning, building permits, etc. for commercial and multifamily	Incentives (PAYT, surcharges, avoided taxes on some diversion streams) *ZW Events*, internal environmental preferred purchasing Reporting Require trees/slash to be diverted from landfill
Facilities (mostly traditional strategies)	New or expansions of facilities for Organics with food C&D facilities; support capacity for transfer, sorting, possible processing Appropriate MRFs, including mini-MRFs Ecosites, grinders, drop-offs, signage *Minimize long term landfill liabilities*	Regional cooperation, incentives for clustering or regionalization, cooperative siting; support capacity for additional diversion; tax benefits for co-location Anaerobic digesters, methane collection, conversion technologies Include clean damaged dimensional lumber in slash management programs Investigate new technologies
C&D (mostly traditional strategies) (traditional plans)	C&D plans Increase recycling of C&D debris Separate dumpsters required with service C&D deposit programs, incentives	Required deconstruction or reuse, recycling Green building codes, training, resources
Upstream activities (*mostly ZW/Stewardship strategies*)	*Support Product stewardship initiatives/policies/ordinances; advocacy, EPR* ADFs for target materials (plastic bag fees, etc.) Materials use/important bans *Strategic partnerships with states, agencies, associations, industry*	*Bottle bills, minimum content standards, takeback requirements* Education, outreach, social marketing *Work with State/Federal legislators to encourage ZW* *Promote markets/market development for recyclables and compost at local, state, and national levels*

Table 6-22: Options for Sustainable Materials Management - ZW, EPP, Market Development and Traditional Strategies – Typical Zero Waste Plan Options[26]

Topic	Options for ZW, EPP, and Market Development Strategies	
Other (*mostly ZW/Stewardship strategies*)	Other specific strategies for small tonnage/high "cost" materials (plastic bag bans, etc.) *City leads by example in ZW; advocates ZW, develops promotional materials and case studies/web links* *Require ZW for community events* Track/monitor/publish progress *Promote re-use policies, reusable bags, use of reusable water bottles, flatware, etc.* *Encourage non-profits and private sector to provide innovative services* *Green building codes/ZW elements/ZW building planning assistance*	Household hazardous waste programs/strategies *Work with industry groups to promote Sustainable Business and Green Business programs* *Implement ZW task force* *Adopt policies for identifying full avoided disposal costs to be basis for evaluating economics of programs/policies* *Promote and incentivize businesses to create and market products/services that reduce toxicity and disposal tonnages* *Conduct/support Life Cycle Cost studies for optimal material management*

ZW/Product Stewardship Strategies beyond those included in traditional Integrated SWM Plans in italics

In crafting the appropriate mix for each of the state regions, the regional planning agency should avoid some of the pitfalls of many zero waste plans:

- Avoid generalities (e.g. "optimize the existing system," "encourage cooperation," "increase awareness of…") and include tangible, enforceable, trackable recommendations
- Be specific and local, and recognize that what already exists affects the next steps and recommendations
- Estimate the impacts and costs – and therefore, cost effectiveness. Put the recommendations in context, and rank by criteria including impact, toxics reduction, and do not forget cost-effectiveness
- Do not overwhelm with dozens of recommendations. Focusing the most important and biggest bang recommendations so activities can be focused and progress might be realized. Recognize that the most effective strategies are unlikely to be the most popular – because they mean change
- Remember a detailed implementation plan, with responsibilities and timeline, and a funding plan

6.4.4 Tailored Strategies for Consideration in Plan's Region

The wide variety of strategies were considered as options that planning agencies may want to consider when regional planning and the authority to initiate programs becomes available in the state. This study analyzed opportunities and gaps in the four designated regions of the state (discussed in Sections 4 and 5, and summarized in Appendix H). Table 6-23 presents a list of program options that should be considered seriously as potentially-suitable in each of the regions:

- when appropriate for the regions if the state gains authorities to require programs
- if regional planning authorities are approved. These programs and infrastructure initiatives should be strongly considered in future regional modeling work

The costs and diversion quantities in tons would be developed as part of the wasteshed's comprehensive Plan.

Table 6-23: Local Program Recommendations for Four Colorado Sub-Regions

Recommendation/Strategy	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Statewide Strategies				
Statewide Recommended Strategies – 2 tier goal, regional planning with grant preferences, tracking; Release streamlined compost siting standards with food; Break down silos/barriers in CDPHE/collaboration	Yes, higher goal	Yes, lower goal; possibly higher for I70 corridor	Yes, lower goal	Yes, lower goal
Statewide level study: Bottle bill; industry-supported programs	Study	Study	Study	Study
Hauler Licensing and reporting, possible state level	Yes, IF auth.	Yes, IF auth.	Yes, IF auth.	Yes, IF auth.
PAYT requirements, possible state level	Yes, unless diversion rate >30%, IF auth.	In I-70 corridor	For communities >4000 pop.	For communitie s >4000 pop.
All landfills and large transfer stations install recycling drop-off and transfer recyclables to MRF – unless H&S already available within 20 miles, possible state level. Landfills have scales; consider balers and cullet machines in some locations for long hauling savings.	Yes, but exempt areas with embedded SF recycling IF auth.	Yes, but exempt areas with embedded SF recycling	Yes	Yes
All landfills and large transfer stations install organics drop-off if composting facility within 20 miles and no drop-off within the area.	Yes, exempt areas with curbside	Yes, in longer run.	Multiple compost sites avail.; mid-longer term	Multiple compost sites avail.; mid-longer term
IF state gains authorities, recommend these; if not, encourage regional planning agency to consider. Potential provide grant points for every one of recommended list they have, etc.				
Cross-sector strategies				
Increased education on recycling, costs of contamination, awareness of recycling opportunity for all	Yes	Yes	Yes	Yes
Yard waste ban (county level)	I-25 Front Range	I-70 corridor		
Cardboard ban (county level)	I-25 Front Range	I-70 corridor		

Table 6-23: Local Program Recommendations for Four Colorado Sub-Regions

Recommendation/Strategy	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Develop procurement standards for use of compost for soil amendment in developments and CDOT	Yes	Yes	Yes	Yes
Purchase compost spreaders to facilitate use of local compost	Yes	Yes	Yes	Yes
Work with farmers on on-farm composting	Yes	Yes	Yes	Yes
Work to arrange for back-hauls from empty retail deliveries donated for rural recycling		Yes, rural areas	Yes, rural areas	Yes, rural areas
Single Family				
Require recycling to be offered for SF				
Require embedded recycling for SF	Yes, populations >4000	Yes, I-70, populations >4000	Consider, mid- to longer run	Consider, mid- to longer run
PAYT by ordinance or other means	Metro Front Range	I-70, populations >4000		
Make EOW solid waste collection possible	Yes	Yes, I-70		
Require 3-bin program (composting included) if goal not met	Yes, metro Front Range			
Explore pros and cons of contracting for service, especially if economies of scale can be significantly improved	Yes	Yes	Yes	Yes
Multifamily				
Assure convenient drop-offs, provide education (in-sink, other programs)	Yes			
Require recycling bins & education in all rental units		Yes		
Require space for recycling (and potentially composting) for new construction and substantial remodels	Yes	Yes	Yes	Yes
Commercial				
Require space for recycling (and potentially composting) for new construction and substantial remodels	Yes	Yes	Yes	Yes
Targeted recycling program requirements for certain sectors, large commercial generators (e.g. ABC law example for bars/restaurants)	Yes, Metro Front Range	I-70	Yes in towns with pop>4000	Yes in towns with pop>4000
Targeted food program requirements for all businesses in food-related sectors, large generators if compost site within 20 miles	Yes, Metro Front Range	I-70		
Encourage downtown business districts to consider contracting for solid waste/recycling for access and waste management for savings	Yes	I-70	Yes, encourage, pop >4000	Yes, encourage, population >4000
Require hotels to have in-room recycling containers	Yes	Yes		
Business recognition programs and technical assistance; business plans for businesses over 50 employees, filed with the county	Yes	Yes	Yes	Yes
Construction and Demolition				
Require recycling bins with any solid waste bins delivered to sites for collection	Yes	Maybe	No	No
Require C&D deposit program; developers may recover their financial deposit if they demonstrate	Yes	Maybe	No	No

Table 6-23: Local Program Recommendations for Four Colorado Sub-Regions

Recommendation/Strategy	Front Range	Mountains	Eastern/ Southeastern	Western Slope
they recycled/reused sufficient materials; low recover requirements until C&D facility available				
Processing				
Siting of additional compost facilities		Yes	Yes	Yes
Use landfill or transfer station as hub or spoke (if a hub is feasible distance) for recycling if there is no Hub or drop-off within 20 miles. Site open as long as host site. For some areas, consider co-location at grocery stores, if preferable. Develop and support H&S in rural areas where possible	Yes non-Metro Front Range, rural	Yes, rural	Yes, rural	Yes, rural
C&D sorting/processing facility	Yes	No	No	No
Longer Term Programs				
Long Term Programs, Sustainable Materials Management and ZW strategies (inventory in Table 6-19)	Consider the Level 4 roll-out region-wide, and the wide-ranging list of ZW & EPP strategies provided in Table 6-19 including upstream options and lobbying; other. Explore industry-funded curbside recycling like Canadian "Blue Box"	Elements of Level 4 strategies (along I-70); Wide range of traditional options including C&D; ZW options including ADFs, ski industry partnerships, ZW Task force, Business incentives; other	Regional planning; move toward shared hauling and infrastructure where practical; increase access; enhanced hub & spoke; economic development assistance; differential surcharges by stream (MSW, recy, organics); industry-sponsored programs; green building codes; other	Regional planning; move toward shared hauling and infrastructure where practical; increase access; enhanced hub & spoke; economic development; differential surcharges; industry-sponsored programs; green building codes, other
Other Program Considerations				
	None – aggressive programs suitable, except in a few rural areas	Aggressive In I-70 with ski industry, less in rural	Mandates & bans unacceptable, unclear if much organics tonnage available, illegal dumping concerns, mountains impede hauls	Mandates and bans unacceptable, unclear if much organics tonnage available, low population density

A number of these programs are already in place in Colorado, and certainly in communities outside the state. Appendix C includes dozens of case studies of these and other strategies, included to assist Colorado communities in understanding the options, and follow-up for more information. Case studies beyond those previously mentioned in Sections 4 and 5 include:

- Recycling and organics options: Fort Collins PAYT ordinance, rural recycling innovations in Virginia, food donation strategies; recycling and composting strategies in Loveland and Fort Collins; Bans; unique composting options
- Commercial issues: Better invoicing
- Schools/Education: University of Colorado – Boulder; K-12 example
- Funding issues: Moving from tax base to user fee; tip fee surcharges
- Other: Aspen's Sustainability Plan; regional planning leadership in Vermont; circular local economies/lifecycle plans; outreach on contamination in Massachusetts; state legislation details for other states

6.4.5 Available Regional Planning Agencies – Operationalizing Planning Work

As mentioned, there is a network of existing regional planning agencies around the state. Local planning in solid waste may be a natural addition to their responsibilities. The list of known agencies, and the areas with apparent gaps in coverage, is provided in Table 6-6.

6.4.6 Strategies for Funding Local Initiatives – Operationalizing Progress

A number of options are available for funding collection and diversion initiatives at the local level (state strategies were provided elsewhere). A number of options are listed in Table 6-24, along with their suitability in Colorado. The table includes strategies suitable for local funding – or for cost savings – to help fund planning and programmatic initiatives.

While new responsibilities and mandates are disliked by communities, unfunded mandates are despised. Any additional responsibilities for local jurisdictions must be packaged with a funding mechanism. Where the authority for the source does not exist, the state may need to consider empowering it. Unfortunately, many communities are not anxious to charge their residents and businesses additional taxes and fees to meet state recycling goals. These mechanisms can address the potential sources for these funds, but not the political will to implement them.

Table 6-24: Potential Funding Sources for Local Communities in Solid Waste Planning/Management/Programs

Assistance	Currently Available	Priority	Considerations	Funding Source	Notes
Revenue Sources					
State-funded Grants	Yes	High	The state makes a grant program available to help fund the specific responsibilities that the state chooses to rely on local authorities to perform. It may also provide a reward or incentive for taking on additional programs and responsibilities	Disposal surcharge revenues	Some states have offered grants that are almost "earned" or guaranteed if the community develops Plans or puts in preferred programs. Here that might include PAYT, contracts for collection
New Direct Funding Authority	No	High	State grants new funding authority to communities	New fees at the local level	California introduced AB939 planning fees. Could be based part on tons, part on participation
User Fees	Yes	High	Funding for direct costs of recycling and composting collection programs are generally recovered through user fees. Cities can assess user fees surcharges on the top of solid waste bills to help pay for new responsibilities; they could be on solid waste or recycling	User fees; potential surcharges through contracts or municipal service delivery	Under contracting arrangements, cities can pay haulers on a basis that differs from the way in which they charge service

Table 6-24: Potential Funding Sources for Local Communities in Solid Waste Planning/Management/Programs

Assistance	Currently Available	Priority	Considerations	Funding Source	Notes
New Taxes	With nexus	Medium	Some cities have implemented specialized commercial taxes (e.g. business and occupation or other taxes) to provide a way to access adequate funding for the system from the commercial sector	Direct assessment on businesses	New fee to fund new responsibilities, and gather funds from the business sector, which benefits but doesn't always pay cities for the direct and indirect solid waste services it receives from communities (litter, road wear and tear, etc.)
Generator Fees/Environmental Fees	Yes	High	Communities invoke a generator fee on households and businesses to help pay for the programs and planning responsibilities	Households and businesses	Some cities have in place already in the state, or may be a new fee to fund new responsibilities
Lower Surcharges/Lower Tip Fees	No	High	Some states have offered lower disposal tipping fees (or reduced surcharges) for communities meeting goals or implementing programs. This is a de facto grant or funding source, depending on who pays tip fees	Savings to the community if it has municipal or contracted service	May be able to structure reimbursement to city even for cities that do not collect or have contracts, based on tons
Direct Surcharge Authority	No	Unlikely	Cities could be authorized to charge surcharges on facilities in their area	New fee on local solid waste tons	Not available in state currently
Shared Disposal Surcharges	Yes	General	State reimburses some share of surcharges to cities with planning responsibilities	From state collected revenues	From increased fees on higher level fee plus potentially from fees raised from out of state tones

Table 6-24: Potential Funding Sources for Local Communities in Solid Waste Planning/Management/Programs

Assistance	Currently Available	Priority	Considerations	Funding Source	Notes
Hauler Registration Fees	No	Medium	Cities can collect fees to cover administration/oversight/ enforcement, etc. related to haulers	From haulers	Expanded responsibilities could mean higher local fees; sharing arrangements could be worked out with the state
Contractor Fees - fees on hauler contracts or operations, or similar	Yes	High	Communities can assess fees to contractors if they establish contracts or districts—for oversight and management, etc.	From haulers	Can be assessed to the level required for oversight. However, under contract arrangements, the city can assess generator fees or similar and add to the bill
Litter Fees, ADFs	No	Med-High	Communities or counties can assess product fees to help fund proper disposal of problematic products (short duty cycle relative to life, hazardous, clean-ups, etc.)	Product fees	In place elsewhere, successful; may require vote; usually linked closely to one product/not "general"
Savings					
Education/Training/ Assistance (avoided cost /savings)	Yes	High	The state can assist cities by putting together webinars on topics, template RFPs and educational materials, etc. to save cities money in designing/researching their own. Some states have hired technical experts on staff to work with cities to help plan strategies	From state revenues/economies in expertise	Use website and webinar series and local meetings to disseminate materials. CDPHE provides expert assistance to communities/regions
Market Development Assistance	Yes	Med-High	Would require considerable staff time		Much desired by stakeholders

Table 6-24: Potential Funding Sources for Local Communities in Solid Waste Planning/Management/Programs

Assistance	Currently Available	Priority	Considerations	Funding Source	Notes
Efficiencies and other BMPs	Yes	High	As listed in the program strategies and discussed in Appendix E; examples include optimizing collection frequencies (reducing to biweekly recycling to add organics), participation incentives, embedded service for economies of scale, etc.	Reduced cost	Very effective; local control issues if no authority over haulers
Industry-Funded Programs	Yes, in some areas	Med-High	Canadian Blue Box program shifted costs of municipal recycling programs to the paper and container industries whose materials are in the curbside recycling bin. Other industry-funded programs include Paint, Mercury Thermostat recycling, etc.	Reduced cost	Major change, successful elsewhere, will require significant lobbying or negotiation
Shared Savings	Yes	Uncertain	Requires agreements	Share of reduced cost	Not demonstrated in solid waste; in place widely for energy

Other Desired Assistance: In addition to direct funding assistance from the state, most of the regional stakeholder meetings were very interested in the state providing direct market development assistance, presumably at the state and local level. Similarly, there was strong interest in training and outreach, including webinars, websites, and other information helpful to devising effective local strategies.

6.5 Summary Recommendations

The detailed cost, program, and facility analyses imply that things are unlikely to change substantially in sustainable materials management in Colorado unless the state interjects policies, incentives, and mandates that force change in the solid waste system. Given the state's authorities, this can be challenging. However, the state can influence change if it links diversion policy to disposal and diversion funding. If CDPHE is committed to finding ways to advance diversion in the state of Colorado, the Project Team recommends:

- **Link the availability of state funds to assist in closing landfills to a requirement that those counties must first pass ordinances or use other means to divert materials from landfills:** PAYT[27] is identified as the priority strategy because this program is already directly within the authorities of Colorado communities, does not require substantial expenditure of county or community funds, and is the single most cost-effective strategy available for diverting materials. The only supporting infrastructure necessary for the program is access to recycling. This may be a curbside program or a reasonably-convenient drop-off recycling program. Grant fund preferences (see below) or landfill compliance savings may help fund these programs where they do not currently exist or where they need expansion. The increase in recycling tons generated from the PAYT incentive should help the economics of these programs. Adoption of PAYT in these areas may also spur adoption of PAYT beyond these counties and communities.
- **Work to increase funding for the RREO grant program and support diversion access, infrastructure, programs, and planning:** Continue to prioritize grant funds to increase access to recycling across the state (including the current focus on hub and spoke, etc.); however, also allocate funds to regional comprehensive planning efforts, but if and only if they 1) cover multiple counties; 2) have the active participation[28] of the local County governments; and 3) if there is a stated commitment to implementing strategies. RREO funds are limited, and planning projects in themselves do not increase diversion. CDPHE should time the requests for increases in RREO funds to maximize chances of success.
- **Provide education, training, and facilitation to improve diversion effectiveness, access, and performance:** CDPHE is empowered to provide training and technical assistance, and should substantially increase its efforts in strategies designed to decrease disposal. CDPHE should use all available channels to provide education, including web pages[29], webinars, stakeholder meetings, conferences, articles, memoranda, manuals and other methods, especially, direct assistance by phone or other means. Initially, the education should be focused on practical information and technical assistance on diversion strategies, best practices, efficiency/effectiveness tips, and feasible “next” strategies to enhance diversion in the residential and commercial sector. The state

[27] The PAYT programs implemented must meet minimum best practices design standards outlined elsewhere in this document. For curbside PAYT, there must be a container available that is no larger than 32 gallons, with other options available. The price incentives for double the service should be 50%-80% extra. There should be access to recycling options that include the basic single stream materials, in a single stream or separated program. If trash containers are provided, recycling containers must also be provided, and embedded in the trash price. The PAYT program may be drop-off in design, with Grand Lake or others as example programs. Education should be provided at least annually.

[28] Demonstrated with a signed commitment of participation as part of the Grant application.

[29] Including potentially a library of links to in-state (and national) comprehensive plans, case studies, program reports, waste compositions, etc.

can also be a source of information on advanced materials management strategies for communities, counties, and stakeholders.

- **Work to get more from existing programs, and leverage existing successes:** Access to at least minimal recycling statewide should be pursued. However, Colorado's overall diversion performance will be best and most sustainably improved by improving recycling in the Front Range, where performance is already stronger than in the rest of the state and conditions are relatively conducive to diversion, and where 83% of the state's waste is generated. Densities are favorable, and the infrastructure exists for many streams. There is an appetite for taking on authority in solid waste. Available waste composition studies clearly demonstrate there remain high percentages of current recyclables still being disposed. One percent improvement in the Front Range translates to four times as much diverted tonnage as one percent improvement in the entire rest of the state – and similarly, one percent improvement in the Western Slope, the second most populous region identified (8%), increases statewide diversion performance by only one-twelfth of one percent. Improving performance in areas with good economics should also improve the chances of sustainable change. The Front Range buries more than $200 million market values in recyclables,[30] including high value plastics (8-12% of landfilled tons in the residential sector), recyclable paper (15% or more, including at least 4% each cardboard and news) and metals. Organics should also be a key focus. At least 25% of the tonnage landfilled in the Front Range is compostable organics, at least two-thirds of which is food. The state should educate on best practices for programs that encourage more diversion, and encourage adoption of programs and strategies that improve effectiveness of capture of existing materials. The focus areas should include: 1) in areas with existing collection programs, encourage adoption of cost-effective strategies that make it affordable to expand diversion to organics, and to collection of "next" recyclables. For example, every-other-week recycling collection may make new organics collection affordable; every other week collection of trash drives diversion of food waste; PAYT and small cans drives diversion; embedded recycling (and consider organics) is highly effective; universal recycling ordinances; and in some cases, contracting for collection may improve economies enough that collection of recycling and organics can be added a little cost beyond the previous cost of trash alone.[31] Local ordinances related to solid waste are powerful and inexpensive local tools. 2) There are significant areas of the Front Range with programs that are weaker than other areas (lacking embedded recycling, PAYT, organics collection, single stream

[30] Using 5-year average market prices for the region.
[31] Case studies of Colorado communities using most of these strategies are provided in Appendix C: Case Studies on Collection and Diversion in this report.

in large containers, performance tracking by haulers, etc.). 3) Lesson-learning opportunities between Front Range communities and between advanced communities nationally and the Front Range (regional meetings, webinars, toolkits, white papers, etc.) may spur further innovation, adoption, and progress. 4) Take a cue from communities that have begun progress in the commercial sector (Fort Collins, Boulder, Vail, etc.). Finally, improved tracking and adopting Percent Recoverables Remaining (PRR) metrics and the associated waste composition studies would help focus Front Range communities on the eligible (and "next") items still remaining in the disposal stream. Focusing attention in these four to five achievable areas is, frankly, the key strategy to significant, affordable, and near-term improvement in state diversion.

- **Regional strategy priorities should vary:** Beyond the Front Range economics (addressed above), organics is likely to be a higher priority in the Front Range than in more rural areas of the state. Rural landfills tend to have a different experience with organics than Metro-area landfills with lower amounts of landscaping trimmings, and similar materials coming into the facility, and the materials tend to come in separate truckloads that can be redirected to compost facilities. In addition, commercial strategies should be a high priority in the Front Range; the number of businesses in the rest of the state is considerably smaller. Similarly, attention in the C&D sector will be difficult in the areas outside the Front Range, as sufficient densities are lacking to support any infrastructure needed. A C&D facility in the Front Range would address a barrier to recycling a significant waste stream. Areas with substantial university presence should focus on successful strategies that have been implemented by successful university programs elsewhere.[32]
- **Encourage innovation to address barriers:** The state should actively encourage development of innovative strategies that address collection and diversion barriers. Collection of trash and recycling separately drives the expense of diversion. Experimentation has already occurred in the state on co-collection of trash in colored bags or containers and (different colored) bagged or loose recyclables, which would reduce recycling collection costs and affordability substantially. This strategy can apply to the commercial sector as well as the residential sector. There ae other innovations – some of which may already be in place but not well known – that may help address Colorado barriers.
- **CDPHE should work to gain the authorities to implement the additional strategies that lead to diversion, and should assure that diversion is part of the state's Climate Plan and**

[32] Leading university programs include the University of Colorado – Boulder, and the winners of the National Recycling Coalition, and now KAB's "RecycleMania" college and university competition. Information on these initiatives are available on the web. Schools programs are also a potential strategy, but the relative costs of collection for this sector (and the institutional sector) follows the pattern for the commercial sector. Appendix C includes a case study for the University of Colorado – Boulder.

environmental agendas: Conduct meetings with stakeholders with a natural affinity to recycling (CAFR, SWANA, environmental groups, non-profits) to find supporting coalitions that can help enhance CDPHE's toolkit for achieving progress in disposal alternatives, linking to improved health and safety in the waste management system. Continue to highlight the job and greenhouse gas abatement advantages, including the literature demonstrating diversion's outstanding cost-effectiveness and speed in achieving progress in GHG.[33] Priority strategies should include: 1) enforce or prioritize progress in access to recycling (Level 3 strategies) and enforcement of goals; 2) PAYT because it is effective, available, demonstrated, and affordable (not an unfunded mandate; and other priorities; 3) consideration of landfill surcharge increases, which have increased diversion in other states and to help fund SMM strategies; and 4) regional planning, tracking, and other strategies listed elsewhere. Consider establishing a long-term standing committee of advisors on the topic. The state should also work on longer-term materials management strategies at the local and state level – including support for research, accumulation of research and case studies, outreach on feasible strategies, support for legislation or opportunities, in-house adoption, and other support. The state can encourage economic development to grow local markets for recyclables in the state and implement in-house strategies related to sustainability, procurement, prevention, and diversion. CDPHE should actively insert itself in state initiatives (committees, projects, etc.) related to climate change, sustainability, and materials management.

- **Progress needs a policy leader:** The literature indicates that progress beyond the *status quo* in recycling is driven by policy leadership[34], and specifically by industry associations, councils, and states. Boulder, Vail, Fort Collins, Lafayette, Longmont, and other examples exist at the local level in Colorado. Progress in Oregon, California, Minnesota, and most recently and notably, Vermont, resulted from state-level policy leadership and well-crafted legislation. Involving CDPHE in an increasing role in technical advice on recycling will be a very helpful role, and continuing and growing a collaborative process (with stakeholders, local governments) will advance materials management in the state. Progress in Colorado would benefit greatly from CDPHE becoming more directly involved in waste diversion if and when authorized by statute.

[33] McKinsey & Company 2009 op.cit., Skumatz 2007 op.cit..
[34] A statistical analysis of this question is included in City of Denver and Skumatz Economic Research Associates, "Toolkit for Commercial Programs", Skumatz Economic Research Associates, 2013.

APPENDIX A: TERMS AND DEFINITIONS

APPENDIX A: TERMS AND DEFINITIONS

"CAFR" is the Colorado Association for Recycling

"CDPHE" is the Colorado Department of Public Health and Environment.

"C.R.S" is the Colorado Revised Statutes.

"Compostables" in this report means organic material that are commonly included in a composting program, including yard wastes, small branches and trimmings, and when allowed, food scraps and food-soiled paper.

"Composting" means the biological process of degrading organic materials that is facilitated and controlled through intentional and active manipulation of piles and windrows. These manipulations may include but are not limited to grinding, mixing of feed stocks and bulking materials, addition of liquids, turning of piles, or mechanical manipulation.

"Composting facility" means a site where compost is produced.

"Composting rate" in means the percent of tons of compostable materials diverted and processed as a fraction of the total "generation" commonly comprised of MSW, recycling, and organics.

"Contracted collection" is the organized collection of residential trash and potentially recyclables and/or organics for all households in a community with the service provided by one (or sometimes more geographically districted) authorized private haulers that earned the right through a competitive bidding process organized by the Community. The city manages the contract, and the city or hauler may provide the billing.

"Daily cover" means using a product as a cover placed upon exposed solid waste in a permitted solid waste facility to control disease vectors, fires, odors, blowing litter and scavenging, without presenting a threat to human health or the environment.

"Department" means the Colorado Department of Public Health and Environment or CDPHE.

"Diversion rate" means the percent of tons of recyclable and compostable materials diverted and processed as a fraction of the total "generation" commonly comprised of MSW, recycling, and organics.

It is the sum of the recycling rate and the composting rate. Diverted materials may also include source reduction.

“Dual stream” is collection of recyclables in two separate containers and streams, keeping separate the fiber streams (paper) from container streams (plastic, glass). Dual stream processing facilities (MRFs) do not include the extra steps necessary to separate single stream materials into individual marketable materials.

“Financial assurance” means the requirements of Section 1.8 of the solid waste regulations and include a detailed written estimate of the cost of hiring a third party to close the largest area of a site and facility that may require closure and shall be the basis for the closure estimate. The closure cost estimate must equal the cost of closing the largest area requiring closure during the active life of the site and facility when the extent and manner of its operation would make closure the most expensive, as indicated by its closure plan through the use of one or more of the financial mechanisms to financially assure full payment of all closure, post-closure, and if applicable, corrective action estimated costs.

“Ground water” means any water below the land surface in a zone of saturation.

“Groundwater monitoring” means those standards established by the methodology and standards established by this Department (5 CCR 1002-8) in the Solid Waste Regulations, Section 2.

“Ground water protection standard” means those standards established by following 40 CFR 258.55(H) and (I) methodology or standards established by this Department (5 CCR 1002-8).

“Hub-and-Spoke” is a model used to increase transportation efficiencies and reduce infrastructure and service redundancies in a regional service area. The model consists of a centralized processing center for recyclables, or “hub,” where material is sorted, baled and/or sold to market. The “spokes” are the surrounding communities that feed the recyclables they collect to the main hub. Typically the hub and spoke communities have a formal agreement that ensures the recyclables collected in the region flow from the spokes to the hub for processing.

“Integrated Solid Waste Management (ISWM)” is a comprehensive waste prevention, recycling, composting and disposal program. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment. ISWM involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions.

“Landfill liner” means a continuous layer of natural or man-made materials beneath and on the sides of a landfill which restricts or prevents the downward or lateral escape of solid waste, its constituents, or leachate. A liner is also used in cap construction to prevent and control vertical movement of fluids.

“Leachate” means liquid that has passed through or had contact with solid wastes and may contain soluble, miscible, or suspended constituents removed from the wastes.

“Material Recovery Facility (MRF)” means a facility consisting of structures, machinery, devices, or persons to sort, bale, or otherwise manage or process source separated recyclable materials prior to conveyance to end markets.

“Medium size MSW landfills” means a landfill that accepts between 25,000 to 200,000 cubic yards of municipal solid waste per year.

“Municipal Solid Waste (MSW)” means solid waste from household, community, commercial sources that does not contain hazardous wastes as defined in the Colorado Hazardous Waste Act.

“Municipal solid waste landfills” means a sanitary landfill where one of the main waste streams accepted is municipal waste.

“Municipal collection” is the organized collection of residential trash and potentially recyclables and/or organics for all households in a community using city staff, billed by the city or embedded in taxes.

“Pay As You Throw” (PAYT) means a solid waste collection and billing system by which households or customers are charged in relation to the quantity of solid waste being collected. These systems use “per can” or “per bag” service increments. The systems most commonly refer to residential service, but programs can also be applied to the commercial sector.

“Plan” means the Colorado Integrated Solid Waste and Materials Management Plan.

“Recycling facility” (see material recovery facility) means a separate facility, or a part of a solid waste disposal facility, where recycling operations are conducted.

“Recycling” is a series of activities by which material that has reached the end of its current use is processed into material utilized in the production of new products.

“Recyclables” are materials recovered from the solid waste stream and transported to a processor or end user for recycling.

"Recycling rate" means the percent of tons of recyclable materials diverted and processed as a fraction of the total "generation" commonly comprised of MSW, recycling, and organics.

"Regional" is multi-jurisdictional, encompassing multiple counties or cities as well as the service providers who operate within those borders.

"Regional MSW landfill" means a landfill that accepts more than 200,000 cubic yards of municipal waste per year.

"Recycling Resource Economic Opportunity (RREO)" means the grant and rebate opportunity fund created by HB 07-1288 with the intent to fund implementation projects that promote economic development though productive management of recyclable materials that would otherwise be treated as discards.

"Request for Proposal (RFP)" means a solicitation which is often made through a bidding process, by an agency or company interested in procurement of a commodity, service or valuable asset, to potential suppliers to submit business proposals.

"SERA" is Skumatz Economic Research Associates.

"Single stream" is collection of recyclables in one (usually large) container or rolling cart combining fiber streams (paper) with container streams (plastic, glass). Single stream processing facilities (MRFs) include sorting and processing equipment capable of separating the streams into individual marketable materials.

"Small size MSW landfill" means a landfill that accepts less than 25,000 cubic yards of waste municipal solid per year.

"Solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, air pollution control facility, or other discarded material; including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations, commercial operations or community activities.

"Solid (Waste) and Hazardous Waste Commission" (SW&HW or S&HW Commission) is the Governor-appointed commission responsible for setting the disposal tipping fee surcharge level that is used to fund CDPHE activities.

“Subscribed or open market collection” is the collection of residential trash and potentially recyclables and/or organics for all households by private haulers contracting one-on-one directly with households, potentially in a competitive market place with multiple haulers covering the same territory. Haulers bill the customers directly for service.

“SWANA” is the Solid Waste Association of North America.

“Solid waste disposal” means the storage, treatment, utilization, processing, or final disposal of solid wastes.

“Solid waste disposal site and facility” means the location and/or facility at which the deposit and final treatment of solid wastes occur.

“Solid waste regulations” means the regulations pertaining to solid waste sites and facilities 6 CCR 1007-2, Part 1 as authorized by the Colorado Solid Waste Act, 30-20-1 C.R.S..

“Stakeholders” means local officials, government employees, private businesses, nongovernmental organizations and interested citizens that are involved in or have an interest at stake within the solid waste and recycling sector.

“Sustainable materials management (SMM)” is an approach to serving human needs by using/reusing resources most productively and sustainably throughout their life cycles, from the point of resource extraction through material disposal. This approach seeks to minimize the amount of materials involved and all the associated environmental impacts, as well as account for economic efficiency and social considerations.

“TPY” means tons per year.

“Tipping fee” is the user fee charged at a landfill or transfer station for deposit of materials for management, and may be charged on a per ton basis or may be charged per cubic yard.

“Transfer station” means a facility at which refuse, awaiting transportation to a disposal site, is transferred from one type of containerized collection receptacle and placed into another or is processed for compaction.

“Waiver” for the purposes of these regulations shall mean a formalized process whereby an applicant may request to be excused from specific portions of these regulations. In general a defensible technical argument must be presented and verified before a waiver may be granted.

"Waste division" is the prevention and reduction of generated waste through source reduction, recycling, reuse, or composting. These actions generate a host of environmental, financial, and social benefits, including conserving energy, reducing disposal costs, and reducing the burden on landfills and other waste disposal methods. (U.S. EPA, 2012)

"Wasteshed" means a regional area of the state usually composed of multiple counties that share a common solid waste disposal and recycling system by use of the same infrastructure including landfills and recycling facilities.

APPENDIX B: LANDFILL ADEQUACY SUMMARY

Colorado Lanfill Evaluations
Integrated Solid Waste and Materials Management Plan

						Design & Operating Requirements									Ground Water Monitoring					Closure Requirements		
Name	County	Facility Size	2012 Tons	2013 Tons	2014 Tons	Access Controls	Adequate Haz Waste Screening Procedures	Stormwater-Water Quality Permit	Air-In Compliance with Open Burning Permit	Adequate Daily Cover	Cover/ Compaction Equipment	Adequate Liner	Adequate Leachate Collection System	Adequate Methane Monitoring	Adequate System of Groundwater Monitoring Wells	Groundwater Sampling	Groundwater Impact from Constituents	Groundwater Waiver Granted	Current Groundwater Waiver	Adequate Closure Cost Estimate (Y/N)	Adequate Post Closure Cost Estimate (Y/N)	Adequate Financial Assurance $ Mech (Y/N)
Front Range																						
Broadacre Landfill	Pueblo			-	-	Y	n/a	Y	n/a	n/a	n/a	Y	Y	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
Buffalo Ridge LF	Weld	L	103,303	131,505	104,457	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
CO Springs LF	El Paso	L	276,051	273,670	263,302	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
Conservation Services, Inc	Adams	L	36,236	40,362	49,229	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
DADS	Arapahoe	L	1,631,439	1,727,586	1,720,197																	
Denver Regional LF South	Weld	M	797	68,331	9,665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
East Regional Landfill	Adams	L	209,242	246,181	196,816	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Foothills LF	Jefferson	L	283,152	261,272	267,823	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Fountain LF	El Paso	L	217,593	234,886	272,929	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Front Range LF	Weld	L	591,919	1,021,554	1,126,550	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Larimer County LF	Larmier	L	201,126	220,446	264,097	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
Midway LF	El Paso	L	244,100	257,983	265,167	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
North Weld Sanitary LF	Weld	L	408,733	460,792	469,886	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
Sedalia Recycling Center	Douglas	L	74,436	66,268	74,142	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Southside SW Disposal	Pueblo	L	140,833	137,520	141,680	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	N
Tower Landfill, Inc	Adams	L	804,834	544,723	701,807	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Mountain																						
Archuleta County LF	Archuleta	M	12,083	12,131	10,814	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Chaffee County LF	Chaffee	L	13,932	20,463	33,098	Y	Y	Y	Y	Y	Y	N-old, Y-NEW	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Custer County LF	Custer	M	2,573	3,520	3,400	Y	Y		Y	Y	Y	WAIVED	N - WAIVED	Y	N	N		n/a	n/a	Y	Y	Y
Eagle County LF	Eagle	L	63,363	66,082	74,568	Y	Y	Y	Y	Y	Y	Y	Y	?	Y	Y		n/a	n/a	Y	Y	Y
Lake County LF	Lake	M	5,367	4,264	5,543	Y	N	Y	N	N	Y	N-WAIVED	N-WAIVED	Y	Y	Y		Y	N	Y	Y	Y
Milner LF	Routt	L	40,871	38,516	31,020	Y	Y	Y	Y	Y	Y	Y-old, Y-new	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Mineral County SWDLF	Mineral	S	511	472	555	Y	N	N	Y	Y	N	N-WAIVED	N-WAIVED	N	N	N		Y	N	N	N	N
Phantom LF	Fremont	L	28,861	18,237	31,833	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	DETECT	n/a	n/a	Y	Y	Y
Pitkin County SW	Pitkin	L	47,760	53,063	49,680	Y	Y	Y	Y	Y	Y	Y NATURAL	N	Y	Y	Y	DETECT	n/a	n/a	Y	Y	Y
Saguache County LF	Saguache	S	5,322	1,647	622	Y	N	N	N	Y	Y	Y	N	N-W/D	N	Y	DETECT	Y	N	Y	Y	Y
San Luis Valley LF	Rio Grande	L	29,667	30,008	30,692	Y	Y	Y	Y	Y	Y	Y-old, N-new	Y-old, N-new	Y	Y	Y		n/a	n/a	Y	Y	Y
Six Mile LF	Gunnison	M	17,051	16,446	3,762	Y	Y	Y	Y	Y	Y	N-old Y-new	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Summit County SWDS	Summit	L	27,005	40,995	43,147	Y	Y	Y	Y	Y	Y	Y-new	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Eastern/Southeastern																						
Campo SWDS	Baca	S		20	30	Y	N	N	N	N	N	N	N-WAIVED	N-W/D	N-W/D	N		Y	N	N	N	N
Prichett SWDS	Baca	S	50	55	48	Y	N	N	N	N	N	N	N-WAIVED	N-W/D	N-W/D	N		Y	N	N	N	N
Springfield SWDS	Baca	M	2,151	3,179	3,076	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	DETECT	n/a	n/a	Y	Y	Y
Two Buttes	Baca	S			35	N	N	N	N	N	N	N	N	N-W/D	N-W/D	N		Y	N	N	N	N
Walsh SWDS	Baca		539	449		Y	Y	N	N	Y	Y/N	N	N	N	N-W/D	N		Y	N	Y?	Y	Y
Eads SWDS LF	Kiowa	S	1,055	1,669	-	Y	Y	N	Y	Y	Y	N	N-WAIVED	N	N	Y		n/a	n/a	Y	Y	Y
Haswell SWDS LF	Kiowa	S	95	150	1,112	N	N	N	N	N	N	N	N-WAIVED	N-W/D	N-W/D	N		Y	N	N	N	N
East Lamar Municipal LF	Prowers	S	11,218	11,124	2,393	Y	Y	Y	Y	Y	Y	N-old, Y-NEW	Y	Y	Y	Y	?	n/a	n/a	Y	Y	Y
Granada SWDS LF	Prowers	S	249	489	390	Y	N	N	N	N	N	N	N	N-W/D	N-W/D	N		Y	N	N	N	N
Holly SWDLF	Prowers	S	1,147	3,982	1,345	Y	Y	N	Y	Y	Y/N	N	N	Y	N	Y	DETECT	Y	N	Y	Y	Y
Firstview Sanitary LF	Cheyenne	S	1,304	1,259	1,320	Y	N	N	N			Y	N	Y	N	N		n/a	n/a	N	N	N
Kit Carson SWDS LF	Kit Carson	M	8,781	9,049	10,804	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
LABC Landfill	Bent	S	729	260	2,998	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Lincoln County LF	Logan	M	2,623	3,542	3,814	Y	Y	Y	Y	Y	Y	Y	Y	Y	N-Piezo	N		Y	N	N	N	N
Logan County LF	Logan		34,141	8,440		Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a			
Manzanola LF	Otero	S	1,156	1,091	1,022	Y	Y	N	Y	Y	N	N	N	N-W/D	N	N		n/a	n/a	Y	Y	Y
Otero County LF	Otero	M	18,360	18,658	14,028	Y	Y	N	Y	Y	Y	Y	Y	Y+W/D	Y	Y		n/a	n/a	Y	Y	Y
Morgan County LF	Morgan	M	24,231	25,573	25,217	Y	Y	Y	Y	?	Y	N	N-WAIVED	Y	N	Y	DETECT	n/a	n/a	Y	Y	Y
Phillips County LF	Phillips	S	2,204	2,197	2,318	Y	N	N	Y	Y	Y	N	N-WAIVED	Y	N-3W/D	N		n/a	n/a			
Sedgwick County LF	Sedgwick		5,095	5,382				N			Y	Y?	N-WAIVED	Y	N	Y		Y	N	Y	Y	Y
Trinidad LF	Las Animas	M	10,956	11,053	11,667	Y	Y	N	N	N	Y	N	N-WAIVED	Y	Y	Y		n/a	n/a	Y	Y	Y
Washington County LF	Washington	M	3,189	4,309	4,899	Y	N	N	N	N	Y	N	N	Y	N	Y		n/a	n/a	N	N	N
Yuma County SWDS LF	Yuma	M	6,755	6,719	6,259	Y	Y	Y	Y	Y	Y	N-WAIVED	N	N-W/D	N-3W/D	N		Y	N	Y	Y	Y
Western Slope																						
Adobe Buttes LF	Delta	M	15,708	35,903	28,799	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Bondad LF	La Plata	L	53,579	79,668	78,341	Y	Y	Y	Y	Y	Y	Y NATURAL	Y	Y	N	Y		n/a	n/a	Y	Y	Y
Broad Canyon LF	Montrose	L	23,408	29,830	32,397	Y	Y	Y	Y	Y	Y	Y	Y	N-W/D	N	N		n/a	n/a	Y	Y	N
Mesa County LF	Mesa	L	157,182	159,670	163,975	Y	Y	Y	Y	Y	Y	Y	N-WAIVED	Y	Y	Y		n/a	n/a	Y	Y	Y
Moffatt County LF	Moffatt	M	13,163	13,647	12,073	Y	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	Y
Montezuma County LF	Montezuma	M	23,053	32,081	29,401	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		n/a	n/a	Y	Y	N
Montrose SWDS	Montrose	M	26,709	25,547	25,528	Y	Y	Y	Y	Y	Y	Y NATURAL	N-WAIVED	N-W/D	N-W/D	n/a		Y	N	Y	Y	Y
South Canyon SWDS	Garfield	L	68,011	58,554	47,656	Y	Y	Y	Y	Y	Y	Y NATURAL	Y	N-W/D	Y	Y		n/a	n/a	Y	Y	Y
S-road Disposal	Mesa	S	533	2,332	1,817	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y		n/a	n/a	Y	Y	
West Garfield SWDS LF	Garfield	M	19,231	22,848	25,547	Y	Y	Y	Y	Y	Y	Y RECOMP	N	Y	Y	Y		n/a	n/a	Y	Y	Y
Wray Gulch LF	Rio Blanco	M	19,930	18,729	10,630	Y	Y	Y	Y	Y	Y	Y RECOMP	N	Y	N-W/D	n/a		Y	N	Y	Y	Y

Notes:
n/a = not applicable
LF = Landfill
N-W/D = not in compliance, using a inadequate system of a wet dry well(s)
DETECT = ground water contamination detected
N-WAIVED = not in compliance but was previously waived by the Dept. with no demonstation for approval
Y = In compliance
SWDF = Solid Waste Disposal Facility
? = additional information needed
SWDS = Solid Waste Disposal Service
N = Not in compliance

APPENDIX C: CASE STUDIES

APPENDIX C – CASE STUDIES

SECTION 3: TRANSFER AND DISPOSAL SYSTEM CASE STUDIES

Mesa County Transfer and Disposal System

Mesa County Solid Waste Management operates four transfer stations within the county. The transfer stations are located in Fruita, Gateway, De Beque and Molina.

The transfer stations were planned based on the solid waste plan for Mesa County written in the late 1990s. Most of the transfer stations were built based on promises from commissioners to provide service in small towns that were not serviced or underserved. The Molina and De Beque transfer stations are on private property that is leased to the county.

The transfer stations do not meet the current definition of a transfer station since they are 20 years old. They are mostly drop off locations that are open and staffed a couple days a week for some and twice a month (Mo) for others. The tipping fee at each transfer station is $15 per load for up to regular sized pickups. The transfer stations also accept recyclables that are taken to the Waste Management MRF in Grand Junction.

The transfer stations see little traffic, sometimes only a handful of loads per day. Fruita is the most visited with 30 – 60 loads each day it is open depending on the season. Fruita is also the only transfer station that is not subsidized by the landfill. Gateway now has solid waste collection service that transports waste south to the Broad Canyon Landfill.

Bent County Transfer and Disposal System

Bent County in Southeastern Colorado does not operate a municipal solid waste landfill. The county made the choice in the 1990s to avoid the costs of constructing and operating a landfill that would comply with Subtitle D regulations. The county instead decided to transport waste collected in the county approximately 23 miles one way to the landfill in neighboring Otero County. The county transports approximately 460 tons of solid waste per month and pays approximately $13/ton in tipping fees at the Otero County Landfill. Bent County does operate a construction and demolition landfill that is located north of Las Animas.

The disposal system, which was started by a private company around 2000, was taken over by Bent County around 2006 or 2007. The disposal system consists of 60 – 70 three cubic yard dumpsters spread around the county. Most of the dumpsters are located in turnouts along county roads. Some larger farming enterprises in the county have dumpsters on their property because of the larger waste quantities generated. The county has also established transfer stations in Las Animas and McClave for city residents to drop off waste.

To provide collection, Bent County and the city of Las Animas created a partnership and share the cost of collection equipment. Residents of the county voted on a fee of $80 annually for every household in the county to fund the disposal and collection system. Larger farm enterprises that have dumpsters located on their property are charged $65 per month. The county acknowledges the transportation costs are high especially for waste that is transported from McClave to Otero County, but the system is solvent and is working well for county residents.

Hinsdale County Transfer and Disposal System

Hinsdale County operates a transfer station in Lake City that collects and routes waste to the Six Mile Landfill in Gunnison County. Hinsdale County had operated a "dump" style landfill that opened in the 1950s, and closed in 1990. Prior to the closure of the landfill, a study was conducted to outline options for future waste management in the county. Based on the study, the county decided that a transfer station would provide the best option and result in a cost savings for the county.

The transfer station does not have scales, but charges customers by container or volume. Rates are posted at the facility entrance, and customers are generally used to the measurement of material, whether it is in a bag, truck bed or trailer. The transfer station operates as an enterprise fund and requires no support from county tax revenue. The rate charged at the transfer station is set to provide an approximately $2/ton surplus over the tipping fee the county is charged at the Six Mile Landfill. This surplus is used within the enterprise fund to operate the transfer station.

Materials brought to the transfer station are loaded into compactors for solid waste and recycling that are transported to other facilities. There is a burn pit for tree limbs and clean wood. The burn pit is used annually under a burn permit to reduce that waste to ash, which is then combined with solid waste for transport to the Six Mile Landfill, which is approximately 70 miles away.

In 2015, the county hauled 604 tons of material from the transfer station to the Six Mile Landfill. This total does not include recycling, which is hauled to another facility. Overall, the facility is working well and the facility is financially self-sufficient which benefits the county.

State of Wyoming Disposal Program

The Wyoming Department of Environmental Quality (WDEQ) formed a Citizen's Advisory Group in 2003, at the direction of the Governor, after the need to address groundwater contamination and plan for the rising cost of providing safe solid waste services became apparent. At that point, groundwater monitoring required under the Subtitle D regulations had been indicating some landfills had groundwater contamination, indicating landfills were generating enough leachate to migrate into groundwater.

In 2006, the state of Wyoming began a groundwater monitoring program, led by the WDEQ, to determine if contaminants were present at any of the unlined landfills in the state. The Wyoming Legislature set aside $7,970,000 to help local governmental entities fund the installation of monitoring networks, and in some cases pay for monitoring. Until this program began, it was believed that the climate in the arid west would limit the generation of landfill leachate (liquid that has passed through or emerged from solid) and the migration of leachate to groundwater. Because of this thinking, landfills in Wyoming and other arid states were designed and operated without liners for almost 20 years after the promulgation of regulations under Subtitle D. Results of the ground water monitoring program indicate that 96% of Wyoming landfills have measurable levels of ground water contamination and 91% have contamination above water protection standards.

During the implementation of the groundwater monitoring program, an Integrated Solid Waste Planning report was completed in 2009 to address the groundwater contamination from unlined landfills and the rising costs of operating safe landfills beyond the financial capabilities of many local governments in Wyoming. The report determined that shared landfills can help control the rising costs. Based on the report, many small landfill operators plan to transfer waste to more cost-effective regional landfills and then close their local landfills. The closure of a landfill and transfer of waste cannot happen until the waste transfer infrastructure is constructed, which can require years to determine need, arrange funding and complete permitting, design and construction. In 2013, an evaluation of local landfills by WDEQ led to the creation of a prioritization list. In 2015, the Wyoming Legislature passed Enrolled Act No. 17 which finalized the priority list and the funding for each community.

The results of all of the available monitoring data submitted from the groundwater monitoring program was evaluated by WDEQ and summarized in a report in June of 2010, indicating the extent to which facilities are contaminating groundwater. The finding of the report estimated the groundwater remediation cost faced by local governments state-wide was about $226 million. Wyoming Statute § 35-11-524 was passed by the Legislature in 2011 and required additional investigations and the preparation of an initial report by December 2012, describing an assessment of the clean-up costs at the highest priority landfills.

In 2013, the Legislature passed Enrolled Act No. 43, which created the Landfill Remediation Program (LRP), which enabled WDEQ to oversee and fund up to 75% of the cost of investigating and remediating contamination at municipal solid waste landfills for up to 10 years. Legislation passed in 2014, required the Legislature to approve a prioritized list of qualified projects prior to the expenditure of funds to conduct remediation activities at high priority landfills. The Priority list was approved in Enrolled Act 2 in the 2015 session clearing the way for remediation activities to begin.

SECTION 4: SOLID WASTE COLLECTION SYSTEM CASE STUDIES

City of Longmont's Municipal Collection System

Longmont Sanitation

The city of Longmont has been providing solid waste and recycling collection services to its residents since it was codified in 1948. The services are delivered by the city sanitation division and funded through monthly subscription fees charged to residents in their utility bills. The city offers a modest pay-as-you throw (PAYT) program that allows residents to select from two container sizes, either 48 gallon (gal) or 96 gallon, which includes an embedded rate for curbside recycling. The city also charges a waste management fee to all residential units that pay for the operation of the waste diversion center, special collection events, household hazardous waste and waste disposal at all city facilities and parks.

In the late 1980s, Longmont began its journey to introduce waste diversion practices for the city. Curbside recycling was introduced when a non-profit organization began a grass-roots recycling effort offered to residents. Soon after that effort began, the city initiated a curbside recycling program.

Over the last 10 years, Longmont has focused on a few key programs to increase recycling opportunities to its residents such as: introducing single stream recycling, having a waste diversion center and providing a limited number of special collection events. The city collects 29,000 tons of solid waste and 12,000 tons of recyclable materials annually, currently maintaining a 30% diversion rate.

Waste Diversion Center

Longmont operates a waste diversion center, an enhanced recycling center that accepts a variety of recyclable materials. When it was opened in 2005, the center only accepted a few commodities: tree branches, cardboard/paperboard, mixed recyclables and bulky metals. Today, that facility has grown to offer enhanced recycling opportunities to the community and accepts single stream recyclables, bulky metals, cardboard, shredded paper, rechargeable batteries, cooking/motor oils, food waste organics, plastic bags and styrofoam. The waste diversion center is visited by over 40,000 customers annually and collects about 5,000 tons of material each year.

Special Collection Events

The city provides two special curbside collection programs that help divert material from the landfill and keep storm drains free and clean of debris: a spring-time curbside branch collection and a fall leaf collection. The purpose of these programs is not only to provide a convenience service to residents, but to divert the woody and leafy debris from the curbside solid waste containers and landfills.

Household Hazardous Waste Management

The city also provides its residents with household hazardous waste services. Longmont provides an annual collection event at the public works facility collecting unused paints and chemicals from residents. This annual collection event is augmented with an intergovernmental agreement with the Boulder County hazardous material collection facility so residents can have a year round opportunity to properly dispose of household chemicals.

Longmont's Future

Longmont is currently planning to launch a voluntary curbside organics collection program along with enhanced pay-as-you throw (PAYT) subscription rates. The new subscription rates, if approved, would include a reduced volume solid waste collection service option that is provided as an every-other-week solid waste collection. These two programs are intended to create a convenient organics curbside collection opportunity for residents and increase Longmont's solid waste diversion quantities.

City of Lafayette's Organic's Collection Request for Proposals (RFP) and Collection Contract

An audit of Lafayette's solid waste in 2013 determined that yard waste and food scraps made up 42% of the landfilled materials from the city. Seeing an opportunity for increased diversion and because the city already had a two-cart PAYT solid waste and recycling system, "the next logical step was a three-cart system." Therefore, Lafayette posted a Request for Proposal (RFP) for the addition of organics collection for single-family households that did not receive solid waste service from home owners associations (HOA) in April of 2014, with notices placed in two local papers in July.

The desired program would include a seven-year contract for a single-hauler with a three-cart PAYT system for collection of solid waste, recycling and organic materials (the city already had a PAYT solid waste and recycling system at the time).

The city collected bids for service, discussed the advantages and disadvantages of each and brought their recommendations to city council. The three bids considered contained the details that follow for monthly collection of a 64-gallon solid waste cart and 32 gallon organics cart respectively: Waste Connections - $5.14 and $3.67, Republic Services - $8.25 and $4.45 and Western Disposal - $10.20 and $3.62. The most inexpensive bid was from Waste Connections, but seemed to lack details and the city did not feel that it was "sustainable." The bid from their current hauler Western Disposal, whom the city had been happy with, was detailed but included a 45% increase in rates compared to their current system which was the highest increase of the three bids. The bid from Republic Services lacked a few details, but included a rate that was reasonable. The representative from Republic Services who attended the meeting was able to immediately supply the missing details. As a result, the Lafayette city council voted to "authorize negotiations" for organics collection with Republic Services on July 15, 2014.

The current details of Lafayette's single-family non-HOA solid waste services are included below.

- PAYT solid waste
- Recycling cost is not embedded in solid waste cost
- Organics cost not embedded, but payment for minimum organics service is mandatory
- Provided solid waste, recycling and organics to 5,759 households (HH) for 4 months 2015
- Solid waste: 1,309 tons or 113.6 lbs/HH/Mo in 2015 for 4 months only
- Recycling: 584.3 tons or 50.7 lbs/HH/Mo in 2015 for 4 months only
- Organics: 235 tons or 20.4 lbs/HH/Mo in 2015 for 4 months only
- In 2015 there were still 70 HHs that asked to have their organics cart taken away, even though they had to pay for service
- In 2015, only about half the town had this city solid waste service – the rest were HOAs that have their own solid waste service
- Organics program started Feb 2015
- Pricing solid waste: 32 gallon $8.33/Mo, 64 gallon $16.66/Mo, 96 gallon $25.00/Mo
- Pricing recycling: $1.00/Mo
- Pricing organics: 32 gallon $4.49/Mo, 64 gallon $7.87/Mo, 96 gallon $11.24/Mo; mandatory pay for 32 gallon
- Extra $0.15/Mo administration fee for solid waste service
- Extra $7/Mo for additional 96 gallon solid waste cart up to two carts; extra solid waste bag stickers for 32 gallon bag $4 each; extra $3/Mo for additional 96 gallon compost cart up to two

- Collection frequency is organics every other week, recycling every other week, solid waste weekly

The following “value-added” services began in 2015:

- Every April a supply of finished compostable material is available to residents free of charge
- A fall curbside pick-up of yard waste
- In the fall, one free curbside pick-up of unlimited bulky items in addition to the quarterly one item pick-up that was already available

City of Golden’s Approach to Include HOAs in PAYT

On November 13, 2014, an ordinance was approved to expand the city of Golden’s PAYT program. All solid waste haulers in the city of Golden were required to offer PAYT to single-family residents, multi-family complexes, HOAs and commercial entities by January of 2016. The minimum size offered for collection must be 32 gallons with additional sizes increasing by 32 gallon increments. Recycling must be provided and the costs must be embedded in the solid waste costs. The hauler can choose to offer carts, bags, and/or tags that meet the previously stated sizing requirements.

There are 61 HOAs and four other housing associations in Golden that include more than 1,600 housing units. Because these account for a large percentage of Golden’s households and therefore have strong effects on recycling and solid waste, the city included requirements for HOAs in the PAYT ordinance. Therefore, all HOAs indirectly have PAYT through hauler licensing requirements. HOAs are not automatically included in the city PAYT solid waste program. If HOAs provide waste collection through a hauler for their residents, then they are not included in the program, but if waste collection is not provided by the HOAs for their residents, then the households are included in the city program. HOAs can opt-in to the city PAYT program at any time. HOAs that do not have the city PAYT service had to meet with their haulers by January 1, 2016 to change their contracts to fulfill the requirements in the PAYT ordinance if necessary. The resulting solid waste costs may be slightly different from those of the city PAYT program depending on negotiated pricing.

Implementation amongst the HOAs was met with opposition and was delayed two times for six months at a time with an original implementation deadline of January 1, 2015 and actual implementation deadline January 1, 2016. Haulers are responsible for ordinance enforcement. Some of the smaller HOAs with less than 100 households chose to opt-in to the city PAYT program, but many of the larger ones thought they could get better rates due to economies of scale on their own. Other reasons that the larger HOAs were resistant were that their boards wanted to retain control over their solid waste and some had bylaws that did not allow for changes to solid waste service, one hauler charged "liquidation damages due to early termination" when some tried to make changes to their service, some claimed their residents did not want PAYT programs, some didn't want to give up the large solid waste cans and some HOAs claimed they already recycle more than the city does. The city of Golden was threatened with lawsuits by three HOAs. The Council then decided to allow compliance exemptions if HOAs can provide data to prove they have a 25% diversion rate by August 1, 2016. If they do this, then they will receive a one-year exemption extension with renewals possible on a yearly basis. If they do not, then they must comply by January 1, 2017. Three HOAs are exempted from the ordinance at this time, but the city hopes they will eventually be brought into compliance. There was initial confusion amongst many HOA residents over whom to call for solid waste service questions/concerns because many thought their HOA was enrolled in the city PAYT program when they were not.

While the initial PAYT single-hauler ordinance passed in 2010 and received substantial outreach and education, it did not require compliance from HOAs. The plan was that HOAs were going to be brought in during the 2014 "Phase 2" with compliance required by January 1, 2015. As a result of this time gap, HOAs were caught by surprise and were unprepared for making service changes. The city believes acceptance could have been improved by implementing Phase 2 within one year and allowing three years for complete compliance. An additional round of outreach in 2014 would have helped the process as well. Another timing circumstance that affected the process was that the city was re-bidding services for their existing single-hauler PAYT program in 2015 when HOAs began inquiring about city PAYT rates. Because those rates had not been determined, HOAs were not able to make decisions about participation in the city's PAYT program. The city of Golden should also have had "star" resident examples chosen from the few HOA residents who called the city and said they thought PAYT would be great in their neighborhood. The city should have done direct outreach to those residents, given them PAYT service, and made them "test cases" that they could use as examples when the HOAs said their residents did not support PAYT programs. A final lesson learned was that the city should have suggested that the HOAs become leaders in the city as "Green Adopters."

The City's PAYT Program

Residential solid waste is collected weekly by a contracted hauler, who provides the carts. It is PAYT and the monthly cost rates are:

- Super Saver 32 gallon: $6.20
- 32 gallon: $7.50
- 64 gallon: $12.60

- 96 gallon: $19.25
- Additional 96 gallon available for $10.85 and solid waste stickers for $2.00 each for up to a 32 gallon bag

Solid waste is billed on residents' quarterly water utility bill, with optional organics, large item pick-up, carryout/carry-in service or drive-in service billed separately by the hauler. Cart size can be changed free of charge within the first 90 days of service. Residents can choose to use any solid waste hauler that is licensed to operate in the city for their waste collection, but if their household is included in the city program, they will be billed for the minimum service.

Single stream residential recycling is collected every other week by the contracted hauler. The hauler provides a 96 gallon recycling cart, but residents have the option for a 64 gallon cart. The cost is embedded in the solid waste rate. Drop-off recycling is also available. Recyclable materials collected curbside include: newspaper, office paper, mixed paper, junk mail, phone books, magazines, brown paper bags, cardboard cereal/tissue boxes, empty aerosol cans, aluminum cans, tin cans, plastic milk jugs, rigid plastics, plastic (#1 - #7), milk/juice cartons, expanded polystyrene (EPS) and glass bottles.

Curbside residential yard waste and food scraps co-mingled collection are available year-round by subscription from Alpine Waste and Recycling. They are collected every other week in 96 gallon carts. The hauler provides the cart as well as a kitchen waste container. Residents who participate in the PAYT program are eligible for the semi-annual curbside collection of yard waste provided by Alpine Waste and Recycling for one week in the fall and spring. During this collection, residents can place the materials in reusable containers or compostable 30 gallon bags on their solid waste collection day.

Multi-family complexes that are less than eight units are included in the city PAYT program and can choose from the cart sizes and prices above, use a dumpster for solid waste and recycling carts or use one dumpster for solid waste and one for recycling. Dumpster prices are volume based. Solid waste prices are equivalent to the three main service levels and adjusted accordingly with dumpster pricing remaining the same. Commercial and industrial entities are excluded from the city PAYT program.

PAYT Ordinances in Golden and Fort Collins

Two cities in Colorado passed ordinances that were very similar and resulted in implementation of PAYT services indirectly through hauler licensing requirements. In 1996, Fort Collins first approved ordinances with the goal of implementing PAYT (these have been updated several times since). The PAYT ordinances adopted in Golden on November 13, 2014 were approved to expand recycling. These ordinances from the two cities have similar requirements and key verbatim language. The major elements that are identical are the following:

- All solid waste haulers in the city were required to be licensed and to offer PAYT to single-family residents, multi-family complexes, HOAs and commercial entities with pricing for 32 gallons carts/bags/ tags with additional sizes increasing by 32 gallon increments.
- Charges are based on container sizes rather than the actual volume of solid waste within the container. Haulers determine the types of containers they will collect and the rates for service of the different sized containers with those for additional containers being equal to or greater than the charge for the first container of equal size.
- Haulers supply the carts, and/or bags and/or labels for carts.
- Solid waste containers may not be overloaded. Charges for bags or excess solid waste volumes need to be proportional by volume to the subscription cost per 32-gallon bag/container.
- Haulers must educate new customers when starting service, and existing customers annually about all of the available solid waste options they offer.
- Haulers that offer bag/tag services only may charge a fixed fee in addition to the PAYT fees for solid waste service only to cover operational costs of routing, fuel and other surcharges.
- Curbside recycling must be offered and the cost is embedded in the solid waste costs.
- Exceptions to the recycling requirements will be made if the hauler provides documentation to the city that verifies there is not sufficient space for the recycling containers.
- Recycling collection from multi-family and/or commercial entities must be frequent enough to prevent recycling container overflow.
- Recyclables may not be commingled with solid waste, must include all the materials designated by the city and must be disposed of at a qualified recycling facility.
- A hauler shall not collect recyclable materials that are required to be recycled.
- Any subcontractors must provide service that is compliant with the code and rules.
- Vehicles used for recycling must be clearly marked.
- Haulers are required to report to the city the rate schedules, number and type of accounts (residential, multi-family, and commercial), number of accounts on each level of service and solid waste tonnages collected from each type of account on at least a quarterly basis based on the weight of a representative sample.
- Hauler licenses must be renewed annually by November 30th for the following year.

There are some differences in the PAYT ordinances. One difference is that many of Fort Collin's requirements are only for single-family residents and HOAs, but Golden's requirements are for single-family residents, HOAs and multi-family complexes and commercial entities. Some additional differences are as follows:

Golden

- Haulers must provide the recycling carts/containers/bags free of charge in at least 64 gallon and 96 gallon sizes.
- Since dumpsters used by multi-family complexes are already volume-based, these complexes can retain their dumpsters or switch to smaller cart service for solid waste and recycling with associated PAYT rates if desired.
- Documentation that illustrates compliance had to be submitted by the haulers to the city by January 1, 2016.

Fort Collins

- Unlimited curbside recycling must be offered in hauler-provided 64 gallon or 96 gallon carts, with some haulers allowed to offer an 18-gallon tub.
- No additional service fees can be charged on residential solid waste bills.
- A hauler may collect any container that has no more than 25%, by volume, of recyclable cardboard.

Vail's 2014 PAYT Ordinance

On July 1, 2014, Vail Town Council members approved an ordinance that made PAYT in Vail mandatory for single-family residents, multi-family residents and businesses with penalties for non-compliance. The language in the document also includes HOAs. The ordinance states that all haulers of solid waste and recycling that operate in the Town of Vail must be registered. The haulers are required to provide new customers with written details of the available variable rate solid waste prices for different container sizes and available sizes for recycling. A list of current materials that can be recycled must be included. The haulers are required to submit a copy of each unique notice to the community development department by January 31st annually.

In 2010, Vail was interested in exploring ways to reduce solid waste and increase recycling. They determined substantial solid waste came from the 120 – 140 commercial entities, especially hotels, condos and restaurants. Therefore, they decided to try to include the commercial sector in their solid waste reduction plans. Specifics to the commercial sector are discussed in the case study that follows called “Vail, CO Commercial PAYT Program with Embedded Recycling.” The town created a local recycling advisory committee that included businesses, haulers, town council members and residents; and hired consultants to aid in the process. They had already tried educating the public and determined that it resulted in only about a 3% increase in recycling. They then prioritized goals/recommendations and voted on many options. Finally, after four years of effort, the town council voted four to three to approve the ordinance with the PAYT and embedded recycling. After the ordinance was approved, the town provided education about the requirements and options to residents. The town put hangers on solid waste and recycling cans, ran ads, and had a website that offered education.

There were concerns about the requirements of this ordinance. One of these was about the cost for servicing an additional container for recycling. This was addressed by embedding the recycling cost in the PAYT solid waste costs. People were also worried about having to pay more for solid waste than they had previously. Since bear proof containers were now required, there were additional costs incurred to either lease them from the haulers or to purchase them. Since the 18-gallon recycling bin would no longer be allowed, residents had to obtain new recycling containers. The town suggested that some of the old solid waste cans could be re-purposed for recycling. There were also concerns over having space for the recycling containers.

As of June 2016, recycling in Vail is “in limbo” and there is a need for police department enforcement of the recycling mandates through fines. It also remains unclear whether all haulers are following the PAYT mandates.

Some lessons learned through implementation and maintenance of the ordinance were that changes should be made to residential services at the same time as commercial services to limit confusion and to ease the education and compliance. The town also determined that it was easier to get businesses to cooperate than residents because many employees supported and wanted to recycle more, whereas many residents did not care. Pairing requirements for mandatory embedded recycling with those for PAYT service was a natural fit and worked very well. The cost of the required bear-proof containers to residents and small businesses were a huge barrier to the program. There needed to be lots of education about the program to improve compliance. Initially haulers were charging too much (and continue to do so), there was confusion about whether recycling was dual stream or single stream since different haulers accepted one but not the other and haulers didn’t help educate to decrease the confusion. However, it is beneficial to have the haulers working with the town as partners to make the transition, as well as continuation of the program a success. And finally, even though hauler reporting is required, it is very challenging to obtain the data.

SECTION 5: DIVERSION MATERIALS MANAGEMENT

Fort Collins' Glass Recycling – Drop-off and Curbside

Glass recycling with single-stream recycling is challenging due to glass breakage into small pieces which are not easily sorted mechanically or manually which causes contamination of other recyclable materials. As a result, only about 30% of glass from single-stream recycling is eligible for glass-to-glass recycling. Fort Collins therefore offers two options for recycling glass to their residential and commercial entities. The first is to self-haul to the city's recycling drop-off center, the Larimer County Recycling Center, or other drop-offs and deposit into designated glass-only bins. Glass from these sites are used to make new glass bottles at a plant based in Wheat Ridge. The second option is for residential and commercial entities to recycle their glass curbside mixed in with their single-stream recycling. The glass is then separated out at a recycling facility, crushed, and then used as alternative daily cover and/or for drainage at landfills. Fort Collins is slowly moving towards eliminating glass in their single-stream recycling and have been "heavily messaging" to residents and businesses to source separate and self-haul their glass to the town drop-off sites set up by Clear Intentions.

Recycling Hub and Spoke - Clean Valley Recycling

Started in 2011 with little money and a lot of passion for recycling, Clean Valley Recycling (CVR) in Swink is the "Hub" of the recycling system in the Arkansas Valley Region. Deanna Hostetler, manager of the non-profit, said, "we started in La Junta as a spoke of Pueblo, but that was just too far." CVR was able to find the "Old Sugar Factory" in Swink and move into its huge warehouse and purchase a baler. This was aided by a CDPHE RREO grant. Recycling goes into large 40-gallon, "potato sack" bags. Residents can drop these off in Swink or at one of the many drop-off sites around the region. Most of the sites are manned with volunteers who receive some of the proceeds received from the materials. Here is a snapshot of their operation:

- Spokes are located within a 30-mile radius to keep down transportation costs
- Recycling bins are only picked up when full
- Recycling bags are sold for $3 per 40-gallon sack
- They currently have two full time equivalents, five part-time equivalents, volunteers, and one driver
- They rely on donations and grants and host a barn dance fundraiser annually in June

- They have recently started curbside recycling pickup for a few communities for approximately $6.50 a month

CVR has partnered with communities such as Lamar. The Lamar Partnership, Inc. manages the drop off site, open two Saturdays a month in the North Thriftway parking lot. When the large, donated container fills up, they haul the material to Swink and it is recycled by CVR. Residents can purchase the recycling bags at the Lamar Chamber of Commerce.

Recycling Hub and Spoke - Angel of Shavano

Angel of Shavano Recycling operates a hub and spoke recycling program in Chaffee County, taking over operations for the county in 2012. Owner Mickey Barry installed better roll-off containers at the three drop off sites where residents place material in separate bins. Once full, they are collected by the company and brought back to their “hub” facility in Poncha Springs for processing. They have three trucks and trailers that they use, picking up the full containers and leaving an empty one behind. That is normally twice per week collection for cardboard and plastics and once per week for everything else, though during the Christmas holidays it can be as often as every day. They process the recycling collected from Waste Management’s curbside pickup, tripled the amount of material coming to the drop off sites and created jobs for five employees. This material means space is somewhat tight with the 40-foot sort lines and horizontal baler. Angel of Shavano sends the material direct to mills, manufacturers or exporters, and reimburses 5% of the total sales of the material to the county and local governments. In 2014 that amounted to $8,285.69. Mickey said “this type of program works especially well in rural areas. Just make sure you start simple with materials like cardboard, #1-2 plastics and paper.”

Commercial PAYT Program with Embedded Recycling

On July 1, 2014, Vail town council members approved an ordinance that made PAYT and recycling in Vail mandatory for single-family residents, multi-family residents and businesses with penalties for non-compliance. Vail was the first town in the “valley” to mandate recycling. The costs for recycling must be embedded in the solid waste rates for residents, multi-family residents and businesses. The owner(s)/occupant(s) of all premises and commercial establishments are responsible for ensuring that no recycling goes into their solid waste, as well as for contracting for recycling service/ensuring delivery of recyclables to a MRF. The way the ordinance is written also includes HOAs. All haulers of solid waste and recycling must be registered.

In 2010, Vail was interested in exploring ways to reduce solid waste and increase recycling. They determined that substantial solid waste came from the 120 – 140 commercial entities, especially hotels, condos and restaurants. Therefore, they decided to try to include the commercial sector in their reduction plans. They created a local recycling advisory committee that included businesses, haulers, town council members and residents; and hired consultants to aid in the process. They had already tried educating the public and determined that it resulted in only about a 3% increase in recycling. They therefore determined that they needed “to do more.” They prioritized goals/recommendations and voted on many options. Finally, after four years of effort, the town council voted four to three to approve the ordinance with the PAYT and embedded recycling which included commercial entities.

There were concerns about implementation of this ordinance – more for mandatory recycling than PAYT since business solid waste was already PAYT due to the way it was serviced. One concern was about how commercial entities would be able to adapt current solid waste policies to be able to comply with the new requirements. Some businesses had their own “structure” that had specific requirements to house their dumpsters or carts, and others shared the “structure.” Most of these structures housed six yard dumpsters that were used for solid waste. There was concern over how they could accommodate a dumpster for recycling as well as the added expense to do so. To help with this, the Town suggested using two three-yard dumpsters instead of one six-yard dumpster, waived building permit fees if a new solid waste structure had to be built, and offered a rebate up to $750 for building and/or signage. There was also concern about the cost of adding and servicing an additional container for recycling. This was addressed by embedding the recycling cost in the PAYT solid waste costs.

Initially one strategy to aid in implementation was to allow for up to two-year recycling exemptions granted by the Vail Planning and Environmental Commission, giving businesses more time to “figure things out.” The town also provided a lot of education about the requirements and options to businesses. They even hired an intern to go door-to-door to speak with them directly, and put informative hangers on their doors. The town put hangers on solid waste and recycling cans, ran ads and had a website that offered education. This extra attention to businesses greatly eased the transition and increased compliance.

As of June 2016, recycling in Vail is “in limbo.” While there are not any complaints noted from the commercial sector, there is a need for police department enforcement of the recycling mandates through fines since many commercial entities seem to believe that the town will not notice recycling non-compliance. However, Vail is planning to use “gentle” enforcement and to use tag hangers to remind and show that they are paying attention. They are also considering re-instating the building/signage rebates.

Some lessons learned through implementation and maintenance of the ordinance were that changes should be made to residential services at the same time as commercial to limit confusion and to ease the education and compliance. The town also determined that it was easier to get businesses to cooperate than residents because many employees supported and wanted to recycle more. And finally that pairing requirements for mandatory embedded recycling with those for PAYT service was a natural fit and worked very well.

City of Boulder: Mandatory Commercial Recycling Ordinance & Food Mandates

The city of Boulder recently passed a new ordinance requiring that all business owners (including multi-family housing owners) must provide recycling and organics service within their buildings. The ordinance, in part, reads as follows:

"All business owners must separate recyclable and compostable material from the solid waste and wherever business owners provide solid waste containers to employees or customers, they must also provide recyclables and compostables containers for employees and customers' use. Containers must be at least as conveniently located as solid waste and be of adequate size and number to prevent recyclables and compostables from being mixed with solid waste."

The ordinance goes on to require that all property owners must be able to demonstrate that they have not only solid waste collection service, but also recyclables and organics collection services for their properties.

The ordinance, city of Boulder Revised Code 6-3-14, becomes effective on June 17, 2016. The city recognized that it would take a considerable period of time for all of the businesses and multi-family landlords to comply with the ordinance and will not begin issuing notices of violation until June 17, 2017.

The penalties for not complying with the ordinance are $500 for a first offense, $1,000 for a second offense and $2,000 for all offenses thereafter. Commercial landlords can pass the responsibility for complying with the ordinance on to their tenants by addressing the responsibility for compliance in their leases. The ordinance is unique in that it is sweeping in scope, encompassing all buildings in Boulder (including single family homes) and that it required not only recycling at businesses, but also separation of organics.

A separate pre-existing ordinance, city ordinance 6-12-5 - Containers for Recycling or Composting Collection, required that haulers provide a certain level of recycling service to multi-family buildings. The ordinance, in part, reads as follows:

"Haulers providing solid waste collection service to multifamily customers through centralized collection areas shall provide containers for recyclable materials at no additional charge. Containers shall be of a sufficient size to accommodate the regular accumulation of recyclables from that customer, but, at a minimum, such container shall be of a volume equal to one-half of the volume of the solid waste collection service. If the city manager requires the collection of compostables, haulers shall provide containers for that service of a sufficient size to accommodate the regular accumulation of compostables from that customer."

This pre-existing ordinance creates an incentive for multi-family building owners to encourage their tenants to recycle in that they can save money on their combined solid waste and recycling service if the tenants recycle effectively.

Boulder County Publicly Owned and Privately Operated MRF

The Boulder County Recycling Center (MRF) was built after a ballot initiative that approved a recycling sales tax was passed, with the ultimate goal of diverting more materials from the landfill. It is owned by Boulder County, operated by Eco-Cycle and began operation in 2001. It includes a materials processing center, drop-off area, tipping floor, offices and a rail spur. It accepts single stream materials from local haulers, residents and small businesses from Boulder County and from any hauler and municipality that has a contracts with the MRF. It does charge a tip fee for single-stream residential materials. The facility uses both mechanized and manual sorting techniques and the initial sorting line splits into a fiber line and container line. It has a baler, several sorting platforms, a corrugated cardboard screen, a fines screen, a double deck paper screen, a French Screen, a cross-belt magnet, an air classifier, an Eddy current separator, an optical system for removal of stones, ceramics and porcelain from glass and an organics separator. Materials accepted are paper, paperboards, plastic containers #1 – 7, aseptic cartons/boxes, steel/tin containers, aluminum beverage containers and foil, all colors of glass containers, office paper and mail products and textiles (in drop-off boxes only). Scrap metal is no longer accepted at this facility.

The facility is about 50,000 square feet, processes an average of 48,000 single-stream tons per year (about 38,880 tons residential, 5,280 tons commercial, and 3,840 tons source-separated materials from drop-offs), and has a capacity of 75,000 tons. The MRF originally only accepted dual-stream materials, but in 2008 began accepting single-stream materials to make recycling more convenient for the community and to increase the recycling rate. While this has been better overall, accepting glass into the system wears down the equipment more quickly and it is challenging to get all of it out of the resulting products. Some of the average per ton prices that the facility sold their materials for in 2014 are: OMP $87, OCC $100, tin/steel $200, aluminum $1500, PET $300, and HDPE $790. The facility also includes a drop-off center. Prepared materials are shipped to recycling mills.

The facility utilizes the following practices when possible to maximize environmental sustainability: daylighting, use of recycled/sustainable materials, water reuse from roofs for irrigation, “innovative water polishing techniques” for wetland protection, xeriscaping and landscaping with native plants, reduction of truck traffic through use of a rail spur and reduction of costs and increases in revenues by having an area where only clean papers from drop-offs are unloaded and put directly into balers.

A best practice to follow when setting up a MRF is to invest in the latest technologies like optical sorters to keep the costs down. A lesson learned in the process was to remove glass to the best of your ability at the beginning of the system to produce cleaner products.

Local Level “Green” Advocates: Eco-Cycle, Boulder CO

Community recycling champions or advocates can be an effective tool for a community to kick-start and continue momentum and interest in diversion programs. Eco-Cycle is a non-profit established in 1976 by a group of residents who were strong advocates for recycling, helping make Boulder one of the first communities in country to have a curbside recycling program.

In 2001, through a contract, they began operating Boulder County’s Recycling Center and remain strong advocates for programs throughout the county. With over 750 volunteers they are able to persuade opinions and effect change. They organize representatives to show up at council meetings and ensure there is public support for environmentally friendly programs. Eco-Cycle advocates participate on local recycling boards and are active in state and national recycling associations. Their Network volunteers distribute hundreds of copies of The Eco-Cycle Guide and help educate and encourage neighbors to be more active. The have also helped establish many programs through the Recycling Center and strive to help the community move towards Zero Waste.

As part of that effort, Eco-Cycle opened the CHaRM facility (also in 2001), to give the community a place to recycle unusual items such as electronics, yoga matts, and mattresses. For mattress recycling they partner with Spring Back Colorado which disassembles and reuses the materials, employing many former drug and alcohol related felons.

Eco-Cycle works with businesses, schools and event organizers to educate on Zero Waste best practices. Although they have worked to facilitate large scale Zero Waste events, they saw demand increasing for small scale events as well. They now have Zero Waste Kits for smaller events.

Education is a large part of their advocacy for Zero Waste and they have won many awards for their efforts to promote diversion. For schools, they provide tours to the recycling facility and educational programs. Their website provides free information and downloadable material.

Alpine Waste Privately Owned and Operated MRF

Alpine Waste and Recycling is the largest privately held commercial solid waste collection company in the Colorado collecting over 300,000 tons of materials per year. In 2007 when Alpine Waste and Recycling's Altogether Recycling Facility (MRF) opened, it was Colorado's second largest single-stream processing facility. Since then, their collection of recyclable materials has gone from 200 tons per month to over 2,600 tons per month eight years later. After expansions in 2011 and 2015, it gained the ability to process more than two times the original capacity of recyclable materials, and now has the highest capacity in the state. The facility accepts single stream materials from 35,000 households, commercial and industrial sources, and processes source-separated materials like post-industrial plastics and scrap paper from commercial printers. The facility uses both mechanized and manual sorting techniques. After the 2011 addition of a commercial single-stream processing line (there was already an existing residential one), the facility currently has three lines. In 2015 at a cost of $5 million, more updates were completed with the old residential line replaced with a Machinex processing system. This system is capable of handling both residential and commercial materials, and had improved material sorting technology and two times the number of transfer belts as before. It has an MACH OCC screen for separating OCC on its commercial line. The facility has a two balers, one of which is the first two ram machine in the US, a MACH Hyspec optical sorter for plastics, a ballistic separator for containers and paper, live-floor material bunkers emptying directly onto conveyors, multiple bin-fed return conveyors, a sorting conveyor for plastics, a debris roll screen for glass, split paper screens, a triple-deck cardboard screen, an Eddy current/ vacuum system for aluminum and a cross-belt magnet for steel. It is also the first facility in Colorado to accept expanded polystyrene (EPS) and has a dedicated line with the first EPS condenser to form "bricks" in the state as well. Materials accepted are paper, paperboards, plastic containers #1 – 7, aseptic cartons/boxes, steel/tin containers, aluminum beverage containers and foil, all colors of glass containers, office paper and mail products and EPS.

The facility is about 50,000 square feet, has the capacity to processes 30 tons/hour, processes more than 6,000 tons per month, and processed an average of 80,000 single-stream tons in 2015 (about 56,000 tons of fiber and 17,000 tons of containers). The facility operates five days per week, and has one full shift and one small shift used to bale materials.

The entire Machinex system design allows for flexibility to meet future needs and market changes. Improvements can still be made to existing operations to increase efficiencies. The ability to switch from one baler to the other by pushing a button decreases facility down time. Alpine continues to educate customers about the damage and problems that contaminants like plastic bags, steel and construction debris can cause in the machines.

Dump and Pick-up: Commercial Brokers: Small Operations around Colorado

There are several small baling operations around Colorado where solid waste haulers have established routes to collect clean cardboard and/or office paper mixes from their customers and then bale them for shipment to market.

These operations are generally built around the hauler's customer base and are dependent upon having one or two customers who produce a sizeable amount of clean materials. The hauler can then add smaller amounts of materials from other smaller generators to construct a route(s) that produces enough material(s) to economically justify the purchase of a baler and the procurement of enough space to store materials before baling and after baling to accumulate a full truck load of materials before shipment to market.

Often these operations are started with a small used baler that the hauler procures through the network of used equipment dealers or from a bankruptcy case. Often they are initially operated in a corner of a haulers existing facility until the volume and economics allow for a dedicated space. Baling costs in these small operations generally are $25.00 to $30.00 per ton.

These operations are often the stepping stone to bigger processing operations as the community and the hauler grow and as the demand for recycling services among the customer base expands.

Denver Residential Curbside Organics Pilot Program

While the economics of diversion in Denver are challenging when compared to the low price of landfilling, a 2008 waste composition revealed that over 50% of the city's residential waste stream was compostable. This program, designed by the city and county of Denver Solid Waste Management Board (SWM), was implemented to improve diversion, provide a valuable service to residents and prevent organics from being landfilled.

Since solid waste services in the city of Denver are paid through a combination of property taxes and general funds, residents are never directly billed for solid waste or recycling services. The city provides unlimited weekly solid waste collection. Residents can enroll in the city's "opt-in" every other week recycling service and receive a 96 gallon cart. Solid waste, recycling and organics are collected on the same day.

After receiving the initial grant funding, the pilot program began in 2008 as a single route through all sectors of the city to gauge interest among a diversity of households and demographics. By the end of the first year, the service had 3,200 satisfied participants and had only experienced minor setbacks like squirrels chewing through some of the carts. In 2010 the city of Denver had an unusually lean budget and could not afford to continue the $15-$17 million program so they told the participants that if they wanted the service to continue, then they would have to pay for it ($9.75/HH/MO or prepay a whole year for $107.25 (which provided a one-month discount). This strategy kept the program running, but did not provide the level of funding necessary for growth and expansion.

In 2012, after a bit of creative thinking, Denver SWM was able to secure a $2 million inter-agency loan from the Denver Department of Environmental Health to help fund a program expansion. However, before SWM could accept the money, staff had to work with elected officials to set-up a special revenue fund (SRF). The loan, coupled with the creation of the SRF, allowed SWM to accept the compost payments, place them in the fund, and subsequently use the fund to service the loan, purchase new carts and trucks and pay for collection and processing. The loan and SRF was approved in the fall of 2013 along with an expansion plan to make service available to over 75% of the city within 10 years, fully pay back the loan in 13 years and provide an on-going funding source for composting into the future. The city is discussing potential options to speed the growth of the program.

City of Louisville: Contracted Solid Waste, Recycling and Organics Collection

The city of Louisville has provided solid waste, recyclables and organics collection service to its residents for over seven years. The city contracted with a private hauler, Western Disposal Services, Inc. to provide the collection service to its residents.

Solid waste is collected weekly and single stream recyclables and organics are collected every-other-week on an alternative schedule. The organics program collects not only yard waste but also food waste including meat and dairy waste.

Under the program, the hauler provides the carts to the customers and customers can choose a 96 gallon, 64 gallon or 32 gallon cart independently for each service. Rates are based upon the cart sizes selected. Following is the current price list for Louisville residents:

Refuse Cart Size	Compost Cart Size	Monthly Cost for Refuse/Compost Service (effective 9/1/14) includes 60¢ service fee	Cost for Recycling any size cart (32, 64 or 96)
32 Gallon	32 gallon	$14.67	$0.00
32 Gallon	64 gallon	$18.29	$0.00
32 Gallon	96 gallon	$21.91	$0.00
64 Gallon	32 gallon	$23.02	$0.00
64 Gallon	64 gallon	$26.64	$0.00
64 Gallon	96 gallon	$30.26	$0.00
96 Gallon	32 gallon	$31.37	$0.00
96 Gallon	64 gallon	$34.99	$0.00
96 Gallon	96 gallon	$38.61	$0.00

Additional carts for solid waste and compostables are $2.50 per month if at 96 gallon service. Prepaid stickers for a 32 gallon bag are $3.35.

In this PAYT pricing model, the cost of recycling is covered in the fee for solid waste collection and the first 32 gallons of organics collection is also covered in the fee for solid waste collection. Additional 32 gallon units of organics collection cost approximately $3.62 each.

Superior's Drop-Off Organics Program

The town of Superior's Waste Diversion Advisory Committee (WDAC) (now the Resource Conservation Advisory Committee) saw the need for some kind of diversion of yard waste in their town. They had gathered survey information about materials that took up space in residents' solid waste carts and determined that yard waste was a huge contributor. Yard waste also made up a large portion of material set-out during the town's bulky item pick-up events. As a result, the WDAC recommended construction of the yard waste drop-off site within the already existing fenced area that the landscaping contractors used for staging. In 2005, the town board approved the plan and the drop-off yard waste organics facility was developed and opened in the same year. It currently consists of a 3,000 square foot outdoor fenced area with two concrete pads to station the roll-offs, and is open seasonally from April through November, and again for a month following Christmas for tree drop-offs. It is open on Saturdays and Sundays from 8:00 AM to 4:00 PM with a lunch closure from 12:00 PM to 1:00 PM and Wednesdays from 4:00PM to 7:00 PM. One part-time employee oversees the open hours. In 2015, 100.8 tons of yard waste were collected from the two 30 cubic yard dumpsters. It costs the town around $49,000 annually to operate the site – hauling and employee costs for management. The town has seen savings from not having to collect yard waste at their bulky events and has been able to compost increasing amounts of yard waste. A limited amount of free compost is also made available for residents to pick-up at the site annually.

The biggest challenge since the site opened has been to achieve a balance between increased usage/availability while minimizing contamination. This problem continues today but has improved with education and site staffing. Also, because only one side of the fenced-in site is open, access and egress for the site exit both occur on the one side. As a result, there are often lines and congestion from residents waiting to get into the site. Therefore, one future plan/improvement for the site is to possibly make it a drive-through for drop-off of yard waste and pick-up of compost.

Private Sector Organics Processing: A-1 Organics

A-1 Organics is Colorado's largest composter with operations in Eaton, Keenesberg and Commerce City. The company also has operations in Las Vegas, Nevada. The company accepts all types of organic materials including green waste, animal manures, clean wood waste, and yard waste, food waste for composting, tree limbs, logs, clean wood (untreated, unpainted), brush, grass, leaves, sod and soil. Products manufactured include compost, compost mixes, soil mixes and mulches.

A-1's composting producing facilities total nearly 600 acres and are located in very rural areas, Eaton and Keenesberg, to eliminate complaints about odor from neighbors. Because manures are included in many of the compost feedstocks, neighbors sometimes "think they smell something."

The company has a wide variety of tipping fees depending upon the material being delivered. Tipping fees for curbside organic materials average $35.00 per ton, but transportation costs to their more remote locations need to be factored into the total cost of disposal.

Private Sector Organics Processing: Western Disposal, Boulder

Western Disposal is a privately owned collection company that services primarily Boulder County collecting solid waste, recyclables and organics. Western Disposal permitted and operates a Class II Compost facility for the processing of the source separated organic and food-waste materials it collects on its residential and commercial routes. In addition to manufacturing compost, Western Disposal also grinds woody material to manufacture wood chips and wood mulch.

Western Disposal developed a yard-waste and food-waste only windrow compost facility on a nineteen acre site within the city of Boulder and has been operating there for over 10 years without any odor complaints from the public.

The Western Disposal site is unique in that it is operated in an industrial part of Boulder and is not located in some remote part of the county. Because Western Disposal does not use any bio-solids in its process it has been able to operate with no odor complaints from its neighbors. The site is used predominantly by Western Disposal but they also accept residential organics from other haulers at a price of $77.00 per ton.

Pitkin County: Compost Program and Processing

Although this program is in Pitkin County, it gathers material and affects diversion throughout the Roaring Fork Valley. This is an example of an effective program created by necessity and aided through RREO grants and rebates from CDPHE. As with many communities in the mountains, Pitkin County has limited options for landfilling sites. As the end of life for the landfill began approaching, and with no alternative site, the county needed an immediate way to reduce materials. A yard waste ban was one of the first steps taken. When a study revealed 40-60% of the landfill material was comprised of food waste and waste related paper, Pitkin County began looking into adding food scraps to the program. Through a grant from the state, they were able to purchase a compost mixer and with a rebate check from the CDPHE, the county was able to purchase much needed bear proof containers which they loan out to businesses and HOA's. They also provide small covered kitchen containers free of charge for single family residents. Though it requires active participation by residents, the program seems to be growing in popularity and currently takes in about 781 tons of food waste and 6,442 of general compostables. Evergreen, the local hauler, has around 200 mostly residential accounts and large businesses (like Whole Foods and the local ski operators) also send their material to the facility. There is a local and very active company in the region that provides curbside pickup of food scraps and education to participants, or residents can drop the material off free of charge at the compost facility at the landfill.

One of the problems composting processors face with residential food waste programs is contamination. The city of Aspen's bag ban program has greatly reduced the plastic in the food waste stream as well as outreach, education and screening at the compost facility. Pitkin County has a large transient population with tourists and second home residents. Although outreach can be difficult regarding food scraps, most residents pay for landscaping service and have the material collected for them. Even without the yard waste ban, the lower price for this material at the landfill ($45 for yard waste vs. $64 for landfill) provides economic incentives for landscapers. The Pitkin County site is Class 5 facility that uses static, non-aerated windrows to process yard trimmings, food waste and biosolids. Adding foods scraps to the mix provides a better quality of compost which is Seal of Testing Assurance certified by the US Composting Council. It is in turn purchased by the landscapers and community members for $35/ton, bringing in a sales revenue of $296,582. They contract with a private company for operations which cost $291,335. Revenue from the incoming materials brings in $614,137.

Residential yard waste and food scraps are a continuous source of material for the county and this program helps fund other diversion programs. Through another grant for outreach and education, Pitkin County, and their largest community of Aspen, have been able to get the word out through mailers, PSAs, newspaper advertisements, half hour weekly television/video spots and website links.

On-Farm Composting/Farm Siting

Organic Producers have limited choices on what products can be used to meet fertility needs for crop production under the National Organic Program rule. The rule states that a producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil or water by plant nutrients, pathogenic organisms, heavy metals or residues of prohibited substances. The national policy then goes on to explain the highly specific criteria for compost production relative to maintained temperature, time of soil incorporation and final carbon-to-nitrogen ratio. The state of Colorado also has regulations for organics processing.

Due to the protective regulations that require monitoring and specific criteria involved in compost production, many facilities do not function as a public organics drop-off site for fear of a contaminated and unusable final product. However, most, if not all, farms compost organic agricultural material generated on-site. Residents/businesses in rural areas either perform backyard composting (BYC), landfill their material or arrange a private drop-off with a local farm. Farm owners are typically open to receiving material, but due to more stringent regulations on solid waste compost facilities, they are unlikely to operate as commercial drop-off locations for non-agricultural organics in the near future.

Eagle County: Multi-Stream MRF

The Eagle County (material recovery facility) MRF is owned and operated by Eagle County and began operation in 2010. It accepts three streams of materials, from residents, multi-family, and businesses in Eagle County and the surrounding areas, doesn’t charge any tip fees, and does not have any profit sharing incentives. The facility uses both mechanized and manual sorting techniques by inmates on one line for co-mingled materials. The paper stream is dumped onto the shop floor and hand sorted before being fed into the baler. The cardboard stream is very clean and is fed directly into the baler. The MRF has an optical sorter, a tin magnet, an Eddy current separator, a glass breaker screen and a dual RAM baler. Materials accepted are newspaper, office paper, magazines, corrugated cardboard, plastic containers #1 – 7, steel/tin containers, aluminum beverage containers and all colors of glass beverage containers. Co-mingled materials are plastics, aluminum cans, steel/tin cans, and glass in one container, newspaper in another and cardboard in a third.

The facility encompasses 14,000 square feet and processes over 5,000 tons per year. Although it does not include a drop-off center, dual stream materials are accepted from six Eagle County managed drop-off sites in Vail, Red Cliff, Avon, Edwards, Eagle and Gypsum. Prepared materials are shipped to recycling end-users. No revenue is produced from glass which is crushed and hauled to a facility in the Denver area that does not charge for disposal.

The pre-MRF separation of the recyclable materials result in very clean products that get "the highest" prices. Some of the prices that the facility sold their materials for in 2016 are the following: OMP $49.96, OCC $78.52, tin/steel $25.49, aluminum $1,020.00 (2015 price), PET $133.24, HDPE colored $362.13 and HDPE natural $504.40. All of the aforementioned prices include transportation costs. The facility processing is under capacity because of the requirements of the source separated incoming materials. Since the facility opened, all three haulers in the area have switched to single-stream recycling. One hauler sorts the recyclable materials into the three streams curbside and continues to bring them to the Eagle County MRF, but the other two now bring their materials to the Denver area. As a result, the tonnages of incoming materials have steadily declined over the last few years with the tonnages from curbside and drop-offs (not including glass) being as follows: 2010 5,834.93 tons; 2011 6,239 tons; 2012 6,179 tons; 2013 5,989 tons; 2014 4888 tons; and 2015 4260 tons. The feeling is that even though multi-stream recycling results in cleaner products that get higher prices in the market, it is more difficult for residents, and haulers prefer to offer single-stream to their customers even if it increases the hauling distance. There are still problems with profitability, material supply and insufficient demand/pricing for products. Conversion to accept single-stream recyclables would be very expensive and there currently are not any plans to do so, but will depend on the hauler's willingness to continue pre-sorting, and whether there are any changes to resident's desire for curbside single-stream service and their willingness to use the drop-offs.

Better Invoicing – Residential and Commercial

Many residential and commercial customers who are billed for their solid waste services by their municipality or hauler(s) often find the invoices to be very confusing. Because these invoices lack clarity, it is difficult to determine the exact services they are paying for and receiving. Many invoices are unclear about service frequency, number and size of containers for solid waste, recycling and organics that are collected, the total number of pickups they are billing for and pricing. There are often vague undefined "codes" on the invoices that appear to correspond to the particular service, but actually are not even consistent within invoices. Or they may just state "Basic Service" without adequate explanation. Many invoices do not show clarity in costs for solid waste versus recycling versus organics, in tax incentives, or in other fees like gas charges, sustainability/environmental fees and solid waste taxes that are included in the total solid waste bill. And finally, the physical location of and absence of information about specific charges can lead to confusion about which solid waste stream the charges actually apply to. For example, locating solid waste taxes and fees immediately after the recycling section of the bill rather than in the earlier solid waste section, makes it seem like recycling costs more than it actually does. Quite often tax percentages and what they are assessed on are not listed clearly. Many of the aforementioned invoicing issues are illustrated in the following figure.

Current Invoice Charges

Administrative Fee	$1.92

[redacted]

1 - Front Load (2 Yd) Scheduled Service (S3)

Date	Description	Reference	Quantity	Unit Price	Amount
01/25	Rate Adjustment 01/15/13-02/28/13		1.0000	$106.56	$38.98
01/25	Basic Service 02/01/13-02/28/13			$81.56	$81.56

1 - Front Load Recycling (2 Yd) Scheduled Service (S4) Single Stream Recycling

Date	Description	Reference	Quantity	Unit Price	Amount
01/25	Recycling Service 02/01/13-02/28/13			$52.14	$52.14
	Total Fuel/Environmental Recovery Fee				$52.61
	Total County Environmental Charge				$83.35
	Total Solid Waste Management Tax				$26.75
	Current Invoice Charges				**$337.31**

This lack of clarity makes it difficult for both residents and businesses to see any potential savings from favoring one solid waste stream over the other, and therefore may actually end up having negative effects on recycling and organics collection. It also makes it extremely difficult to comparison shop for services so residents and businesses may not end up with the best combination of price and service possible. Therefore, invoice clarity that includes solid waste stream-separated information about service frequency, volumes of solid waste, number of pick-ups, pricing, taxes and additional fees can be extremely beneficial to both residential and commercial customers.

Aspen Sustainability Plan

In recognition of Aspen's dependence on climate and natural resources for a thriving economy, healthy ecosystems and exceptional quality of life, Aspen's city council adopted the city of Aspen's Canary Action Plan in 2007, which commits to reducing community greenhouse gas emissions 30% by 2020 and 80% by 2050, below 2004 levels.

The plan contains background information on climate change, results from the city's baseline greenhouse gas inventory and action steps to address greenhouse gases from various sectors. It also includes goals for renewable energy for the city's municipal utility, goals for community deployment of renewable energy systems and calls for increasing Colorado's renewable electricity standard and the renewable energy portfolio of the rural electric cooperative that also serves the city.

This Climate Action Plan is a widely cited example of a community that was an early adopter for greenhouse gas reduction strategies and commitments. The reductions goals were set to comply with levels that the International Panel on Climate Change (IPCC) called for to avert climate catastrophe at the time the plan was adopted by city council. The plan showcases actions that the city's municipal utility and other internal departments can take to affect community wide emissions. The report also outlines actions that can be taken by various sectors.

The plan calls for the creation of a "low carbon footprint" guideline for city events which has resulted in the green events checklist and event report cards available at: http://aspenpitkin.com/Living-in-the-Valley/Green-Initiatives/Aspen-ZGreen/Events/. The Canary Initiative has also developed an energy tracker for business and citizens to track their energy use (http://aspenpitkin.com/Living-in-the-Valley/Green-Initiatives/Aspen-ZGreen/) and a carbon calculator and offset program for offsetting emissions (www.canarytags.com).

Unique Considerations for Composting in Eastern Colorado

After nearly 30 years of monitoring nitrogen levels in Rocky Mountain National Park (RMNP), the Colorado Air Quality Control Commission, the Colorado Department of Public Health and Environment (CDPHE), the National Park Service (NPS) and the U.S. Environmental Protection Agency (EPA) determined that changes were occurring in the types of organisms and biochemistry of the park's soil and forest ecosystems from the increased nitrogen. As a result, in 2010, they endorsed an agreement called the Rocky Mountain National Park Initiative Nitrogen Deposition Reduction Contingency Plan. The latter three agencies worked together and determined that 1.5 kg of nitrogen per hectare per year (kg N/ha/yr) wet deposition was the "critical load" threshold above which negative environmental changes would occur. They then used a glidepath approach to set the following goals for the reduction of nitrogen levels in RMNP to: 2.7 kg N/ha/yr by 2012; 2.4 kg N/ha/yr by 2017; 2.1 kg N/ha/yr by 2022; 1.8 kg N/ha/yr by 2027; and 1.5 kg N/ha/yr by 2032.

One source of nitrogen that was studied came from ammonia. The agencies determined that there was a "sharply decreasing east-to-west gradient" of ammonia concentrations from field measurements in Colorado, and that the highest concentrations were in the northeastern part of the state where there were many livestock operations and farms. Livestock and farms produce large volumes of ammonia emissions that combine with nitrogen oxides from vehicles, as well as other combustible sources, to create nitrogen particles. It was shown using tracers that upslope winds from the east (common in the spring and summer) then blow this nitrogen into RMNP. Therefore, weather conditions and time of year are important regarding this source of nitrogen and could be an important part of the overall reduction in the park.

To aid in this reduction of ammonia, the agencies recommended some best management practices that farmers could follow. Nitrogen level tracking has been used to provide “alerts” on a daily basis so activities that might cause nitrogen increases can be avoided when the levels are already high. Some of the current voluntary practices to reduce the amount of ammonia produced specifically by livestock manure that are being evaluated through use within Colorado are the following:

- Scraping pens/alleys when wind/temperature/nitrogen conditions are favorable or using water to rinse rather that scraping them
- Changing methods for handling manure after removal from pens
    - Composting – aerate/turn compost on non-windy/low temperature/nitrogen favorable days, add biodegradable carbon sources, manage pile moisture, manage pile temperature and decrease pile pH
    - Stockpiling – aerate/turn on non-windy/low temperature/nitrogen favorable days, may be favorable to mounding (being evaluated)
- Incorporate manure into the soil as quickly as possible, even at a shallow depth, during cool, dry, and calm weather
- Irrigate immediately after application of manure to land

The reduction of nitrogen in RMNP as a result of most of the aforementioned practices is still being evaluated. Hopefully a decrease to the next nitrogen-level goal in 2017 will be achieved in the park and levels will continue to decrease steadily in the future.

Successful K-12 Program: Delta School District (Non-Front Range)

Delta County School District 50J has created an environmental education coordinator position though their newly formed educational foundation, The Nature Connection. Their part time coordinator is connecting resources throughout Colorado (including multiple state and federal agencies) to enhance student’s education with hands on in class opportunities as well as field applications for students K-12 throughout the district. Colorado Parks and Wildlife trained 24 Teaching Environments Naturally (TEN) teachers in site based field applications in the district resulting in helping 982 students from second to eighth grade experience field studies this fall in TEN related activities.

While The Nature Connection teaches *Leave No Trace,* a set of wilderness etiquette and proper waste disposal guidelines, they mainly provide education for students on how and where to get outside. The primary idea being that deeper connections between individuals and nature will lead to a heightened sense of environmental stewardship within the community. Their biggest accomplishment has been collaboration and connecting local resources to student learning. Networking and team work have been the most important aspect of this project. Crucial elements of a successful education program:

- Strong support from the local school district, which offered a building and a funded Environmental Education Coordinator position. This position is currently part-time, but with funding from the anticipated GOCO Grant it will become a full-time job.
- Teach children to engage older residents and interview them on ways to improve their local community. Strong emphasis on community building.
- A partnership with Western Colorado Community Foundation has given The Nature Connection non-profit status and subsequent financial benefits.
- Do research via stakeholder feedback. Provide an online survey where data is collected and sorted out by area so it is possible to focus on the specific needs of each community.
- Lots of grant writing to ensure consistent levels of funding.

CU Boulder - An Education in Sustainability

Colorado is home to over 30 colleges and universities, creating the opportunity to educate and innovate in diversion and material management. CU Boulder is one of those universities leading the way through their on campus efforts, and working to collaborate with other state institutions. As a participant in AASHE's Sustainability Tracking, Assessment & Rating System™ (STARS)) - the university voluntarily reports their programs and diversion statistics to the group for national ranking. They currently have a gold ranking and received four out of four points for innovation.

Though not required, CU has a long history of sustainability through student lead interest. Recognized as one of the oldest and largest environmental centers in the country, and the first university to start a recycling program, CU Boulder received the National Recycling Coalitions "Outstanding School Program" award in 1995. In the 1970's, students voted to fund the Eco/Environmental Center with student fees, which also help fund the Recycling Program. With Jack DeBell leading the way since 1984 as the first profession Director of Recycling, CU's programs now reach far beyond a simple campus recycling program.

Sustainability reaches throughout the campus and community with LEED's building standards, student "Eco" bus passes, The Blueprint for a Green Campus and Campus Master Plan with formal guidelines for recycling, recycled content purchasing policy, a green energy campaign, on site composting facility and bag ban for student dining services, zero waste events and football games, public/private partnerships including student run outreach in the local community, and in 2015, a new on campus Recycling Operations Center opened, designed to increase landfill diversion rate and reach 90% diversion goal.

An institute of higher learning is an excellent place to introduce and engage future generations in sustainability practices. CU Boulder offers an undergraduate and graduate degree in environmental studies. They also have over 118 sustainability courses that over 300 include some form of sustainability education. Sustainability research involving students and faculty is also on going. This information and practices are hopefully something that will be carried and dispersed wherever these students go. CU Boulder has been host to many waste diversion and environmental conferences. In 2016, Jack DeBell helped organize the first of its kind Colorado Campuses Recycling Forum.

Although CU Boulder is working hard to achieve great progress, there is no state directive requiring them to do so, or connecting the universities to pool their combined potential. Without that state level influence on policy, there is a missed opportunity for things like purchasing policies and construction contract C&D diversion clauses. Without these higher level policies, Colorado cannot "fully nurture the opportunities of over 30 universities. The chain of command could be mobilized to meet those challenges" commented Jack DeBell.

Regional Leadership Example – Chittenden, Vermont

Authorized by Act 78, Vermont's first solid waste law, solid waste districts are government entities that design regional solutions to the solid waste challenges faced by their member towns and cities. The Chittenden Solid Waste District (CSWD) is a union municipal district chartered by the state of Vermont in 1987. Its mission is to reduce and manage the solid waste generated within Chittenden County in an environmentally sound, efficient, effective and economical manner.

Each of the 18 member municipality's governing board appoints a representative and an alternate to serve on the Board of Commissioners. The Board meets monthly to set policy and make major decisions. Commissioners' votes are weighted by population. The district's annual budget proposal is approved by the governing bodies of the member municipalities. The votes on the budget are not weighted, and a simple majority is required to approve the budget. Like other municipalities, CSWD has its own ordinance. It governs how solid waste is managed in the county. CSWD must comply with the state's solid waste laws and meet the performance standards in the Vermont Materials Management Plan.

CSWD's programs and facilities are intended to affect the production, consumption and disposal decisions made by residents, businesses, and institutions, resulting in less waste produced and proper disposal. Ordinance highlights:

- Mandatory separation requirements for special wastes, yard trimmings, mandatory recyclables, and unregulated hazardous waste.
    - **Special wastes** are defined as "discarded major appliances (such as refrigerators, stoves and washers), tires, untreated wood, state-banned electronic devices, untreated regulated medical waste, waste oil, lead-acid batteries, nickel-cadmium and other rechargeable batteries, mercury-containing batteries, paint [excluding solidified water-based paint in quantities of less than one (1) gallon], scrap metal, and, commencing July 1, 2016 and thereafter, asbestos-free asphalt shingles, unpainted/unstained plywood, and unpainted/unstained oriented strand board."
- Mandatory education requirements for haulers, multi-unit residential and commercial property owners/managers, and special event venue owners/managers regarding separation requirements.
- Requirement that providers of solid waste containers for use by the general public must also provide an equal number of recycling containers.
- Requirement for haulers to offer collection of recyclables (and soon yard debris and food scraps under state law).
- Labeling requirements for solid waste, recycling, and food scrap collection containers.
- Banned Materials Fee: $20 ($60 minimum per load) fee charged on full loads delivered to disposal facilities (landfill-bound) containing 10% or more by volume of special wastes, yard trimmings, mandatory recyclables, or food scraps (phased in), or any amount of hazardous waste.

Tips for Other Regions

Be transparent with activities, policies, and finances. Keep member municipalities informed. You cannot manage what you do not measure. Education and enforcement are key. Boots on the ground to assist businesses, institutions and multi-unit properties are critical. Partnerships with businesses, institutions, non-profits and trade groups are an excellent way to spread your messages and good will. Involve stakeholders in planning and policy development.

Innovations in Rural Recycling: Amelia County, Virginia

Amelia County, Virginia received the Virginia award for Outstanding Rural Innovation in 2015. There are six convenience centers owned publicly, operated by Waste Management. Details on the centers include:

- One facility is open 24/7
- Other five have reasonable hours (40/week)
- No charge to residents
- 5% profit share with WM (county receives 25%)

Program Strategies

- First focus on local economic strengths and weaknesses and any comparative advantage.
- Regionalization (collaboration with other municipalities, regions, and businesses).
- It is the policy of the Virginia Waste Management Board to require each region to develop comprehensive and integrated solid waste management plans that, at a minimum, consider and address all components of the hierarchy (Source Reduction, Reuse, Recycle, Resource Recovery/WTE, Incineration, Landfilling):
    - Establish requirements for public and environmental health
    - Rules for designation of regional boundaries and waste shed boundaries for solid waste management plans
    - Provide reasonable variance and exceptions (for different economics/demographics)
- Spread out industry responsibility as well as reduce transportation costs by providing convenient colocation facilities and subsequently boost the economics of area diversion via reduced costs, increased participation and decreased contamination. For example, Food Lion accepts plastic bags, NAPA (auto parts) accepts car batteries, and a local towing company pickups and delivers many inoperable vehicles all for recycling.
- Regional Policy: “It is the Policy of the Board of Supervisors that the citizens of the county should be encouraged to recycle with the goal to meet or exceed the recycling requirements mandated”.
- Diversion (Recycling/Organics) not required, but strongly encouraged through this policy, infrastructure development, consistent education and community engagement (including annual and semi-annual events), strong data tracking and reporting, and many public/private partnerships and collaboration to spread the responsibility throughout the industry.

Other Ideas

- Use of converted farm equipment for sorting and initial processing of materials like newspaper and glass. (Glass can be ground and used in paving. Shredded newspaper can be used in soil preparation, and animal bedding).
- Appropriate container size based off of completed waste composition.
- Routing efficiency studies.
- Cooperative marketing (to share resources and save money).

Drop-off Organics in Summit County, CO

The Summit County Resource Allocation Park (SCRAP), owned and operated by Summit County, was an upgrade made to the Summit County Landfill in order to offer a drop-off location for organic waste material, as well as create a circular local economy by providing on-site processing and resale of High Country, Class 1 high-quality compost. This operation was designed primarily as food waste pilot program with Whole Foods separating and providing any leftover organic materials. However, the program quickly evolved as a solution to dealing with the large amounts of beetle kill (dead trees left standing from the pine beetle) in the Summit County area.

The largest challenge for the development of this program has been the transient population of Summit County (tourists and seasonal residents) that possesses a "throw-away" mentality and is generally unfamiliar with local services, programs and acceptable forms of waste diversion. Nevertheless, the program continues to grow successfully because the economics work. SCRAP is profitable, saves the community money on landfill disposal costs, provides a high quality usable product for the residents and has therefore created a circular local economy. Their main advice to other communities attempting to start on-site organics processing is to introduce accepted items slowly. It is easier to gradually accept more waste streams than try to sort out contamination. Programs which go slowly and gather consistent feedback on what is working and what is not save money.

Circular Local Economies: Lifecycle Plastics and Recycle Projects

Laura Brower is the founder of Lifecycle Plastics, the postconsumer food-grade plastics processor based in Commerce City, and run by Recycle Projects, a Colorado-based nonprofit organization. The process technology research and development conducted by Recycle Projects paved the way for the Lifecycle solution. Lifecycle is 'closing the loop' on the Colorado plastics market by processing locally disposed of food-grade plastic and plans to sell the finished product to manufacturers in the Front Range.

Process

Lifecycle's technology uses water to separate plastic regrind by density. First, they grind all the food grade plastic together, then the plastic gets washed and the labels removed. Afterwards, the plastic is sent through our automated sorting technology where the separated polymers streams are dried and shipped as regrind. Lifecycle takes all the food grade plastic they can handle and makes sure it gets converted back into a usable product.

Mission

The mission of Lifecycle Plastics is to provide a national solution for recycling single-use, food grade plastic. This not only saves 50% more energy than producing new plastic, it reduces the amount of natural resources extracted to produce virgin plastic, and it extends the lifetime of plastic as it gets recycled over and over again.

Elements Crucial to Success

- Capita: Received a grant for start-up funding.
- Partnership with Boulder County/Eco-Cycle MRF: Collaborated on an employee training program to help pre-sort out food-grade plastics.
- Close working relationship with manufacturers in the Front Range and out-of-state (Colorado markets are not yet developed enough to absorb the quantity of material produced by Lifecycle).
- Research and development: Lifecycle is currently evolving and the improvement of the process and equipment is an on-going operation.

Obstacles

- Still learning and gathering information on industry legislation and Food and Drug Administration regulation. Have a legal team for support, but will not really start working with them until the plastics recycling process has been totally ironed out.
- Lack of industry network: Due to the young and underdeveloped nature of this industry in Colorado, there is not a readily available group to seek out with questions or requests for assistance.

Tips

- Follow your head and your heart: Research the end markets really well so you do not attempt to jump into one that does not exist. People will say no end markets or potential sources of revenue exist, but do not get discouraged.
- Develop strong relationships with industry stakeholders to create a support network.

- Economic/industry development takes a long time: Do not expect immediate success.
- Put pressure on the state to have goals/planning, structured support (mentorship, business support, logistic support), easy connections to legislators, and opportunities for direct funding or at least assistance procuring direct funding.

Contamination Education Program - Springfield, MA

Contamination is a problem in that it clogs recycling systems or ruins what were otherwise salvageable materials. That cuts into the commodity stream at the back end of recycling systems, which ultimately impacts revenues and profitability. The bullet points from Springfield's education program follow:

- The third largest city in Massachusetts.
- An urban, economically challenged city with a lot of language barriers with the residents.
- 2008-2009 rolled out a single stream recycling program with huge success. Increased diversion and doubled recycling rates. Grew from 4,000 tons to 8,000 tons in one year.
- A contamination problem developed. There is some question to how much contamination since the metrics for measuring contamination are subjective. They were being told by the processor that they were not comfortable with the amount of contamination they were being given.
- In May, a program was launched to address the contamination problems.
- Within two weeks, contamination dropped from nine trucks being flagged to no trucks being flagged.
- Barrels were left behind.
- Proactive steps are being taken to make sure that Springfield was not one of the communities that were bringing contaminated recycling to the MRF. The markets have sort of stagnated because of the drop in oil prices, having less paper, the Chinese green fence – all those factors have contributed to the drop in revenue which makes the processors more carefully scrutinize loads.
- Education and effectively communication with residents are critical components of managing contamination.
- Leaving the barrels behind is key but when the barrel is left behind, a tag must be put on the barrel explaining the reason it was not picked up.
- Flyers were distributed to neighborhood groups and senior centers to help educate on recycling and contamination.

Collaboration: Southwest Colorado Council of Governments (SWCCOG)

Established in 2009 the council consists of five counties in the southwestern corner of Colorado and includes 14 local governments. They cover a sparsely populated area of approximately 6,500 square miles. SWCCOG member work to share resources and reduce redundancies among the members. Collectively they were able to conduct a waste study in late 2014 as a State of Colorado Recycling Resource Economic Opportunities (RREO) grant project. As part of this, they developed a Recycling Task Force with both public and private members. They concluded that "improving the economics of recycling was an important goal, and that regionalizing diversion activities, expanding public outreach, creating diversion incentives and providing better access to recycling collection were important components." Members were able to discover obstacles and opportunities for greater waste diversion.

A representative of SWCCOG participated in one of the CDPHE stakeholder's meetings and shared their insight to regional issues with nearby communities and the state. They are collaborating to look at issues in a way many other communities in other meetings have suggested as a way to move forward in their region's diversion goals. SWCCOG efforts help identify lacking programs and facilities and share best practices. They are currently looking for actionable goals and further partnering opportunities, recognizing that each member community has a different level of solid waste facilities and programs.

The State of Colorado: Implications for Food Donations

Food waste in Colorado has implications beyond making up about 15-25% of the materials filling up landfills. Take into consideration the amount of water used for agriculture and that "more than one quarter of total fresh water goes to food waste." There are also the effects of deforestation, and methane gas pollution and the sad fact that one in seven Coloradans struggle with hunger at that food insecure households are on the rise.

Many restaurants, grocery stores and large venue events and are still reluctant to donate extra food, paying instead to have someone to haul it to the landfill. One of the biggest reasons they do this is fear of lawsuits, that it may be illegal. But since 1996, the federal government has had the Bill Emerson Good Samarian Food Donation Act that states that "a person is not subject to civil or criminal liability arising from the nature, age, packaging, or condition of "apparently wholesome food" that the person donates in good faith to a nonprofit organization for ultimate distribution to needy individuals (e.g., a food bank)." Colorado has its own version of the law, C.R.S. §§ 13-21-113 with similar wording, and most recently in 2015, the Colorado Charitable Crop Donation Act passed where local producers can receive a 25% tax credit for the wholesale value of the food that they produce and donate to Colorado food banks and pantries. To date, there have been no lawsuits regarding these laws.

In Colorado, there are about 95 cities with food pantries from Durango and Edwards to Greeley and Lamar and multiple ones in the larger metropolitan areas. For those that cannot take food to the pantries, there are nonprofits like Food Bank of the Rockies, Denver/Boulder Food Rescue, and We Don't Waste Food that will come and collect the food for you. The Executive Director of We Don't Waste Food said he started in 2009, "picking up donations in his station wagon." The donations quickly outgrew that and he now has three refrigerated trucks, three full time employees and three part time employees and last year provided 6.8 million servings of food for the needy. They now collect food from all the main sporting arenas in Denver and the convention center. All this is done on grants and donations. "Everything is picked up and dropped off on the same day, free of charge, and there is very little waste."

Changing from Solid Waste Included in Tax Base to User Fees

One of the benefits in charging user fees instead of a general tax is that it is specific to those using the service. For solid waste service it has the added benefit of reminding residents that there is an actual cost for services provided, especially as more communities struggle to balance their budgets. In Colorado there are still many communities that offer unlimited amounts of solid waste disposal combined in property taxes, making it solid waste seem "free" when it is buried in a larger budget. This gives residents an "indiscriminate dependence on disposal of waste" and makes it harder to encourage diversion. There are many versions of user based fees in Colorado from: complete volume based fees, where users pay according to the amount they individually dispose of, and reap the benefits of reducing solid waste through recycling; to a combination of a base tax for everyone and an additional fee based on individual usage.

There are pros and cons to changing to user fees instead of taxes. The most important item to keep in mind when establishing user fees is that the fee must be used for the service provided. The National Conference of State Legislatures warned about this more than a decade ago when it stated, "If user charges exceed the cost of providing services, or if separate accounting is not used, governments are vulnerable to court rulings that such charges are taxes." Some of the reasons user fees for solid waste are becoming more common:

- It puts control of the payment for service in the hand of the users
- Increases public's awareness of the cost of providing a service
- Avoids having to raise taxes for increase cost of service
- More flexible than taxes for price adjustments and can respond to demand
- Can provide direct financial incentives for diversion

A few things to consider when changing to user fees is to provide plenty out information about where the funds are going and what services will be provided. Administration cost of collecting fees needs to be considered though it is often combined with other utilities such as water service. Compared to taxes, user fees may have increased impacts to low income and senior members of the community and exceptions or discounts may need to be included

Tip Fee Surcharges/Environmental Fees

Funding mechanisms such as environmental/solid waste fees or higher or lower tip fees can be used for paying for solid waste and diversion programs or used to encourage participation by making one alternative cheaper than another. The following example highlights one regions various approaches.

The six county Solid Waste Management Coordinating Board (SWMCB) is located in the twin cities area of Minnesota. Solid waste surcharges and taxes are used by both the state and some of the counties in the region. These fees, taxes, and other mechanisms incentivize alternative management options by increasing the cost of solid waste and generate revenue for landfill closures, groundwater monitoring, recycling grants, household hazardous waste facilities and other solid waste services.

The state solid waste management tax was implemented in 1997 and imposes a sales tax on waste hauling customers that is collected by haulers. The residential tax is 9.75% on solid waste services and commercial and institutional customers are charged a 17% sales tax on their solid waste services (there is a different mechanism used for non-solid waste). Three of the six counties in the SWMCB region also impose their own hauler-collected service charges on solid waste, including Hennepin, Ramsey and Washington counties.

Hauler billing for recycling services, including source separated organics, is exempt from the state tax and county charges, which helps make recycling a more attractive alternative.

Anoka County: The county has a solid waste management charge on all properties that is charged through the property taxes. The current fee is from $23 to $36 for residential properties and $80 to over $2,000 per year for commercial properties. The residential fees are based on the type of dwelling and the commercial fees are based on the value of the property improvement. County staff reports that they are planning on lowering fees by 33%.

Carver County: County ordinances say the county shall impose a solid waste management fee on property taxes and the county has the authority to impose a service fee on solid waste services in the county.

Hennepin County: The county imposes a solid waste management fee of 14.5% on commercial generators and 9% on residential generators. The fee is assessed on solid waste bills by the haulers as a condition of their operating license and remitted monthly to the county. The county also imposes, by ordinance, a fee of $2.00 per cubic yard of solid waste accepted and disposed at a facility for mixed solid waste (landfills). The fee is reduced for waste-to-energy facilities and there is no fee for recycling. The county also has a county collected solid waste management fee that is added to property taxes, the rate for this fee is currently set at zero.

Ramsey County: The county imposes a solid waste management charge on the sales price of solid waste services on the generator. The residential charge rate is 28% and the commercial charge rate is 53%.

Washington County: Similar to Ramsey County, Washington County imposes a charge on all MSW generators. One rate of 37.5% is assessed to both residential and non-residential generators.

Large Scale Private Sector Material Recovery Facility: Altogether Recycling

The Denver area is served by two large scale Material Recovery Facilities. One owned by Waste Management, Inc., the country's largest recyclables processor and a second one owned by Alpine Waste Solution's Altogether Recycling.

Altogether Recycling's facility, located in Denver, was built in 2007 was the first facility in the state to accept #3-7 plastics and aseptic (milk) cartons; it is currently the only company in the market to accept rigid plastics. Altogether Recycling is currently the second largest recycling facility in the state, processing in excess of 6,000 tons of recycling per month.

The existence of two large MRF facilities in the Denver area promotes competitive pricing for materials and competition to take more and more materials so that haulers can expand the list of materials that they will collect in their curbside recyclables collection programs.

State Legislation from Oregon, Vermont and New York

Older Oregon Legislation

Oregon has passed several series of solid waste legislation over the years. Their first, the Opportunity to Recycle Act, was passed in 1983. It established the following hierarchical solid waste strategies – reduce waste generation, reuse, recycle, compost, recover energy from materials that cannot be composted, recycled, reused or reduced, and finally dispose of all others that are remaining. Drop-off recycling centers were required for all "wastesheds", and monthly curbside recycling had to be provided in communities with more than 4,000 residents.

The next piece of legislation, the 1991 Oregon Recycling Act (Senate Bill 66), required a statewide solid waste management plan and set a 50% statewide "recovery" goal by 2000. Other requirements were annual calculation of material recovery rates, every other year waste composition studies, additional recyclable materials/opportunities, establishment of a statewide household hazardous waste program, product procurement and recycled content requirements, funding for school recycling/reduction education, and providing grants. Counties/cities/metro districts were given three - eight choices in solid waste/recycling service options. Community size and location determined how many items they had to comply with.

Newer Oregon Legislation

Two programs to increase resource recovery were developed by the coalition of recycling and solid waste management members in 1997. One was providing a 2% recovery rate credit to local governments for additional solid waste programs, and the other was providing up to 6% total credits for additional solid waste programs toward individual wasteshed goals. Additional clarifications to existing requirements and program changes were made in 1997 including the addition of curbside collection of food scraps and compostable paper for commercial and industrial entities. By 2000, the 50% statewide recovery goal had not been achieved, so two new goals - 45% recovery by 2005, and 50% recovery by 2009 were established for the state with House Bill 3744 in 2001. New/amended solid waste management plans with voluntary individual recovery goals were submitted by the wastesheds and updated in 2006 and 2010. Technical reviews of solid waste management plans were conducted if these goals were not met and suggestions for improvements were offered. Some additional goals of HB3744 were that there would not be any annual increase in: a) per capita solid waste generation after 2005 and b) total solid waste generation after 2009. It also increased how wastesheds could receive the 2% recovery rate credit, and provided recovery rate credit for waste-to-energy participants. The state met its 50% recovery goal in 2010.

In 2012, "Materials Management in Oregon, 2050 Vision and Framework for Action" was adopted. In order to fund this action and vision, Senate Bill 245, which allows for the following increases in fees: tipping fees from the current $0.81 to $1.18; permit fees from $0.30 to $0.58; and with orphan site fees remaining at $0.13 was initiated in 2015. The bill included other revisions/additions as well. In 2015, Senate Bill 263 added four new recycling strategies to the already existing ones that dealt with residential food waste, commercial recycling, construction and demolition and commercial food waste. It also increased the required numbers that had to be provided by certain communities/cities/counties based on population and location. Along with some other refinements and revisions, it set the following new recovery goals: increased the statewide goal to 52% by 2020 and 55% by 2025; set a 25% food and plastics goal by 2020; and set a 25% carpet goal by 2025. SB 263 also set the solid waste generation goals to be 15% below 2012 levels by 2025 and be 40% below by 2050.

Vermont Legislation

Vermont passed its Universal Recycling Law (Act 148) in 2012. This law includes phased-in landfill bans of food scraps from commercial entities generating 104 or more tons per year by 2014, 52 or more tons per year by 2015, 26 or more tons per year by 2016, 18 or more tons per year by 2017 and from all businesses and residents by 2020; from mandatory recyclables by 2015; of yard waste by 2016; and of clean wood in 2016. The following hierarchical diversion practices for yard waste and food scraps are encouraged: reduction, smart acquisition/use/reuse, diversion of consumables to people, diversion of consumables to agriculture/composting/energy recovery. All facilities permitted to accept solid waste (including transfer stations and drop-off centers) must accept and divert from the landfill the following materials: mandatory recyclables by 2014 at no extra charge, yard waste by 2015, and food scraps by 2017. Haulers that collect solid waste in the State must also provide collection for the following materials: mandatory recyclables by 2015 at no extra charge, yard waste by 2015, and food scraps by 2017. Solid waste haulers must provide PAYT statewide for residents by 2015, yard waste collection by 2016, and food scraps collection by 2017. Public buildings must provide recycling containers with solid waste cans by 2015 except in restrooms.

New York Legislation

New York has a Beyond Waste Plan that was written in 2010 and was scheduled for updates in 2013. Section 360 deals with solid waste. To be more effective and provide legal authority, the statutory structure of the Plan would need to be changed. As it currently is, it can only provide “direction and goals.” The state goals are phased-in reductions of generation per capita that began with the 2010 goal of 4.1 lbs. solid waste/day/capita, to 2016’s 2.9 lbs. solid waste/day/capita, to 2030’s 0.6 lbs. solid waste/day/capita. The state planning units will set their own individual goals that are in line with the state’s. Some of the additional goals within this plan are to increase the following: reuse, recycling, composting of organics, product stewardship, “green jobs” and to minimize the following: solid waste disposal, climate impacts, waste export.

Fort Collins PAYT Ordinance

In 1996, Fort Collins adopted its PAYT ordinance. This legislation requires that solid waste haulers operating in the city must by licensed and has the following requirements for all single-family residents including those in HOAs: solid waste rates must be volume-based and cannot include supplemental service fees, and recycling must be offered in 18 gallon bins or 64/96 gallon carts free of charge. The PAYT ordinance has been updated over the years to close loopholes that solid waste haulers were using to avoid PAYT especially when it came to HOAs, to adapt to changing options for service /markets like moving to wheeled carts and adding single-stream recycling, and to “fine-tune” the system in general.

Some suggestions that the city has for program implementation are to get base-line solid waste data before implementation if possible since it will provide credible measurements of program impacts. Also, it is a good idea to add PAYT requirements for commercial and multi-family customers at the same time as single-family ones, since it’s easier and less overall effort to make all of the changes at once. The interviewee believes that PAYT has been the “cornerstone” of waste reduction and recycling progress in Fort Collins especially since they have privatized solid waste haulers. Another detail that has been helpful in Fort Collins from regulatory standpoint is that their definition of a single-family home is a residence that has its own solid waste bin, and a multi-family home is a residence with a shared solid waste bin. This demarcation makes it much easier for solid waste haulers and others (unless communities adopt PAYT system-wide) since the 8-unit or other definitions often leave many locations in grey areas or do not make sense on the ground. This way, if the haulers are providing one cart per unit/house, they know the PAYT rules apply.

Fort Collins Cardboard Ban

As of March 2013, corrugated cardboard generated by residents and commercial/industrial entities in Fort Collins is banned from the solid waste and must be recycled or composted (or reused). The city, which was the first in Colorado to initiate this type of ban, expected to recover around 12,000 tons as a result. Residents can still include cardboard in their curbside single-stream recycling, or bring it to drop-off centers. Businesses can either include it in their single-stream recycling, arrange to have it collected separately depending on hauler contracts or bring it to drop-off centers.

Five months before adopting this ordinance, the city council solicited input from both residents and commercial entities about the advantages and disadvantages of the ban. Banning cardboard from landfill disposal in Fort Collins was driven by the community goals of 50% waste diversion and the climate action goal of preventing 42,000 tons of CO_2 from being released. Cardboard was targeted since it is ubiquitous and easily-identified and has strong recycling markets. Enacting the ban on cardboard disposal resulted in an increase in single-stream recycling in town (the manner in which most the cardboard is recycled), as well as increases in cardboard collected separately from businesses and cardboard brought to the city's recycling drop-off center. However, for maximum effectiveness, it would be helpful to pair the landfill ban with a requirement for service provision (including all sectors in the community in PAYT or requiring recycling collection or other mechanism to ensure all locations covered by the ban also have recycling collection service).

Recycling/Composting Strategies with Potential in the Loveland/Fort Collins Area

The ten stakeholder meetings throughout Colorado for this Plan provided a lot of information about existing area programs, what is currently working well, program gaps/barriers, successes/resources, neighbor sharing opportunities, near and long-term ideas, types of assistance/funding needed and roles of the entities involved. Here is a summary of what a group based in the Loveland/Fort Collins area came up with. The following are solid waste strategies that have potential:

- Require diversion tracking in every jurisdiction/region: Gathering information is the basis for understanding the status of a community's programs, identifying opportunities, and tracking the impact of programs or changes in the community. This ties well with a licensing requirement for haulers operating in the community. It is important to coordinate tracking forms/fields with other nearby jurisdictions to make it as simple as possible for haulers to report. Be sure to gather information for all sectors: residential, multi-family, commercial and industrial.
- Regional plans: Much of the infrastructure needed for waste management or diversion operates on a regional scale. Working with regional partners to identify opportunities and work together toward solutions and needed infrastructure.
- Funding mechanisms: Acknowledging the importance of funding mechanisms and the difficulty of creating them.
- Scale requirements by population density: The idea here was to have fewer requirements from the state for smaller communities/rural counties than for population centers.
- Regional resource recovery parks: Efficiencies can be gained by siting multiple waste/resource recovery locations at the same site, and funding them from the entire region/"wasteshed."
- Statewide requirement to license haulers: This was in recognition that licensing haulers is an important entry into waste management and diversion programs in communities. Licensing haulers to operate in the community/jurisdiction and requiring insurance and reporting of tonnage information are an important foundational step.

- Commercial sector recycling or composting requirements: Including in PAYT or requiring recycling/composting service creates an equal playing field in the community in that every business participates in recycling

The following strategies/systems have been working well in the area:

- Sustainability/carbon action/waste diversion goals (local): Having a diversion goal has been an important part of the development of programs in Fort Collins. Once the city council has set a clear direction, it provides a framework for further policy and program development. Highlighting the nexus between waste diversion and sustainability or climate action goals has also been important in garnering support for advancing programs and policy.
- Curbside yard waste/trimmings/organics/recycling with PAYT
- Local champions.
- Local volunteers/advocates/non-profits are invaluable to building a successful diversion program.

The following is a list of “what’ missing” from the area programs/systems:

- Local champions: If recycling or composting advocates are not participating in the process of creating programs or policy, the conversation quickly becomes one-sided.
- Depending on town, same list as above (maybe the "working well" group above).
- Equitable funding mechanisms for diversion.
- In some areas, motivation/reason/political will to divert.
- Proximity to compost facility or transfer station.
- Regulations allowing partnerships for small-scale composting with local farmers.

And finally, opportunities that were noted for sharing resources and other items with neighbors included a construction and demolition sort facility, a regional planning approach and regional resource recovery parks.

CASE STUDY SOURCES

Section 3: Transfer and Disposal System

Mesa County

- Phone conversation with Cameron Garcia, Solid Waste & Sustainability Division Director

Bent County

- Phone conversation with Bill Long, County Commissioner

Hinsdale County

- Phone conversation with Robert Hurd, Hindsdale County Road and Bridge Supervisor

State of Wyoming

- Phone conversation with Craig McOmie, Remediation and Cease & Transfer Program Manager
- Citizens' Advisory Group on Solid Waste and Department of Environmental Quality Report: Improving Solid Waste Management in Wyoming by The Citizens Advisory Group on Solid Wastes dated October 28, 2004

Section 4: Solid Waste Collection System

City of Longmont's Municipal Collection System

- Written by Charles Kamenides- City of Longmont as response to request from SERA

City of Lafayette's Organic's Collection Request for Proposals (RFP) and Collection Contract

- http://www.cityoflafayette.com/219/Residential-Waste-Collection-Services
- http://www.dailycamera.com/lafayette-news/ci_26156570/lafayette-moves-add-curbside-composting
- SERA Staff Interviews and research (DB) 2016

City of Golden's Approach to Include HOAs in PAYT

- http://www.cityofgolden.net/live/additional-resources/trash-recycling/
- SERA Staff Interviews and research (DB) 2016

PAYT Ordinances in Golden and Fort Collins

- http://www.cityofgolden.net/media/Ord%201868%20PAYT%20code%20amendments.pdf
- http://www.fcgov.com/recycling/pdf/trash_ordinance_20090519.pdf
- SERA Staff Interviews (DB) and research 2016

Vail's 2014 PAYT Ordinance

- http://www.vaildaily.com/news/10671655-113/ordinance-recycling-vail-council
- SERA Staff Interviews and research (DB) 2016

Section 5: Diversion Materials Management

Fort Collins' Glass Recycling – Drop-off and Curbside

- http://www.fcgov.com/recycling/glass.php
- http://www.fcgov.com/recycling/pdf/20080826_glass_study_final_report.pdf
- SERA Staff Interviews and research (DB) 2016

Recycling Hub and Spoke - Clean Valley Recycling

- Phone conversations and onsite visit, SERA Staff with Deanna Hostetler, and SERA Presurvey for CDPHE Stakeholder meetings
- SERA Staff Interviews and research (MS) 2016

Recycling Hub and Spoke - Angel of Shavano

- Phone conversation SERA Staff and Mickey Barry January 2016
- angelofshavanorecycling.com
- salidachamber.org/angel-of-shavano-recycling/

Commercial PAYT Program with Embedded Recycling

- http://www.vaildaily.com/news/10671655-113/ordinance-recycling-vail-council
- SERA Staff Interviews and research (DB) 2016

City of Boulder: Mandatory Commercial Recycling Ordinance & Food Mandates

- SERA Staff Interviews and research (GH) 2016

Boulder County Publicly Owned and Privately Operated MRF

- http://www.bouldercounty.org/env/recycle/pages/recyclingcenterfacts.aspx
- SERA Staff Interviews and research (DB) 2016

Local Level "Green" Advocates: Eco-Cycle, Boulder CO

- SERA Staff research (DD) 2016
- http://www.ecocycle.org/zero-waste-events
- https://www.ecocycle.org/files/pdfs/press-releases/Eco-Cycle-Spring_Back_CO_Press_Release-Mattresses-12-01-15.pdf

Alpine Waste Privately Owned and Operated MRF

- http://www.recyclingtoday.com/article/alpine-waste-recycling-mrf-expansion/
- http://waste360.com/mrfs/alpine-waste-upgrading-denver-recycling-plant
- SERA Staff Interviews and research (DB) 2016

Dump and Pick-up: Commercial Brokers: Small Operations around Colorado

- SERA Staff Interviews and research (GH) 2016

Denver Residential Curbside Organics Pilot Program

- "Growing a Compost Program in the Mile High City," Juri Freeman, City and County of Denver, Resource Recycling
- SERA Staff Interviews and research (MS) 2016

City of Louisville: Contracted Solid Waste, Recycling and Organics Collection

- SERA Staff Interviews and research (GH) 2016

Superior's Drop-Off Organics Program

- http://superiorcolorado.gov/services/trash-recycling
- SERA Staff Interviews and research (DB) 2016

Private Sector Organics Processing: A-1 Organics

- SERA Staff Interviews and research (GH) 2016

Private Sector Organics Processing: Western Disposal, Boulder

- SERA Staff Interviews and research (GH) 2016

Pitkin County: Compost Program and Processing

- Phone conversation SERA Staff and Jack Johnson, Pitkin County 3/29/16
- http://www.landfillrules.com/
- www.cityofaspen.com/recycling
- SERA Staff Interviews and research (DD) 2016

On-Farm Composting/Farm Siting

- SERA Staff Interviews and research (MS) 2016

Eagle County: Multi - Stream MRF

- http://www.eaglecounty.us/RecyclingWaste/Recycling/Materials_Recovery_Facility_(MRF)/
- http://www.eaglecounty.us/RecyclingWaste/Recycling/Where_to_Recycle/
- SERA Staff Interviews and research (DB) 2016

Better Invoicing – Residential and Commercial

- "Commercial Contracts and Billing – Big Barriers to More Recycling", Dawn BeMent, SERA, CAFR Meeting October 2014
- SERA Staff Interviews and research (DB) 2016

Aspen Sustainability Plan

- SERA Staff Interviews and research (MS) 2016

Unique Considerations for Composting In Eastern Colorado

- https://www.colorado.gov/pacific/sites/default/files/AP_PO_Nitrogen-Deposition-Reduction-Plan-NDRP-Contingency-Plan-Final-Version.pdf
- https://www.colorado.gov/pacific/sites/default/files/AP_PO_Agricultural-Producer-Nitrogen-Fact-Sheet.pdf
- Other sources:
- https://www.colorado.gov/pacific/sites/default/files/AP_PO_Nitrogen-Deposition-Reduction-Plan-NDRP-Contingency-Plan-Final-Version.pdf
- http://articles.extension.org/pages/22686/ammonia-deposition-in-rocky-mountain-national-park:-what-is-the-role-of-animal-agriculture
- https://www.colorado.gov/pacific/sites/default/files/AP_PO_Agricultural-Producer-Nitrogen-Fact-Sheet.pdf
- http://climatechangeconnection.org/solutions/agriculture-solutions/livestock-production/manure-management/
- http://extension.colostate.edu/topic-areas/agriculture/best-management-practices-for-reducing-ammonia-emissions-manure-application-1-631d/
- http://ammoniabmp.colostate.edu/link%20pages/feedlot%20compost%20stockpile.html
- SERA Staff Interviews (DB) and research 2016

Successful K-12 Program: Delta School District (Non-Front Range)

- SERA Staff Interviews and research (MS) 2016

CU Boulder- An Education in Sustainability

- http://www.colorado.edu/ecenter/recycling; https://stars.aashe.org/institutions/university-of-colorado-at-boulder-co/report
- Interview Jack DeBell & SERA Staff (DD) June 2016

Regional Leadership Example – Chittenden, Vermont

- SERA Staff Interviews and research (MS) 2016

Innovations in Rural Recycling: Amelia County, Virginia

- SERA Staff Interviews and research (MS) 2016

Drop-Off Organics in Summit County, Colorado

- SERA Staff Interviews and research (MS) 2016

Circular Local Economies: Lifecycle Plastics and Recycle Projects

- SERA Staff Interviews and research (MS) 2016

Contamination Education Program - Springfield, Massachusetts

- SERA Staff Interviews and research (MS) 2016

Collaboration: Southwest Colorado Council of Governments (SWCCOG)

- Staff Interviews and research (DD) 2016

The State Of Colorado: Implications for Food Donations

- http://www.hungerfreecolorado.org/policy-and-advocacy/the-colorado-charitable-crop-donation-act/
- http://www.foodliabilitylaw.com/2009/11/articles/legislation-and-regulation/donate-food-generously-and-with-immunity/
- http://www.hungerfreecolorado.org/hungerfacts/
- http://www.foodpantries.org/st/colorado
  Hall KD, Guo J, Dore M, Chow CC (2009) The Progressive Increase of Food Waste in America and Its Environmental Impact. PLoS ONE 4(11): e7940. doi:10.1371/journal.pone.0007940
- Phone conversation 3/30/16 SERA Staff and Arlan Preblud Executive Director We Don't Waste www.wedontwaste.org
- SERA Staff Interviews and research (DD) 2016

Changing From Solid Waste Included In Tax Base to User Fees

- http://www.governing.com/columns/smart-mgmt/col-risks-of-raising-non-tax-revenue.html
- Maine Townsman, January 1994 by Michael L. Starn, Editor
- MN Pollutions Control Agency 2015 Solid Waste Policy Report www.pca.state.mn.us/sites/default/files/lrw-sw-1sy15.pdf
- SERA Staff Interviews and research (DD) 2016

Tip Fee Surcharges/Environmental Fees

- SERA Report "Diversion Research Studies: Commercial and Organics Recycling -Final Report-
- Submitted to: Solid Waste Management Coordinating Board, 2011

Large Scale Private Sector Material Recovery Facility: Altogether Recycling

- SERA Staff Interviews and research (GH) 2016

State Legislation from Oregon, Vermont and New York

- https://www.oregonlegislature.gov/bills_laws/ors/ors459.html
- http://www.vtsolidwastedistrict.org/portal/index.php?option=com_content&view=article&id=198&Itemid=62
- http://www.nyenvlaw.com/wp-content/uploads/2015/05/Chapter-6-Solid-Waste-Regulation.pdf
- SERA Staff Interviews and research (DB) 2016

Fort Collins PAYT Ordinance

- Sources: http://www.fcgov.com/recycling/ordinances.php
- SERA Staff Interviews and research (DB) 2016

Fort Collins Cardboard Ban

- http://www.fcgov.com/recycling/ordinances.php
- http://www.fcgov.com/recycling/cardboard.php
- SERA Staff Interviews and research (DB) 2016

Recycling/Composting Strategies with Potential in the Loveland/Fort Collins Area

- Table exercises from 2016 CDPHE Loveland Stakeholder Meeting
- SERA Staff Interviews and research (DB) 2016

APPENDIX D: FUNDING SOURCES

APPENDIX D: FUNDING SOURCES

Government incentives – whether at the federal, state or local levels – can potentially provide financial benefits for a variety of solid waste and recycling projects. These funding sources are often provided on a competitive basis, and are not specific to the solid waste and recycling industry. If a project can secure additional funding, it will typically allow for a reduction in the capital and/or operating costs. This section provides an overview of potential governmental incentives that public and/or private solid waste and recycling entities could utilize or have historically been for solid waste management or recycling projects.

State Grant/Funding Programs

The Recycling Resources Economic Opportunity (RREO) Act (HB 07-1288) created the RREO Grant Program with the intent to fund implementation projects that promote economic development through the productive management of recyclable materials that would otherwise be treated as discards. Projects that meet this goal are designed to implement recycling, composting, anaerobic digestion, source reduction, and beneficial use/reuse for a wide variety of materials.

Since its inception, the grant program has awarded more than $7.1 million to businesses, local governments, nonprofit groups, schools and universities throughout Colorado to help develop recycling infrastructure. A few grant recipients are highlighted below:

- Lake County was awarded $165,498 to triple the amount of recycling accomplished in the County and create a sustainable revenue stream for recycling services in the future by (a) providing increased access to recycling at two drop-sites; (b) increasing Lake County's ability to store and process material; and (c) providing the institutional and educational support needed to make increased access a long-term economic success.
- Clean Valley Recycling was awarded $29,790 to expand its hub and spoke recycling model by bringing services into additional communities (Crowley, McClave and Eads) and by accepting greater quantities of recyclable materials (specifically, cardboard, plastics and glass). Equipment and supplies purchased with grant funds will increase Clean Valley's processing capacity.
- Terra Firma Recycling was awarded $99,333 to develop a hub and spoke recycling network that can potentially serve 16,000 people within a 75 mile radius of Trinidad. Grant funds will purchase equipment and supplies to increase storage capacity, improve processing capabilities, and develop an education and outreach campaign.

Website: https://www.colorado.gov/pacific/cdphe/recycling-grants-and-rebates

US Department of Agriculture (USDA)

Community Facilities Direct Loan and Grant Program

Through the Community Facilities Direct Loan and Grant Program, the USDA provides affordable funding to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service to the local community, such as solid waste or recycling services, for the orderly development of the community in a primarily rural area. Private, commercial or business undertakings are excluded. Public bodies, community-based nonprofits, and federally-recognized Tribes serving rural areas including cities, villages, townships and towns as well as Federally Recognized Tribal Lands with no more than 20,000 residents according to the latest U.S. Census Data are eligible for this program.

Example: Encore Life, a non-profit in Wray, Colorado that offers a variety of programs and services in eastern Yuma County, was able to purchase security equipment and pallet jack with scale through funding from the Community Facilities Loan and Grant Program for its electronics recycling program.

Rural Utilities Services Program

Through Rural Utilities Service Water and Environmental Programs (WEP), rural communities can obtain the technical assistance and financing, typically through long-term, low-interest loans, necessary to develop drinking water and waste disposal systems. WEP provides funding for the construction of waste facilities in rural communities and is the only Federal program exclusively focused on rural waste infrastructure needs of rural communities with populations of 10,000 or less. The funds may also be used for collections and landfill closure. Grants within WEP include:

- Solid Waste Management Grant
- Water & Waste Disposal Grants to Alleviate Health Risks on Tribal Lands and Colonias
- Water & Waste Disposal Loans and Grants
- Water & Waste Disposal Loan Guarantees
- Water & Waste Disposal Predevelopment Planning Grants
- Water & Waste Disposal Revolving Loan Funds
- Water & Waste Disposal Technical Assistance and Training Grants

Example: The San Luis Valley Ecosystem Council received $75,000 in funding from the FY 2015 Solid Waste Management Grant to enhance the capacity and efficiency of current local landfill operations in Saguache County and integrate illegal dumping into currently landfill operations.

Websites: http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program; and http://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs

Private Funding Sources

While there are various potential private funding sources, this section describes the Recycling Partnership, Closed Loop Fund and Bloomberg Philanthropies.

The Recycling Partnership

The Recycling Partnership (Partnership), formerly the Curbside Value Partnership, is an industry-funded national recycling nonprofit with the goal to improve curbside residential recycling in the United States. The Partnership provides resources for communities (4,000 or more households) starting programs with recycling carts or switching from bins to carts. To accelerate the local level adoption of recycling best management practices, the Partnership uses highly leveraged grants coupled with technical assistance.

For 2016, the Partnership grants offered were for:

- Cart procurement: $7.00 per cart delivered up to $500,000
- Education and outreach implementation: $1.00 per household up to $50,000
- Access to technical assistance and the CARTs campaign materials valued at $139,000

Example: In 2015, the Recycling Partnership awarded a grant for residential recycling carts to the City of Santa Fe. The grant dollars will assist Santa Fe with purchasing new recycling carts. Additionally, the City will receive assistance with a customized public education campaign and with technical planning to support the cart deliveries to its 29,000 households. Santa Fe anticipates that cart distribution will take place in the late fall of 2016.

The Closed Loop Fund

The Closed Loop Fund (CLF) was created to increase recycling rates and is funded by consumer goods companies and retailers. The CLF provides zero interest loans to municipalities and low interest loans to private companies. The goal for CLF is to invest $100 million in recycling infrastructure from 2015 to 2019.

Example: The Closed Loop Fund is investing in conversion from dual to single stream recycling collection systems in Quad Cities, Iowa, and Portage County, Ohio, both important Midwest markets for recycling. The loan will aid in the purchasing of new recycling carts and trucks, making it easier for citizens to recycle and significantly increasing recycling rates.

Bloomberg Philanthropies

Bloomberg Philanthropies focuses on environment, public health, education, government innovation and the arts. Bloomberg also has an initiative dubbed the “Mayors Challenge” where cities submit innovative ideas to improve city life and have a chance at winning a $5 million grand prize or one of four additional $1 million grants.

Example: During the 2012-2013 Mayors Challenge, the City of Houston won a Bloomberg Philanthropies grant of $1 million for their “One Bin for All” initiative. The city is currently in the process of evaluating proposals to design, construct and operate a facility to reach the 75% diversion rate goal.

Websites: http://recyclingpartnership.org/; http://www.closedloopfund.com/; http://www.bloomberg.org/

New Market Tax Credit

The New Market Tax Credit (NMTC) Program is a federal program operated by the Department of Treasury that provides investors with federal tax credits for qualified development in low income communities. The tax credit is provided to a specialized financial institution called a Community Development Entity who invests in the NMTC applicant. The tax credit provided to the investor is claimed over a seven-year credit period. In each of the first three years, the investor receives a tax credit equal to five percent of the total amount paid for the stock or capital interest at the time of purchase. For the next four years, the value of the tax credit is six percent annually. The tax credit can be applied for multiple times in a row for the same project.

Example: The City of Albuquerque (through a public-private partnership with Friedman Recycling) utilized new market tax credits as a part of its efforts to build and operate a new single-stream material recovery facility in the city.

Website: http://www.cdfifund.gov/what_we_do/programs_id.asp?programID=5

Tax-Exempt Private Activity Bonds

Private activity bonds provide tax-exempt financing for the furtherance of governmental and qualified purposes, which may include the construction of solid waste disposal (which could include various types of recycling activities) facilities. Qualified private activity bonds are issued by a state or local government, the proceeds of which are used for a defined qualified purpose by an entity other than the government issuing the bonds.

Qualified private activity bonds must be approved by the governmental entity issuing the bonds and, in some cases, each governmental entity having jurisdiction over the area in which the bond-financed facility is to be located. Public approval can be accomplished by either voter referendum or by an applicable elected representative of the governmental entity (e.g. Pueblo City Council) after a public hearing following reasonable notice to the public.

Example: The City of Dallas City Council approved the issuance of private activity bonds for the landfill gas to energy project at the McCommas Bluff Landfill as required by IRS regulations. The contractor, Dallas Clean Energy, used a conduit issuer, Mission Economic Development Corporation, as the issuer of the private activity bonds.

Website: http://www.irs.gov/pub/irs-pdf/p4078.pdf

APPENDIX E: COST MODELS FOR COLLECTION AND DIVERSION

APPENDIX E: COST MODELS FOR COLLECTION AND DIVERSION

E.1 Diversion Collection and Processing Cost Modeling by Regions and Typologies

This appendix presents overall cost models estimating the per-ton costs for:

- Collection of trash, recycling, and organics (residential and commercial)
- Diversion processing (recycling and organics)
- Drop-off sites
- Hauling and dead-head collection of materials from drop-offs and distant landfill and other sites

The common unit in the models is cost per ton,[1] which allows the “building up” of costs and comparisons between sectors, materials and regions. Section E.7 uses the results from each of these elements of collection and diversion, and presents the costs for scenarios for each region, based largely on the travel distances to and between service, processing and market locations.

These costs are used to assess the costs and feasibility of programmatic and policy options for diversion in regions of the state, with consideration of urban/suburban vs. rural conditions. The cost models for a state-level Plan cannot represent any one community, nor will they directly represent the costs for any specific area. Detailed modeling assumptions are overwhelmed by the wide array of diversity in labor, equipment, land purchase, local competition, market fluctuations and dozens of other variables. The planning level models are designed to avoid providing depth in some areas when other areas have wide variability. The section focuses on providing the information necessary to understand the opportunities and challenges in the four regions. The cost models are designed to serve as an aid to communities and counties that may be considering programs and policies in their area. The figures may be used as “look-up” tables for approximate cost elements in the planning work for new diversion service and program initiatives around the state.

E.2 Profit Discussion

Note that, per the convention in the rest of the report, the costs in this appendix **do not include profit** for either municipal (return on investment) or private haulers (profit). It should be noted that this leads to estimates that are under full cost-of-service for haulers, because haulers pay their overhead costs out of these markups. Governments already have people on staff to cover the clerical, payroll and personnel,

[1] Although a few models present additional units, including cost per household for collection, and hauling costs per cubic yard and ton-mile.

routing costs, etc. that the hauler would cover from a mark-up, so government can presumably charge a lower markup.

Municipal service may need to add anywhere from 3% (for a low return on investment) to 5% to perhaps as much as 15% for "contingencies." Private hauler figures for profit vary. Some haulers wish for 100% profit; for collection, we more commonly see figures in the 20-30% range[2], and depending on competitiveness in the area, figures for facilities, hauling, or collection could be anywhere in the range (20%-100%) – based on "what the market will bear." Therefore, figures in this appendix can and should be multiplied by relevant profit assumptions, based on the local conditions.

E.3 Cost Models of Collection of Residential and Commercial Trash, Recycling and Organics

E.3.1 Residential Collection

Tables E-1, E-2 and E-3 model the costs for residential collection for:

- Collection service for trash, recyclables, and organics (with and without food scraps) offered to all households on a weekly basis, and on a voluntary basis. It is assumed that about 15% of households sign up (particularly relevant assumption for organics and recycling). Collection is more expensive because of the skipped homes that do not participate
- Collection service for trash, recyclables and organics provided to all households on a weekly basis, with all households participating
- Collection of each service on an alternate-week basis, with collection of slightly less materials resulting savings
- Economies of scale reduce costs in collection. These models assume the economies from one service provider, not because that is the norm in Colorado, but because any other assumption would be arbitrary, and every town is different. Using one service provider, rather than many, tends to reduce costs because equipment is used more intensively, homes are not passed by without collection, etc.

The results are provided on a per-ton basis (the main performance indicator for this section). Recall that the costs presented do not include any profit. The cost per ton figures also do not include tipping fees or

[2] Some suggest 10%; haulers report higher figures.

hauling (from a transfer station), but this component represents the cost of collection alone. The estimates for each region of the state that are presented in Section E.7 provide all-inclusive comparisons.

Table E-1: Residential Collection Cost per Ton: Voluntary Curbside[1]

Assumptions	Urban / Suburban				Rural			
	Trash	Recycling	Organics	Organics with Food	Trash	Recycling	Organics	Organics with Food
Assumed Participation Rate	15%	15%	15%	15%	15%	15%	15%	15%
Cost per Hour Truck & Driver	$60	$60	$60	$60	$60	$60	$60	$60
Tons Collected per day	20	14	14	16	20	14	14	16
Collection Efficiency Relative to Urban	100%	100%	100%	100%	75%	75%	75%	75%
Revised Cost per Hour[2]	$81	$81	$81	$81	$81	$81	$81	$81
Assumed lbs./HH/week (per participant)	48	25	25	30	48	25	25	30
Assumed Tons/HH/year (per participant)	1.25	0.65	0.65	0.78	1.25	0.65	0.65	0.78
Collection Cost/Ton[3]	$35	$50	$50	$44	$46	$66	$66	$58

1. SERA National Model, run with Colorado Assumptions
2. Truck and Driver - adjusted for collection efficiencies and participation rate
3. No profit, no tip fee, no haul, no revenue, no processing

Table E-2: Residential Collection Cost per Ton: Mandatory Curbside[1]

Assumptions	Urban / Suburban				Rural			
	Trash	Recycling	Organics	Organics with Food	Trash	Recycling	Organics	Organics with Food
Assumed Participation Rate	100%	100%	100%	100%	100%	100%	100%	100%
Cost per Hour Truck & Driver	$60	$60	$60	$60	$60	$60	$60	$60
Tons Collected per day	20	14	14	16	20	14	14	16
Collection Efficiency Relative to Urban	100%	100%	100%	100%	75%	75%	75%	75%
Revised Cost per Hour (Truck & Driver)	$60	$60	$60	$60	$80	$80	$80	$80
Assumed lbs./HH/week (per participant)	48	25	25	30	48	25	25	30
Assumed Tons/HH/year (per participant)	1.25	0.65	0.65	0.78	1.25	0.65	0.65	0.78
Collection Cost/Ton[2]	$24	$34	$34	$30	$32	$46	$46	$40

1. SERA National Model, run with Colorado Assumptions
2. No profit, no tip fee, no haul, no revenue, no processing

Table E-3: Residential Collection Cost per Ton: Every-Other-Week[1]

Assumptions	Urban / Suburban				Rural			
	Trash	Recycling	Organics	Organics with Food	Trash	Recycling	Organics	Organics with Food
Assumed Participation Rate	100%	100%	100%	100%	100%	100%	100%	100%
Cost per Hour Truck & Driver	$60	$60	$60	$60	$60	$60	$60	$60
Collections per Week	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tons Collected per day	20	14	14	16	20	14	14	16
Reduction in Collection, Less Frequent Collection	2%	2%	8%	8%	2%	2%	8%	8%
Collection Efficiency Relative to Urban	100%	100%	100%	100%	75%	75%	75%	75%
Revised Cost per Hour (Truck & Driver)	$30	$30	$30	$30	$40	$40	$40	$40
Assumed Lbs./HH/week (per participant)	47	25	23	28	47	25	23	28
Assumed Tons/HH/year[2]	1.22	0.15	0.14	0.17	1.22	0.15	0.14	0.17
Collection Cost/Ton[3]	$12	$17	$17	$15	$16	$23	$23	$20

1. SERA National Model, run with Colorado Assumptions
2. Per participant, corrected for collection frequency
3. No profit, no tip fee, no haul, no revenue, no processing

The main observations from these models include:

- Costs per ton are higher in rural areas because collection stops are farther apart – and collections per hour are lower
- Universal mandatory service is cheaper than optional service (obviously, the economies relate to the percent of households signed up for collection)
- Every other week service is substantially cheaper than weekly service for all materials

Commercial collection costs are presented in Table E-4. Again, the data focus on comparisons of cost per ton for collection. Tipping fees and hauling costs for the various streams are not included here, but are included in Section E.7. The major findings are:

- Collection costs are lower in urban/suburban areas because of greater densities, and it is assumed that trucks will need to cross to multiple communities to obtain a full load (with travel time between communities)
- Recycling is the least expensive service – assuming both trash and recycling are provided to all businesses. However, at the generator level, adding recycling collection for businesses may almost double solid waste management bills to businesses, largely because, like for the residential

sector, the major portion of the cost of collection is getting the truck to the container – regardless of which material, or how much of it, is collected

- Organics is more expensive because universal service to all businesses is not suitable. Since uptake and distances are difficult to model, the estimated costs are higher; including tip fee, it is more expensive per ton than trash, even though the material is substantially heavier per cubic yard. If organics collection was provided to all businesses, costs would not be that different than trash, because the major cost is collection, and there are similar tipping fees (although volumes for organics would be substantially smaller)
- If recycling is not provided for all businesses, costs will also increase per ton, with arguments similar to the discussion of organics collection costs

These findings are used in developing the program recommendations discussed in the following section.

Table E-4: Commercial Collection Costs per Ton[1]

Assumptions	Urban / Suburban			Rural		
	Trash	Recycling	Organics with Food	Trash	Recycling	Organics with Food
Cost per Hour Truck & Driver	$55	$55	$55	$55	$55	$55
Efficiency Multiplier Compared to Urban Trash	100%	100%	100%	75%	75%	75%
Adjusted Cost/hr.	$55	$55	$55	$73	$73	$73
Tons per day	20	14	16	20	14	16
Pounds per CY	85	75	300	85	75	300
Percent Full	100%	100%	100%	100%	100%	100%
Collection Cost/Ton	$28	$39	$34	$37	$52	$46

1. SERA National Model, run with Colorado Assumptions; collection cost only, no profit, no tip fee, no revenues, no processing

Note that the table includes no tip fee for recyclables. Five-year average revenues have been about $140 for mixed single stream recyclables for the Colorado market, and the facilities paid small payments to hauler and communities for those tons. However, markets have decreased during the past couple of years such that some facilities are charging $35 per ton for delivered single-stream materials, and that figure is more than landfill tipping fees in some areas. Given that the study is a 20-year plan, current prices (at one point in time) were not considered appropriate for developing long-term options, and instead, the Project Team used five-year average market prices to better represent markets.

E.4 Recycling and Organics Processing Costs

E.4.1 Recycling Processing Costs

Table E-5 summarizes the estimated costs per ton for four types of recycling processing facilities that have possible roles in the state of Colorado – near or longer term. They range in size from very small dump and pick operations, to medium-sized automated single stream facilities managing up to 42,000 tons per year (TPY). For areas outside the Front Range, where there is already substantial coverage for recycling processing, larger plants are not generally justified because population densities do not support them.

Certainly, there are myriad assumptions affecting these figures. However, the costs of processing are in the range expected for automated plants – and different real-world plants make different business decisions. Specific plants are run with various degrees of management efficiency, face a wide range of processing effectiveness and cleanliness of input streams, and experience layout and equipment differences, and so on. The results are being used as planning assumptions. These costs are used – along with transport costs – in modeling the effects of new program recommendations in later sections.

Table E-5: Recycling Material Recovery Facility (MRF) Cost: Net Revenues per Ton[1,2]

MRF Type	Tons Per year	Site, Improvement and Building Costs	Equipment Cost	Annualized Building[3]	Annualized Equipment[3]	Annual Operating Expenses	Annual Total Costs	Cost Per Ton	5-Year Average Single Stream Per Ton Revenue[4]
Dump and Pick	4,800	$350,000	$500,000	$28,000	$77,000	$461,000	$566,000	$118	$120-170
Small Manual	6,000	$900,000	$1,000,000	$72,000	$155,000	$715,000	$942,000	$157	$120-170
Small Automated	20,000	$2,400,000	$2,000,000	$193,000	$309,000	$1,091,000	$1,593,000	$80	$120-170
Medium Automated	42,000	$5,500,000	$5,000,000	$441,000	$774,000	$1,494,000	$2,709,000	$65	$120-170

1. Not including hub and spoke
2. SERA National Model, run with Colorado Assumptions; no profit
3. Based on 20 years and 5% cost of capital for the building and eight years and 5% cost of capital for the equipment
4. Range provided; revenues vary with composition of materials collected single stream

E.4.2 Composting Facility Costs

Windrow is the most common processing option in Colorado.[3] Table E-6 summarizes the cost for various refinements of a windrow operation – including consideration of a standalone facility vs. one co-located

[3] The analysis focused on windrow based composting and did not include other technologies such as anaerobic digestion.

at a landfill. The figure provides information on major cost elements, and the resulting cost per ton – excluding profits. Table E-6 shows:

- Composting costs per ton model are about $41-46 per ton when operating at the high end of tons.
- Co-location of the facility with a landfill results in savings from equipment and personnel sharing. The savings reduction is about $5-10 per ton.

These costs, along with collection and hauling costs, are used in discussing diversion options in Section 6.

Table E-6: Compost Facility Cost per Ton[1,2]

Assumptions	Stand-Alone Facility	Co-Located at Landfill or other Facilities
Tons Inbound or Cubic Yards Outbound	10,000-20,000	10,000-20,000
Equipment Capital Cost	$1,355,000	$1,230,000
Equipment Cost Recapture	$143,300	$135,000
Equipment Operating Cost	$506,800	$506,800
Personnel	$263,200	$172,300
Total Annual Costs	$913,300	$814,000
Assumed Tonnage Processed	10,000-20,000	10,000-20,000
Cost per Ton Processed	$46-91	$41-81
Cost per Finished Yard of Compost	$46-91	$41-81

1. Reduction assumption: 1 ton of material inbound = 1CY of material outbound
2. SERA National Model, run with Colorado Assumptions; no profit

E.5 Drop-off and Hub & Spoke Facilities

E.5.1 Trash, Recycling and Organics Drop-offs Using Dumpsters

Table E-7 and Table E-8 provides information on the cost per ton for delivery of drop-off service (likely unstaffed) using multiple eight-cubic yard dumpsters at a potentially-remote site. The results are presented in cost per ton and cost per ton-mile terms. The data shows that:

- Costs increase substantially the longer the haul
- The costs per-ton decrease as greater volumes are collected
- The costs for recycling are lowest because the tip fee is assumed to be zero in this Plan
- Organics service is the most expensive of the three services; it has the highest tip fee in the modeling assumption

E.5.2 Recycling Drop-Offs and Hub and Spoke

Drop-off facilities are an important part of the services and "opportunity-to-recycle" picture in Colorado. Table E-7 presents results for recycling drop-off facilities of various sizes and configurations. These include simple moveable trailers, hub and spoke, and convenience center configurations. Because the range of costs is so broad, costs from a number of sites were assembled and statistical analysis performed to identify the planning level estimates of the basic site administration and operations and maintenance (O&M) costs as a function of site size. The results show that small facilities (including trailer-based options) are substantially more expensive (per ton) than larger sites, partly because of the fixed costs of operation, which is spread across fewer tons. The cost of adding the basic baler and sorting needs of a hub are also shown. The total hub "adder" costs relate to processing costs including a baler and sorting capabilities. Typical costs from the RREO grant applications for hub and spoke follow. Balers cost about $15,000-$55,000 (and about $90,000 and much more for facilities larger than these). New or upgraded electrical may be needed for a baler. Additional 15-40 cubic yard roll-offs cost about $4,000-$9,000 each. One site described a simple sort line for plastics that cost $4,500 to set up; machine-based sort lines would be more expensive.

Table E-7: Drop-off Facility Costs per Ton

Assumptions	Towable Diversion Drop Site[1]	Community Convenience Center, Rural, Recycling (no processing)[2]	Added Costs for Hub[3]	Community Convenience Center, Rural, Refuse[2]
Annual Total Tons Processed	13-38	50-750		500-3,500
Capital Cost	$28,000	n.a.		n.a.
Annualized Capital (8 yrs., 5%)	$7,264	n.a.		n.a.
Annual Administration and O&M	n.a.	$40,000+$50/ton throughput		$90,000+$60/ton throughput
Basic Processing (baling/year)	n.a.	n.a.	$7,250	n.a.
Hauling		Table E-9	Table E-9	Table E-9
Tipping Fee or Revenue		Revenue $0-$140/Ton		
Cost per Ton Excluding Hauling and Tip fee or Revenues	$191-559/ton	$100-$850/ton	Add $10-$30/ton[4]	$85-$240

1. Described in LBA Associates, "Southwestern Colorado Waste Study", 2015. The cost computations in that report were presented differently, so some elements are "n.a." in Table E.7.
2. Estimated by SERA using regression using eight recycling convenience center sites in New Mexico over a range of sizes, administration and O&M costs, excluding hauling and tipping fee. From Table 1-6, "Solid Waste Assessment & Management Study, Santa Fe County," by Leidos, March 2014. Planning Level estimates. Note the study recommended adding compactors for larger sites taking cardboard.
3. Assembled from Hub and Spoke RREO Grant applications provided by CDPHE. Typical costs from the RREO grant applications for hub and spoke follow. Balers cost about $15,000-$55,000 (and about $90,000 and much more for facilities larger than these). New or upgraded electrical may be needed for a baler ($6,000-$10,000 or more). Additional 15-40 cubic yard roll-offs cost about $4,000-$9,000 each (used cost about $4,000). One site described a simple sort line for plastics that cost $4,500 to set up; machine-based sort lines would be more expensive. Storage or baler covers are quite expensive; a storage building for one application was $216,000, and baler cover building was $63,000, and paving ranged from $20,000-$65,000. The costs in the Table E-7 focus on a baler and mid-range electrical, spread over eight years.
4. No baler was included for a site smaller than 250 tons per year; the costs per year truncated at $30/ton.

Table E-8: Cost per Ton by Cubic Yards and Distance[1]

Cost Per Ton[2]	Distance[3]									
	5	10	25	50	75	100	125	150	175	200
8	$70	$111	$232	$434	$637	$839	$1,041	$1,243	$1,445	$1,648
16	$50	$70	$131	$232	$333	$434	$536	$637	$738	$839
24	$43	$57	$97	$165	$232	$300	$367	$434	$502	$569
32	$40	$50	$81	$131	$182	$232	$283	$333	$384	$434
40	$38	$46	$70	$111	$151	$192	$232	$273	$313	$354
48	$37	$43	$64	$97	$131	$165	$199	$232	$266	$300
56	$36	$42	$59	$88	$117	$146	$174	$203	$232	$261
64	$35	$40	$55	$81	$106	$131	$156	$182	$207	$232
72	$34	$39	$52	$75	$97	$120	$142	$165	$187	$210
80	$34	$38	$50	$70	$91	$111	$131	$151	$172	$192
88	$34	$37	$48	$67	$85	$104	$122	$140	$159	$177
96	$33	$37	$47	$64	$81	$97	$114	$131	$148	$165
104	$33	$36	$46	$61	$77	$92	$108	$123	$139	$154

1. SERA National Model, run with Colorado Assumptions and long distance dedicated collection assumptions; No profit, no tip fee, no haul, no revenue, no processing
2. Trash based on a tip fee of $30 per ton and 85 lbs. per cubic yard
3. Distances are one way using eight cubic yard dumpsters

E.6 Hauling and Transporting Materials

E.6.1 Collection of Roll-offs

Table E-9 presents the costs for collection, hauling and disposal of 40 CY roll-offs containing loose residential trash, recycling, yard waste, yard waste and food scraps. The results are presented as "per ton" costs, with assumptions about hauling distances ranging from 0-300 miles. Of course, some of the distances are not cost-effective, and that is part of the important picture to show what is and what is not practical in various areas of Colorado.

Table E-10 presents similar results using a tractor/trailer arrangement. Tables E-11 and E-12 present the figures assuming no collection truck compaction.

Table E-9: Hauling Costs per Ton- Roll-off, with Collection Compaction[1,2,3]

Assumptions[4]	Haul Trash	Haul Recycling	Haul Organics – Yard Waste	Haul Organics including Food
Staff and Truck / Hour	$55	$55	$55	$55
Speed	50	50	50	50
CY per Roll-off	40	40	40	40
Pounds/CY	85	75	200	300
Collection Truck Compaction Ratio	2.5	2	2.5	2.5
Max Tons/Load	10	10	10	10
Calculated Tons per Load	4.25	3	10	10
Cost Per Ton				
<10 miles	$1.81	$2.57	$0.77	$0.77
25 miles	$6.47	$9.17	$2.75	$2.75
50 miles	$12.94	$18.33	$5.50	$5.50
75 miles	$19.41	$27.50	$8.25	$8.25
100 miles	$25.88	$36.67	$11.00	$11.00
150 miles	$38.82	$55.00	$16.50	$16.50
200 miles	$51.76	$73.33	$22.00	$22.00
300 miles	$77.65	$110.00	$33.00	$33.00
Adder: Per-Ton Tip Fee	$30.00	$0.00	$35.00	$36.00

1. Hauling costs per ton if 25-ton payload basic modeling assumption drivers for roll-off costs; equipment capital costs are spread over 5-8 years, depending on equipment, with 5% cost of capital
2. Tip fees and payload assumptions for all materials follow the table. Lower driver labor costs and benefits assumed for rural areas
3. SERA National Model, run with Colorado Assumptions
4. Based on using a 40-cubic yard roll-off; distances are based from facility and exclude tip fees

Table E-10: Hauling Costs per Ton Transfer Trailer, with Collection Compaction[1]

Assumptions[2]	Trash	Recycling	Organics	Organics with Food
Staff and Truck / Hour	$55	$55	$55	$55
Speed	50	50	50	50
CY per Trailer	153	153	153	153
Pounds/CY, Loose	85	75	200	300
Collection Truck Compaction Ratio	2.5	2	2.5	2.5
Max Tons / Load	25	25	25	25
Calculated Tons / Load	16.3	11.5	25.0	25.0
Cost Per Ton				
<10 miles	$0.47	$0.67	$0.31	$0.31
25 miles	$1.69	$2.40	$1.10	$1.10
50 miles	$3.38	$4.79	$2.20	$2.20
75 miles	$5.07	$7.19	$3.30	$3.30
100 miles	$6.77	$9.59	$4.40	$4.40
150 miles	$10.15	$14.38	$6.60	$6.60
200 miles	$13.53	$19.17	$8.80	$8.80
300 miles	$20.30	$28.76	$13.20	$13.20
Adder: Per-Ton Tip Fee	$30.00	$0.00	$35.00	$36.00

1. SERA National Model, run with Colorado Assumptions: No profit
2. Distances based from Facility, exclude tip fee

Table E-11: Hauling Costs per Ton - Roll-off, Loose (not compacted)[1,2,3]

Assumptions[4]	Haul Trash	Haul Recycling	Haul Orgs (YW)	Haul Organics including Food
Staff and Truck / Hour	$55	$55	$55	$55
Speed	50	50	50	50
CY per Roll-off	40	40	40	40
Pounds/CY Assumed	85	75	200	300
Collection Truck compaction ratio	1	1	1	1
Max Tons / Load	10	10	10	10
Calculated Tons per Load	1.7	1.5	4.0	6.0
Cost Per Ton				
<10 miles	$6.18	$7.00	$2.63	$1.75
25 miles	$22.06	$25.00	$9.38	$6.25
50 miles	$44.12	$50.00	$18.75	$12.50
75 miles	$66.18	$75.00	$28.13	$18.75
100 miles	$88.24	$100.00	$37.50	$25.00
150 miles	$132.35	$150.00	$56.25	$37.50
200 miles	$176.47	$200.00	$75.00	$50.00
300 miles	$264.71	$300.00	$112.50	$75.00
Adder: Per-Ton Tip Fee	$30.00	$0.00	$35.00	$36.00

1. Hauling costs per ton if 25-ton payload basic modeling assumption drivers for roll-off costs; equipment capital costs are spread over 5-8 years, depending on equipment, with 5% cost of capital
2. Tip fees and payload assumptions for all materials follow the table. Lower driver labor costs and benefits assumed for rural areas
3. SERA National Model, run with Colorado Assumptions
4. Based on using a 40-cubic yard roll-off; distances are based from facility and exclude tip fee

Table E-12: Hauling Costs per Ton - Transfer Trailer, Loose (not compacted)[1]

Assumptions2	Trash	Recycling	Organics	Organics with Food
Staff and Truck / Hour	$55	$55	$55	$55
Speed	50	50	50	50
CY per Trailer	153	153	153	153
Pounds/CY, Loose	85	75	200	300
Collection Truck Compaction Ratio	1	1	1	1
Max Tons / Load	25	25	25	25
Calculated Tons / Load	6.5	5.7	15.3	23.0
Cost Per Ton				
<10 miles	$1.61	$1.83	$0.69	$0.46
25 miles	$5.77	$6.54	$2.45	$1.63
50 miles	$11.53	$13.07	$4.90	$3.27
75 miles	$17.30	$19.61	$7.35	$4.90
100 miles	$23.07	$26.14	$9.80	$6.54
150 miles	$34.60	$39.22	$14.71	$9.80
200 miles	$46.14	$52.29	$19.61	$13.07
300 miles	$69.20	$78.43	$29.41	$19.61
Adder: Per-Ton Tip Fee	*$30.00*	*$0.00*	*$35.00*	*$36.00*

1. SERA National Model, run with Colorado Assumptions; no profit
2. Distances are based from facility and exclude tip fees

E.7 Summary Cost Results by Region

E.7.1 Introduction to the Regional Cost Results

The cost models from the previous sections were used as inputs to construct planning level regional cost models for the key services and programs. The key to the definition of the scenarios is the distance grid, presented as Table E-13. Distances, densities and the associated transportation costs are the major factors affecting the feasibility of collection and diversion in various regions of the state. For this reason, the scenarios are defined based on distance and "urban/rural" categorization. Each column in Table E-8 provides a "typical" distance to landfills, recycling sites, and compositing sites within the regions, and these values are used to calculate costs for collection and diversion options in each region.

Table E-13 also defines the regional scenarios in terms of the distance of major MRFs in the region from the markets. End-user markets for individual materials recovered in Colorado are located around the country (and internationally), but the locations of the "optimal" markets at any one time vary; brokers work continually to find the best price for a facility's recovered materials. The Project Team used simpler approaches to understand the relative feasibility of recycling diversion options in the four regions of the state. Review of the stakeholder pre-surveys and interviews with brokers and MRF managers makes it clear that sales in the Western region sometimes go to Albuquerque or Salt Lake City, and Eastern MRF sales sometimes go to Oklahoma. Some materials have local end-user markets, particularly some of the high-value plastics, and looking forward, potentially glass. Beyond market price, driving distance is not the only factor affecting choice of market destination. The quality of roads, the greater the number of carriers and availability of backhauls also affect freight rates and influence where materials go. Denver is advantageous in these characteristics. To corral the scope of the scenario analysis, the Project Team determined to use distance to Denver markets as the best proxy distance to market. While Denver is not directly a "market" for all materials, using Denver as the common destination allows the scenarios to measure the difference in costs for the other regions relative to the Front Range's costs. Finally, the specific destination for the materials may not be Denver, but the distance to Grand Junction to Denver is fairly similar to the distance to Salt Lake City. The end points for the various regions that were used were Grand Junction (Western Slope), Sterling and Alamosa (Eastern/Southeastern), Denver Metro (Front Range), and Eagle County (Mountains).

Note that distances to the compost sites were not given much additional treatment beyond the 40-50 mile distances noted in the table. Given its weight and low value, it is not feasible to transport the material much beyond a fairly small area.

Table E-13: Scenario Definitions: Distance Assumptions (Miles)

Round Trip	Trash Facility	Recycling Facility	Composting Site	Recycling Markets
Front Range	20	20	40	40
Mountains	40	60	40	250
Western Slope	50	80	40	500
Eastern/Southeastern	50	100	40	350

These scenarios do not consider material by material distances (e.g. glass and plastic are the only local markets; paper mills can be 700 or more miles away). Centroid distances to Denver were used as proxies.

E.7.2 Regional Cost Results

Using the cost figures presented in the previous section, the cost for each service and region can be built up. Table E-14 provides the summary results, reflecting the fully vertically integrated costs. The ranges reflect differences in assumptions about costs, profits, and other inputs. To compute the costs at zero recycling revenues, subtract $140 from the recycling entries in Table E-14. Table E-15 provides the costs for just collection and tipping fees, to indicate the collection portion is not "free."

Table E-14: Regional Cost per Ton Results including Collection, Transport, Processing, Tip Fees and 5-year Average Recycling Revenues – Fully Vertically Integrated [1]

Total Costs	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Voluntary Residential Collection				
Trash	\$70-\$80	\$80-\$100	\$90-\$110	\$90-\$110
Recycling	\$10-\$30	\$140-\$190	\$200-\$290	\$280-\$410
Organics	\$90-\$110	\$100-\$110	\$110-\$130	\$110-\$130
Mandatory Residential Collection				
Trash	\$60-\$70	\$70-\$80	\$80-\$90	\$80-\$90
Recycling	\$-10-\$10	\$120-\$170	\$180-\$270	\$260-\$380
Organics	\$80-\$90	\$80-\$90	\$90-\$100	\$90-\$100
Every Other Week Residential Collection				
Trash	\$50-\$50	\$60-\$70	\$60-\$70	\$60-\$70
Recycling	\$-20-\$-10	\$100-\$140	\$160-\$240	\$230-\$350
Organics	\$60-\$70	\$60-\$70	\$60-\$70	\$60-\$70
Commercial Collection				
Trash	\$60-\$70	\$70-\$90	\$80-\$100	\$80-\$100
Recycling	\$0-\$20	\$120-\$180	\$190-\$280	\$260-\$390
Organics	\$80-\$90	\$80-\$90	\$90-\$100	\$90-\$100

1. Excluding avoided tip fee

Table E-15: Regional Cost per Ton Results including Only Collection and Tipping Fees

Collection plus Tip Fee	Front Range	Mountains	Eastern/ Southeastern	Western Slope
Voluntary Residential Collection				
Trash	\$65	\$69	\$76	\$76
Recycling	\$50	\$55	\$66	\$66
Organics	\$85	\$90	\$101	\$101
Mandatory Residential Collection				
Trash	\$54	\$57	\$62	\$62
Recycling	\$34	\$38	\$46	\$46
Organics	\$69	\$73	\$81	\$81
Every Other Week Residential Collection				
Trash	\$42	\$43	\$46	\$46
Recycling	\$17	\$19	\$23	\$23
Organics	\$52	\$54	\$58	\$58
Commercial Collection				
Trash	\$58	\$61	\$67	\$67
Recycling	\$39	\$44	\$52	\$52
Organics	\$69	\$73	\$81	\$81

E.7.3 Residential Collection of Trash, Recycling, and Organics

Review of the residential results for Table E-14 shows the following conclusions:

- Every other week service is substantially cheaper – largely because the vast majority of the cost of collection is getting the truck to the door (the "stops"), not the material collected. Because the costs are mostly about collections, optimizing service is about minimizing collections – or collecting more material types (trash, recycling, and organics) with the same number of stops. For example, organics can be added fairly cost-effectively if recycling collection frequency is reduced.
- Recycling is considerably more expensive outside of the Front Range/Mountain regions. Although collection cost differences are part of the cause, the largest difference is because the materials must be shipped further to facilities and markets.
- Organics is more expensive per-ton than trash or recycling. However, collection of food scraps with the yard waste is more cost-effective than yard waste alone, and diverts more tons (shown in earlier tables in this appendix). Per-ton costs for organics are not estimated to be substantially lower in the Front Range areas than in the rest of the state because it is assumed materials would only be processed within the region, and we assumed similar distances in each region. The value of the materials and the bulkiness makes it difficult to have markets outside the nearby surrounds.
- Collecting recycling every other week costs less than weekly service, and, as noted elsewhere in the Plan (Section 6), reduces diverted tonnages only marginally. Taken as a whole, the extra recycling tons collected from weekly collection vs. every other week collection are about four times as costly per ton as the recycling collected from an every-other-week program. Most importantly, because costs are largely about getting the truck to the door (regardless of amount collected), eliminating one recycling collection (and/or one trash collection) can open the door to addition of organics collection at minimal extra cost, losing one-to-three percentage points of recycling diversion, but adding 18% to more than 20% of organics collection. This has a strong positive effect on overall diversion rates.
- Universal service (providing service to all households in the community) is more economical than voluntary trash service. Universal (or mandated or embedded) recycling or universal organics is cheaper per household (and per ton) than optional or voluntary programs – and of course, diverts more tons than programs with only 15% participation (a common result for voluntary recycling programs).
- Economies of scale reduce costs in collection. These models assume the economies from one service provider, not because that is the norm in Colorado, but because any other assumption would be arbitrary, and every town is different. Using one service provider, rather than many, tends to reduce costs because equipment is used more intensively, homes are not passed by without collection, etc. Towns using these results should realize that service provided with

multiple haulers in the same geographic area is almost certainly going to cost more than the figures provided in this Plan. Beyond consolidating collection for one service, research indicates using one service provider for *multiple* materials – trash, recycling, and organics – also leads to lower costs.

E.7.4 Commercial Collection of Trash, Recycling and Food Scraps

Review of Table E-14 shows the following:

- Costs per ton for collection for recycling are lower than trash and organics – assuming traditional ranges of tons per collection. However, trash will presumably always be some part of the solid waste stream, and state law requires proper disposal of these materials. Adding recycling, or adding organics will be just that, an addition to the trash bill. If tons were traded on a one-for-one basis between trash and recycling streams, the per-ton figures would imply savings for businesses. However, per-ton figures mask the fact that the rates to businesses are constructed in two parts: the fixed portion covering getting the truck to the door, and the variable portion related to the management of collected materials. Few businesses can reduce trash volumes enough to make up for the fixed cost of getting the recycling truck to the door even once per week. Small businesses have particular difficulties.[4]
- Trash and recycling cost more in the more rural areas. This is because trucks are more likely to have to collect in multiple small towns to fill the truck, increasing distances to fill trucks.
- Recycling costs considerably more outside the Front Range. This is partly because trucks are assumed to need to visit multiple towns to fill the truck, and because it is assumed that recycled materials must be transported longer distances outside the Front Range.

E.7.5 Hauling Options and Impacts on Costs

Table E-9 and E-10 have important implications for the results in Table E-14. The results show:

- Shipping to market via transfer trailer is substantially cheaper per ton (in dollar and percentage terms) compared to hauling via 40 cubic yard boxes. This becomes pronounced as distances increase, like those seen in the Western Slope and Eastern/Southeastern areas. The more loads shipped, the greater the expense for a site.

[4] Strategies to address small businesses include adding them to the residential program, using 96-gallon recycling containers so the containers fit in small "screened" areas, and other approaches. However, the economic issue is difficult to address without requiring embedded recycling in the commercial sector, akin to the practice in the residential sector.

- The barrier to using transfer trailers is the loading facility. It is expensive to construct a facility that allows the transfer of materials from boxes, trucks, etc. into to transfer trailer, requiring two-level facilities, or other capital expenses. Further, going out of the way to accomplish this transfer can be a barrier, so the determination of optimal location of sites would be complicated, even if they could be afforded (or were funded by grants or state funds or other). This is discussed in more detail in Section 3.
- There is a significant effect on the effective (or "net") market price for recyclables, based on the region (higher transfer costs regardless of method for Western Slope and Eastern/Southeastern), and for the difference between transfer trailer vs. roll-off.

E.7.6 Drop-offs and Hub and Spoke

Table E-7 provides cost data for these facilities. The results show:

- Interviews with operators around the state, literature review on drop-offs on other states and cost model calculations showed wide variations in operating costs, based on site setup and many other conditions. Drop-offs will have difficulty operating profitably in today's markets, but fare better at five-year market prices.
- Very small facilities are high cost, and are not showing a profit. Note that the costs exclude land purchase, and note also that the costs for these facilities are affected by a wide array of assumptions. Some facilities are staffed by avid volunteers, reducing costs. Others are co-located in ways to reduce costs. Creativity appears to be a hallmark of these small, local options.

E.7.7 Recycling Processing Facilities

Table E-5 relates to the costs for recycling processing facilities. The results show:

- Table E-5 shows that small manual MRFs have a hard time making a profit. Dump and pick facilities are marginally profitable in the regions excluding the Western Slope. Automated processing – although a substantial capital investment – is profitable in most of the scenarios. However, these facilities must have a large enough population base to provide the higher annual tonnages associated with the plant.
- Profitability is higher in the rural areas when hauling is achieved by transfer trailer.

E.7.8 Composting Processing Facilities

Table E-6 shows the costs for compost facility processing. The results show:

- Costs per ton for processing range from $41 or $46 per ton when processing 20,000 tons, and higher figures if the facility processes less material. This is higher than the assumptions made in this report ($35/ton). The assumptions in the Plan are based on reported tipping fees from the pre-survey, and from existing facilities.
- These figures are not out of the range of costs for new facilities located in other areas.
- The fully loaded costs for the facilities would not show a substantial difference by region of the state. This is because it was assumed that compost plants would not be shipping product far afield (bulky and relatively low-value product). The distance that materials would be transported both to the facility (and presumably away) were assumed to be quite local, and the same distance assumptions were used for each region of the State.
- Note that the composition of the materials delivered to Front Range vs. non-Front Range sites will probably differ. Grass, yard waste, and food scraps are most common in the Front Range; other areas may divert branches and land clearing, but perhaps less lawn care materials.

E.7.9 Summary and Implications

In summary, Table E-14 presents planning level costs for key collection and diversion options. The ranges reflect differences in assumptions about costs, profits, and other inputs. The figures show that:

- Recycling in the Front Range is generally profitable, and the challenges to diversion in the Eastern/Southeastern and Western Slope areas are substantial.
- Organics collection does not appear profitable, especially with zero market value as assumed in this report. Adding in a $30 avoided tipping fee improves the situation relative to trash.
- Every other week collection can help make collection of recyclables more cost-effective, and studies indicate that the loss in tons is relatively minor.

What is not shown in the table is that the costs for distant locations could improve on the order of $20-$40 per ton if the transport was made via trailer instead of roll-off. This is relevant in the Eastern/Southeastern and the Western Slope regions, and might bear attention from the RREO grant program.

APPENDIX F: LEVEL 1 AND LEVEL 2 COLLECTION AND DIVERSION RECOMMENDATIONS – SUPPORTING RATIONALES AND POTENTIAL CDPHE AUTHORITY OPPORTUNITIES

APPENDIX F: LEVEL 1 AND LEVEL 2 COLLECTION AND DIVERSION RECOMMENDATIONS – SUPPORTING RATIONALES AND POTENTIAL CDPHE AUTHORITY OPPORTUNITIES

As discussed in Section 6 and elsewhere within the Plan, CDPHE's primary existing authorities focus on landfill and facility permitting, inspection and monitoring. These are statutory responsibilities that have substantial associated enforcement authorities. CDPHE's authorities related to collection and diversion are more commonly addressed via resolutions or general statements in the CRS, but lack the crucial enforcement (and funding) authorities that would significantly enhance Colorado's opportunities to move diversion and sustainable materials management in the state. Given that this is a 20-year Plan, the document considers and develops recommendations under the authorities in place in the near-term. However, it also develops priorities for strategies that would support strong sustainable materials management in future situations under which CDPHE may have access to broader authorities. This appendix explores the Level 1 and Level 2 collection and diversion recommendations and discusses:

- Explanation of key elements of the recommendation
- The rationale for the recommendation and why it is important in moving diversion and sustainable materials management forward in the state
- The statutory or other underpinnings supporting the authority or for those recommendations that are not currently supported by existing authority, suggestions are provided about opportunities for funding or authorities that may be indirectly or directly pursued [1]

Some aspects of these authorities may also be relevant, helpful or necessary for implementing one or more of the more advanced elements of the transfer and disposal recommendations identified in Section 3. Note that the authorities necessary for the Level 3 and Level 4 recommendations included in Section 6 are new authorities (similar to those discussed in this appendix) and are acquired by CDPHE.

Garnering stakeholder and industry support toward these strategies would be helpful if the CDPHE is to approach the Legislature, the Solid Waste and Hazardous Waste Committee or other entities that could help the state acquire additional capabilities and funding for moving sustainable materials management forward.

[1] The "potential authority" notes were developed by SERA after several detailed (and extremely helpful) discussions with David Kreutzer, an attorney for CDPHE, about CDPHE's existing statutory authorities in this topic area. Note that the potential authority concepts were developed by SERA and are not the responsibility of or attributable to Mr. Kreutzer. The discussions were held in April and May 2016.

Table F-1: Level 1/State-Level Recommendations for CDPHE

Recommendation		Why	Authority/Funding Notes
Overview	**Detailed**		
1. Adopt the recommended Two-Tier Diversion goal and support/conduct activities to achieve the goals	• Adopt the recommended Two-Tier Goal (Front Range/Rest of state) for near term and longer term Specific goals are included in the Plan • Goals are set as "Diversion Rate" (combining recycling and organics) and "Percent Recoverables Remaining" for 2021, 2026 and 2036 (5, 10 and 20 year horizons) • Publicize and provide information to help cities/counties move toward the goal • Post regional results on CDPHE website	• Required content element of 20-year plan • Goal set to encourage compliance with "reduce waste, cost-effective… protect environment," etc. aspects of 30-20-101.5 CRS • Posting regional results encourages comparisons and competition among regions/communities/ counties and encourages progress	• Consistent with requirements of 20-year Plan contents • Authority not needed to adopt and publicize a goal and measurement results • Consistent with 30-20-101.5 CRS • No new authority or funding needed • No existing authority to enforce
2. Improve performance tracking and reporting on diversion	• Improve already-required reporting/tracking by adding statistics on residential vs. commercial, regional information as possible • Introduce a second metric "Percent Recoverables Remaining" (PRR) that measures the amount of recyclables and compostables still being disposed to track improvements, be less susceptible to economic cycles and best inform next steps priorities • Track performance on both metrics; publicize to encourage competition • Post-performance statistics/updates on the web and otherwise publicize the information to encourage regional/community/county competitions and improvement • CDPHE's work on this recommendation should be coordinated with the transfer and disposal recommendations to capture disposal facility data	• Must currently report to Legislature on tracking results • If not measured, status and progress toward goal will not be known, nor will it likely improve substantially without the feedback • Tracking by sub-area and by sector (residential/commercial) provides information on progress, and opportunities to identify/target local and state programs and activities • Can lead to economic development opportunities locally when quantities and types of materials available as feedstock are known • New tracking method better shows where progress is needed and better identifies effective strategies	• Legislation already requires CDPHE to report on tracking. Does not stipulate exact content. CDPHE presumably can adjust what it considers adequate • No additional authority required • Some additional funding likely needed, including periodic medium-level waste composition studies and possibly waste tracking software

Table F-1: Level 1/State-Level Recommendations for CDPHE

Recommendation		Why	Authority/Funding Notes
Overview	**Detailed**		
3. Enhance diversion training/technical assistance and outreach on diversion	• Increase training and technical assistance with a focus on diversion strategies (in addition to landfill issues) • Conduct regional training sessions as a method to continue the stakeholder engagement/sharing/ discussion process from the Plan's 10 regional stakeholder meetings • Conduct regular and frequent webinars and other cost-effective outreach approaches to offer training to cities/counties/regional planning agencies on suitable diversion options and best management practices. • Post useful documents on the website (fact sheets, case studies, best practices, template ordinance language, etc.) • Encourage CDPHE staff to function as technical assistance ambassadors. Encourage communities/counties/planning agencies to contact CDPHE for technical assistance, advice and information on diversion • Publicize this capability/service • Maintain a ready list of high-performing strategies and best practices for the various state regions for potential introduction at key points if progress is not achieved, and for interested communities • CDPHE's work on this recommendation should be coordinated with the transfer and disposal recommendations to provide technical assistance	• Advice and training resources would support the goal and progress in reducing waste and increasing compliance assistance and cost-effectiveness in waste management per 30-20-101.5, CRS • CDPHE already provides technical advice, but focuses on disposal and compliance. Agencies need advice, and CDPHE is well-positioned, with relationships/contacts • Can help improve strategies and prevent poor waste management strategies being implemented/continued • Can get CDPHE staff involved before problems arise • Prevention is cost-effective	• No new Authority required; CDPHE has a history of providing outreach • Using webinars, websites, etc. is inexpensive, but some additional funding likely/may be needed • Consistent with "prevention" focus for CDPHE direction and action • No change in authority, just a change in focus and additional funding, because hosting outreach meetings and training requires additional funding and official function approval
4. Increase inspection efforts on non-adequate landfills, providing economic signals for compliance and diversion	• Get tougher on inspection of inadequate landfills and re-check progress toward hard timeline regularly • Become more consistent regarding economic incentives to comply and provide incentives that underline the potential cost-effectiveness of diversion activities (as well as regionalized disposal where appropriate)	• Addressing inadequate landfills is a core part of the Plan • Providing economic incentives improves relative cost-effectiveness of diversion alternatives to localities and encourages diversion	• Authority already available and directly consistent with existing CDPHE activities

Table F-1: Level 1/State-Level Recommendations for CDPHE

Recommendation		Why	Authority/Funding Notes
Overview	**Detailed**		
	• CDPHE's work on this recommendation should be coordinated with the transfer and disposal recommendations to enforce current regulations		
5. Establish regionalized solid waste planning emphasizing diversion	• Recommend regional/wasteshed planning for management of solid waste • Explore relationships with groups of counties, COGs and similar entities for regional comprehensive integrated solid waste and materials management planning focusing on the hierarchy of reduction, diversion, disposal and wise long-term waste management • CDPHE's work on this recommendation should be coordinated with the transfer and disposal recommendations to consider regionalization options	• Encourages more cost-effective, compliant disposal facilities • Encourages consideration of more cost-effective, regionalized diversion and disposal options – and supporting infrastructure becomes more feasible • Increases diversion and progress toward goal	• Cooperation/exploration of cooperative agreements does not require authority or substantial new funding • No authority necessary, but authority would substantially strengthen coverage, compliance, planning
6. Support/fund/ incentivize regionalized solid waste planning	• Provide economic support and incentives for regional integrated comprehensive solid waste/materials management plans • In short term, use RREO grants to support this activity and provide funding • In near and longer term, work to identify other funding sources • Provide incentives for conducting planning through RREO grant, modifying the award criteria to favor regional planning • Given there are no direct funding sources for CDPHE, identify other incentives that can be provided besides direct funding. Consider the following options. After a certain date, areas with completed plans are eligible apply for RREO grants (but not other areas); areas with completed plans receive a streamlined process or higher priority for permitting for facilities and enforcement regulations, etc. similar to the current Environmental Leadership Program (ELP or incorporate into ELP	• Provide support needed to accomplish cost-effective waste management and higher diversion; removes key barriers from preparation of plans • Provides tangible incentives/encouragement to prepare plans; lack of eligibility for grants encourages pressure from regional stakeholders and ELP advantages encourages pressure from regional agencies/stakeholders	• May not need additional authority in order to provide some immediate support – either via RREO or prioritization/ streamlining of other CDPHE services • Priorities/scoring for RREO grants easily accomplished • Longer term may want to investigate additional funding sources

Table F-1: Level 1/State-Level Recommendations for CDPHE

Recommendation		Why	Authority/Funding Notes
Overview	**Detailed**		
	• CDPHE's work on this recommendation should be coordinated with the transfer and disposal recommendations to support sustainable funding strategies for local programs		
7. Fill gaps in recycling opportunities/drop-offs network and support existing infrastructure	• Require recycling drop-offs at landfills or transfer stations in areas identified as "gaps" for recycling to provide "opportunity to recycle" statewide. Gaps should be identified as areas without a drop-off site within 25 miles of a population center with at least 4,000 population or within the county • Update the list periodically to account for new and closing drop-off facilities • Recognize to agencies they may be able to recover costs through the landfill tipping fee • Require compliance with minimum design standards	• Assures reasonably-convenient minimal recycling access across the entire state • Serves residential, commercial, and multi-family generators • Much more cost-effective if co-located • Does not undermine existing drop-off or hub and spoke operations/network • Compliance inspections of the sites can be conducted with disposal site inspections • Requiring recovery through landfill fees encourages cost-effective design	• No specific authority available • May be consistent with prevention authority and landfill inspection activities • Consistent with 30-20-101.5 CRS • Inspecting the sites co-located at disposal facilities would be easily verified as part of inspection process. Inspections may be warranted if solid waste facility, rather than solid waste disposal facility language prevails
8. Implement ZW, LCA, MM, reduction and other polices and principles in CDPHE operations	• Identify appropriate zero waste (ZW), life cycle cost analysis (LCA), materials management (MM) and reduction strategies for implementation in CDPHE offices, contracts, procurement, enforcement, and other operations • Track/assess results • Disseminate information on successful initiatives. • Continually evaluate progress and implement additional strategies as the field progresses	• Agency walks the talk for prevention, cost-effectiveness, and environmental protection • Agency demonstrates effective practices and provides information on practical initiatives suitable in the state	• No additional authority needed – operational policy choices/direction from management. • Authority for CDPHE and all state agencies to implement Department wide waste reduction plan with goals under the Greening Government Executive Order

Table F-1: Level 1/State-Level Recommendations for CDPHE

Recommendation – Overview	Recommendation – Detailed	Why	Authority/Funding Notes
9. Support ZW/MM/LCA where possible	• Encourage and support state/regional/local agencies to implement ZW, LCA, MM, reduction and other polices and principles into their plans and operations. • Provide information about potential strategies, policies and best practices • Support and disseminate research and projects on these topics • Consider providing incentives, including possible grant preferences for agencies incorporating/studying these initiatives in the medium and longer run	• Meets elements of the guidelines for content for the 20-year Plan • Keeps CDPHE informed about best practices that may be suitable within the state • Provides information to communities, on strategies consistent with goals of prevention and (short- and longer-term) environmental protection	• No additional authority needed/consistent with agency's mandate to educate, work toward prevention, and protect the environment
10. Seek additional supporting authorities for near/longer term diversion and materials management progress	• Seek additional authority to set/require and enforce goals and regional planning • Seek additional authority to provide stronger support to require planning, enhance diversion, support development of diversion infrastructure and increase funding for planning and diversion • Seek additional authority to require/enforce high-impact, suitable, reduction/ZW/MM initiative statewide or for areas of the state (e.g. market development, bans, PAYT, and other high-impact options) • Acquire additional funding authority to support diversion and MM projects, programs, research. • Acquire more direct authority to improve financial/economic incentives in the market for diversion and materials management. • If strategies discussed in Section 6.3.2 are not available from minor changes in rules, etc., work to obtain key authorities directly through legislation	• CDPHE lacks all authorities needed for efficient and successful implementation and enforcement of goals related to the Plan's requested content, and this Plan's recommendations and suggested local initiatives • CDPHE lacks all authorities needed to provide (paraphrased) '… improved policies and procedures for … promoting the community ethic to reduce waste… and promote innovative and cost-effective protection of the environment and quality of life…' in the state of Colorado	• CDPHE lacks all authorities needed for efficient and successful implementation and enforcement of goals related to the Plan's requested content and for meeting statements in 30-20-101.5, CRS, 30-20-100.5, CRS and other legislative declarations, resolutions, etc

Table F-2: Authorities and Recommendations that will Assist in Achieving Recommendations in Table F-1

Issue/Desired Authority	Why	Perceived/Real Barriers	Possible Approaches
1. Enforcement of adopted diversion goals	• To drive implementation of diversion strategies at the local and regional level • Require cities/counties/ regions or haulers to report tonnages collected trash, recycled, and composted tonnage regularly • Facility tonnages (recycling, composted, transfer station and disposal facilities) should also be tracked • Recommend posting of the performance at the city, county, and regional planning agency level on the web annually by May 1	• CDPHE lacks statutory authority to enforce a goal • Unambiguous and consistent definitions and reporting methods will be required • Best sources of data are haulers; they may be concerned about sector- or community-level data as their routes cross lines, but workable reporting guidelines are in place in multiple communities (using customer counts, and other proxies to apportion tons)	• CDPHE may be able to argue that reporting requirements extend to the data needed to provide the data for tracking • If cities/counties/regions are required to report tonnages, they may prefer to request the state to acquire the authority and gather the data for them, or support legislative changes for the authority
2. State licensing of haulers	• To support higher quality of tracking and more useful tracking – for residential vs. commercial and local (city/county/wasteshed) tonnage and performance data. Haulers are among the only sources for	• CDPHE lacks this authority, and only has authority to regulate disposal sites and facilities • Reporting when haulers cross community lines or collect residential on the same route	• CDPHE must file reports to Legislature on tonnages. Certain information (city, wasteshed, residential vs. commercial, etc.) is impossible to collect through current facility data approach. CDPHE could argue a need for greater reporting authority/access to file reports that better meet the legislative requirements/expectations • CDOT licenses/has limited authorities on large trucks including haulers. Work with CDOT to potentially expand to help regulate materials management trucks

	tonnage data – at least by sector or community • To identify who is operating in the state, to support enforcement of safe waste disposal, that firms are managing waste as they advertise and customers are paying for • There is licensing of haulers for waste tires, and waste grease; should be expanded for these relatively parallel materials • To provide access for enforcement of other strategies that may arise	is a perceived barrier; however multiple towns in Colorado and elsewhere require reporting, and have established easy guidelines that address the issues of separating community tonnages and tonnages by sector that are workable by haulers • Can consider omitting haulers below a certain size for administrative ease	• Possible relationship to FCC regulations. CDPHE responsibilities (or other environmental agencies) might be interpreted to be the agency responsible for enforcing that trucks hauling solid waste are bringing materials to disposal sites, those hauling recyclables are actually taking them to a recycling/processing facility, etc. Similar cases have been brought in Colorado, but as crimes of "theft by deception," Must be brought by District Attorney • There may be a possibility of reinterpretation of existing licensing of waste tire and waste grease haulers to more materials • Per steps taken to license trucks hauling waste tires and waste grease, explore industry support for acquiring similar authorities • Haulers are among the best sources for tonnage data because they are the first step, avoid double-counting (an issue with some types of facility reporting), and know the source. If cities are requested/required to report tonnages, they may request the state to acquire the authority and gather the data for them, or support legislative changes for the authority
3. Authority to require (regional/wasteshed) planning and establish regional planning authorities	• Integrated plans, diversion progress, better landfill management/ operations • Opportunity to illustrate to counties that operating more regionalized facilities and system – perhaps with increased diversion – may be cheaper and more efficient. In addition, may illustrate that operating fewer, more regionalized landfills may reduce budgets • Facilitate growth/expansion of reuse and	• CDPHE has no authority except regulating disposal sites/facilities • Counties have apparent solid waste authority in Colorado, but have no particular motivation to plan or cooperate in planning because it incurs extra cost and takes on more responsibility than they have elected to take on previously	• Non-attainment of air quality may be a strategic approach. Making a scientific link between non-attainment and methane generation from landfills may argue that waste planning to reduce/divert compostables (including paper, etc.) from the landfill can help achieve attainment, providing design and enforcement authorities through CDPHE or through air agencies/department. However, the current definition of attainment may not include methane from any facilities except oil and gas. Unless these definitions change, this may not be a strong option • Water quality may provide a link, making the case that better landfill and diversion planning lessens risk to water tables, runoff, etc • Continue to encourage planning projects under the existing RREO grant program, prioritizing them for funds, and prioritizing regional plans. Explore options for increasing RREO funds for these projects. Set deadlines for period in which the plans need to be completed, after which the area becomes ineligible for any RREO grants in order to provide an

	remanufacturing businesses regionally to take advantage of economies of scale • CDPHE should coordinate these efforts with transfer and disposal recommendation to consider regionalization options		incentive to complete regional plans. Another incentive would be provided by allowing areas with plans to receive streamlined processes, or priorities in permitting and inspections • Explore whether the inconsistency of language in various legislation (solid waste disposal facilities vs. solid waste facilities) provides any opportunity for a wedge for requiring plans • The Department might have authority to request additional funds of the SW&HW Commission and greater on authorities based on the declaration for planning and funding 30-20-101.5, CRS
4. Authority to provide funds for (regional/wasteshed) planning activities	• Funding planning, assistance, strategies, enforcement • Providing incentives for agencies to consider taking on authority/planning tasks • Encouragement for agencies to work together/plan and implement cooperatively • CDPHE should coordinate these efforts with the transfer and disposal recommendation to consider regionalization options	• CDPHE has no funding beyond what the SW & HW Commission provides through landfill surcharge they set; no specific inclination to change	• Air quality non-attainment link (described above) may provide access to funds • Instituting a possible bottle bill (new legislation) could provide access to funding to support the recommendations. A nexus study likely would be needed to provide the link to broader system expenditures. CDPHE should be sure to address issues of strictly separate accounting and application of unclaimed escheats to recycling/diversion during the development of any bottle bill legislation and program • CDPHE might have authority to request additional funds of the SW&HW Commission and greater on authorities based on the declaration for planning and funding 30-20-101.5 CRS • Revise the criteria for the RREO rebate funds to allow application to broader diversion activities. • There is support for illegal dumping strategies at the SW&HW Commission and from landfills. Perhaps advanced disposal fees can be introduced on key litter/illegal dumping components as a funding source. This strategy would require introducing logic that some of the costs are associated with a larger, integrated system, not purely litter (nexus-plus). Additionally, note there is not current authority at CDPHE for product-based fees, only waste material authorities • Leveraging off the illegal dumping nexus, consider a similar strategy –introducing a “convenience fee” (a la Nebraska), which imposes a surcharge on convenience stores and fast food on the rationale that their takeaway waste constitutes a large component of litter. Again, nexus-plus study needed, and there

			is not authority at CDPHE for product-based fees, only waste material authorities. • Consider introduction of a possible fee on first wholesale sale on toxics (a la Washington state), to help fund a system for their proper management/disposal. Again, a nexus-plus study is likely necessary to expand beyond toxics to broader system funding support (if appropriate), and recall that product-based fees are not currently in CDPHE's authority
5. Ability to implement and enforce collection & diversion strategies best applied at state level	• Some effective, high-impact, cost-effective, market, incentive, and programmatic strategies are best implemented at the state level (some education, PAYT, bans, surcharges, source reduction and/or recycling rate goals, etc.)	• CDPHE lacks this authority and has authority only over solid waste disposal facilities only	• Non-attainment of air quality standards may be a rationale for implementing diversion strategies. Certain solid waste diversion strategies may be fast, cheap, and effective at reducing methane and reaching air attainment. Note the caveats associated with methane's limited inclusion in the attainment accounting mentioned above • Explore whether the inconsistency of language in various legislation (solid waste disposal facilities vs. solid waste facilities) provides a wedge for allowing implementation of effective statewide strategies
6. Authority to increase landfill surcharge	• To provide economic incentive for recycling, funding planning, assistance, strategies, enforcement • Recommend two-tier landfill surcharges, with a higher surcharge for waste from communities that have not met recycling goals or implemented plans. Recommend substantial dollar differential per ton to provide meaningful incentive (as large as justifiable from study)	• CDPHE has no funding sources beyond what the SW & HW Commission provides through landfill surcharge (they set CDPHE's allocation) Commission has no specific inclination to change. • A few other states have established surcharges as high as $4-$9/ton; the range across states is wide	• Work with Governor's office to revise priorities for criteria for appointment to the SW&HW Commission toward candidates with diversion experience and not primarily landfill or industry focus; increase/diversify recruitment efforts; and provide recycling industry testimony/education to the SW&HW Commission. • Revise the criteria for the RREO rebate funds to allow application to broader diversion activities (if these are funded through decisions of SW&HW Commission). • Consider using the litter/illegal dumping nexus as justification for increased funds through this or other funding mechanisms (described above) • Justified as funds for non-attainment strategies (described above)
7. Pursue legislation to obtain authorities	• To acquire priority authorities needed to help	• CDPHE lacks these authorities	• Directly pursue legislation to acquire priority elements of these authorities and others the CDPHE identifies to help implement

	implement and enforce the 20 year Plan		and enforce the 20 year Plan. Work with industry, CAFR, and stakeholder for them to support/implement this objective
8. If authorities are gathered, establish two-pronged prescriptive/performance goal options	• Strong progress not possible to guaranteed without enforcement authority • Gain authority to enforce performance goals as listed in Level 1 • Gain authority to enforce recommended prescriptive elements for Collection and Diversion (See Level 3 Strategies) • These requirements are invoked if performance goals are not reached • Provides opportunity for strong additional progress by reviewing Level 4 state-level options	• CDPHE lacks authorities currently	• Directly pursue legislation to acquire priority elements of these authorities and others the CDPHE identifies to help implement and enforce the 20-year Plan. Work with industry, CAFR, stakeholders for them to support/implement this objective

APPENDIX G: ESTIMATED 2016 TONNAGES BY REGION

APPENDIX G: ESTIMATED 2016 TONNAGES BY REGION

The calculations in Section 6 include tonnages and values for each of the four planning regions. These figures are presented in this appendix.

Table G-1: Estimated 2016 Tonnages – Front Range

	Waste Composition		Tons				
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Paper	20.4%	26.7%	1.0%	570,100	412,800	16,100	999,000
Cardboard/Bags	3.9%	11.5%	0.0%	109,300	178,200	-	287,500
Newspaper	4.2%	3.5%	0.0%	118,400	53,700	-	172,100
Office Paper	1.0%	3.0%	0.0%	27,300	45,900	-	73,200
Paperboard	2.2%	1.5%	0.0%	60,100	23,600	-	83,700
Junk Mail	2.2%	1.5%	0.0%	60,100	23,600	-	83,700
Magazines/Catalogues	1.8%	0.8%	0.0%	51,000	11,800	-	62,800
Dairy/Juice	0.1%	0.3%	0.0%	3,600	3,900	-	7,500
Non-Recyclable Paper	5.0%	4.7%	0.0%	140,200	72,100	-	212,300
Plastic	12.3%	12.3%	0.0%	343,700	190,200	-	533,900
Plastics 1&2	7.7%	1.4%	0.0%	213,900	20,900	-	234,800
Rigid Plastics 3-7	0.4%	0.4%	0.0%	11,400	5,700	-	17,100
Polystyrene	0.3%	1.1%	0.0%	8,600	17,100	-	25,700
Other Rigid Plastics	1.6%	3.9%	0.0%	45,600	60,800	-	106,400
Plastic Bags/Film/Wrap	2.3%	5.5%	0.0%	64,200	85,600	-	149,800
Other Plastics	0.0%	0.0%	0.0%	-	-	-	-
Metal	3.5%	5.2%	2.0%	97,800	80,400	32,100	210,300
Aluminum Cans	0.5%	0.2%	0.0%	15,200	2,400	-	17,600
Tin Cans+AG19	1.1%	0.4%	0.0%	30,400	6,500	-	36,900
Other Ferrous	0.5%	1.0%	0.0%	15,200	15,400	-	30,600

Table G-1: Estimated 2016 Tonnages – Front Range

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Other Aluminum	0.4%	0.3%	0.0%	10,900	4,900	-	15,800
Other Non-Ferrous	0.4%	0.6%	0.0%	10,900	8,900	-	19,800
Appliances	0.5%	0.4%	0.0%	15,200	6,500	-	21,700
Other Metal	0.0%	2.3%	0.0%	-	35,700	-	35,700
Glass	2.3%	2.8%	1.2%	64,300	43,300	18,900	126,500
Organics	40.1%	33.4%	5.1%	1,120,600	516,400	81,900	1,718,900
Yard Waste	8.4%	6.4%	5.1%	234,700	99,200	81,900	415,800
Food Scraps	17.4%	16.2%	0.0%	486,300	250,300	-	736,600
Textiles/Rubber/Leather	3.8%	2.2%	0.0%	106,200	34,600	-	140,800
Wood	2.9%	6.2%	0.0%	81,000	96,000	-	177,000
Diapers	4.9%	0.7%	0.0%	136,900	11,000	-	147,900
Other Organics	2.7%	1.6%	0.0%	75,500	25,200	-	100,700
E-waste	2.2%	0.6%	0.0%	61,500	9,300	-	70,800
Problem Wastes	18.8%	15.9%	4.7%	525,400	245,800	75,500	846,700
HHW	0.1%	0.1%	0.0%	1,700	2,000	-	3,700
C&D	0.0%	0.0%	85.7%	-	-	1,375,800	1,375,800
Rock/Concrete/Brick	0.0%	0.0%	31.2%	-	-	500,900	500,900
Asphalt Shingles	0.0%	0.0%	18.0%	-	-	289,000	289,000
Wood (treated)	0.0%	0.0%	11.1%	-	-	178,200	178,200
Wood Dimensional	0.0%	0.0%	10.0%	-	-	160,500	160,500
Drywall - Clean	0.0%	0.0%	5.1%	-	-	81,900	81,900
Drywall - Paint	0.0%	0.0%	10.3%	-	-	165,400	165,400
Other	0.3%	3.0%	0.3%	9,500	45,900	5,100	60,500

Table G-1: Estimated 2016 Tonnages – Front Range

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Total 2016	100.0%	100.0%	100.0%	2,794,600	1,546,000	1,605,400	5,946,000
Total 2021	-	-	-	3,051,200	1,688,000	1,752,800	6,492,000
Total 2026	-	-	-	3,310,200	1,831,200	1,901,600	7,043,000
Total 2036	-	-	-	3,816,800	2,111,500	2,192,600	8,121,000

Table G-2: Estimated 2016 Tonnages – Mountains

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Paper	20.3%	29.2%	1.0%	23,900	32,800	700	57,400
Cardboard/Bags	3.4%	13.0%	0.0%	4,100	14,600	-	18,700
Newspaper	3.4%	3.0%	0.0%	4,000	3,400	-	7,400
Office Paper	1.5%	2.3%	0.0%	1,700	2,600	-	4,300
Paperboard	2.9%	2.3%	0.0%	3,500	2,600	-	6,100
Junk Mail	2.7%	2.8%	0.0%	3,100	3,200	-	6,300
Magazines/Catalogues	2.1%	1.9%	0.0%	2,400	2,200	-	4,600
Dairy/Juice	0.5%	0.2%	0.0%	600	200	-	800
Non-Recyclable Paper	3.8%	3.6%	0.0%	4,500	4,100	-	8,600
Plastic	12.5%	12.9%	0.0%	14,700	14,400	-	29,100
Plastics 1&2	6.5%	2.3%	0.0%	7,700	2,600	-	10,300
Rigid Plastics 3-7	0.6%	0.8%	0.0%	700	900	-	1,600
Polystyrene	0.4%	0.9%	0.0%	400	1,000	-	1,400
Other Rigid Plastics	2.0%	3.4%	0.0%	2,300	3,800	-	6,100
Plastic Bags/Film/Wrap	3.0%	5.4%	0.0%	3,500	6,100	-	9,600

Table G-2: Estimated 2016 Tonnages – Mountains

	Waste Composition			Tons			
	Residential	**Commercial**	**C&D**	**Residential**	**Commercial**	**C&D**	**Total**
Other Plastics	0.0%	0.0%	0.0%	-	-	-	-
Metal	4.5%	5.3%	2.0%	5,300	5,900	1,400	12,600
Aluminum Cans	0.8%	0.7%	0.0%	1,000	800	-	1,800
Tin Cans+AG19	1.3%	0.5%	0.0%	1,600	600	-	2,200
Other Ferrous	0.7%	1.0%	0.0%	800	1,100	-	1,900
Other Aluminum	0.5%	0.3%	0.0%	600	400	-	1,000
Other Non-Ferrous	0.5%	0.6%	0.0%	600	700	-	1,300
Appliances	0.7%	0.4%	0.0%	800	500	-	1,300
Other Metal	0.0%	1.8%	0.0%	-	2,000	-	2,000
Glass	4.6%	3.9%	1.2%	5,400	4,400	800	10,600
Organics	40.1%	31.6%	5.1%	47,400	35,500	3,600	86,500
Yard Waste	8.4%	5.8%	5.1%	9,900	6,500	3,600	20,000
Food Scraps	18.1%	17.2%	0.0%	21,300	19,300	-	40,600
Textiles/Rubber/Leather	3.6%	1.8%	0.0%	4,300	2,000	-	6,300
Wood	2.8%	4.9%	0.0%	3,300	5,500	-	8,800
Diapers	4.7%	0.6%	0.0%	5,600	600	-	6,200
Other Organics	2.6%	1.3%	0.0%	3,100	1,500	-	4,600
E-waste	2.0%	0.6%	0.0%	2,400	700	-	3,100
Problem Wastes	14.4%	12.6%	4.7%	17,000	14,100	3,300	34,400
HHW	0.1%	0.1%	0.0%	200	100	-	300
C&D	0.0%	0.0%	85.7%	-	-	60,400	60,400
Rock/Concrete/Brick	0.0%	0.0%	31.2%	-	-	22,000	22,000
Asphalt Shingles	0.0%	0.0%	18.0%	-	-	12,700	12,700
Wood (treated)	0.0%	0.0%	11.1%	-	-	7,800	7,800

Table G-2: Estimated 2016 Tonnages – Mountains

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Wood Dimensional	0.0%	0.0%	10.0%	-	-	7,000	7,000
Drywall - Clean	0.0%	0.0%	5.1%	-	-	3,600	3,600
Drywall - Paint	0.0%	0.0%	10.3%	-	-	7,300	7,300
Other	1.6%	3.9%	0.3%	1,900	4,400	200	6,500
Total 2016	100.0%	100.0%	100.0%	118,200	112,300	70,400	300,900
Total 2021	-	-	-	128,800	122,400	76,700	328,000
Total 2026	-	-	-	142,600	135,500	84,900	363,000
Total 2036	-	-	-	169,300	160,900	100,800	431,000

Table G-3: Estimated 2016 Tonnages – Eastern/Southeastern

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Paper	19.8%	36.8%	1.0%	15,800	27,900	400	44,100
Cardboard/Bags	2.0%	17.5%	0.0%	1,600	13,300	-	14,900
Newspaper	0.8%	1.6%	0.0%	600	1,200	-	1,800
Office Paper	2.9%	0.2%	0.0%	2,300	200	-	2,500
Paperboard	5.3%	4.7%	0.0%	4,200	3,600	-	7,800
Junk Mail	4.2%	6.7%	0.0%	3,400	5,100	-	8,500
Magazines/Catalogues	2.8%	5.5%	0.0%	2,200	4,200	-	6,400
Dairy/Juice	1.6%	0.0%	0.0%	1,300	-	-	1,300
Non-Recyclable Paper	0.2%	0.6%	0.0%	200	500	-	700
Plastic	12.9%	14.5%	0.0%	10,300	11,000	-	21,300
Plastics 1&2	3.0%	5.3%	0.0%	2,400	4,000	-	6,400
Rigid Plastics 3-7	1.3%	2.0%	0.0%	1,000	1,500	-	2,500
Polystyrene	0.6%	0.4%	0.0%	500	300	-	800
Other Rigid Plastics	2.9%	1.8%	0.0%	2,300	1,400	-	3,700

Table G-3: Estimated 2016 Tonnages – Eastern/Southeastern

	Waste Composition			Tons			
	Residential	**Commercial**	**C&D**	**Residential**	**Commercial**	**C&D**	**Total**
Plastic Bags/Film/Wrap	5.1%	5.0%	0.0%	4,100	3,800	-	7,900
Other Plastics	0.0%	0.0%	0.0%	-	-	-	-
Metal	7.6%	5.5%	2.0%	6,100	4,200	800	11,100
Aluminum Cans	1.6%	2.2%	0.0%	1,300	1,700	-	3,000
Tin Cans+AG19	2.1%	0.7%	0.0%	1,700	500	-	2,200
Other Ferrous	1.1%	1.0%	0.0%	900	800	-	1,700
Other Aluminum	0.8%	0.3%	0.0%	600	200	-	800
Other Non-Ferrous	0.8%	0.6%	0.0%	600	400	-	1,000
Appliances	1.1%	0.4%	0.0%	900	300	-	1,200
Other Metal	0.0%	0.3%	0.0%	-	200	-	200
Glass	11.4%	7.2%	1.2%	9,100	5,500	500	15,100
Organics	40.1%	26.1%	5.1%	32,000	19,800	2,100	53,900
Yard Waste	8.2%	4.0%	5.1%	6,500	3,000	2,100	11,600
Food Scraps	20.0%	20.2%	0.0%	16,000	15,300	-	31,300
Textiles/Rubber/Leather	3.2%	0.4%	0.0%	2,500	300	-	2,800
Wood	2.4%	1.1%	0.0%	1,900	800	-	2,700
Diapers	4.1%	0.1%	0.0%	3,300	100	-	3,400
Other Organics	2.2%	0.3%	0.0%	1,800	200	-	2,000
E-waste	1.4%	0.6%	0.0%	1,100	500	-	1,600
Problem Wastes	1.1%	2.6%	4.7%	900	2,000	1,900	4,800
HHW	0.4%	0.0%	0.0%	300	-	-	300
C&D	5.0%	8.4%	0.0%	4,000	6,400	-	10,400
Rock/Concrete/Brick	0.0%	0.0%	31.2%	-	-	12,900	12,900
Asphalt Shingles	0.0%	0.0%	18.0%	-	-	7,400	7,400
Wood (treated)	0.0%	0.0%	11.1%	-	-	4,600	4,600
Wood Dimensional	0.0%	0.0%	10.0%	-	-	4,100	4,100
Drywall - Clean	0.0%	0.0%	5.1%	-	-	2,100	2,100
Drywall - Paint	0.0%	0.0%	10.3%	-	-	4,300	4,300
Other	5.3%	6.7%	0.3%	4,200	5,000	100	9,300

Table G-3: Estimated 2016 Tonnages – Eastern/Southeastern

	Waste Composition			Tons			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Total 2016	100.0%	100.0%	100.0%	79,800	75,800	41,400	197,000
Total 2021	-	-	-	87,100	82,700	45,200	215,000
Total 2026	-	-	-	94,400	89,700	49,000	233,000
Total 2036	-	-	-	106,500	101,200	55,300	263,000

Table G-4: Estimated 2016 Tonnages- Western Slope

	Waste Composition			Total			
	Residential	Commercial	C&D	Residential	Commercial	C&D	Total
Paper	19.8%	36.8%	1.0%	39,000	68,900	1,100	109,000
Cardboard/Bags	2.0%	17.5%	0.0%	3,900	32,800	-	36,700
Newspaper	0.8%	1.6%	0.0%	1,600	3,000	-	4,600
Office Paper	2.9%	0.2%	0.0%	5,700	400	-	6,100
Paperboard	5.3%	4.7%	0.0%	10,400	8,800	-	19,200
Junk Mail	4.2%	6.7%	0.0%	8,300	12,500	-	20,800
Magazines/Catalogues	2.8%	5.5%	0.0%	5,500	10,300	-	15,800
Dairy/Juice	1.6%	0.0%	0.0%	3,200	-	-	3,200
Non-Recyclable Paper	0.2%	0.6%	0.0%	400	1,100	-	1,500
Plastic	12.9%	14.5%	0.0%	25,400	27,100	-	52,500
Plastics 1&2	3.0%	5.3%	0.0%	5,900	9,900	-	15,800
Rigid Plastics 3-7	1.3%	2.0%	0.0%	2,600	3,700	-	6,300
Polystyrene	0.6%	0.4%	0.0%	1,100	700	-	1,800
Other Rigid Plastics	2.9%	1.8%	0.0%	5,700	3,400	-	9,100
Plastic Bags/Film/Wrap	5.1%	5.0%	0.0%	10,000	9,400	-	19,400
Other Plastics	0.0%	0.0%	0.0%	-	-	-	-

Table G-4: Estimated 2016 Tonnages- Western Slope

	Waste Composition			Total			
	Residential	**Commercial**	**C&D**	**Residential**	**Commercial**	**C&D**	**Total**
Metal	7.6%	5.5%	2.0%	15,000	10,300	2,200	27,500
Aluminum Cans	1.6%	2.2%	0.0%	3,200	4,100	-	7,300
Tin Cans+AG19	2.1%	0.7%	0.0%	4,100	1,300	-	5,400
Other Ferrous	1.1%	1.0%	0.0%	2,200	1,900	-	4,100
Other Aluminum	0.8%	0.3%	0.0%	1,600	600	-	2,200
Other Non-Ferrous	0.8%	0.6%	0.0%	1,600	1,100	-	2,700
Appliances	1.1%	0.4%	0.0%	2,200	800	-	3,000
Other Metal	0.0%	0.3%	0.0%	-	600	-	600
Glass	11.4%	7.2%	1.2%	22,500	13,500	1,300	37,300
Organics	40.1%	26.1%	5.1%	79,000	48,800	5,600	133,400
Yard Waste	8.2%	4.0%	5.1%	16,200	7,500	5,600	29,300
Food Scraps	20.0%	20.2%	0.0%	39,400	37,800	-	77,200
Textiles/Rubber/Leather	3.2%	0.4%	0.0%	6,200	700	-	6,900
Wood	2.4%	1.1%	0.0%	4,800	2,000	-	6,800
Diapers	4.1%	0.1%	0.0%	8,000	200	-	8,200
Other Organics	2.2%	0.3%	0.0%	4,400	500	-	4,900
E-waste	1.4%	0.6%	0.0%	2,800	1,100	-	3,900
Problem Wastes	1.1%	2.6%	4.7%	2,200	4,900	5,200	12,300
HHW	0.4%	0.0%	0.0%	800	-	-	800
C&D	5.0%	8.4%	0.0%	9,900	15,700	-	25,600
Rock/Concrete/Brick	0.0%	0.0%	31.2%	-	-	34,300	34,300
Asphalt Shingles	0.0%	0.0%	18.0%	-	-	19,800	19,800
Wood (treated)	0.0%	0.0%	11.1%	-	-	12,200	12,200
Wood Dimensional	0.0%	0.0%	10.0%	-	-	11,000	11,000

Table G-4: Estimated 2016 Tonnages- Western Slope

	Waste Composition			Total			
	Residential	**Commercial**	**C&D**	**Residential**	**Commercial**	**C&D**	**Total**
Drywall - Clean	0.0%	0.0%	5.1%	-	-	5,600	5,600
Drywall - Paint	0.0%	0.0%	10.3%	-	-	11,300	11,300
Other	5.3%	6.7%	0.3%	10,500	12,500	400	23,400
Total 2016	100.0%	100.0%	100.0%	197,000	187,200	109,800	494,000
Total 2021	-	-	-	217,300	206,500	121,100	545,000
Total 2026	-	-	-	240,100	228,100	133,800	602,000
Total 2036	-	-	-	285,900	271,700	159,400	717,000

APPENDIX H: OPPORTUNITIES AND GAPS BY REGION

APPENDIX H: OPPORTUNITIES AND GAPS BY REGION

H.1 Introduction

The calculations of program suitability and opportunities presented in Section 6 are based on the presence and gaps in facilities and access in recycling, hub and spoke, composting sites and geographic considerations. The tables in this section summarize those factors for each of the four planning regions of the state. The information in these tables was used in developing programmatic recommendations and calculations included in Section 6.

The figures in each of the four sections represent the tonnages, and cost per ton associated with each region assuming the recommended number of programs are implemented in each region (eight in Front Range, five in Mountains, and four in Eastern/Southeastern and Western Slope). The total of the results for these regional graphs make up the totals presented in the figures in Section 6. Each figure presents the estimated tonnage recovery from the selected programs, and the cost per ton for the community (if the program is delivered by the community) or cost per ton for the generator (if the program is largely a requirement imposed by the community).

Note that the tonnage estimates by material and by region are included in Appendix G. A high level summary comparing services, gaps and opportunities across all regions is provided in Table H-1.

Table H-1: Services, Gaps, Barriers, and Opportunities Summary by Colorado Sub-Region

	Front Range	**Mountains**	**Eastern/Southeastern**	**Western Slope**
Population (and % of State) (5.2 M)	4,332,041 (83.5%)	319,969 (6%)	157,455 (3%)	388,115 (7.5%)
Gaps in recycling access including hub and spoke/drop-off recycling	Pueblo area; Colorado Springs Area; Western reaches of Larimer, Boulder, & Jefferson Counties; Weld County (except Greeley); Parts of Douglas, Adams, Elbert Counties. *Gaps (Colorado Springs 439K; Pueblo 108K; proxy estimate missing 13%)*	Grand County; Jackson County; Clear Creek County; Gilpin County *Gaps (Grand 15K, Jackson 1K, Clear Creek and Gilpin 15K)*	Plains, in general; Morgan County; Huerfano County. *Gaps (Plains Generally 155K, specifics - Morgan 28K, Huerfano 6K)*	Moffat County (one drop-off); Rio Blanco County; Garfield County; Western Slope, in General. *Gaps (Moffat and Rio Blanco 19.5K, Garfield 58K, Western Slope most; preliminary estimate missing 100K+)*

H.1.1 Front Range

This section includes tables supporting the development of the recommendations and computations listed in Section 6.4.

- Table H-2 outlines the collection and diversion gaps and opportunities
- Table H-3 and Table H-4 present known hub and spoke operations and gaps
- Table H-5 presents the organics opportunities

Table H-2: Gaps and Opportunities – Front Range

Population (and % of State) (5.2 M)	4,332,041 (83.5%)
Gaps in recycling access including hub and spoke/drop-off recycling	Pueblo area; Colorado Springs Area; Western reaches of Larimer, Boulder, & Jefferson Counties; Weld County (except Greeley); parts of Douglas, Adams, Elbert Counties *Gaps (Colorado Springs 439K; Pueblo 108K; proxy estimate missing 13%)*
Estimated percent of population with coverage	87% of area population (preliminary estimate); 3.8 million.
Active organics options	Bennet, Aurora, Colorado Springs, Pueblo, Boulder
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Organics siting guidelines
Special Opportunities	Density, facilities, organized collection fairly common, appetite for green and zero waste in areas
Potentially-acceptable strategies	Regional planning, Hauler licensing, Goals, some support for bans, EPR, PAYT, H&S, Surcharges, Mandated diversion, Education

Table H-3: Locations and Gaps in Hub and Spoke – Front Range

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Denver metro	Numerous throughout	Alpine W&R, WMI, BCRCD	curbside, drop-off centers, res/commercial	Denver metro, north Front Range
Pueblo	Swink, Trinidad, others	WE Recycle	curbside, drop-off centers, res/commercial	South east central
Larimer	Throughout Larimer County	Larimer County	curbside, drop-off centers, res/commercial	Larimer, some Weld
Colorado Springs	Throughout El Paso, Pueblo, and some Mountain Counties	Bestway Recycling	curbside, drop-off centers. Res/commercial	El Paso, Teller, Pueblo, Fremont

Table H-4: Gaps in Hub and Spoke – Front Range

Location	Notes
Pueblo area	Minimal resources available for a large and dense population center
Colorado Springs area	Minimal resources available for a large and dense population center – includes Castle Rock, Teller County
Western reaches of Larimer, Boulder and Jefferson counties	Some drop-off centers available but curbside pretty much non-existent, lower population densities, mountainous terrain makes transportation more difficult
Weld County	Only access near Greeley
Parts of Douglas, Adams, Elbert Counties	Lone Tree, Parker Centennial, Elizabeth, Aurora etc. have practically no access yet populations are growing immensely in those locations

Table H-5: Public Composting Operations[1] – Front Range

Location	Operator	Service Area/Type	Class
Bennet	Alpine East Regional Landfill	Front Range/residential and commercial drop off	2
Aurora	Waste Management (DADS)	Front Range/residential and commercial drop off	1
Colorado Springs	Don's Garden Shop	Southern Front Range/residential	3
Pueblo	Midway Organic	Unknown but guessing southern Front Range/ commercial and residential drop off	1
Boulder	Western Disposal	North Front Range/residential and commercial drop off	2

1. Does not include Class V agricultural on-farm only facilities

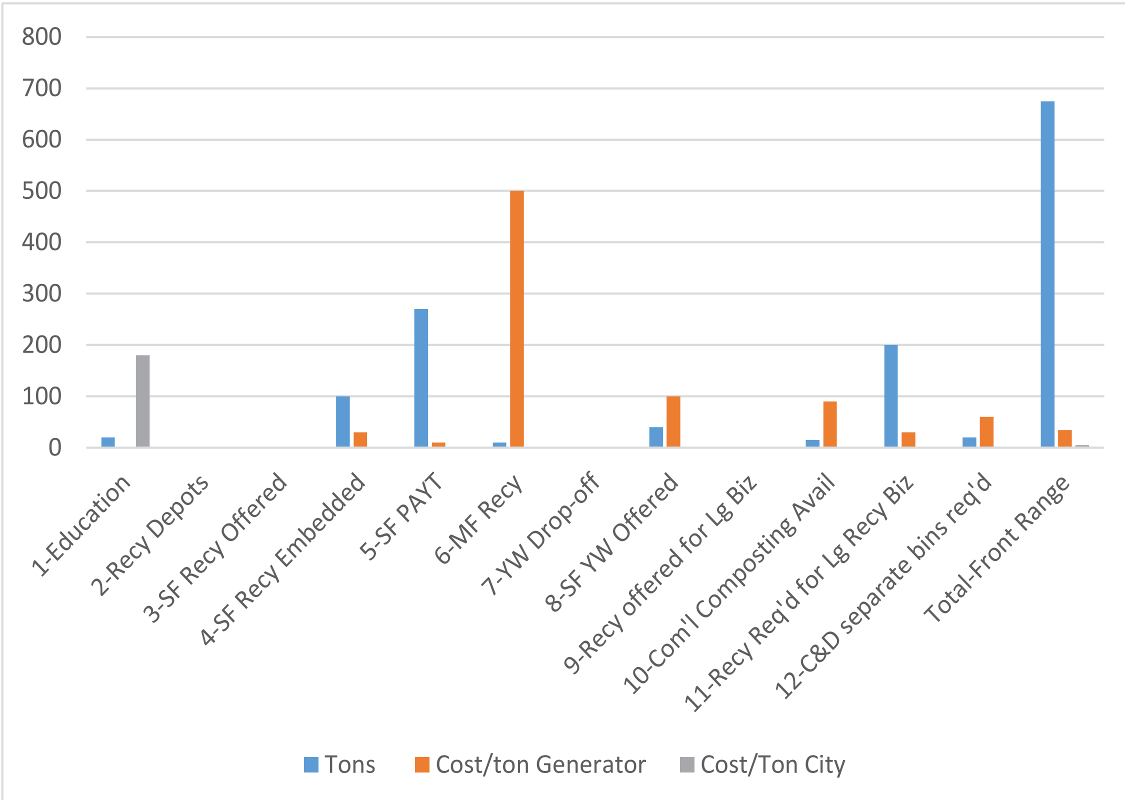


Figure H-1: Diverted Tons and Cost / Ton from Selected Level 3 Strategies in Front Range[1,2]

1. Assumes Front Range implements: 1, 4, 5, 6, 8, 10, 11, 12 (8 programs)
2. Note that these Level 3 programs are more fully described in Section 6.

H.1.2 Mountains

This section includes tables supporting the development of the recommendations and computations listed in Section 6.4

- Table H-6 outlines the collection and diversion gaps and opportunities
- Table H-7 and Table H-8 present known hub and spoke operations and gaps
- Table H-9 presents the organics opportunities

Table H-6: Gaps and Opportunities – Mountains

Population (and % of State) (5.2 M)	319,969 (6%)
Gaps in recycling access including hub and spoke/drop-off recycling	Grand County; Jackson County; Clear Creek County; Gilpin County *Gaps (Grand 15K, Jackson 1K, Clear Creek and Gilpin 15K)*
Estimated percent of population with coverage	90% of area population, 290K population covered
Active organics options	Milner Landfill, Snowmass Village, Saguache, Center, Hooper, Glenwood Springs, Dillon
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Transient populations/2nd home owners; Lack transfer stations/no regionalization, compost processing missing
Special Opportunities	Have MRF; green ethic with interested industry
Potentially-acceptable strategies	Planning areas, hub and spoke, recycling goals (2-tiered), landfill surcharges, possibly PAYT, solid waste tax, consideration of WTE

Table H-7: Locations and Gaps in Hub and Spoke – Mountains

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Canon City	Fremont & Custer counties	Phantom LF (Twin Enviro), Howard Disposal	curbside, drop-off centers, res/commercial	Fremont & Custer
Salida	Buena Vista, Poncha Springs	Angel of Shavano	drop-off centers	Chaffee; also accepts from Park, Hinsdale
Archuleta	Pagosa Springs	Archuleta County	drop-off centers	Archuleta (takes to Durango)
Creede/Del Norte	Crestone, Monte Vista, South Fork	MDS – was Recycle Creede, now being serviced by a small local hauler	drop-off centers	Hinsdale, Mineral, Rio Grande, Alamosa
Gunnison	Crested Butte	Gunnison County	drop-off centers	Gunnison
Leadville	Around Leadville	Lake County	drop-off centers	Lake
Breckenridge	Summit County	Summit County, Waste Management	drop-off centers, some curbside by Waste Management, residential/commercial	Summit
Wolcott	Vail, Red Cliff, Eagle, Edwards, Gypsum	Eagle County	drop-off centers, some curbside by Waste Management	Eagle
Pitkin	Basalt, Carbondale, Snowmass	Pitkin County	drop-off centers, some curbside	Pitkin
Steamboat	Hayden, Oak Creek	Twin Enviro, WM	drop-off centers, some curbside	Routt

Table H-8: Gaps in Hub and Spoke – Mountains

Location	Notes
Grand County	LF closed, currently studying options for solid waste/recycling solutions for entire valley (Winter Park, Tabernash, Kremmling, Hot Sulphur Springs, etc.) and Rocky Mountain National Park
Jackson County	Nothing seems to be available
Clear Creek and Gilpin counties	Minimal drop-off centers in Idaho Springs, Golden State Park.

Table H-9: Public Composting Operations[1]– Mountains

Location	Operator	Service Area/Type	Class	Notes
Milner	Milner Landfill (Twin Enviro	Routt County/residential and commercial drop off	1	
Snowmass Village	Pitkin County	Pitkin County/residential and commercial drop off	5	Surprised to see them listed as a Class 5
Center	Compost Technologies		None listed	No information found
Hooper	Soil Solutions	South Central Mountains (sell nationally)	5	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be
Glenwood Springs	South Canyon Disposal Site (City of Glenwood Springs)	Glenwood Springs/residential and commercial drop off	1	
Dillon	Summit County	Summit County/residential and commercial drop off	1	

1. Does not include Class V agricultural on-farm only facilities

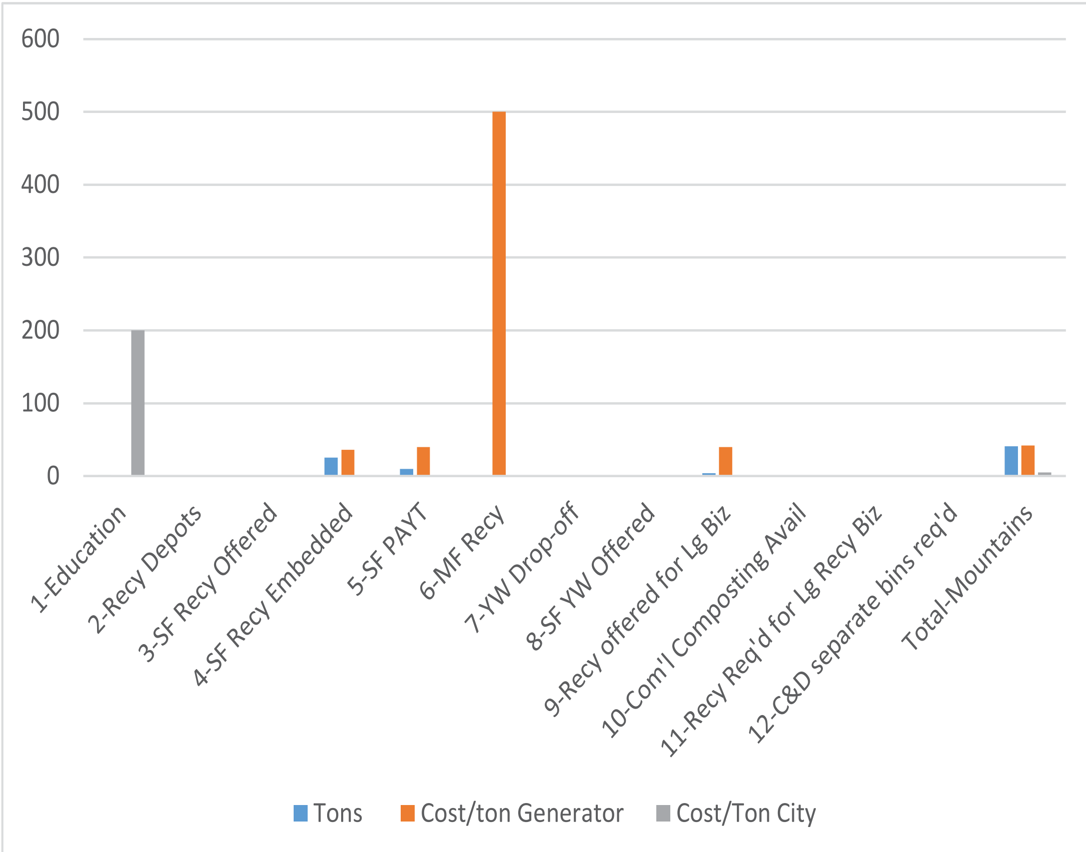


Figure H-2: Diverted Tons and Cost / Ton from Selected Level 3 Strategies in Mountain Region[1,2]

1. Assumes Mountains implement: 1, 4, 5, 6, 9 (5 programs)
2. Note that these Level 3 programs are more fully described in Section 6.

H.1.3 Eastern/Southeastern

This section includes tables supporting the development of the recommendations and computations listed in Section 6.4

- Table H-10 outlines the collection and diversion gaps and opportunities
- Table H-11 and Table H-12 present known hub and spoke operations and gaps
- Table H-13 presents the organics opportunities

Table H-10: Gaps and Opportunities – Eastern/Southeastern

Population (and % of State) (5.2 M)	157,455 (3%)
Gaps in recycling access including hub and spoke/drop-off recycling	Plains, in general; Morgan County; Huerfano County *Gaps (Plains 155K, Morgan 28K, Huerfano 6K)*
Estimated percent of population with coverage	60% of area population (preliminary estimate; 94K
Active organics options	Yuma, Ft. Lupton, Akron, Eaton, LaSalle, Erie, Keenesburg, Hudson, Fort Morgan
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Market access/transportation, want local control and want fewer landfill inspections/enforcement, lack MRFs; low incomes, illegal dumping concerns
Special Opportunities	
Potentially-acceptable strategies	2 tier goals, WTE; some support for Hub and Spoke, severance funding, differential taxes by stream; environmental/generator fees; facility co-location incentives; bottle bill; economic development assistance, hauler contract fees; industry funded programs

Table H-11: Locations and Gaps in Hub and Spoke – Eastern/Southeastern

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Denver	Sterling	Waste Management	Curbside (Sterling, other), drop-off center, res/commercial	Julesburg, Sterling, other towns in NE (NorthEast)
Yuma (new)	Keenesburg, Hillrose, Eckley	Quest Services	drop-off centers, commercial CS, ag	NE and EastCentral
Denver	Numerous	South-east and EastCentral Recycling	drop-off centers	14 counties in east central and southeast, 1 in KS
Swink	La Junta, Rocky Ford, Manzanola, Fowler, Ordway, Ead	Clean Valley Recycling	drop-off centers	Southeast – 7 counties
Trinidad		TerraFirma	drop-off centers	Las Animas County

Table H-12: Gaps in Hub and Spoke – Eastern/Southeastern

Location	Notes
Plains, in general	Despite the variety of hub and spoke operators, the eastern plains cover a vast amount of territory with a low population density limiting the effectiveness of individual programs. Some material may go out of state
Morgan County	Area is becoming more populated but no specific service (besides one drop-off center) is available in the county
Huerfano	Minimally serviced

Table H-13: Public Composting Operations[1] – Eastern/Southeastern

Location	Operator	Service Area/Type	Class	Notes
Yuma	Ace Composting	Unknown	1	Listed as 'fertilizer mixer' company
Ft. Lupton	BOSS Compost	Front Range for sales, unknown for intake (manure, definitely)	None listed	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be
Akron	Colorado Compost	Unknown	3	No online info
Eaton	A1 Organics	Eastern, Front Range/Residential & commercial drop off	3	
La Salle	Heartland BioDigester	Statewide/Commercial only	None listed	AD & Compost
Erie	PermaGreen	Statewide distribution through retailers	3	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be
Keenesburg	A1 Organics	Wholesale only	1	
Hudson	Stromo/Renewable Fiber	Eastern/Front Range	None listed	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be
Fort Morgan	Teague Enterprises	No info online	2	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be

1. Does not include Class V agricultural on-farm only facilities

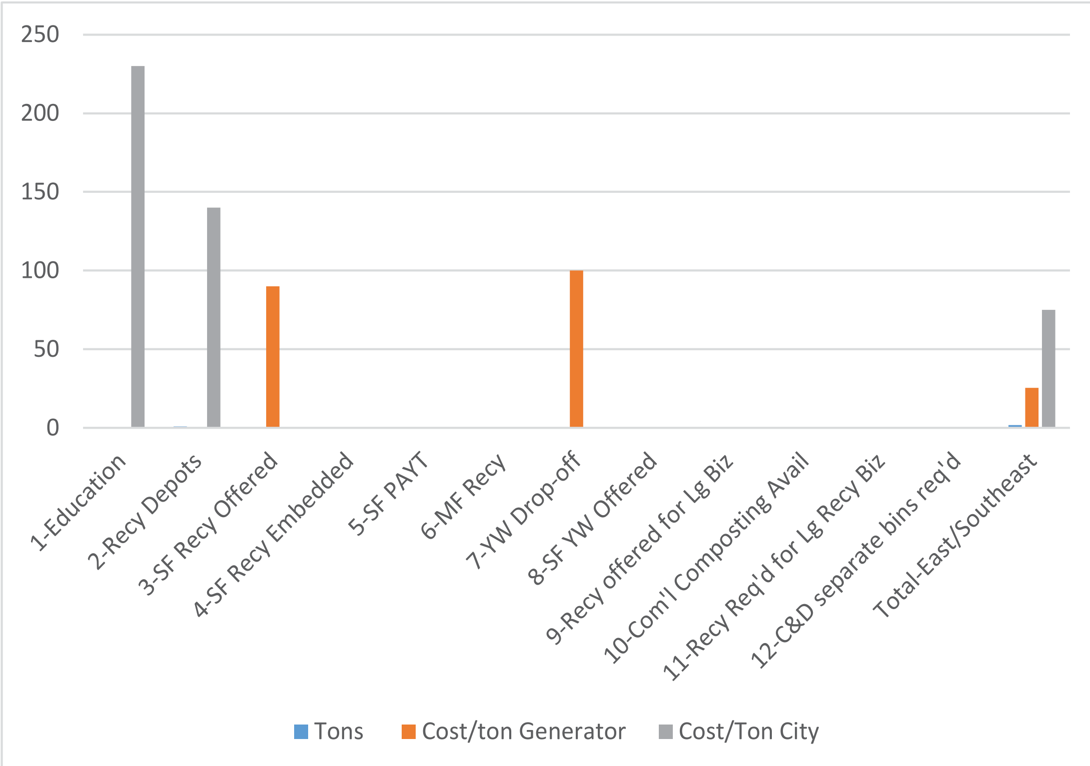


Figure H-3: Diverted Tons and Cost / Ton from Selected Level 3 Strategies in Eastern/Southeastern Region[1,2]

1. Assumes Eastern/Southeastern implements: 1, 2, 3, 7 (4 programs)
2. Note that these Level 3 programs are more fully described in Section 6.

H.1.4 Western Slope

This section includes tables supporting the development of the recommendations and computations listed in Section 6.4

- Table H-14 outlines the collection and diversion gaps and opportunities
- Table H-15 and Table H-16 present known hub and spoke operations and gaps
- Table H-17 presents the organics opportunities

Table H-14: Gaps and Opportunities – Western Slope

Population (and % of State) (5.2 M)	388,115 (7.5%)
Gaps in recycling access including hub and spoke/drop-off recycling	Moffat County (one drop-off); Rio Blanco County; Garfield County; Western Slope, in General *Gaps (Moffat and Rio Blanco 19.5K, Garfield 58K, Western Slope most; preliminary estimate missing 100K+)*
Estimated percent of population with coverage	75% of area; 288K population covered
Active organics options	Austin/Delta County, Grand Junction
Barriers/Special Concerns – beyond markets/profitability, low landfill fees	Lack transfer stations, hub and spoke in some areas, lack end markets, significant rural population
Special Opportunities	
Potentially-acceptable strategies	Partial support for Regional planning, hub and spoke, two-tiered state goals, reporting, solid waste taxes, LF surcharges, economic development assistance, industry-supported programs, severance funding, possible WTE, possible PAYT, OCC bans

Table H-15: Locations and Gaps in Hub and Spoke – Western Slope

Hub Location	Spoke Locations	Operator(s)	Types	Service Area
Grand Junction	Locations in Mesa & Delta Counties	Mesa County, Grand Junction Curbside Recycling Indefinitely (with City)	curbside, drop-off centers	Mesa and Delta
Montrose	Paradox, Gateway, Ouray, Nucla	Bruin Waste	drop-off centers	Montrose, Ouray & San Miguel (some Delta/San Juan)
Durango	La Plata, Montezuma, San Juan, Dolores	City of Durango, Phoenix Recycling	curbside, drop-off centers	La Plata, Montezuma, San Juan, Dolores

Table H-16: Gaps in Hub and Spoke – Western Slope

Location	Notes
Moffat and Rio Blanco counties	One drop-off center in Meeker
Garfield	Limited availability drop-off centers along I-70 in Glenwood, Rifle and others; some curbside in larger towns
Western Slope, in general	Have some programs but many have failed. Distances, coupled with difficult terrain, weather and sparser population impact transportation/cost to market. Some material may flow to Utah or New Mexico

Table H-17: Public Composting Operations[1] – Western Slope

Location	Operator	Service Area/Type	Class	Notes
Austin (Delta County)	CB Industries	Western Slope	1	Difficult to tell whether or not they take organics from the public or who commercial suppliers might be
Grand Junction	Mesa County	Mesa County/ residential and commercial drop off	1	

1. Does not include Class V agricultural on-farm only facilities

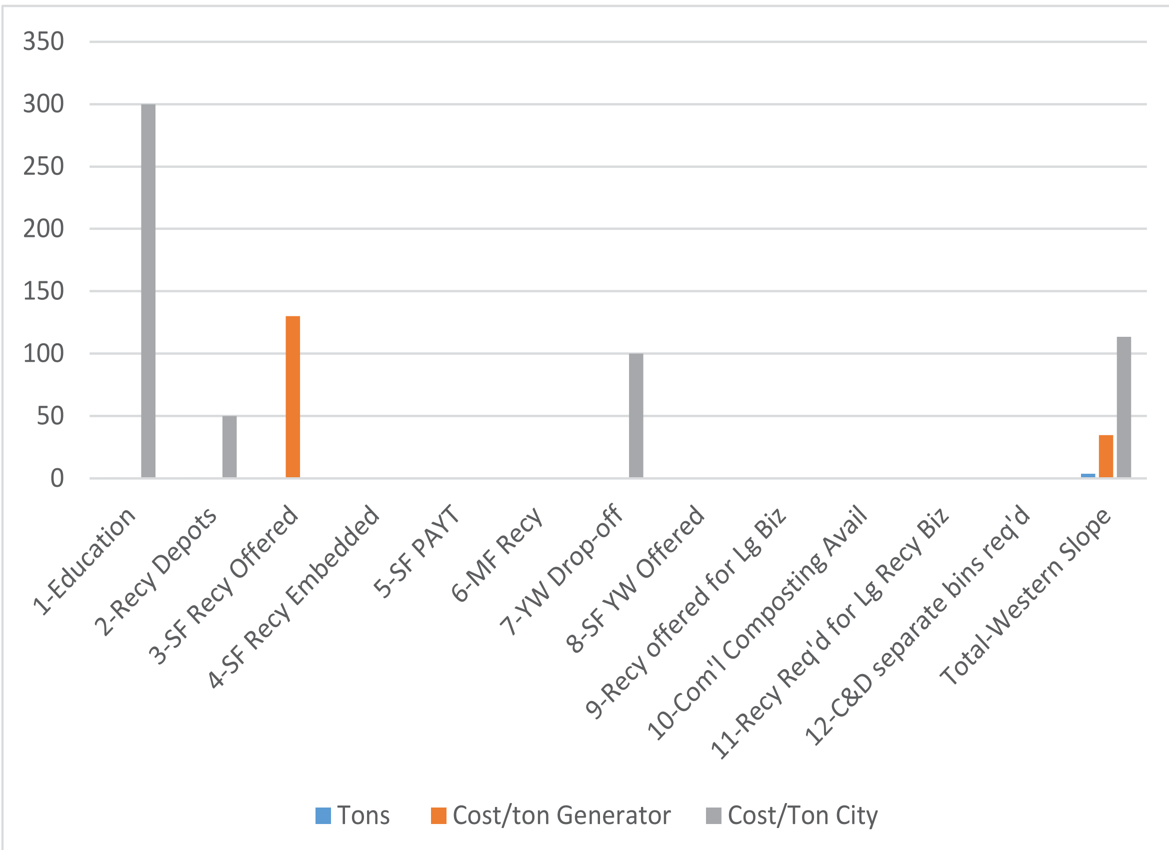


Figure H-4: Diverted Tons and Cost / Ton from Selected Level 3 Strategies in Western Slope[1,2]

1. Assumes Western Slope implements: 1, 2, 3, 7 (4 programs)
2. Note that these Level 3 programs are more fully described in Section 6.

H.2 Summary Results

Table H-18 provides a high-level summary of the results of the implementation of selected Level 3 strategies in each region. The results show:

- Most of the tons are generated in the Front Range, which is also reflected in the low statewide costs for the set of programs
- The costs in the Eastern/Southeastern and in the Western Slope are 2.5-3.7 times the cost per ton found in the Front Range, identifying the influence that travel distance and low densities have on the affordability of diversion in those regions
- The cost to implement programs from the community perspective are quite low in the Front Range and Mountains; they consist of the education and drop-off programs. The drop-off option (with the associated transportation) is more expensive in the Eastern/Southeastern and Western Slope regions. The remainder of the programs are assumed to be directed by the communities or counties through ordinance or other method, with the cost borne by the generator
- These costs assume a five-year average of $140 per ton in single stream mix revenues, and zero revenues for organics. To the extent the market prices differ from those values, these weighted average costs would need to be adjusted.

Table H-18: Weighted Average Cost per Ton of Level 3 Options by Region[1,2]

For Selected Subsets of Level 3 Options	Front Range	Mountains	Eastern/ Southeastern	Western Slope	Statewide
Diverted Tons (in thousands)	675	41	2	4	722
Weighted Cost per Ton – Generator	$34	$42	$26	$35	$35
Weighted Cost per Ton - Community	$5	$5	$75	$113	$6
Weighted Cost per Ton - Total	$40	$47	$101	$148	$41

1. Selected subset of strategies for each region
2. Assumes Front Range implements: 1, 4, 5, 6, 8, 10, 11, 12 (8 programs); Mountains implement: 1, 4, 5, 6, 9 (5 programs); Western Slope and Eastern/Southeastern implements: 1, 2, 3, 7 (4 programs)

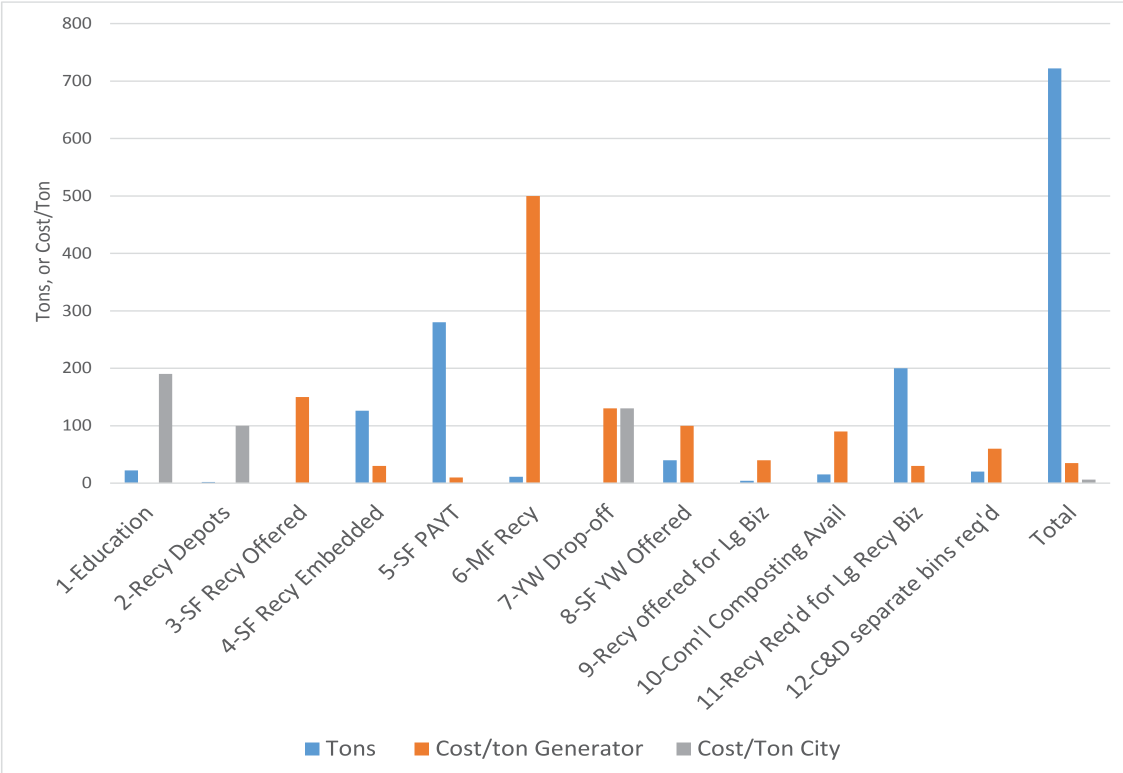


Figure H-5: Diverted Tons and Cost / Ton from Selected Level 3 Strategies Statewide[1,2]

1. Assumes Front Range implements: 1, 4, 5, 6, 8, 10, 11, 12 (8 programs); Mountains implement: 1, 4, 5, 6, 9 (5 programs); Western Slope and Eastern/Southeastern implements: 1, 2, 3, 7 (4 programs)
2. Note that these Level 3 programs are more fully described in Section 6.

CREATE AMAZING.

9785 Maroon Circle, Suite 400
Centennial, CO 80112
burnsmcd.com

Appendix B

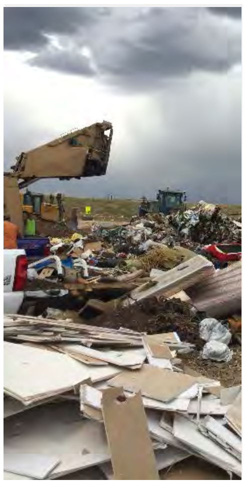
Final Report – Phase 1 Regional Wasteshed Planning Study

This page intentionally left blank.

R3 CONSULTING GROUP, INC.
RESOURCES · RESPECT · RESPONSIBILITY

FINAL REPORT

Regional Wasteshed Planning Study



SUBMITTED TO:

The North Front Range Wasteshed Planning Coalition

July 15, 2016

Report Submitted Digitally as PDF

CONSULTING GROUP, INC.
RESOURCES · RESPECT · RESPONSIBILITY

www.r3cgi.com

1512 Eureka Road, Suite 220, Roseville, CA 95661
Tel: 916-782-7821 | Fax: 916-782-7824

2600 Tenth Street, Suite 411, Berkeley, CA 94710
Tel: 510-647-9674

627 S. Highland Avenue, Suite 300, Los Angeles, CA 90036
Tel: 323-559-7470

July 15, 2016

North Front Range Wasteshed Planning Coalition
C/O Mr. Honoré Depew
Environmental Planner
Environmental Services Department
City of Fort Collins
215 North Mason Street, 1st Floor
Fort Collins, Colorado 80524

Subject: North Front Range Regional Wasteshed Planning Study Final Report

Dear Mr. Depew:

R3 Consulting Group, Inc. (R3) is pleased to submit the attached Final Report of our Wasteshed Planning Study for the North Front Range Regional Wasteshed Planning Coalition.

We wish to thank Coalition member staff from Larimer County, the Town of Estes Park, the City of Loveland, the City of Fort Collins for information and insights in support of this Study. We also wish to thank and recognize staff participation from other key members of the Wasteshed's overall solid waste infrastructure, including Gallegos Sanitation, RAM Waste Systems, Waste Management, A-1 Organics, and many others who provided information and insights during the course of conducting this Study.

* * * * * * *

We appreciate the opportunity to be of service to the North Front Range Regional Wasteshed Planning Coalition. We look forward to staying in touch with the Coalition as it takes the next steps in its planning process, and welcome updates and additional communications as the process unfolds. Please don't hesitate to contact me by phone at (510) 292-0853 or by email at gschultz@r3cgi.com with any updates, comments, or questions.

Sincerely,

R3 CONSULTING GROUP

Garth Schultz

Garth Schultz | Principal

This page intentionally left blank.

Table of Contents

Table of Contents

North Front Range Wasteshed Facility Maps

Tables

Figures

Appendices

This page intentionally left blank.

1 Executive Summary

This North Front Range Regional Wasteshed Planning Study (Study) was commissioned by the City of Fort Collins on behalf of the North Front Range Regional Wasteshed Planning Coalition (the Coalition). The Coalition is comprised of the City of Fort Collins, the City of Loveland, the Town of Estes Park, and Larimer County. The Coalition is organized into technical and policy committees.[1] The term "wasteshed" is used to describe an area where waste, much like water or air, does not adhere to boundaries. The regional wasteshed of Colorado's North Front Range (Wasteshed) is an area in and around Larimer County consisting of all solid waste generated by cities, towns and unincorporated areas and handled by publicly and privately operated solid waste infrastructure.

One of the primary key infrastructure elements within the Wasteshed is the Larimer County Landfill, which will close due to lack of additional capacity around the year 2025. The Coalition Technical Advisory Committee (TAC) has been working since May 2015 to outline a long-term planning process for the Wasteshed that will help the regional community achieve new levels of responsible materials management. The Coalition engaged R3 Consulting Group, Inc. (R3) to supplement its Wasteshed planning efforts via this Study, with the specific objectives of:

- Describing current solid waste handling conditions, policy, collection operations and infrastructure for transferring, disposing and processing solid waste materials;
- Quantifying the amount of solid waste currently handled and projecting the amount of each solid waste type that will need to be handled in the future;
- Identifying the gaps between how much waste will be generated in the future and how much waste current infrastructure can handle;
- Identifying and describing the feasible options that the Coalition might consider as opportunities for future handling of solid waste; and
- Describing the various funding approaches that could be considered for funding capital and operating expenses for additional solid waste infrastructure.

This Study includes detailed sections that address each of these objectives, and describe R3's approach and analysis relating to each. General methodology for conducting the Study is included as Appendix A. Main findings are summarized below.

Current Conditions

The Wasteshed includes infrastructure for collection (or "hauling") of solid waste (from residents, businesses, and industry) to transfer stations, recycling and organics processing

---

1 The Technical Advisory Committee (TAC) is a planning group comprised of staff from each Coalition member agency that meets regularly to address options for the future solid waste management and resource recovery opportunities within the Wasteshed. The Policy Advisory Committee (PAC) is comprised of elected officials from each Coalition member agency for the purpose of providing policy direction and recommendations on regional solid waste planning and operations.

facilities and several landfills[2] including the Larimer County Landfill. Solid waste streams handled by these infrastructure elements include:

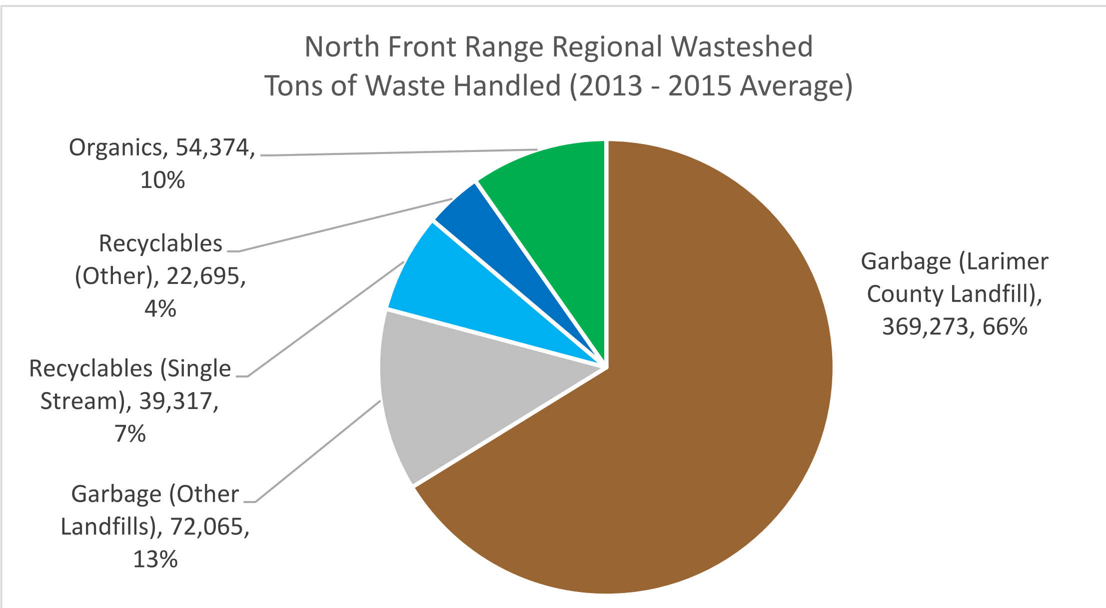
- Recyclables that can be manufactured into new products or product feedstocks;
- Organics, which includes yard wastes, wood waste, and food wastes, that can be composted, mulched or used for energy production;
- Construction and demolition (C&D) materials that can be recycled and reused; and
- Garbage, which includes those materials that do not fit into the above categories and/or are disposed of in landfills.

Solid waste collectors ("haulers") operate in a market system wherein customers choose their own collector, or may choose to self-haul their solid waste (residents in Loveland automatically receive service from the City). Collectors choose which solid waste facilities to use, including those that are in Larimer County and outside of it. Coalition members have, to varying degrees, implemented policies and practices that aim to increase diversion of solid waste from landfills.

Current and Future Waste Handling

Between 2013 and 2015, solid waste infrastructure in the Wasteshed handled over 550,000 tons of solid waste per year.[3] The vast majority of this material was landfilled garbage, with most of that garbage being landfilled at the Larimer County Landfill, as shown in Figure 1.

FIGURE 1



---

2 There are at least three private landfills (located in neighboring Weld County) used by haulers in the region, in addition to the Larimer County Landfill.

3 This figure does not include concrete, asphalt and rock, and other materials handled by the City of Fort Collins' Hoffman Mill Road Crushing Facility and other similar facilities in the Wasteshed, as the infrastructure for these materials is robust and with high economic demand for those services and materials. This Study focuses on the materials generated by homes and businesses.

Between 2013 and 2015, approximately 80% of the solid waste handled in the Wasteshed was landfilled as garbage, 10% of it was collected as recyclables, and another 10% as organics. Currently, 60% of the solid waste that is collected as garbage and disposed of at the Larimer County Landfill is comprised of recyclables, organics and mixed C&D materials that could be diverted from landfill disposal and recovered for other purposes. Future amounts of solid waste generated and handled in the Wasteshed are projected to increase significantly, in proportion to projected population growth. By 2040, the amount of garbage, recyclables, organics and mixed C&D solid waste is projected to be over 800,000 tons annually, with between 560,000 and 650,000 tons estimated for landfill disposal.

Opportunities Assessment

Current solid waste infrastructure is generally sufficient to meet the current waste handling needs in the Wasteshed. However, upon closure of the Larimer County Landfill around 2025, solid waste infrastructure will need to handle approximately 20% more solid waste than it does now and, additionally, will need an alternative for the roughly 415,000 to 440,000 tons of waste that would otherwise be disposed of at the County landfill. There is significant opportunity for developing infrastructure in the Wasteshed for all solid waste streams.

Feasible Options

Feasible options for future waste handling include taking no action and using other area infrastructure (with likely increases in collection and disposal costs), or developing one or more infrastructure elements in the Wasteshed, potentially including:

- Central Transfer Station
- New Landfill
- Materials Recovery Facilities
- Organics Composting Facility
- C&D Processing Facility
- Waste-to-Energy Facilities

These alternatives can be combined to varying degrees; some can be implemented as standalone activities or in combination with other options.

Funding Approaches

There are a variety of potential funding approaches available to the Coalition for financing the costs of new infrastructure; however, as a result of current open market conditions, several of these possibilities involve higher levels of risk than others. The available funding alternatives for consideration include:

- Fees
- Taxes
- Public-Private Partnerships
- Regional Solid Waste Agency

Variables that could affect the necessary funding amounts for Wasteshed solid waste infrastructure in the future include, but are not limited to:

- The timing of solid waste infrastructure construction;
- Locations and property ownership for future solid waste infrastructure;
- Size and scale of the facilities chosen for consideration;
- Potential future increases in garbage disposal or processing fees; and
- Other possible changes to disposal or processing fees for recycling and organics.

This page intentionally left blank.

2 Current Conditions

This section describes current solid waste handling conditions, solid waste policy, collection operations and infrastructure for transferring, disposing and processing waste materials in the Wasteshed.

2.1 Wasteshed Overview

The North Front Range Regional Wasteshed in Larimer County, Colorado straddles the eastern Rocky Mountains along the foothills and the beginning of the Great Plains, combining rural mountainous terrain with lower lying urban and suburban environments. Populations are concentrated in Loveland and Fort Collins, and distributed sporadically across unincorporated Larimer County and Estes Park. As the gateway to Rocky Mountain National Park, the Town of Estes Park sees up to 4 million visitors per year. As a result of these geographic and demographic differences, the Wasteshed's solid waste handling systems, including its collection, transfer, disposal and processing elements, are also varied in their application. This presents particular challenges and opportunities with respect to regional development of solid waste infrastructure.

Collection infrastructure for residential, commercial and industrial solid waste collection services are primarily provided by private hauling companies that operate within each city, town, and the County (with the exception of Loveland, which operates a municipal collection service for its residents). All solid waste haulers operate in a market system wherein customers may choose their own hauler, or may choose to self-haul their solid waste. While the open market system fosters price and service competition among haulers, it also means that these companies can make their own choices in terms of where they bring the materials they collect for disposal or processing. As a result, regional planning entities like the Coalition have no guarantee that haulers will use any new solid waste infrastructure, which could make it difficult to finance that infrastructure.

Politically speaking, each member agency is diverse and varies from urban to rural, creating some differences in approach to policy and planning. The more urban communities of Fort Collins and Loveland have adopted policies and/or programs that increasingly foster non-landfill alternatives including diversion of recyclables and organics. However, due in part to the relatively low cost of landfilling in Colorado ($18-$25/ton) those types of policies and programs are less efficient, more expensive, and not as well supported in the more rural portions of the County. Additionally, a lack of state-wide diversion goals makes it difficult to establish diversion from landfills as a priority or requirement. The State of Colorado is currently developing an Integrated Solid Waste and Materials Management Plan[4] for the purpose of assessing and planning for solid waste and diversion over the next twenty years.

---

[4] An overview of the State's Integrated Solid Waste and Materials Management Plan, and the full Plan, can be found online at: https://www.colorado.gov/pacific/cdphe/integrated-solid-waste-management-plan

2.2 Existing Transfer, Disposal and Processing Infrastructure

The Wasteshed utilizes a variety of transfer stations, landfills, recycling processing facilities and organics processing facilities to transfer, dispose and recover solid waste. A map of current conditions, on the following page 7, shows the existing facilities used for transfer, processing and disposal of each of the main solid waste streams including garbage, recyclables, and organics from Fort Collins, Loveland, Estes Park, unincorporated Larimer County and the other municipalities in the Wasteshed. A detailed list of current facilities is included as Appendix B.

Landfills

Larimer County Landfill

The Larimer County Landfill is centrally located between the geographic centers of Coalition members, being eight miles from Fort Collins, 34 miles from Estes Park and nine miles from Loveland. The ownership of the land under operation is split between jurisdictions with Fort Collins owning 50%, Loveland owning 25% and Larimer County owning the remaining 25%.

All development on the land is owned solely by the County, which also owns an adjacent, undeveloped parcel south of the active landfill. The landfill opened in the 1960's and the County of Larimer took over operations of the Landfill in 1973. Since its opening, there have been three vertical expansions to the landfill's height that increased its capacity. It is currently anticipated to be full in approximately ten years and no further expansions are possible at the current landfill location. Gas produced by the landfill is captured and flared, and may potentially be connected to pipelines and used as an energy source in the future.

In 2015, the landfill received 378,000 tons of garbage for disposal. The landfill receives between 500 and 900 vehicles per day and estimates that 10-20% of garbage comes from out-of-County. According to the 2006 Waste Characterization Study commissioned by the County (Appendix C), waste self-hauled to the landfill accounts for 7% of incoming volume, but accounts for a large proportion of the daily vehicle traffic to the landfill. As further discussed in Section 3 of this report, the 2006 study also found that 60% of waste disposed at the landfill could be diverted and recovered via existing programs for recyclables and organics in the region.[5]

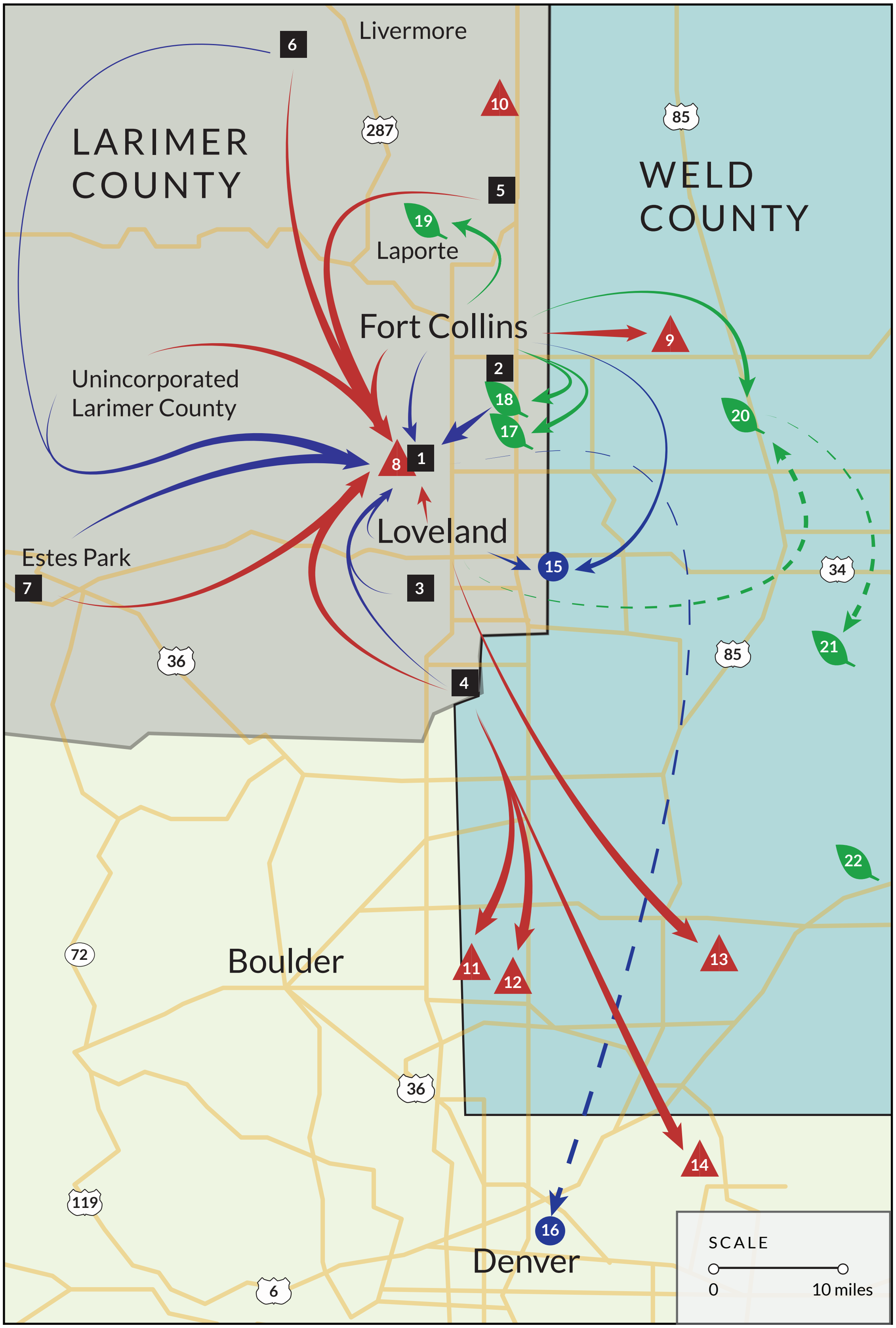
The landfill also includes a household hazardous waste (HHW) drop-off facility and a recycling transfer station (Recycling Station) operated by Waste Management, Inc. (WM). WM has plans to install additional equipment in 2016 to allow for some recyclable materials to be delivered directly to market rather than to the Denver WM materials recovery facility (MRF).

---

5 The County is currently in the process of conducting a new waste characterization study, the results of which are anticipated to be available by the end of 2016. It is understood that the 2016 study will compare and analyze changes in the composition of waste accepted at the Larimer County Landfill between 2006 and 2016. R3 anticipates that while individual categories and types of waste may change slightly, there will likely not be significant changes to the main waste categories (garbage, recyclables, organics and C&D) assessed via this Wasteshed Planning Study. Any difference can be analyzed and reviewed once the 2016 characterization is completed, though significant changes to the projections included in this Study are not anticipated.

NORTH FRONT RANGE WASTESHED FACILITY MAP

Current Conditions



MAP KEY

- Garbage
- Recyclables
- Organics
- Long-Haul Truck

TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

North Weld Landfill

Waste Management of Northern Colorado owns and operates the North Weld Landfill in Ault, 15 miles east of Fort Collins, 30 miles northeast of Loveland and 55 miles northeast of Estes Park. The landfill currently disposes of garbage from Fort Collins, other jurisdictions in Larimer and Weld Counties, and jurisdictions in the State of Wyoming. The North Weld Landfill has the capacity to accept all garbage generated within the Wasteshed. Landfill gas is not captured for recovery or flaring and the facility does not include HHW collection, recycling or other diversion functions.

Denver Regional Landfill

Waste Connections, Inc. owns and operates the Denver Regional Landfill located in Erie, approximately 50 miles south of Fort Collins, 35 miles south of Loveland and approximately 50 miles southeast of Estes Park. Due to its close proximity to the Front Range Landfill, it does not normally service garbage from the North Front Range. There are no plans to expand this landfill as the surrounding environment will not allow for it.

Front Range Landfill

Waste Connections, Inc. also owns and operates the Front Range Landfill, also located in Erie, which reportedly does not currently accept much or any waste from communities in the Wasteshed. The landfill has an annual capacity of 1.5 million tons and disposes of approximately 140,000 tons a month of mixed solid waste, C&D material and soils. The current closure date is projected to be between 2046 and 2056. Waste Connections is expecting to update this landfill's permit to allow for an inbound capacity of 3 million tons of material annually, which would likely shorten the lifespan of the landfill.

Buffalo Ridge Landfill

Waste Management, Inc. owns and operates the Buffalo Ridge Landfill located in Keensburg, 55 miles southeast of Fort Collins, 60 miles southeast of Estes Park and 43 miles southeast of Loveland. Currently, this site does not report to be a destination for garbage generated in the Wasteshed.

Tower Road Landfill

Located near Denver International Airport, in Commerce City, the Tower Road Landfill is operated by Republic Services and accepts garbage from the public. The City of Loveland periodically utilizes the Tower Road Landfill for disposal at times when they cannot dispose of garbage at the Larimer County Landfill due to wind closures.

Transfer Stations/Drop-Off Facilities

Timberline Recycling Center

The Timberline Recycling Center in Fort Collins provides a drop-off recycling site available for residents and local businesses to use at no charge. Annually, 1,440 tons of recyclables are received at this recycling center. In addition, for $5 per visit, people can bring a variety of "hard-to-recycle" materials and place them into appropriate containers for recycling in an adjacent, staffed area.

Loveland Recycling Center and Green Waste Drop-off

The City of Loveland Recycling Center, located at the Loveland Municipal Services Center campus, offers recycling and green waste drop off to all Loveland residents free of charge, and to residents from neighboring jurisdictions for a fee. This facility receives approximately 2,000 tons of recyclables per year. Green waste is also accepted and approximately 26,000 tons of compostable material is received annually. The City hires A-1 Organics to chip these materials on site and transport them to the company's Eaton location for composting.

Estes Park Transfer Station

The Estes Park Transfer Station, operated by Larimer County, accepts garbage and recyclables from residents and four waste haulers (WM, Doering Disposal, Atlas Disposal, and a new recycling hauler). The facility, which does not accept organic waste, transfers between one and two trucks of garbage per day to the Larimer County Landfill (three to four loads of garbage during the summer months), and one load of recyclables every two days. Overall, approximately 12,000 tons of solid waste are transferred per year. During the months of October through April, the facility is open three days a week. From May through September the hours of operation are increased to accommodate summer visitors. The facility has the ability to handle up to 20,000 tons per year.

Larimer County Drop-off Transfer Stations

Larimer County operates three convenient drop-off locations in Wellington, Berthoud and Red Feather where local residents and others can drop-off garbage for a fee. These drop-off stations are open and limited at varying times throughout the year, and accept bagged waste from the public. Waste that is accepted from the public is placed into large containers, which are periodically transported via truck to the Larimer County Landfill. The Berthoud and Red Feather locations also accept recyclables, which are handled and transported via similar methods, with the contents delivered to the Larimer County Recycling Station.

Recyclables Processing Facilities

Hoffman Mill Road Crushing Facility[6]

The City of Fort Collins' Hoffman Mill Road Crushing Facility processes approximately 100,000 tons per year of material, which includes porcelain toilets, asphalt, concrete and pit run. The Crushing Facility does not contain a processing line and does not accept mixed material or garbage. It is operated as an enterprise fund with no disposal or processing fee for accepted materials. Finished product is sold to public and private customers.

Waste Management/Recycle America Franklin Street Materials Recovery Facility

This Denver-area materials recovery facility (MRF) operated by WM accepts mixed "single-stream" recyclables from throughout Denver and surrounding communities, as well as the Wasteshed. All single-stream recyclables and many other recyclables collected in the Wasteshed are long-hauled via transfer trucks from the Larimer County Recycling Station to the Franklin Street MRF. At the MRF, materials are sorted via a variety of mechanical and manual means to separate various recyclable commodities (e.g., paper, cardboard, glass,

---

6 Per City of Loveland Staff, there are three or more other facilities in the Wasteshed, in Fort Collins and in Loveland, that also handle, process and recycle concrete and asphalt. Information for those facilities will be included in the Final Report.

plastic, metals, etc.) from one another and then baled or otherwise stored for transport. Materials are then marketed to buyers and shipped offsite for remanufacturing.

Waste-Not Recycling, Inc.

The Waste-Not Recycling facility in Johnstown processes commercial recyclable material from Fort Collins and Loveland, and currently processes roughly 1,000 tons a month, mostly of cardboard. Other materials processed include aluminum, tin, paper and plastic. The facility also processes source-separated C&D material for recovery.

Loveland Concrete and Asphalt Recyclers

In addition to the Hoffman Mill Road Crushing Facility in Fort Collins, there are also three privately owned concrete and asphalt recycling operations located in the City of Loveland. Jake Kaufman and Son, Inc. accepts broken asphalt and concrete (without rebar), as does Ward Construction. Coulson Excavating Co. accepts broken asphalt.

Organics Processing Facilities

Drake Water Reclamation Facility

The City of Fort Collins' primary wastewater treatment plant currently has four anaerobic digesters and treats the majority of the wastewater from the municipality. The facility currently processes approximately 37 tons of food waste per day (13,000 tons of food waste per year) and has additional food waste capacity. The City uses biogas produced on site from anaerobic digestion to heat the plant in winter and is enhancing capacity to use the gas for combined heat and power as a strategy to further reduce greenhouse gas emissions. The digestate byproduct is land applied on a 25,000 acre City-owned ranch as a means of landfill diversion and soil enhancement.

Hageman's Earth Cycle, Inc.

Hageman's Earth Cycle in Fort Collins accepts grass clippings, garden waste, leaves, branches, sod and soil, cedar shingles and rock and gravel. Hageman's acts as an organics transfer station for yard trimmings and also collects/processes clean wood into wood chips. Organics received by Hageman's Earth Cycle are transferred to local and regional organics processing facilities for composting and other beneficial uses. Hageman's Earth Cycle accepts approximately 20,000 tons per year of organic material.

Doug Weitzel, Inc.

Weitzel's, in Fort Collins, accepts grass clippings, leaves and branches from the public for composting. The facility receives approximately 1,000 cubic yards per year of material, which is transported and composted off-site at the company's compost yard.

A-1 Organics, Inc.

A-1 Organics owns and operates three facilities in Weld County and Adams County. These facilities accept wood waste, green waste, food waste, animal waste and packaged food waste. The facility closest to the Wasteshed is the Eaton location, which has the ability to accept between 500 and 600 tons of material per day for windrow composting. A-1 also provides source materials for the Heartland Biogas Facility, which processes organic materials for energy production. Overall, A-1 reports that they are able to handle more organic waste than what is currently being processed at their facilities. Challenges include contamination and fluctuating end market prices.

Local Dairies

Some dairies in the Wasteshed are permitted to compost on-site, however they are not currently processing material from the Wasteshed. Some private haulers reported using other local dairies as outlets for green waste collected from residents.

2.3 Current Diversion Practice and Policy

A variety of solid waste policies and practices have been adopted by the Coalition's member agencies. Fort Collins has an established diversion goal, ordinances to ban certain materials from disposal, and incentives for changing behavior from a disposal-first to diversion-first mindset. Loveland, although without a specific diversion goal, achieves high diversion rates as a result of high participation in recyclables and organics programs. Estes Park, despite being very rural and fairly remotely situated in mountainous terrain, operates a recycling drop-off facility at the transfer station, year round. Solid waste collectors in rural Larimer County provide limited curbside recycling collection services, but some drop-off and transfer station locations are available for recyclables throughout the County. Despite the member agencies' differences politically, geographically and logistically, they have all made considerable strides towards diversion of materials from landfills.

City of Fort Collins

Pay-As-You-Throw (PAYT) Ordinance

Fort Collins' PAYT Ordinance requires waste haulers to provide a "variable can rate" (i.e., the customer rate varies based on the size of garbage can) to customers as an economic incentive for diverting recyclable and compostable material.

Cardboard Ordinance

In 2013, Fort Collins passed an ordinance that requires residents, businesses and industrial operations to divert cardboard from landfill disposal by disallowing the material to be placed in trash containers.

Electronic Waste (E-Waste) Ordinance

Fort Collins' ordinance, passed in 2007, bans the landfilling of electronics and was followed by State legislation passed in 2013 that makes it illegal to landfill electronics anywhere in Colorado.

Construction and Demolition Debris

The Construction and Demolition (C&D) Debris building code in Fort Collins requires the diversion of concrete, wood, metals and cardboard from all new residential and non-residential construction projects.

Zero Waste Goals

In 2013, the Fort Collins City Council unanimously adopted the following Zero Waste goals:

- 2020 Goals: 75% of waste diverted from landfills and a target of 3.5 pounds per person per day of garbage generation
- 2025 Goals: 90% of waste diverted from landfills and a target of 2.8 pounds per person per day of garbage generation

- 2030 Goal: Approaching Zero Waste

The Zero Waste goals establish diversion as a priority and demonstrate potential political support for diversion facilities that help to decrease landfilling of recyclable and compostable material.

City of Loveland

Loveland operates its own trash collection utility for residents and has a PAYT Ordinance similar to that of Fort Collins, which provides an economic incentive for diversion to its customers. The City also has a hard-to-recycle material management program, educational programs, curbside recycling and curbside organics collection. Loveland is successful at diverting waste and in 2015 had a diversion rate of 61% of total collected material, which includes residential, some multifamily, roll off and hard-to-recycle waste.

Larimer County and Town of Estes Park

Larimer County has a PAYT Ordinance, which preceded the Fort Collins Ordinance, and similarly requires waste haulers to provide a "variable can rate" to customers as an incentive to divert waste.

Estes Park residents actively use their drop-off facility for recyclables and many residents and businesses subscribe to curbside recycling collection programs offered by local haulers. Solid waste collectors operating in unincorporated Larimer County offer curbside recycling to some customers. Additionally, the County operates three transfer stations (two of which accept recyclables) located throughout the County, as well as the recyclables and HHW drop-off facility and recyclables transfer station adjacent to the Larimer County Landfill.

3 Current and Future Waste Handling

This section quantifies the amount of solid waste currently handled in the Wasteshed (inclusive of the four primary waste streams of garbage, recyclables, organics, and C&D) and projects the amount of each solid waste that will need to be handled in the Wasteshed in the future.

3.1 Current Waste Handling in the Wasteshed

Each Wasteshed Coalition member tracks the amounts of solid waste “handled” in the region in different ways. Loveland and Fort Collins track amounts of solid waste *collected* by some or all solid waste haulers, who pick up solid waste from residents, businesses or industrial customers. Larimer County tracks the amounts of solid waste *received* from solid waste haulers and those residents, businesses or industrial customers who choose to self-haul their solid waste. Estes Park does not separately track the amount of solid waste from its community, but most of Estes Park’s tonnage is assumed to be included in the information tracked by Larimer County.

Because of the difference in how data is tracked and managed, the amount of waste generated within the Wasteshed cannot be derived as a function of the total amount collected or the total amount received, since accurate totals for either do not exist. For this reason, the information presented in this section refers to solid waste handled in the Wasteshed as data that combines two different sets of information. The solid waste tracking abilities of each of the Coalition members are described below, followed by estimates of the current amount of solid waste handled in the Wasteshed for the three-year period from 2013 to 2015.

Larimer County Landfill and Recycling Station

Larimer County tracks the amount of garbage and recyclables received by the Larimer County Landfill and Recycling Station, but not does not track data regarding the origin of those materials. As a result, the County’s data pertaining to the amount of garbage received for landfilling and the amount of recyclables received at the Recycling Station for transfer to the WM Franklin Street MRF include any and all materials delivered by all parties using County facilities, including the other Coalition members (e.g., Estes Park, which does not separately track amounts of solid waste). The County’s data also includes waste received from other Larimer County cities, towns and unincorporated areas, and waste from neighboring counties and states; however, amounts of waste from these sources are included in the aggregate data tracked by the County, and are not identifiable by community or source.

Table 1, on the following page, details the amount of garbage and recyclables received by the Larimer County Landfill and Recycling Station from the Loveland, Fort Collins, Colorado State University (which delivers all garbage and recyclables to the County facilities) and all other sources. The amount of garbage received from the cities of Fort Collins and Loveland is only 25% of the total amount landfilled, while the amount of recyclables received from those sources is almost 60% of the total amount recycled. Additionally, it is estimated by Fort Collins’ licensed haulers that on average, only about 50% of the garbage collected in Fort Collins is received at the Larimer County Landfill (the remaining amount is received at the North Weld Landfill).

TABLE 1

Larimer County Landfill and Recycling Center Tons of Waste Received 2013 to 2015					
Waste Stream		**Year**			**3-Year Average**
		2013	**2014**	**2015**	
Garbage	Loveland	19,952	21,548	21,780	21,093
	Fort Collins	63,319	62,217	85,750	70,428
	All Other Sources	253,225	309,382	270,647	277,752
	Subtotal	**336,496**	**393,146**	**378,177**	**369,273**
Recyclables	Loveland	5,673	5,622	5,600	5,632
	Fort Collins	15,990	17,412	15,715	16,373
	All Other Sources	16,975	16,690	18,273	17,313
	Subtotal	**38,638**	**39,724**	**39,589**	**39,317**
Larimer County Total		**375,135**	**432,870**	**417,766**	**408,590**

City of Loveland

The City of Loveland tracks the amount of garbage, recyclables and organics collected via its City-run residential curbside and drop-off programs, and also tracks the amount of solid waste handled by other haulers operating within the City. Because the City of Loveland conducts an upwards of 95% of residential solid waste collection, the City's data is considered to be largely representative of the actual amount of waste that is generated by Loveland's residential sector. Nearly all commercial and industrial waste generated in Loveland is handled by other private haulers who provide reports of tonnages collected to the City.

All garbage collected by the City is disposed at the Larimer County Landfill (and thus included in Larimer County's data) and all curbside recycling is delivered to the Recycling Station for transfer and delivery to the WM Franklin Street MRF. Recycling collected via drop-off at the Loveland Recycling Center and Green Waste Drop-Off is either delivered to the County Recycling Station or is shipped directly to other local or regional recycling processors. Organics collected by the City via curbside and drop-off programs are ground on-site at the Loveland Recycling Center and Green Waste Drop-Off and then hauled by A-1 Organics to their facilities. Table 2 below details the amount of garbage, recyclables and organics collected by the City of Loveland and reported by private haulers. It should be noted that the organics tons include an unknown amount of organics that were collected from outside the City.

TABLE 2

City of Loveland Tons of Waste Collected 2013 to 2015				
Waste Stream	**Year**			**3-Year Average**
	2013	**2014**	**2015**	
Garbage	54,370	57,305	58,497	56,724
Recyclables	10,934	12,293	11,006	11,411
Organics	22,241	18,960	26,374	22,525
Loveland Total	**87,545**	**88,558**	**95,877**	**90,660**

City of Fort Collins

The City of Fort Collins tracks the amount of garbage, recyclables, and organics collected and reported by all licensed haulers operating in the City per the City's PAYT Ordinance. The City also collects data from other recycling businesses on a voluntary basis. In 2015, 29 licensed haulers (of which only three provide residential collection service) provided reports to the City of the amounts of solid waste they collected in Fort Collins during that year. These reports include specific information about the amounts of garbage, recyclables, and organics collected from single-family residential, multi-family residential, commercial and industrial solid waste generators. The amounts of C&D material collected by licensed haulers are included in their reported amounts of recyclables (for materials such as metals, concrete, asphalt, rock, brick, stone, etc.) and organics (for materials such as clean wood).

In their reports, licensed haulers are required to document the amount of garbage delivered to landfills in the region, including the Larimer County Landfill, the North Weld Landfill, the Denver Regional Landfill and the Front Range Landfill. Licensed haulers are not required to report destination facilities for their recycling. However, the Larimer County Recycling Center is the primary destination facility for "single-stream" recycling in the Wasteshed (a mix of paper, cans, bottles, cardboard, plastics, etc.). Other "source-separated" recyclables collected in the City, including via the City's Timberline Recycling Center, are also mostly taken to the Larimer County Recycling Station.

Similarly, licensed haulers do not include destination facilities for their organics, with the exception of a few hundred tons that are reported as delivered to Hageman Earth Cycle. The larger haulers interviewed during the course of this Study stated that they deliver their organics to A-1 Organics, the City of Loveland, and to local dairies who use the organics as bedding for cattle (in the case of yard waste), feed for pigs (in the case of a food scraps pilot project), and other beneficial uses. Some food scraps from Colorado State University are also delivered to the City's Drake Water Reclamation Facility for digestion along with sewage.

Table 3 details the amount of garbage, recycling and organics reported to the City of Fort Collins.

TABLE 3

City of Fort Collins
Tons of Collected Waste Reported 2013 to 2015

Waste Stream	Year			3-Year Average
	2013	2014	2015	
Garbage	139,600	138,416	149,465	142,493
Recyclables	50,166	50,483	51,153	50,601
Organics	29,503	31,282	34,761	31,849
Fort Collins Total	**219,269**	**220,180**	**235,379**	**224,943**

Overall Waste Handling in the Wasteshed

Providing an overall summary of the amount of waste handled and tracked by Coalition members in the Wasteshed is not a straightforward exercise. Amounts of solid waste are tracked differently by each Coalition member, an unknown amount of solid waste is "imported" from other areas outside the Wasteshed, and an unknown amount of solid waste is similarly "exported" to other destination facilities outside the Wasteshed. As a result, the amounts listed in Tables 1-3 cannot simply be added together to yield a total for the Wasteshed because certain amounts of waste are double-counted in each table.

Table 4 accounts for those differences (where the differences are known), and yields an overall total amount of waste handled in the Wasteshed. This includes all tons received at the Larimer County Landfill and Recycling Station, some of which are understood to come from outside the County. This analysis does not include tons for any Larimer County cities or towns (with the exception of Fort Collins) that are exported out-of-county, as those data were not available for this Study. For the same reason it does not include tonnages for the other various private waste handlers, recyclers, organics processors, or reuse facilities in the Wasteshed for which data were not available. While these parties are important and valuable parts of the overall solid waste infrastructure in the Wasteshed, they typically handle much smaller portions of the waste stream than are detailed in Table 4.

Based on available data, an average of 558,000 tons of solid waste is handled in the Wasteshed per year, inclusive of garbage, recyclables and organics.

TABLE 4

North Front Range Regional Wasteshed
Current Tons of Waste Handled

Waste Stream	Year			3-Year Average
	2013	2014	2015	
Garbage (Larimer County Landfill)	336,496	393,146	378,177	369,273
Garbage (Other landfills)	76,281	76,199	63,715	72,065
Recyclables (Single-stream)	38,638	39,724	39,589	39,317
Recyclables (Other)	22,462	23,052	22,571	22,695
Organics	51,744	50,242	61,135	54,374
Wasteshed Total	**525,622**	**582,363**	**565,187**	**557,724**

Waste Handling vs. Waste Generation

An important consideration regarding the amount of solid waste in the Wasteshed is the amount of waste generated by residents, businesses and industry, as compared to the amount of waste "handled" as reported in Table 4 above. Given the available data, the best means of estimating the overall amount of waste generated in the Wasteshed is to estimate the amount of waste generated per capita within the Wasteshed, and then multiply that figure by the population in the Wasteshed.

Using the amount of solid waste handled within and reported to the City of Fort Collins and the City of Loveland, we can estimate the amount of solid waste generated within the region in terms of pounds per person per day (PPD). On average in those two cities between 2013 and 2015, there were approximately 315,000 tons of solid waste collected from residents, businesses and industry (not including concrete, asphalt, rock, etc.). When divided by an estimated population of those two cities at 231,000 in 2015, that yields approximately 1.4 tons per person per year, or about 7.5 pounds per PPD. Multiplying those figures by the total County population of approximately 330,000 yields approximately 450,000 tons of solid waste currently generated per year in the Wasteshed. This figure is somewhat less than the amounts listed in Table 4, which is the result of solid waste being imported into the Wasteshed from other areas. Table 5, below, details the projected tons of waste generation in Larimer County resulting from this analysis.

TABLE 5

Projected Larimer County Waste Generation (Tons) Based on Fort Collins and Loveland Per Capita Figures	
Fort Collins and Loveland Reported 2015 Solid Waste Tons	315,603
Fort Collins and Loveland 2015 Population	231,094
Tons per Person per Year	1.4
Pounds per Person per Day	7.5
Larimer County Wasteshed Population	329,559
Larimer County Waste Generation	**450,075**

3.2 Future Waste Handling in the Wasteshed

In order to project the amount of waste that will need to be handled by the Wasteshed in the future, subsequent to the closure of the Larimer County Landfill (around 2025), the following must be considered:

- The amount of waste currently handled in the Wasteshed (from Table 4);
- The degree to which that amount of waste will change over time, which is generally a function of future changes in population (Table 7); and
- The degree to which recovery (e.g., recycling, composting, or other means) of currently-landfilled waste may change over time (Table 8).

This section details each of these variables and provides projections of the future amounts of garbage, recyclables, organics and mixed C&D that may be handled by the Wasteshed.

Population and Waste Handling Growth

As shown in Table 6 and Figure 2, and based on population projection information published by the State of Colorado[7] and the City of Loveland (for Loveland's population only, a 2.6% increase per year), the population of Larimer County is projected to increase 47% by 2040.

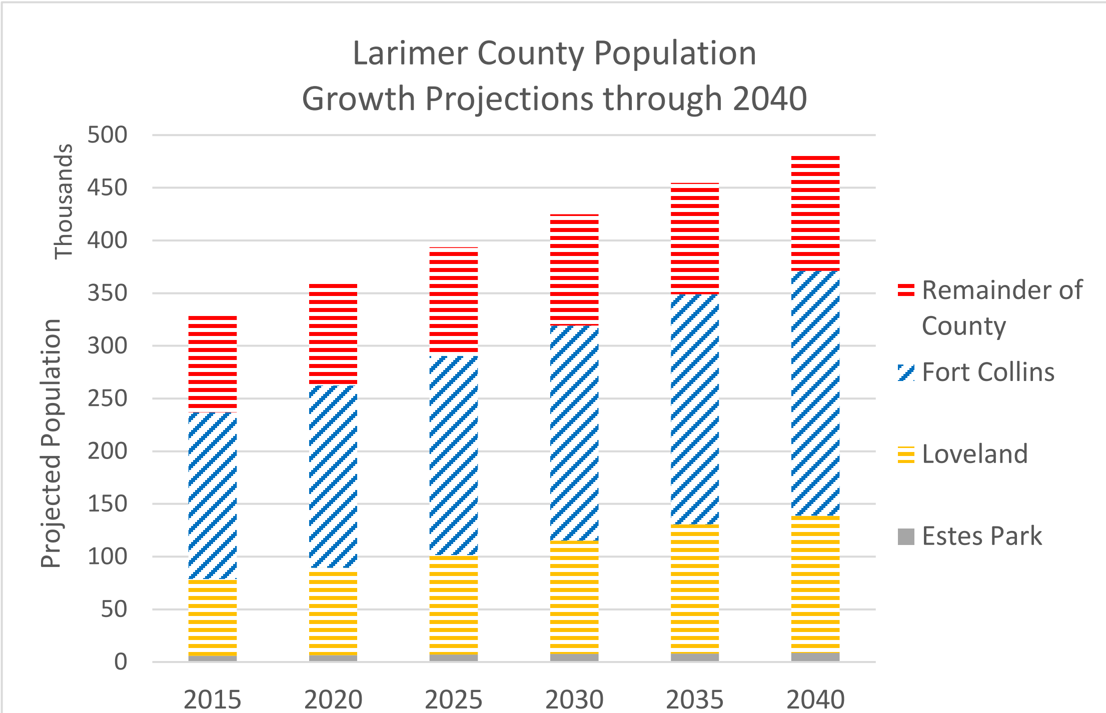
TABLE 6

Larimer County Population
Growth Projections through 2040

Community	2015	2020	2025	2030	2035	2040
Estes Park	5,858	6,407	6,995	7,552	8,081	8,591
Loveland	72,794	82,924	94,463	107,608	122,581	130,328
Fort Collins	158,300	173,131	189,022	204,088	218,359	232,159
Remainder of County	92,607	97,973	103,038	105,634	105,573	112,245
Total	**329,559**	**360,434**	**393,517**	**424,882**	**454,593**	**483,322**
Cumulative Percent Increase	**NA**	**9%**	**19%**	**29%**	**38%**	**47%**

7 https://dola.colorado.gov/demog_webapps/dashboard.jsf?county=69

FIGURE 2



Applying the projected amount of growth (47%) to the 3-year average amount of waste handled in the Wasteshed (Table 4) yields over 800,000 tons of waste handled by the year 2040, as shown in Table 7.[8]

TABLE 7

Wasteshed Handling Projected Tons through 2040						
Waste Stream	**3-Year Average**	**2020**	**2025**	**2030**	**2035**	**2040**
Garbage	441,338	482,686	526,990	568,994	608,782	647,255
Recyclables	62,012	67,821	74,047	79,948	85,539	90,945
Organics	54,374	59,468	64,926	70,101	75,003	79,743
C&D (Mixed)	0	0	0	0	0	0
Total	**557,724**	**609,975**	**665,963**	**719,043**	**769,324**	**817,943**

It is important to note that the modelling used in Table 7 assumes that the Wasteshed will continue to landfill garbage and divert recyclables and organics in the same proportions that were averaged between 2013 and 2015, which may not be the case.

8 It should be noted, however, that population is not a driver for predicting the amount of waste originating from Estes Park. The population figures do not reflect the visitation of tourists, only residents. In 2015 Rocky Mountain National Park had 4.1 million visitations, the third most visited park in the nation; waste disposed of by visitors is handled via the Wasteshed solid waste systems.

It is possible, as a result of continued diversion policy, programs and new initiatives undertaken by Coalition members, that waste currently sent to landfills may be diverted in greater amounts in the future. This potential is analyzed and discussed in the following section.

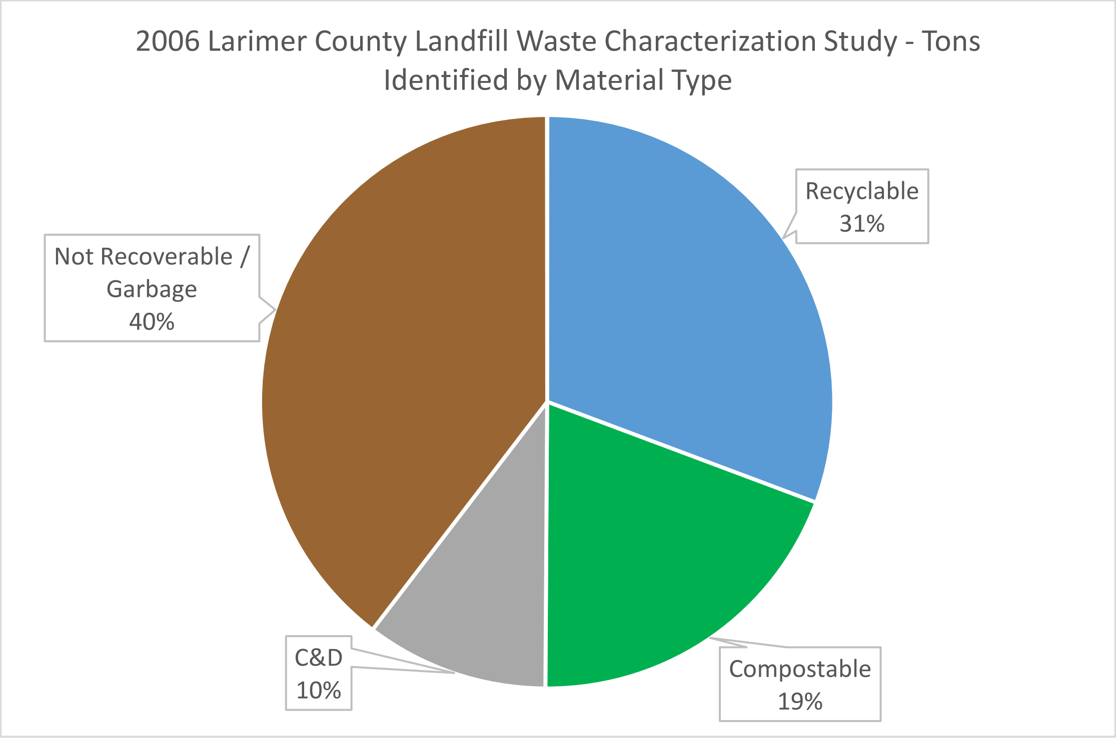
Composition of Landfilled Waste

In 2006, Larimer County commissioned a Waste Composition Study of incoming solid waste at the Larimer County Landfill. That study provided information about the types and quantities of garbage that the landfill receives, and found that of the garbage received by the landfill in 2006:

- 31% could have been recycled by existing recycling programs in the Wasteshed;
- Over 13% was food waste and another 5% was compostable paper, each of which could have been composted or otherwise diverted;
- Over 6% was yard waste, which could have been composted or diverted; and
- 10% was C&D materials (clean wood and block/brick/stone), which could have been recycled.

As such, over 50% of the garbage received at the landfill could have been conceivably diverted from landfills via existing recycling, organics and C&D programs. Figure 3, shows the overall results of the 2006 study. 60% of the materials that were received for disposal at the Larimer County Landfill were characterized as recoverable via recycling, composting, or C&D recovery, with the remaining 40% more suitable for landfilling given the existing recycling, composting and recovery infrastructure in the Wasteshed. This suggests that, even without new types of infrastructure, there is potential for future capture or additional recycling of materials that are currently landfilled and categorized as garbage.

FIGURE 3



Section 3

Current and Future Waste Handling

Projected Waste Handling with Increased Landfill Diversion

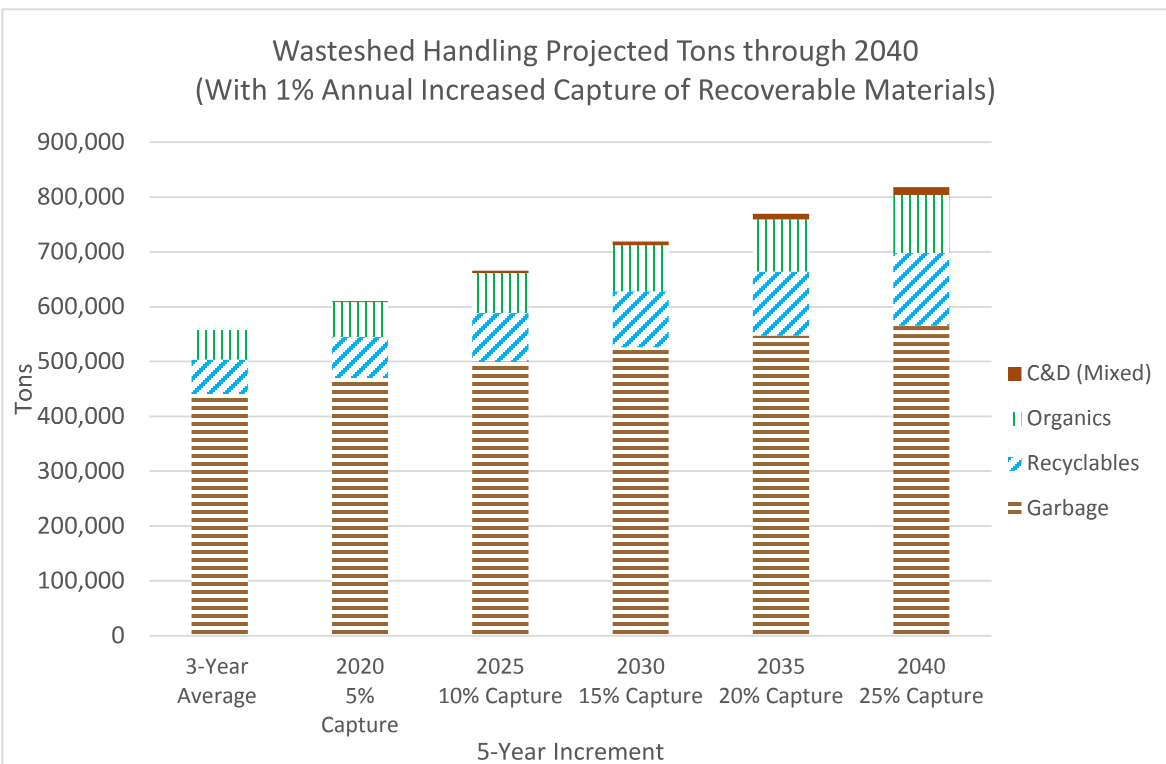
Table 8 and Figure 4 show how the amounts of waste, by waste stream, would change if policies, programs and new infrastructure were effective at incrementally capturing 5-25% of the 60% of recoverable materials (i.e., materials with the potential to be collected as recyclables, organics or C&D) that are currently disposed of as garbage at the Larimer County Landfill. Capturing additional divertible materials could decrease the amount of needed landfill capacity by over 80,000 tons in 2040 (a 13% reduction over the status quo scenario presented in Table 7). However, this would necessitate a corresponding increase in infrastructure for recyclables, organics and C&D diversion capacity (a 46% increase in capacity for those waste streams overall).

TABLE 8

Wasteshed Handling
Projected Tons through 2040
(With 1% Annual Increased Capture of Recoverable Materials)

Waste Stream	3-Year Average	2020 5% Capture	2025 10% Capture	2030 15% Capture	2035 20% Capture	2040 25% Capture
Garbage	441,338	470,489	500,358	525,860	547,249	565,479
Recyclables	62,012	74,021	87,583	101,872	116,815	132,510
Organics	54,374	63,385	73,480	83,955	94,767	106,009
C&D (Mixed)	0	2,080	4,542	7,355	10,493	13,945
Total	**557,724**	**609,975**	**665,963**	**719,043**	**769,324**	**817,943**

FIGURE 4



4 Opportunities Assessment

This section identifies the gaps between future waste generation and the ability of current infrastructure to handle and process that amount of waste, subsequent to the closure of the Larimer County Landfill.

4.1 Ability of Current Infrastructure to Meet Future Waste Handling Needs

Current infrastructure for garbage, recyclables, and organics is generally sufficient to meet the current waste handling needs in the Wasteshed. However, upon closure of the Larimer County Landfill around 2025, not only will the solid waste infrastructure need to handle the 20% increase in solid waste from population growth, but it will also need an alternative place to take the waste that would otherwise have been disposed of at the Larimer County Landfill (roughly 415,000 to 440,000 tons annually). This section describes whether and how each main element of the current infrastructure in the Wasteshed can meet waste handling needs in 2025 and beyond.

Transfer Stations

Current infrastructure for transferring solid waste from collection and self-haul vehicles is limited and, even assuming the County retains its transfer station after landfill closure, will not be sufficient to handle the Wasteshed's future waste streams.

All of the garbage transfer stations (Estes Park, Berthoud, Wellington and Red Feather Lakes) are small and set up to direct waste to the Larimer County Landfill, not away from it. Recycling transfer stations (including the above and the Fort Collins' Timberline Recycling Center and Loveland Recycling Center, and the larger transfer station at the Larimer County Recycling Station) could potentially handle slightly greater amounts of recyclables, but are not designed to handle much more volume or handle recyclables from private haulers (except for the Larimer County Recycling Station).

There are three organics transfer stations operating in the Wasteshed: Loveland's drop off facility, which is operating near maximum capacity, Weitzel's and Hageman's Earth Cycle, none of which have potential for significant expansion. There is currently no transfer station capacity for C&D materials in the Wasteshed, and there is no known transfer capacity for any of these streams within a reasonable distance outside of the Wasteshed.

Processing Infrastructure

While regional landfill infrastructure (one active landfill in Larimer County and four in neighboring counties) could be sufficient to handle future amounts of garbage generation in the Wasteshed, current recyclables and organics processing infrastructure is limited and there is no infrastructure for processing of mixed C&D materials.

Of the three primary recycling processing facilities in or near the Wasteshed, Waste-Not-Recycling has some additional capacity to process additional recyclables. There is also some additional processing capacity being added to the County Recycling Station that would allow on-site separation and marketing of cardboard and other fiber materials, but this does not add to that facility's capacity for accepting a greater amount of recyclables. Overall, none of the recycling facilities are currently set up or designed to accept significant increases in the amount of recyclables they could accept.

Organics processing in the region is similarly limited with few recognized organics processing facilities operating in the Wasteshed. The City of Fort Collins' Drake Water Reclamation Facility has the ability to accept source-separated food scraps, and could potentially increase the amount of food scraps accepted in the future, for anaerobic digestion. There are a few local dairies and farms that currently are permitted by the State to compost, and some that take green waste from solid waste collectors. However, none of these are known to have significant opportunities for expansion or increased acceptance of organics. Organics processing facilities operating in nearby Weld County could accept significantly more material, most notably A-1 Organics in Eaton and the Heartland bio-digester facility, southeast of Greely.

4.2 Opportunities for Additional Infrastructure

By 2040, unless all solid waste collectors direct-haul their solid waste to other regional landfills, there will likely be a significant need for more facilities to handle solid waste in the Wasteshed. Overall, by 2040, even if 25% more garbage were shipped to other area landfills, there will likely be an opportunity to provide for handling of approximately 475,000 tons per year of garbage. Similarly, assuming that current transfer and processing infrastructure for recyclables and organics could enhance handling and processing capacity by 25%, there will likely be a need for additional recyclables and organics transfer and processing capacity in 2040.

In all, there is an opportunity in the Wasteshed for additional transfer and other solid waste infrastructure to handle approximately 582,000 tons per year across all waste streams in 2040, even if current infrastructure increases its handling capacity as noted above. This is summarized in Table 9, below, which shows the estimated difference between the Wasteshed's 2040 handling needs and the ability of current infrastructure (with 25% enhancements) to meet those needs.

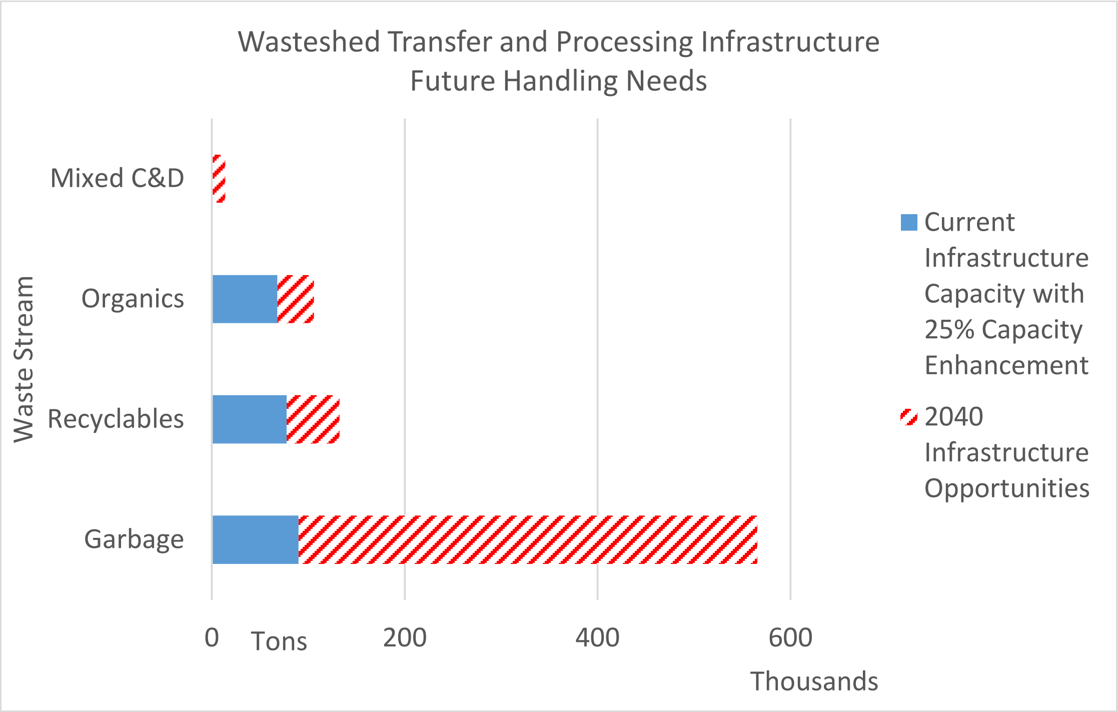
TABLE 9

Wasteshed Transfer and Processing Infrastructure
Estimated Annual Capacity (Tons)

Waste Stream	Current Infrastructure (Excluding Larimer County Landfill)	Current Infrastructure Capacity with 25% Capacity Enhancement	2040 Future Handling Needs	2040 Infrastructure Opportunities
Garbage	72,065	90,081	565,479	475,397
Recyclables	62,012	77,515	132,510	54,995
Organics	54,374	67,967	106,009	38,042
Mixed C&D	0	0	13,945	13,945
Total	**188,451**	**235,563**	**817,943**	**582,380**

Figure 5 further illustrates the gap between the ability of current solid waste infrastructure (with 25% enhancement in capacity) to meet the Wasteshed's 2040 solid waste handling needs.[9] The red (diagonal pattern) portions of each bar represent the overall level of opportunity to provide additional local transfer, processing and disposal infrastructure within the Wasteshed.

FIGURE 5



---

9 These calculations are based on the assumption that not all solid waste collectors will direct-haul garbage to other area landfills and that recovery rates of recyclable, organic and C&D materials will increase by approximately 1% per year, achieving up to 25% recovery of currently landfilled (but recoverable) materials by 2040.

This page intentionally left blank.

5 Feasible Options

This section identifies and describes the feasible options that the Coalition might consider for future handling of solid waste in its planning for the closure of the Larimer County Landfill.

5.1 Overview

The North Front Range Regional Wasteshed Coalition has a variety of disposal and diversion-based solid waste management options when the Larimer County Landfill closes. Provided in this section are alternatives for disposal, transfer and processing facility infrastructure elements that could be feasibly implemented within the Wasteshed. In defining these alternatives, R3 assessed the following considerations:

- Estimated costs for implementing strategies that involve the development of infrastructure, including initial capital, operating expenses, and potential changes in monthly solid waste rates paid by residents;
- Policy foundations needed to implement each;
- Benefits and drawbacks that the Coalition may expect to encounter as a result of pursuing each alternative;
- Changes in greenhouse gas emissions resulting from solid waste transportation and diversion of solid waste materials; and
- Other considerations.

Options Can Be Iterative

The options described below are able to be combined to varying degrees; some can be implemented as standalone activities (most notably the Central Transfer Station and New Landfill alternatives) or in combination with others. It should be noted that most of these undertakings would benefit from implementation of a Central Transfer Station. If the Coalition chooses to pursue a Central Transfer Station, other options could be considered, funded, and implemented iteratively as determined to be feasible. Construction of a Central Transfer Station in the near term could lengthen the remaining life of the Larimer County landfill, and could provide contingency capacity as needed (e.g., in the event of additional debris from flooding, or delays in developing other infrastructure).

Cost Estimate Disclaimer

Cost estimates provided in this section are not quotes but rather are estimates based on the professional experience of R3 and sub-consultant Sloan/Vazquez/McAfee. Actual costs will vary depending on facility scale, scope, design, and timing of construction. Operating costs stated below are inclusive of annual amortization of financing amounts for initial capital investments as well as annual operating costs (but not depreciation/replacement costs of new facilities). Projections of monthly cost per household are range estimates based on the assumption that households will bear the cost of 25-50% of the new infrastructure (in proportion to their total share of the waste stream compared to business and industry) with those costs being distributed evenly among 136,000 households.

5.2 Status Quo (No Action Taken Upon Closure of County Landfill)

Description

In this scenario, no decisions are made to change the current trajectory of the solid waste landscape in the Wasteshed, the Larimer County Landfill closes, as projected, and no additional County facilities, including a new landfill, are built. In this case, the Wasteshed's garbage would most likely be directed by solid waste collectors and self-haulers to one of the nearest alternative landfills (North Weld Landfill, Denver Regional Landfill, Front Range Landfill, Buffalo Ridge Landfill, or Tower Road Landfill). Altogether these landfills have adequate available capacity to accept garbage generated in the Wasteshed.

Estimated Costs

For the status quo, there would be no cost of constructing or operating additional infrastructure in the Wasteshed. However, there would be increased costs of transportation for some or all solid waste collectors operating in the Wasteshed, as well as potential increased costs of disposal at other area landfills. These values have not been estimated by this Study, as current solid waste collector costs are not known, and it is not possible to predict the future cost of landfilling after the Larimer County Landfill closes. As such, it is important to recognize that, because the cost of collection and landfilling are likely to increase under this scenario, monthly customer rates will almost certainly increase. As the Coalition further considers future Wasteshed infrastructure needs, it may wish to consider a cost study to specifically evaluate these potential increases as a baseline against which the cost of new infrastructure can be measured and explained to the community.

Benefits

In the event that no action is taken and the Larimer County Landfill closes, land already purchased by Larimer County could become available for other uses.

Drawbacks

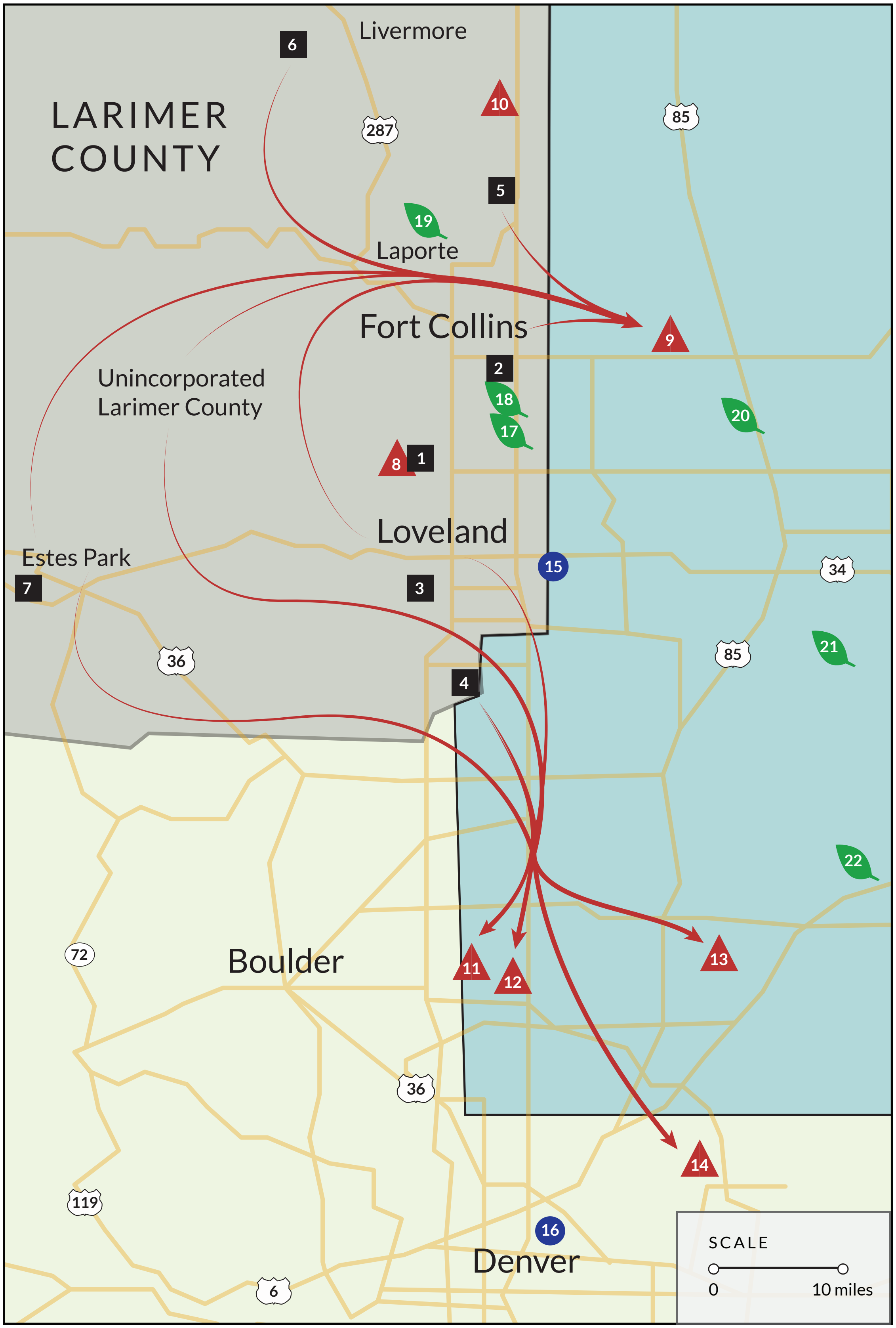
Choosing to do nothing, including not building a new landfill, may lead to increasing the cost of disposal fees at other landfills, due to lack of competition from the current low-cost Larimer County Landfill. In the event of natural disasters (such as the flood in 2013 which generated a large volume of contaminated organic waste), the Coalition may be faced with expensive disposal fees if the only choices for disposal are private landfills. Due to the increased travel distance for transporting more solid waste to North Weld Landfill, an *additional* 6,000 metric tons of carbon dioxide equivalent (CO2E) would be emitted into the atmosphere, the equivalent of an additional 1.2 million cars on the road per year.[10] Additionally, landfill gases are not captured by the North Weld Landfill, which would increase greenhouse gas (methane) emissions from waste landfilled at that location, although this impact was not quantified for this Study.

---

[10] CO2E impacts developed in keeping with the Environmental Protection Agency (EPA) Waste Reduction Model (WARM). Equivalent impacts of CO2E based on 211 cars per year per metric ton of CO2E (MTCO2E), and are rounded to the nearest thousand.

NORTH FRONT RANGE WASTESHED FACILITY MAP

Status Quo - No Action Taken Upon Closure of County Landfill



MAP KEY

Garbage

TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

5.3 Central Transfer Station

Description

The Coalition may consider building a regional transfer station, adjacent to the existing Larimer County landfill, for the purpose of accepting garbage, recyclables, organics and C&D material. Although there are small-scale drop-off facilities in Estes Park, Loveland, Fort Collins, and at Waste-Not Recycling, the Wasteshed currently lacks large-scale regional transfer capacity for garbage, organics and C&D material, and has only one medium-scale transfer station for single-stream recyclables, located at the current Larimer County Landfill site.

One possible design for a transfer station would be to provide a one-stop location for all four commodity types, with distinct staging areas for unloading and briefly storing separated material. The material would then be loaded into long-haul vehicles and delivered to a processing facility for recovery, or to a disposal facility. This alternative could direct waste materials to other landfills, recycling and organics facilities in and outside of the Wasteshed. It could be built before the closure of the Larimer County Landfill, which would provide additional options for collecting waste and help extend the life of the current Larimer County Landfill. A map on page 30 illustrates the potential flow of waste that could result from constructing a Central Transfer Station.

Estimated Costs

A new transfer station located adjacent to the current Larimer County Landfill site, if designed to transfer the approximately 720,000 tons per year[11] that are estimated for 2040, would have an initial capital cost of nearly $20,000,000 and an annual operating cost (which for all estimates in this section includes amortization of capital costs) of over $15,000,000. Please note that the 720,000 tons per year figure is in keeping with the projected 2040 tons values listed in Tables 7 and 8 on pages 18 and 20, but assumes that approximately 100,000 tons of garbage generated within the Wasteshed would be directed to other area landfills (in keeping with current trends. The same is true of the other facility capacity projections in this Study.

Per ton fees to cover the costs of the facility are estimated to be $22 per ton, which would be in addition to fees charged at receiving landfills, or recycling, composting and/or C&D facilities. The estimated monthly cost per household in Larimer County (not including additional fees for landfilling and diversion processing) would be approximately $2-$5 per month. This amount would need to be added to the landfill or processing amounts for the total impact to households.

Benefits

- A central transfer station would allow convenient delivery and drop-off of material by self-haul customers as well as commercial collection vehicles;
- Could facilitate increased diversion by providing more choices for garbage, recyclables, organics and C&D;

---

[11] Tonnage capacity or "throughput" estimates for all facilities are based on future waste handling needs and assume modest increases in the amounts of materials diverted from landfills. All throughput estimates used are rounded to the nearest ten thousand. Throughput estimates for all options listed in this section are included in Table 10.

- Would allow usage by more types of waste hauler vehicles (i.e., "split" vehicles for collection of more than one type of commodity in each truck);
- Would potentially provide for more consistent collection routes for waste haulers, as they could choose to send all trucks to one centralized facility;
- Long-haul vehicles are able to be loaded to maximum capacity, which reduces vehicle miles traveled fuel costs, and greenhouse gas (GHG) emissions; and
- Would *reduce* CO2E emissions by an estimated 48,000 metric tons per year, which is the equivalent of taking 10 million cars off the road each year.

Drawbacks

- Directing four types of solid waste to one location requires additional vehicles for both inbound and outbound tonnage, which could create heavy vehicle traffic and require upgrades to roads, throughways and intersections; and
- Transferring heavy, bulky C&D material damages waste hauling trucks, significantly shortening their useful life and increasing maintenance costs in comparison to hauling non-C&D materials.

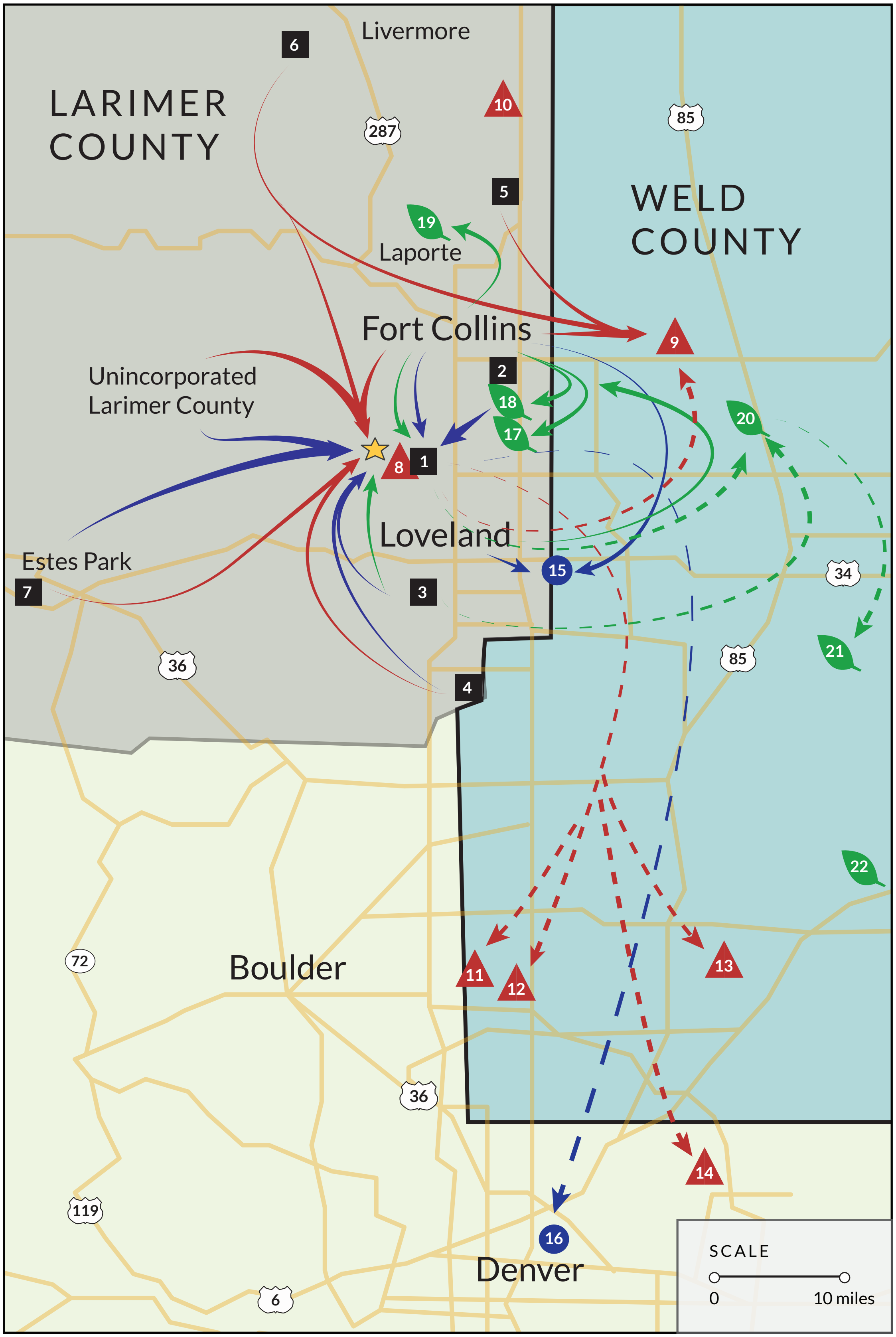
Other Considerations

The current County landfill location is desirable for a transfer station due to its centralized location between Fort Collins, Loveland, Estes Park and unincorporated Larimer County. The Larimer County Landfill site is already home to the Recycling Station. The site may require infrastructure improvements to accommodate increases in traffic from self-haul customers and commercial waste trucks transporting additional materials. The current landfill is a convenient location: waste haulers and self-haul customers already deliver material there, which reduces the chance of losing customers due to relocation. Any transfer station would need to contain a large covered and paved space for separated materials.

The photo below depicts a "pit" style transfer station where waste is unloaded by self-haulers and waste hauler trucks, emptied into various pits and then delivered by long-haul trucks to final processing facilities.

NORTH FRONT RANGE WASTESHED FACILITY MAP

Central Transfer Station



MAP KEY

- Garbage
- Recyclables
- Organics
- Long-Haul Truck
- New Potential Central Transfer Station

TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

5.4 New County Landfill

Description

This option involves the County, potentially with other Coalition members, building a regional landfill on County-owned land north of Fort Collins that was specifically purchased by Larimer County in 2006 to accommodate the future disposal needs of the Wasteshed. A new regional County landfill would have the potential to service Fort Collins, Estes Park, Loveland, unincorporated Larimer County and other jurisdictions in Colorado and Wyoming. It could also potentially facilitate additional functions such as a transfer station or material recovery facility (MRF). A map of the possible flow of waste to this new landfill location is included on page 33.

Estimated Costs

A new landfill at the northern location already owned by the County, designed to accept the 460,000 to 540,000 tons of solid per year estimated for in-County disposal for 2040, would have an initial capital cost of $15,000,000 and an annual operating cost of over $10,000,000. Per ton disposal fees to cover the costs of the facility are estimated to be $20 per ton at the facility (not including costs to transfer or transport garbage to the landfill). The estimated monthly cost per household in Larimer County would be approximately $2-$3 per month.

Benefits

- Would provide waste haulers and customers with more choices for garbage disposal, thus maintaining landfill competition and potentially helping to keep disposal fees low;
- A County-owned landfill would allow for adequate solid waste tracking and monitoring, and ensure that the waste disposal is well-managed in a way that considers the best interests of the community;
- Could provide continued financial benefits to the County, especially in the event of a natural disaster that causes a large volume of material to be disposed;
- Would keep revenue generated from disposal fees in-county; and
- Could be designed to include additional diversion elements, such as a composting facility.

Drawbacks

- There is no guarantee that material will be directed to a new County Landfill by waste haulers, especially considering that the location of County-owned property near the Town of Wellington is equidistant to the Front Range Landfill from Loveland and Estes Park, and farther than the North Weld Landfill from these communities.
- A new landfill alone (without additional diversion elements) does not facilitate increases in the diversion of recoverable materials; and
- Due to the longer distances from some communities in the Wasteshed, could *increase* CO2E emissions by 1,000 metric tons per year, which is the equivalent of an additional 210,000 cars on the road each year.

Other Considerations

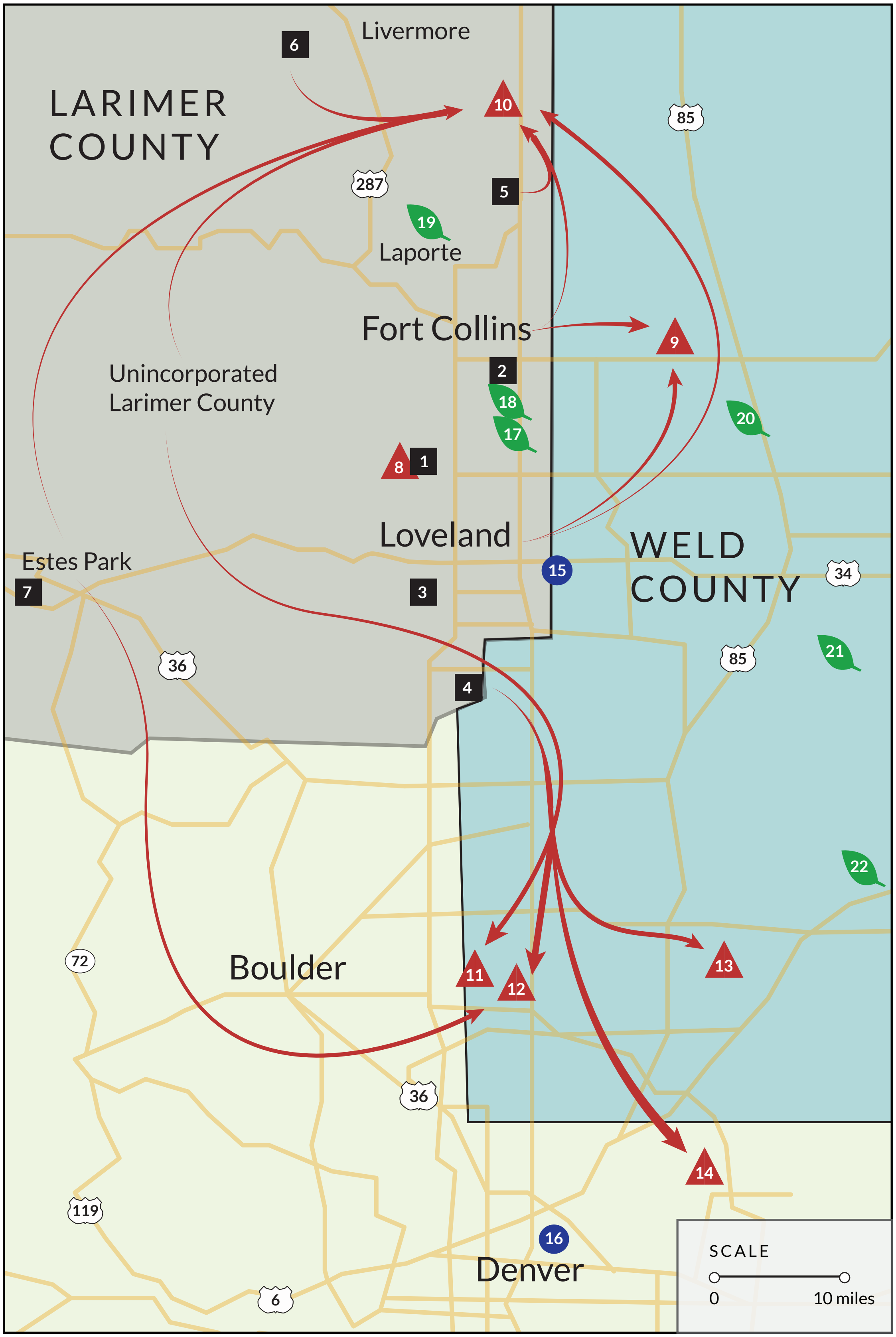
In 2006 Larimer County purchased a 640-acre section at the intersection of County Roads 76 East and 11 North. This potential site for a new lanfill near the Town of Wellington and north of Fort Collins has relatively few neighbors in the surrounding area. The low water table at this site would meet state and federal regulations. Access to county roads is reasonably good. Other locations could be considered, but finding a location that meets these requirements and is not yet developed or privately purchased may be difficult.

A new County landfill could expand the lifespan of the current Larimer County Landfill if built and operating prior to its closure. However, due to the planning horizon needed to design and build a new landfill (five to ten years), and the uncertainty around design, planning and permitting processes, it is possible that a new landfill might not be operational before the current landfill closes.

The photo below depicts the actual property owned by the County as the potential site for a new County landfill. The site is bisected by high-tension power lines, is bordered by roads on all sides, and has relatively few neighbors.

NORTH FRONT RANGE WASTESHED FACILITY MAP

New County Landfill



MAP KEY

Garbage

■ TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

5.5 Materials Recovery Facility (MRF)

Description

This option involves building and operating a new regional materials recovery facility, which may be built in conjunction with other alternatives. The purpose of this facility would be to process recyclable material from the Wasteshed as the final contact point before sending it out to end markets. A materials recovery facility could be designed to accommodate mixed loads of recyclables (e.g., "single-stream" from curbside collection routes) or to process combined loads of mixed solid waste, inclusive of garbage, recyclables and organics. A map of the possible flow of waste to a MRF is included on page 36.

Single-Stream Processing Facility ("Clean" MRF)

A "clean" MRF could be built to almost any size specification for accepting and processing commingled or source-separated recyclables from curbside collection programs, drop-off sites or transfer stations. A small MRF has the ability to process 50 tons of recyclables per day whereas larger facilities process between 200 and 300 tons of recyclable material per day. A clean MRF can recover up to 90 percent of recyclable material.

The Recycling Station at the current landfill site was originally built as a MRF but was transitioned into primarily serving as a transfer station by WM. It was transitioned to a transfer station in 2003 in order to facilitate handing and processing of single-stream recyclables.

Mixed-Waste Processing Facility ("Dirty" MRF)

A "dirty" MRF has the potential to process between 200 tons of mixed solid waste per day for smaller facilities, up to 700 tons of material per day for larger facilities. Average recovery rates for a dirty MRF are between 5% and 45% of incoming material, meaning that 55%-95% of material does not get diverted.

Estimated Costs

A clean MRF designed to process the 91,000 to 132,000 tons of "conventional" recyclables per year that are estimated for 2040 would have an initial capital cost of nearly $30,000,000 and an annual operating cost of over $10,000,000. Per ton disposal or processing fees to cover the costs of the facility, including the processing costs, are estimated to be $95 per ton. The estimated monthly cost per household in Larimer County would be approximately $2-$3 per month.

A dirty MRF designed to process the nearly 700,000 tons of mixed solid waste per year that are estimated for 2040, would have an initial capital cost of nearly $85,000,000 and an annual operating cost of over $60,000,000. Per ton disposal or processing fees to cover the costs of the facility are estimated to be $87 per ton, which also includes all processing costs. The estimated monthly cost per household in Larimer County would be approximately $9-$19 per month.

Benefits

- Would provide an increase in recyclable material recovery infrastructure, which would increase diversion;

- Would keep revenues/costs in-county by capturing the recyclable material commodities, rather than delivering them for private MRF processing;
- May be able to tailor sorting and acceptable materials to benefit local end markets (i.e., support a local circular economy with recovered materials remanufactured locally); and
- Estimated to *reduce* CO2E emissions up to 48,000 metric tons per year, which is the equivalent of taking approximately 10 million cars off the road each year.

Drawbacks

- Lack of transportation infrastructure would make delivering recyclable material to end markets difficult (i.e., there is no rail for delivering by train, one-lane roads could cause slow delivery, Wasteshed not located near a port, etc.);
- Processing recyclable material is generally a more expensive operation than landfilling, especially for a dirty MRF; and
- Fluctuating commodity prices/demand would make it difficult to predict return-on-investment and brings a larger element of risk.

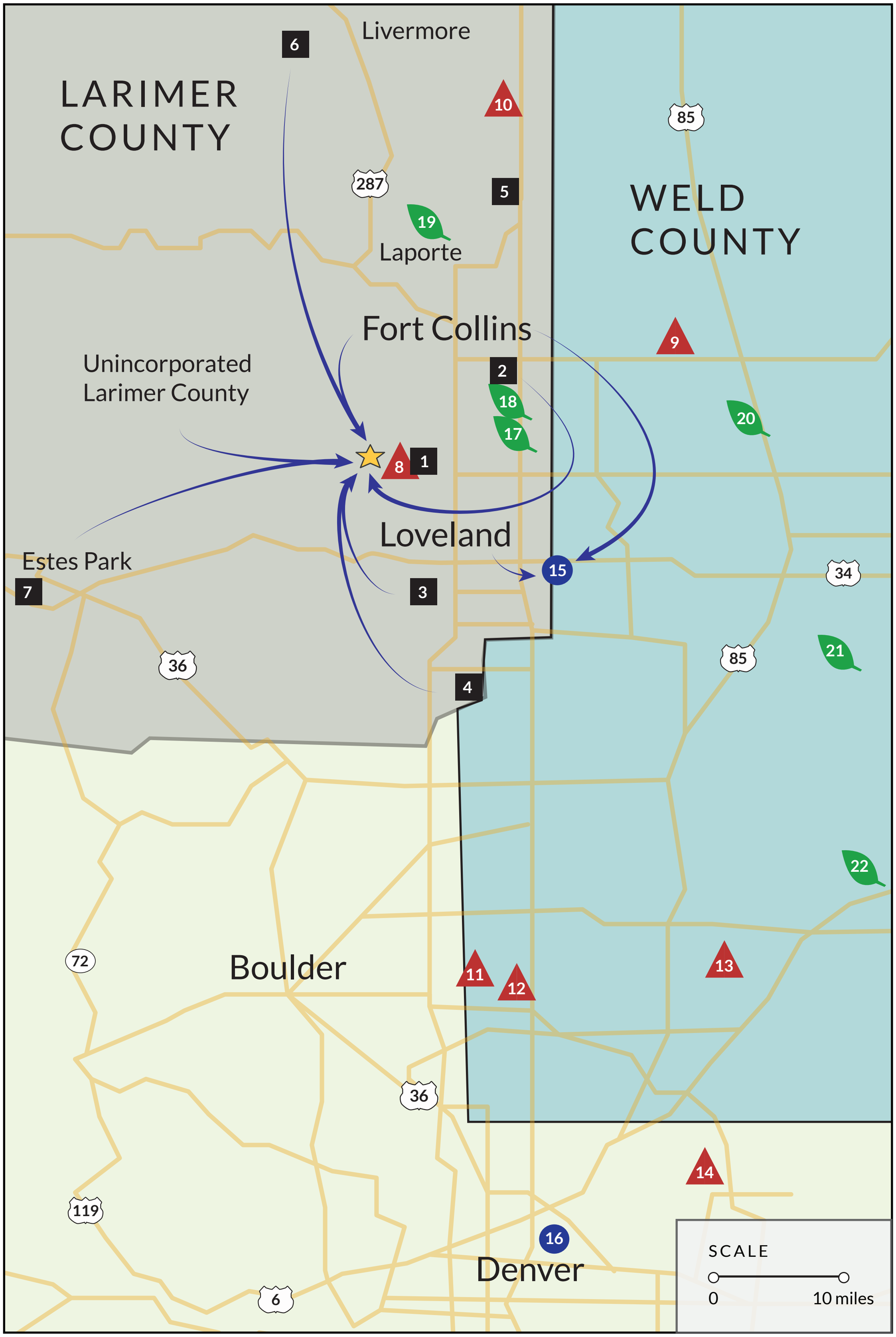
Other Considerations

The County's current landfill is a viable site for a MRF due to its central location and some existing equipment for "baling" recyclables. If the Coalition was to consider this location, infrastructure improvements would be necessary, such as road expansions, adding new intersection traffic control lights, and possibly building a rail line for shipping final material to end markets.

Below is a photo of a typical "clean" MRF sorting line, where recyclable material is sorted out by type and then baled or consolidated for shipping to market.

NORTH FRONT RANGE WASTESHED FACILITY MAP

Materials Recovery Facility



MAP KEY

Recyclables

New Potential County MRF

TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

5.6 Organics Composting Facility

Description

Although the Wasteshed currently has a variety of organics processing facilities, a new, centralized organics composting facility is an alternative for the regional Coalition to consider. A compost facility may be used in conjunction with a waste-to-energy site, such as the recently-opened Heartland facility, in central Weld County. This new anaerobic digestion (AD) system processes food waste into pipeline-ready biogas, which is purchased by a Sacramento, CA utility company, on a 20-year contract. Other options include an "aerated static pile" compost facility, which takes between three and six months for material to break down into compost. "Aerated windrow" composting is another method used to process high volumes of mixed organics material. A map of the possible flow of waste to this new composting facility location is included on page 39.

Estimated Costs

A new compost processing facility designed to compost the 80,000 to 106,000 tons of organic material per year that are estimated for 2040 would have an initial capital cost of $4,000,000 and an annual operating cost of nearly $5,000,000. Per ton disposal or processing fees to cover the costs of the facility are estimated to be $52 per ton. The estimated monthly cost per household in Larimer County would be approximately $1 per month.

Benefits

- Would increase waste diversion from landfills by providing a processing facility to handle large volumes of organics;
- Would establish the infrastructure necessary for possible future diversion policy, such as requiring curbside or commercial organics to be collected separately;
- Could allow revenue to be kept in-county by recovering, processing and delivering organics to end markets as compost products;
- Would provide an end-market product beneficial to the region's farmers, gardeners and landscapers as soil enhancement, as well as for road projects and natural area restoration;
- Could accept digestate from waste-water treatment plants;
- Would provide a closer, more convenient location for local waste haulers to deliver organics, including the City of Loveland;
- Could motivate other Larimer County communities and haulers to start organics collection/drop-off programs; and
- Estimated to *reduce* CO2E emissions by 4,000 metric tons per year, which is the equivalent of taking nearly 850,000 cars off the road each year.[12]

[12] It should be noted that the EPA WARM model may under-represent the amount of CO2E emission reductions that could be realized from diverting and composting organic materials. Future updates to the EPA WARM model are expected to yield different results that may indicate a greater emissions reduction than stated here.

Drawbacks

- There is adequate organics processing capacity currently, thus making an organics processing facility not entirely necessary to meet current supply levels; and
- Would be in direct competition with regional compost processing facilities such as A-1 Organics and organics transfer operations such as Hageman's Earth Cycle and Weitzel's.

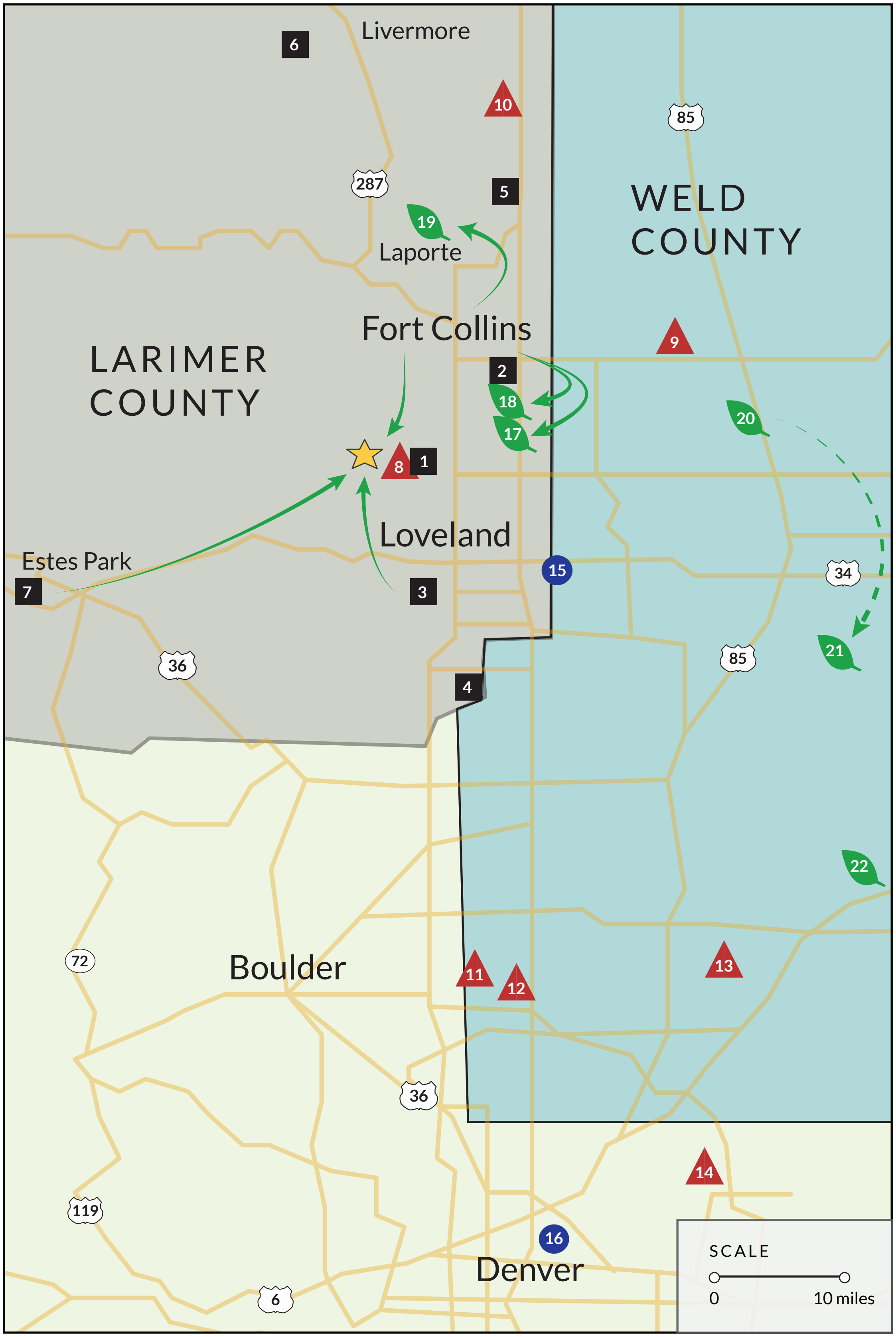
Other Considerations

The County's current landfill is a viable location for a compost processing facility due to its centralized location and ample space. Limiting factors include the proximity to neighbors, who may object to odors that are a result of compost activities. Additionally, potential water run-off issues may affect neighbors' water supply, as the location has low water tables. There is also the potential for a compost facility to be sited at the same location as a new landfill.

The photo below depicts an example of a large-scale composting facility operating on the top of a closed landfill. This composting facility processes mixed loads of residential, commercial, and industrial organics including green waste and food waste. The resultant compost is used in landscaping and for agricultural amendments.

NORTH FRONT RANGE WASTESHED FACILITY MAP

Organics Processing Facility



MAP KEY

Organics

New Potential County Organics Processing Facility

TRANSFER STATIONS

1) Larimer County Recycling Center
2) Fort Collins Timberline Recycling Center
3) Loveland Recycling Center / Green Waste Drop-off
4) Berthoud Transfer Station
5) Wellington Transfer Station
6) Red Feather Transfer Station
7) Estes Park Transfer Station

LANDFILLS

8) Larimer County Landfill
9) North Weld Landfill
10) Larimer County North Landfill (undeveloped)
11) Front Range Landfill
12) Denver Regional Landfill
13) Buffalo Ridge Landfill
14) Tower Road Landfill

RECYCLING PROCESSING FACILITIES

15) Waste-Not Recycling
16) Franklin Street MRF

ORGANICS PROCESSING FACILITIES

17) Drake Water Reclamation Facility
18) Hageman's Earth Cycle Inc.
19) Local Dairies
20) A-1 Organics (Eaton)
21) Heartland Biogas Facility
22) A-1 Organics (Rattler Ridge)

5.7 C&D Processing Facility

Description

This option involves building and operating a construction and demolition (C&D) processing facility to receive and process source-separated or mixed loads of C&D material. With the exception of the large amounts of concrete, asphalt and aggregate recycled at local operations in Fort Collins and Loveland (such as the City of Fort Collins' Hoffman Mill Road Facility), much of the Wasteshed's C&D material is currently landfilled. There is currently no regional facility for separating mixed loads of C&D. A C&D processing facility would allow for material from construction and demolition sites to be diverted from landfills by providing a staging area and/or sorting line, either indoors or outdoors, to recover certain materials. Due to weather conditions in the region, an outdoor processing line may be difficult to operate year-round.

The City of Fort Collins currently has a building code that requires four materials to be diverted from landfills (wood, metal, cardboard, and aggregates). Requiring construction projects to meet certain diversion requirements may provide a greater supply of mixed C&D material loads to a processing facility.

Constructing a C&D facility may occur in conjunction with other alternatives, such as locating it at a transfer station. This would allow material to be processed in place rather than transferring it or redirecting the material to a landfill. A C&D processing facility that doesn't require the material to go through a transfer station prior has the potential to keep costs at a minimum. This is an additionally valuable option to the Coalition considering the recent and continued commercial and residential growth in the region.

Estimated Costs

A new C&D processing facility located adjacent to the current Larimer County Landfill if designed to process the 14,000 (or more) tons per year of C&D material that are estimated for 2040, would have an initial capital cost of nearly $4,000,000 and an annual operating cost of approximately $1,000,000. Per ton disposal or processing fees to cover the costs of the facility are estimated to be $52 per ton. The estimated monthly cost per household in Larimer County is less than $1 per month.

Benefits

- Would provide a unique avenue for C&D mixed-material processing, which is currently nonexistent in the Wasteshed;
- Would increase diversion of solid waste from landfills;
- Would enable haulers to provide an additional service to their commercial customers – collection and diversion of mixed C&D material from building projects;
- Recycled C&D material can provide a benefit to the community by providing a generally cheaper choice than using virgin materials for building projects;
- Would establish the infrastructure necessary for possible future diversion policy, such as requiring diversion from C&D projects, and would allow builders to more easily comply with ordinances in some jurisdictions; and

- Is estimated to *reduce* CO2E emissions by 1,000 metric tons per year, which is the equivalent of taking nearly 210,000 cars off the road each year.

Drawbacks

- This facility is unlikely to be profitable enough to attract strong public-private partnerships. As such, this facility ought to be considered as an ancillary facility to one of the others listed above.

Other Considerations

If a C&D processing facility was built within the next five years it could extend the lifespan of the landfill. C&D makes up a large portion (by volume) of what is disposed in the Larimer County Landfill and a processing facility has the ability to capture and divert much of that material. The Larimer County Landfill is a viable location for a regional C&D processing facility due to its central location and its close proximity to a large portion of the commercial and residential development in the region.

The photo below shows a mobile C&D processing facility where mixed loads are dumped on the ground, loaded onto a conveyor, and hand sorted into separate bins by sorters.

5.8 Waste-to-Energy Facilities

Constructing a waste-to-energy (WTE) facility would allow the Coalition to (potentially) gain revenue for garbage material by capturing, processing and selling or using the energy released during the "conversion process." A regional WTE facility may produce energy to be used within the Wasteshed by the Platte River Power Authority, or to be sold to out-of-county companies. More information about WTE facilities, in a 2012 report commissioned by the City of Fort Collins, is provided in Appendix E.

Anaerobic Digestion (AD)

Anaerobic digestion is the biological breakdown of organic materials in the absence of oxygen, which allows methane and carbon to be captured and used as a fuel to generate energy. As a result of this process, a digestate material is produced that can be used as a soil amendment or composted. This option is less feasible for the processing of municipal solid waste than other compost processes due to its expensive capital costs and unreliable operating variables such as quality of feedstock, end markets, etc.

Biomass Conversion

Biomass conversion is the controlled combustion of wood, when separated from other solid waste, for producing electricity or heat. Non-woody materials such as those in garbage and recyclables and non-wood organics tend to produce a lot of ash in a biomass burner and are not considered to be desirable feedstock.

Pyrolysis[13]

Pyrolysis systems use thermal energy to break down solid waste in the absence of oxygen. This process is used for the production of fuel liquids or pyrolysis oils. It also produces certain gases and a solid "biochar" product that can be used directly as a soil amendment or refined for other uses. Some pyrolysis products may be toxic or corrosive. Both pyrolysis and gasification produce a significant volume of byproduct, which must be disposed of in landfills.

Gasification

Gasification is the thermal decomposition of solid waste material (primarily woody materials or others such as tires) through the application of heat with the partial addition of extra air or oxygen, which produces a gaseous, fuel-rich product that contains carbon monoxide, hydrogen, methane and other lighter hydrocarbons. It also produces liquids such as tars or oils and soil amendments like biochar and ash. The gases are combusted to produce steam or electricity for power generation. Bio-gasification is the same process as gasification, without adding heat to the garbage; however, it is less efficient than thermal gasification. The high quality of gaseous outputs and the lower facility costs makes gasification a more viable alternative than anaerobic digestion for managing the disposal of municipal solid waste.

Estimated Costs

Annual operating costs for a new WTE facility designed to process approximate 50,000 tons per year of wood or other appropriate WTE source material "feedstock" are estimated to be

13 R3's research indicates that pyrolysis may not yet be viable for many large scale applications.

$20,000,000 to $25,000,000, depending on the type and amount of feedstock, and a number of other factors not evaluated as part of this Study.[14]

Benefits

- WTE facilities would provide potential for diversion by reducing the amount of organic material sent to landfills;
- Would allow the Coalition to generate energy from garbage;
- Some WTE facilities (pyrolysis) produce energy considered to be "renewable" under Colorado's Renewable Energy Standard;
- WTE could lower greenhouse gas emissions by displacing fossil fuel emissions and capturing carbon in the waste, which would have otherwise been released into the atmosphere as carbon dioxide from composting or as methane from landfilling;
- The biochar product resultant from pyrolysis and the digestate from AD processes may provide beneficial soil amendments to farms and backyard gardens; and
- WTE processes break down material, which would reduce the volume of garbage and thus help extend the lifespan of local landfills.

Drawbacks

- WTE facilities require an extremely high initial capital investment and typically are most successful when built at a large scale;
- AD facilities may not be necessary considering the current regional AD capacity for processing organic material, which includes the Heartland Biodigester in Weld County and the Drake Water Reclamation Facility in Fort Collins;
- The success of WTE is somewhat unpredictable in the long-term, as it is contingent on the quantity and quality of feedstock, energy prices and end-markets; and
- WTE facilities can't be turned off and on or scaled back – they must run 24/7 and may compete with other end markets for valuable resources.

Other Considerations

A reimbursement policy could allow energy customers to take advantage of electricity or fuel that comes from WTE facilities and help offset the high initial cost of construction. Establishing such a "solid waste stabilization account" could incentivize customers to opt for electricity that came from these facilities rather than from fossil fuels.

[14] Factors critical to the operating costs of WTE facilities include suitability of feedstock the cost of energy, federal and state grant funding, and others factors that were not the focus of this Study. As such, these estimates are based on research of operating costs of other facilities, and are reported as conservative estimates for a rough comparison of order of magnitude only.

5.9 Summary of Options

Tables 10 (below) and 11 (on the following page) summarize the costs and other considerations for the materials management options discussed in previous sections of this Study. As stated at the beginning of Section 5, cost estimates provided herein are not quotes, they are estimates based on the professional experience of R3 and sub-consultant Sloan/Vazquez/McAfee. Estimates provided should be used for comparison between options listed.

Actual costs – including initial capital cost, operating cost, and estimated monthly household cost – for each type of facility will vary depending on a variety of factors including but not limited to:

- Size of facility;
- Scope, design, location, and timing of construction;
- Amount of material handled as compared to the design efficiency for the facility;
- The value of the materials resulting from materials recovery processes (e.g. compost, metals, paper, plastics, etc.);
- Operator profit margin (if any);
- Government fees (if any); and
- The amount that haulers charge their customers for the cost of transfer, transport, and disposal/processing services, which can vary between residential, commercial and industrial accounts.

TABLE 10

Summary of Estimated Costs for New Infrastructure Options						
Facility Option	**Estimated Capacity (Tons)**	**Initial Capital Cost**	**Operating Cost per Ton**	**Annual Operating Cost**	**Estimated Monthly Household Cost (Range)**	
Central Transfer Station	720,000	$19,200,000	$22	$15,840,000	$3	$5
New County Landfill	500,000	$15,000,000	$20	$10,000,000	$2	$3
Clean MRF	110,000	$29,700,000	$95	$10,450,000	$2	$3
Dirty MRF	700,000	$83,500,000	$87	$60,900,000	$10	$20
Organics Composting Facility	90,000	$4,000,000	$52	$4,680,000	<$1	$1
C&D Processing Facility	20,000	$3,700,000	$52	$1,040,000	<$1	$1
Anaerobic Digester*	50,000	UNKNOWN	$400*	$20,000,000*	$3*	$7*
Biomass Conversion*	50,000	UNKNOWN	$400*	$20,000,000*	$3*	$7*
Gasification/Pyrolysis*	50,000	UNKNOWN	$500*	$25,000,000*	$4*	$8*

Annual operating cost estimates are inclusive of annual amortization of financed funding for initial capital investments as well as annual operating costs, but not depreciation/replacement costs of new facilities. Likewise, per ton operating costs assume that facilities will process the number of estimated tons listed – processing fewer tons would increase the per ton cost in order to cover fixed costs of operation.

Waste-to-energy (WTE) facility cost estimates (marked with "*") are based on research that yielded only operating costs per ton, which theoretically include operational costs, capital amortization, and revenue elements. Cost estimates for WTE facilities are dependent on an even larger number of factors than other types of facilities, including suitability of source material, the cost of energy, federal and state grant funding, and additional factors that were not the focus of this Study. As such, these estimates are reported as conservative estimates for a very rough comparison only.

Estimates of monthly costs per household are based on the assumption that households will bear the cost of 25-50% of the new infrastructure (in proportion to their total share of the waste stream compared to business and industry) with those costs being distributed evenly among an estimated 125,000 households across Larimer County.

TABLE 11

Summary of Benefits and Drawbacks for Feasible Options
In Ascending Order of Estimated Monthly Household Cost

Facility Option	Estimated Capacity (Tons)	Estimated GHG Emissions Increase (Reduction) (MTCO2E)	Potential for Additional Diversion	Potential to Extend life of Current Landfill	Estimated Monthly Household Cost (Range)	
Status Quo	-	6,000	None	None	UNKNOWN	
C&D Processing Facility	20,000	(1,000)	Medium	Medium	<$1	$1
Organics Composting Facility	90,000	(4,000)	Medium	Low	<$1	$2
Clean MRF	110,000	(45,000)	High	Medium	$2	$3
New County Landfill	500,000	1,000	None	None	$2	$3
Central Transfer Station	720,000	(48,000)	Low	High	$3	$5
Anaerobic Digester	50,000	UNKNOWN	Medium	None	$3*	$7*
Biomass Conversion	50,000	UNKNOWN	Medium	None	$3*	$7*
Gasification/Pyrolysis	50,000	UNKNOWN	Medium	None	$4*	$8*
Dirty MRF	700,000	(48,000)	High	Low	$10	$20

It is important to note that the actual monthly rates paid by solid waste customers are inclusive of the costs for several solid waste system components, namely:

- Collection;
- Transfer (if applicable);
- Transportation (if applicable); and
- Disposal and/or processing.

The estimated monthly household costs listed in Tables 10 and 11 are only representative of the costs related to operation of the facility options discussed in this Study. All but one of these options address the disposal/processing component of the solid waste system, with the only exception being the Central Transfer Station (which, as the name suggests, addresses the transfer component). Cost estimates for these facilities are not inclusive of the costs related to the other components of the solid waste system.

For example, costs and impacts for the New County Landfill option represent the estimated cost of disposal at that facility, but do not include any potential additions to the cost of collection, transfer or transport, which could increase fees charged by haulers. As another example, the monthly household costs for the Central Transfer Station do not include the cost per ton “tipping fees” charged at destination facilities, which could range from $20 to $95 per ton or more depending on the waste stream (as shown in Table 10). As such, the *total* estimated monthly cost for routing solid waste through a Central Transfer Station would need to include collection costs, transfer costs, and disposal/processing costs in addition to those listed above.

One way to view the estimated monthly household costs listed in Tables 10 and 11 is like a menu; the costs for the Central Transfer Station, New County Landfill, Clean MRF, Organics Processing Facility and C&D Processing Facility can all be added together to provide a rough estimate of the total cost to solid waste customers for the construction and operation of those facilities. However, it would not be accurate to add the estimated monthly household costs to the total monthly rates currently paid by solid waste customers because current rates *already include* costs for collection, transfer, transport and disposal/processing of the solid waste collected by haulers.

For a more accurate measure of how monthly rate payer costs would change as a result of new solid waste infrastructure, the portion of the current rates that cover the costs of collection operations[15] would need to be revised to reflect changes in facility locations. That would be added to the costs corresponding to the estimated monthly household costs listed in Tables 10 and 11, for applicable facilties. However, current costs of collection – and potential changes to them related to potential new facility locations – were not evaluated in conjunction with this Study, as collection operations were not its focus and those data were not available. Future analysis could seek to estimate the total rate impact of collection costs plus the costs of new facilities, once specific facilities and locations are identified for closer study.

[15] Which is the total monthly rate less amounts that are currently related to transfer, transport and disposal/processing.

6 Funding Approaches

This section describes various approaches that could be considered for funding capital and operating expenses if the Coalition decides to investigate additional solid waste infrastructure such as those identified in Section 5 of this report.

Estimates of costs in this report are planning level estimates intended only for the purposes of comparing alternatives. They do not represent specific quotes for building or operating new systems or infrastructure.

Variables that could affect the necessary funding amounts for Wasteshed solid waste infrastructure in the future include, but are not limited to:

- The timing of solid waste infrastructure construction (current pricing estimates are in 2016 dollars);
- Locations and property ownership for future solid waste infrastructure;
- Size and scale of the facilities chosen for consideration;
- Potential future increases in garbage disposal or processing fees as the Larimer County Landfill closes and landfill price competition in the region decreases; and
- Unknown changes to disposal or processing fees for recyclables and organics, as markets for both are currently fluctuating (current recycling markets are at their lowest point since the Great Recession).

6.1 Fees

Benefits of Using Collection and Disposal or Processing Fees

Solid waste handling fees, either for customer collection rates or on each incoming unit of solid waste into a facility, represent one potential means of funding the capital and operating expenses related to development of new solid waste infrastructure. They allow the owner and operator of new infrastructure to fund initial capital expense and operating costs by recovering revenue directly from users of that infrastructure (i.e., solid waste customers and/or haulers). Initial capital costs are typically amortized over a period of 20 to 30 years for large solid waste infrastructure, with ongoing operating costs also recovered via the fees.

For example, a central transfer station with a capital expense of $20,000,000 (amortized over 20 years) and annual operating expenses of $15,000,000 would need to generate $16,000,000 annually via fees to cover the $1,000,000 in initial capital plus the $15,000,000 for operation.

Barriers to Using Collection Fees

Using collection fees to finance new solid waste infrastructure may be challenging in the Wasteshed's open market solid waste collection system. Charging fees on individual private (and Loveland's public) haulers would require each Coalition member agency to regulate haulers operating in their community. Agencies would use this authority to assess, collect and remit collection fees to the owner and operator of the new solid waste infrastructure. However, challenges to applying new waste-collection fees include the sheer number of haulers operating in the region and the lack of current frameworks for assessing, collecting and remitting such fees. One approach could be to create a regional agency to set, assess, and collect fees from each of the region's haulers. (This alternative is discussed in more detail below).

Barriers to Using Disposal or processing Fees

There are also challenges to collecting fees on tons or cubic yards delivered to any new solid waste infrastructure in the Wasteshed. Overall, the process is much simpler than charging fees on solid waste collection because the owner and operator of the infrastructure would assess the fee on all incoming units without the need for regulatory oversight or new systems. The risk is that incoming tonnage into the facility would not be sufficient to cover capital amortization and annual operating costs, thus resulting either in deficits or disposal or processing fees so high that customers will choose to use other facilities.

Currently, private haulers in the Wasteshed are free to choose the facilities to which they deliver their solid waste, and unless the Coalition were to regulate and require those haulers to direct their solid waste materials to the new infrastructure (i.e. "flow control"), there would be no guarantee of incoming material on which the owner and operator could collect revenue to fund the operation. As in the prior example, the Coalition could potentially change these conditions by creating a regional agency that would regulate the region's private haulers and require them to direct their solid waste "flow" to the new infrastructure.

Certain types of new infrastructure in the Wasteshed could be favorable enough to private haulers that, at per unit fees below a certain amount, they would voluntarily use that local infrastructure in lieu of other regional alternatives. A cost-effective central transfer station, for example, could improve operational routing and create other efficiencies for solid waste collectors, who then might use it even if the total cost per ton were higher than would be charged at other, more distant facilities.

6.2 Taxes

Benefits of Using Voter Approved Taxes

Voter approved taxes, such as parcel taxes, sales taxes, or taxes on solid waste collectors could be used as a means of financing new infrastructure capital and operating costs. Financing all or a portion of the solid waste infrastructure via taxes would help ensure funding of ongoing expenses regardless of the amount of waste handled. This would decrease (or eliminate, in the case of full funding with taxes) the risk that new infrastructure might not be financially viable. It would also help keep solid waste collection and disposal or processing costs low, by shifting the cost of new infrastructure from solid waste customers to tax payers.

Boulder County has applied a solid waste tax since 1994 that generates approximately $1.8 million per year. It is charged to residential and commercial customers by waste collectors and passed through to the County as an "occupation tax" that funds waste reduction efforts.

Barriers to Using Voter Approved Taxes

In order to finance all or a portion of the costs of new infrastructure for the entire Wasteshed, the Coalition would likely need to introduce a County-wide ballot initiative. Though Coalition members could potentially run separate but coordinated ballot efforts to achieve the same aim, such an effort could result in inequities in the amounts and levels of funding paid by taxpayers in different communities.

6.3 Public-Private Partnerships

Benefits of Public-Private Partnerships

Other funding methods discussed in this section generally assume that Coalition member agencies in the Wasteshed would wholly own and operate new solid waste infrastructure elements. However, that doesn't have to be the case. The County currently contracts with Waste Management to operate the Recycling Station for transfer and processing of recyclables, and similar relationships could be developed for future infrastructure. The Coalition could contract with private solid waste companies to build and operate new infrastructure on publicly owned property, such as the County-owned potential landfill site north of Fort Collins, or the current landfill location. Such an approach could eliminate some or all of the financial risk that the Coalition would otherwise bear if it owned and operated the infrastructure itself.

Drawbacks of Public-Private Partnerships

Although strong public-private partnerships could reduce financial risk, they also provide the Coalition with less control over factors such as pricing, materials handled and other operational concerns. For such a partnership to be attractive to private companies, they would need a level of assurance that they could set per-ton prices that would cover the cost of operations, which could negate some of the benefits of public ownership (i.e., keeping disposal or processing costs low).

6.4 Regional Solid Waste Agency

Regardless of which funding approaches the Coalition might choose to finance new infrastructure, the Coalition may wish to consider forming a regional solid waste agency to formalize its role in solid waste management for the Wasteshed. In the most basic sense, such an agency could consist of an intergovernmental agreement to which each of the current (and future) Coalition members would be a party. The agreement could define the mission and function of the agency, and address how to implement funding measures discussed in this section (e.g., setting collection or disposal or processing fees, implementing a County-wide solid waste tax, etc.).

Forming a regional solid waste agency for the Wasteshed could help ensure that any new regional infrastructure is developed and managed to best fit the needs of each Coalition member, as well as the Wasteshed as a whole. Additionally, the agency could serve as a platform for the development and implementation of region-wide solid waste policies and programs. Finally, a regional solid waste agency could provide the opportunity to control the flow of solid waste in the Wasteshed (and thereby mitigate some of the challenges and risks to financing new infrastructure). A "flow control" policy would guarantee that a certain amount of solid waste tonnage is delivered to potential new facilities, thus making the initial capital investment easier to finance as a sufficient supply of solid waste would be assured.

However, solid waste agencies can be time-consuming and difficult to create (or dissolve) and are generally most effective when they have a stable and secure funding source to achieve a specific mission or purpose (e.g., to construct new regional solid waste infrastructure). Even the most streamlined agencies can be costly to operate because they require their own administrative infrastructure to operate, such as staff time, convening a board of directors, and other overhead costs.

For the Coalition, depending on the type and location of desired regional solid infrastructure and the means of financing it, a regional solid waste agency may or may not be necessary. For example, a regional agency might not be necessary if the Coalition were to decide to build and operate a central transfer station at the site of the current landfill, with public ownership of the infrastructure and private operation funded by disposal fees. In this case, the existing arrangement between Larimer County and the cities of Fort Collins and Loveland for the ownership and operation of the Larimer County Landfill and Recycling Station could be expanded to include the new transfer station. The three parties would still share ownership of the underlying land, and the County could arrange for the building, financing, and operations of the transfer station in much the same way that it does now for the Larimer County Landfill and Recycling Station.

Appendix A

Methodology

Appendix A Methodology

R3 used the following methodology to conduct the North Front Range Regional Wasteshed Study, conducted over the course of 2 months:

- Request for information from Coalition members – This initial request for information from Coalition members allowed R3 to gain an understanding of the background and current state of solid waste management policies and practices in the Wasteshed, and also review necessary documents to better help us formulate our approach and methodology for the Study.
- Phone Call Kick-off meeting – Our kick-off meeting was conducted to provide the coalition with an overview of our approach and methodology and to ensure that all necessary components of the Study were included. This also provided an opportunity to develop an approach and schedule for the site visits and stakeholder meetings.
- Site visits and stakeholder meetings – After initial phone call meetings to kick-off the project, R3 staff spent four days on-site meeting with the TAC member agencies, waste haulers, recyclers and facilities currently used. The goal of this visit was to assess the operations of each of the primary solid waste operations in the region, discuss the opportunities and challenges that exist within the Wasteshed and determine the waste flow of materials and what the capacity needs and resources currently are. During these on-site assessments, R3 was also able to request additional data and clarify existing documents from agency members.
    - R3 conducted site visits at the Larimer County Landfill, North Weld Sanitary Landfill, Timberline Recycling Center, Fort Collins Recycling Center, Loveland Recycling Center and Green Waste Drop-Off, Estes Park Transfer Station, Hoffman Mill Road Crushing Facility, Drake's Water Reclamation and Uncle Benny's Building Supplies.
- Initial list of options meriting consideration – R3 presented the coalition with a preliminary list of solid waste options for initial review, in order to eliminate any options that were not of interest and were thus omitted from consideration.
- Waste Generation and analysis – Upon completion of the on-site assessments, R3 analyzed the collected information and developed key findings regarding the current handling and processing capabilities, opportunities for enhancement of those capabilities, and barriers to achieving them. R3 also analyzed current infrastructure, funding mechanisms, policies and other related solid waste practices to identify where the gaps and opportunities in such details exist.
- Generation of feasible options – We drew on the above tasks and our extensive experience assessing, designing, and implementing similar options for our wide range of municipal clients throughout the nation, to develop a list of options that addresses the needs for any additional solid waste handling and processing in the region. R3 developed this list of options to addresses the needs for any additional solid waste handling and processing in the region. These options will address the needs for additional tonnage capacity, while taking into account the financial and political realities faced by Coalition members.
- Description and research related to feasible options – In conjunction with the above task, R3 evaluated the potential costs, policies, effect on diversion and greenhouse gas emissions, and advantages and disadvantages to determine the details of the options.

Appendix B

Current Solid Waste Infrastructure Details

Appendix B Current Solid Waste Infrastructure Details

Name	Owner	Operator	Materials Handled	Location	Hours
Larimer County Landfill	Fort Collins, Loveland, Larimer County	Larimer County	Appliances, electronics, tires, batteries, furniture, MSW, C&D debris, yard waste, dead animals, etc.	5887 S. Taft Hill Rd., Fort Collins	8 am – 4 pm M-Sat
North Weld Sanitary Landfill	Waste Management	Waste Management	Yard waste, MSW, C&D debris, biosolids, CERCLA waste, E&R wastes, industrial & special waste, asbestos non-friable and friable, auto shredder fluff, etc.	40000 W C R 25, Ault, CO 80610	6:30 am (Summer, 7:00 am (Winter) – 4:30 pm M-F; 7 am – 3 pm Sat
Denver Regional Landfill	Waste Connections, Inc.	Waste Connections, Inc.	MSW, C&D debris, yard waste, dead animals, non-hazardous commercial and industrial waste, waste water treatment plan sludge, soil, treated lumber, etc.	1441 Weld County Rd 6, Erie, CO 80516	6 am – 5 pm M-F; 6 am – 2 pm Sat
Buffalo Ridge Landfill	Waste Management	Waste Management	Yard waste, MSW, C&D debris, biosolids, CERCLA waste, E&R wastes, industrial & special waste, asbestos non-friable and friable, etc.	11655 WCR 59, Keenesburg, CO 80643	7 am – 4 pm M-F; 8 am – 1 pm Sat
Front Range Landfill	Waste Connections, Inc.	Waste Connections, Inc.	MSW, C&D debris, yard waste, dead animals, non-hazardous commercial and industrial waste, waste water treatment plan sludge, soil, treated lumber, etc.	1830 Weld County Road 5, Erie, CO 80516	6 am – 5 pm M-F; 6 am – 2 pm Sat
Estes Park Transfer Station	Larimer County	Larimer County	Household garbage, recyclables	455 Elm Rd., Estes Park, CO 80517	8 am – 4 pm T, Th, Sat (Oct – Apr); 8 am – 4 pm T-Sat (May, Sep); 8 am – 4 pm M-Sat (Jun, Jul, Aug)

Name	Owner	Operator	Materials Handled	Location	Hours
Berthoud Transfer Station	Larimer County	Larimer County	Household garbage, recyclables	South of HWY 56, County Line Rd., Berthoud	9 am – 4 pm W-Sat
Wellington Transfer Station	Larimer County	Larimer County	Household garbage	County Rd. 70, Wellington	9 am – 4 pm Sat, Sun
Red Feather Transfer Station	Larimer County	Larimer County	Household garbage	Red Feather Lakes Rd.	9 am – 4 pm 1st Sat of mo.; 9 am – 4 pm every Sat.
Loveland Recycling Center/Green Waste Drop-off	City of Loveland	City of Loveland	Metal, electronics, household appliances, glass, concrete, yard waste, green waste, untreated lumber, leaves and branches, etc.	400 N. Wilson Ave., Loveland, CO 80537	7:30 am – 4:30 pm T-Sun
Fort Collins Timberline Recycling Center	City of Fort Collins	City of Fort Collins	Cardboard, paper, glass, aluminum, plastic hard-to-recycle materials, etc.	1903 S. Timberline Rd., Fort Collins CO 80524	8 am – 6 pm T-Sat (Summer); 8 am – 4:30 pm (Winter)
WM Recycling Transfer Station	Waste Management	Waste Management	Source separated recyclables (cardboard, paper, plastic, metals, etc.)	5887 S. Taft Hill Rd., Fort Collins	8 am – 4 pm M-Sat
Hoffman Mill Road Crushing Facility	City of Fort Collins	City of Fort Collins	Pit run, asphalt, concrete, toilets	1380 Hoffman Mill Rd., Fort Collins, CO 80524	7 am – 5 pm M-F (Apr to Oct); 7:30 am – 4 pm M-F (Nov to Mar)
Waste-Not Recycling MRF	Waste-Not Recycling	Waste-Not Recycling	Commercial source separated recyclables (cardboard, paper, plastic, metals, etc.), mixed C&D material	1065 Poplar St, Johnstown, CO 80534	8 am – 4 pm M-F
Waste Management MRF	Waste Management	Waste Management	Single stream recyclables, source separated recyclables	5395 Franklin St., Denver, CO 80517	Various

Name	Owner	Operator	Materials Handled	Location	Hours
Drake's Water Reclamation Facility	City of Fort Collins	City of Fort Collins	Wastewater; food scraps from CSU	3036 Environmental Dr, Fort Collins, CO 80525	8 am – 5 pm M, T, Th, Fri; 10 am – 5 pm W
Hageman Earth Cycle Composting	Hageman Earth Cycle Composting	Hageman Earth Cycle Composting	Grass clippings, garden waste, leaves, sod and soil, branches, cedar shingles, rock and gravel	3501 E. Prospect Rd. Fort Collins, CO 80525	7:30 am – 5 pm M-F; 8 am – 4:30 pm Sat
Doug Weitzel, Inc.	Doug Weitzel, Inc.	Doug Weitzel, Inc.	Grass clippings, garden waste, leaves, branches	2630 West Mulberry St., Fort Collins, CO 80521	Seasonal
A-1 (Eaton)	A1 Organics	A1 Organics	Green waste, animal manures, clean wood waste, yard waste	16350 WCR 76 Eaton, Colorado 80615	7:30 am – 5 pm M-F
A-1(Rattler Ridge)	A1 Organics	A1 Organics	Animal waste, biosolids, yard waste, organic materials (including food)	12002 WCR 59 Keenesburg, CO 80643	6:30 am – 4:30 pm M-F
Mountain View Farm Composting Facility*	Mountain View Farm	Mountain View Farm	Various organics	6875 N. County Rd. 9, Loveland, CO 80538	Various
Colorado Iron and Metal*	Colorado Iron and Metal, Inc.	Colorado Iron and Metal, Inc.	HHW, scrap metal, aluminum	903 Buckingham St., Fort Collins, CO 80524; 2929 N. Garfield Ave, Loveland CO 80538	8 am – 4:30 pm M-F; 8 am – 12 pm Sat
Aragon Iron and Metal*	Aragon Iron and Metal	Aragon Iron and Metal	Non-ferrous metals, batteries, vehicles, appliances, steel, cast iron, used tires	516 US-287, Fort Collins, CO 80524	8 am – 4:30 pm M-F

Name	Owner	Operator	Materials Handled	Location	Hours
Rocky Mountain Battery*	Rocky Mountain Battery	Rocky Mountain Battery	Steel, batteries, non-ferrous metals, electronics, small appliances	1475 N. College Ave., Fort Collins, CO 80524	8 am – 4:45 pm M-F; 8 am – 3:30 pm Sat
Uncle Benny's Building Supplies*	Uncle Benny's Building Supplies	Uncle Benny's Building Supplies	Lumber, hardware, landscaping, windows, flooring, plumbing	1815 S. Co Rd. 13C, Loveland, CO 80537	8 – 6 pm M-F; 9 – 2:30 Sat
Habitat for Humanity*	Habitat for Humanity	Habitat for Humanity	C&D materials, windows, plumbing, tools, clothing and textiles, small appliances	4001 S. Taft Hill Rd, Fort Collins, CO 80526	9 am – 5 pm T-Sat
I.T. Refresh*	Onsite Electronics Recycling	I.T. Refresh	Household appliances, electronics	100 N. Link Ln #100, Fort Collins, CO 80524	7:30 am – 4 pm M-F
EcoThrift*	EcoThrift	EcoThrift	Household appliances, clothing, furniture, electronics, vehicles	314 N. Howes St., Fort Collins, CO 80521	10 am – 6 pm M-f; 9 am – 5 pm Sat; 11 – 4 pm Sun
Larimer County Food Bank*	Larimer County	Larimer County	Food (edible)	1301 Blue Spruce Dr., Fort Collins, CO 80524; 2600 N. Lincoln Ave., Loveland, CO 80538, various other	1 pm – 6 pm M-F; 9 am – 2 pm T-Sat

*Some of the facilities listed above are not mentioned in the Study but listed here to provide a more comprehensive list of facilities in the region.

This page intentionally left blank.

Appendix C

2006 Larimer County Landfill Waste Characterization

MSWCONSULTANTS

LARIMER COUNTY, COLORADO

TWO-SEASON WASTE COMPOSITION STUDY

Final Report

May 2007

MID ATLANTIC SOLID WASTE CONSULTANTS
625 Sawyer Road, New Market, MD 21774 301/607-6428
842 Spring Island Way, Orlando, FL 32828 407/380-8954
2291 Limehurst Drive, Atlanta, GA 30319 404/496-4872
www.mswconsultants.us

LARIMER COUNTY

TWO-SEASON WASTE COMPOSITION STUDY

TABLE OF CONTENTS

This page intentionally left blank.

1. INTRODUCTION

BACKGROUND

The Larimer County Solid Waste Department operates the Larimer County Landfill, a 180-acre municipal solid waste disposal facility just south of Fort Collins. Situated on a 650-acre site, the landfill receives approximately 500 tons of solid waste per day. In addition to the County Landfill, the Solid Waste Department is responsible for an integrated waste management system that includes four transfer stations, five recycling drop-off sites, two permanent household hazardous waste (HHW) collection sites, and a Material Recovery Facility (MRF, a.k.a. Recycling Center). The MRF, which is owned by Larimer County and operated by Waste Management-Recycle America, recently converted to a "single stream" facility, and processes over 100 tons of recyclable containers and paper fiber materials each day.

In any integrated waste management system, it is critical to understand both waste generation and waste composition patterns of the local wasteshed. Regular monitoring of these data improve the Solid Waste Department's ability to operate and maintain current solid waste infrastructure, plan for future facility needs, and evaluate current and potential new source reduction and recycling programs. To this end, in 1998 Larimer County conducted a waste characterization study (1998 Study) to determine the composition of residential, commercial, and self-haul waste disposed at the Larimer County Landfill. The study results have been used to support planning efforts for the County's waste management services and to provide a baseline for monitoring changes in waste disposal.

In the ensuing years since the completion of the 1998 Study, a great deal has changed in Larimer County that has impacted the waste stream. County demographics have evolved significantly. Changes in the private collection and disposal market have caused a shift in waste flows. Further, over time, other more recent waste composition studies have consistently shown that the waste stream itself is changing. Such changes in disposed waste come about because of trends like light-weighting of products and packaging, the ongoing shift from glass and fiber-based packaging to plastic packaging, and fluctuations in residential and commercial construction, renovation, and demolition activities, to name but a few examples.

In 2006, Larimer County retained MSW Consultants, LLC, to perform an updated waste composition study (2006 Study). The 2006 Study seeks to achieve the following objectives:

- Develop statistically defensible estimates of the annual composition of wastes disposed at the Larimer County Landfill;
- Differentiate between the composition of Residential, Commercial, Construction and Demolition (C&D), and Self-haul Wastes to enable sector-specific recycling and diversion program evaluation;
- Estimate the quantity of Residential, Commercial, C&D, and Self-haul wastes currently delivered to the Landfill so that a Landfill-aggregate waste composition can be estimated

based on the weighted average contribution of wastes from each of these four generator sectors;

- Evaluate the efficacy of current recycling and diversion programs in place in Larimer County;
- Identify opportunities for incremental recycling and diversion programs that may target disposed materials that are still occurring in high volumes; and
- Enable a comparison of waste composition against the 1998 Study to detect trends in the composition of disposed waste.

REPORT ORGANIZATION

This report presents the background, methodology, and results of the two-season waste composition study that was conducted at the County Landfill. The report is divided into the remaining three sections:

- **Methodology:** This section summarizes the detailed sampling plan that was developed to assure that waste composition results would be statistically representative of the total disposed waste stream and also achieve a meaningful level of statistical validity. This section also summarizes elements of the field data collection methodology.
- **Gate Survey:** Because of limitations to the landfill accounting system, it is not currently possible to tabulate incoming material volumes by waste generator (especially residential and commercial wastes in compactor trucks; and C&D and commercial loose waste in roll-offs and other non-compactor commercial trucks). This section summarizes the methodology and results of a gate survey that was conducted to provide defensible estimates of the quantity of wastes delivered to the facility by the main waste generator classes.
- **Results:** Detailed composition results are presented for the aggregate of disposed waste at the Landfill, as well as for the Residential, Commercial, C&D and Self-Haul streams individually. This section also provides comparative data with the 1998 Study.

ACKNOWLEDGEMENTS

MSW Consultants would like to thank the following parties for their help in accomplishing the field data collection for this project:

- Steve Harem, Larimer County Environmental Specialist; and
- Robert "Dane" Nielsen, Landfill Manager.

The project would not have been successful without the ongoing help and cooperation from these individuals and their staff.

2. METHODOLOGY

SAMPLING PLAN SUMMARY

Prior to conducting any field data collection, a Sampling Plan was developed to assure that the incoming truckloads of waste that were ultimately sampled and sorted were representative of the entire incoming waste stream. This section summarizes the pertinent details of the Sampling Plan that governed field data collection.

SEASONALITY

There were two separate one-week field data collection events. The first field data event started on September 11, 2006 and was completed September 15, 2006; these dates were representative of the "summer" season. The second field data event started on December 4, 2006 and was completed December 8, 2006; these dates were representative of the "winter" season. Collectively, the data from these two seasonal sorts have been combined and analyzed to develop an annual aggregate estimate of the composition of wastes disposed in the County landfill.

WASTE GENERATION SECTORS

For the purposes of this study, a total of four generator sectors were defined:

- **Residential Waste:** Includes residentially generated garbage and trash that is collected by private or public haulers, primarily in compactor vehicles. Residential wastes encompass waste from single family households as well as multi-family apartments and condominiums.

- **Commercial Waste:** Includes municipal solid wastes generated in the commercial, institutional, agricultural, and industrial sectors, and delivered by private haulers primarily in compactor trucks or in compacting roll-off boxes. May include some non-compacted wastes delivered in open top roll-off boxes and in other vehicles. Note that commercial wastes exclude any "special" wastes that may be generated in these sectors.

- **Self-haul Waste:** Encompasses residentially generated wastes that are delivered to the landfill by the actual residential generator. Self-haul waste includes small to mid-size deliveries of waste in cars, pick-up trucks and vans, including those with trailers. Self-haul wastes are recorded separately by the gate house.

- **C&D Waste:** This includes all wastes that are generated as a result of construction, demolition and renovation activities, regardless of who is delivering the wastes. C&D wastes may be delivered by private (or public) haulers in roll-off boxes, and also may be delivered by self-haulers or contractors on construction/demolition/renovation projects (e.g., roofing contractor delivering shingles).

2. METHODOLOGY

SAMPLE SELECTION

MSW Consultants requested, and the County provided, a range of data about incoming material deliveries to the landfill. The following tables were assembled from the incoming material data and provided a basis for targeting a stratified random allocation of incoming loads that reflects the overall delivery patterns at the landfill.

RESIDENTIAL WASTE DELIVERIES AND SAMPLING TARGETS

Larimer County was able to provide summary information on the haulers that delivered virtually 100 percent of the COMPACTED WASTE, which includes all Residential Waste. Table 2-1 estimates the proportion of each hauler's deliveries that are believed to be Residential Waste, and shows the resultant seasonal sampling targets.[1] Further, Table 2-1 shows how close the actual samples were compared to the stratified targets.

Table 2-1 Residential Waste Deliveries (cubic yards, 2005) and Sampling Targets

Hauler	Total COMPACTED WASTE (CY) [1]	Residential Fraction	Residential Volume (CY)	Percentage of Total	Sample Targets	Actual Samples
Canyon Utilities	3,485	80%	2,788	1.7%	0	0
City of Loveland, Solid Waste	39,889	100%	39,889	23.9%	8	9
Dick's Trash Hauling Service	27,143	75%	20,357	12.2%	2	3
GSI (Gallegos Sanitation, Inc.)	91,058	60%	54,635	32.7%	10	11
Ram Waste Systems, Inc.	34,964	60%	20,978	12.6%	4	7
S & S Sanitation	12,464	80%	9,971	6.0%	2	0
Skyline	1,238	100%	1,238	0.7%	0	0
United Waste (new customer)	0	100%	unknown	0.0%	0	1
Waste Management	28,339	60%	17,003	10.2%	2	0
Total	**258,681 [2]**			**100.0%**	**30**	**31**

[1] Unadjusted for compaction.

[2] Column does not sum because several haulers with limited deliveries are not shown.

1 At the time the sampling plan was developed, calendar year 2005 data was the most current. Interviews with County staff were used to supplement the 2005 data to assure its representativeness.

Note that Larimer County does not track whether incoming waste is residential or commercial waste, and at the time the sampling plan was developed the gate survey had not yet been performed (see Section 3). MSW Consultants interviewed County staff to obtain a "best estimate" of the proportion of each haulers' trucks that were each of the types above. Although this is an imperfect method, we believe the information gathered was suitable for the purposes of developing and implementing a reliable sampling plan. Further, with the completion of the gate survey, we can conclude that these sampling targets were reasonable and fairly reflected a distribution of samples that align with the universe of waste deliveries.

COMMERCIAL WASTE DELIVERIES AND SAMPLING TARGETS

Commercial waste is coded under both the COMPACTED WASTE and the COMMERCIAL LOOSE accounts in the County's accounting system.[2] The County provided a range of supplemental data to illustrate the sources of commercial waste. Table 2-2 summarizes these data, and also reflects a comparison of actual samples against the targeted sample distribution. As shown, the samples obtained in the study were reflective of the sampling targets.

Table 2-2 Commercial Waste Deliveries (cubic yards, 2005) and Sampling Targets

Hauler	COMPACTED WASTE (CY) [1]	COMMERCIAL LOOSE (CY)	Total Delivered (CY)	Percentage of Total	Sample Targets	Actual Samples
CSU (Colorado State University)	32,988	750	33,738	6.5%	2	2
Dick's Trash Hauling Service	27,143	1,429	28,572	5.5%	2	3
GSI (Gallegos Sanitation, Inc.)	145,693	31,569	177,262	34.0%	14	16
Ram Waste Systems, Inc.	55,942	7,979	63,921	12.3%	6	3
Waste Management	45,342	11,143	56,485	10.8%	4	8
All Other Haulers	0	141,324	141,324	27.1%	12	7
Total	**322,444 [2]**	**199,193 [2]**	**521,637 [2]**	**100.0%**	**40**	**39**

[1] Compacted Waste volumes have been adjusted to reflect an average compaction ratio of 4 to 1.

[2] Column does not sum because haulers with limited deliveries are not shown.

[2] A statistically insignificant portion of commercial waste is also delivered as Commercial Minimum Loads. This was excluded from the analysis.

2. METHODOLOGY

SELF HAUL DELIVERIES AND SAMPLING TARGETS

Self haul wastes are wastes delivered in cars, trucks, and other vehicles not specifically designed for waste hauling. Larimer County maintains close track of self-haul wastes in the landfill accounting system. Table 2-3 summarizes the quantities and coding of self-haul wastes. Table 2-3 also shows the actual samples that were obtained in comparison to the targeted number of samples. Note that MSW Consultants was able to obtain significantly more samples than originally expected; this additional data will further increase the statistical validity of the findings.

Table 2-3 Self Haul Waste Deliveries (cubic yards, 2005) and Sampling Targets

Landfill Account	Volume (CY)	Percent of Total	Sample Targets	Actual Sampled
Minimum Load in Car	1,687	1.1%	0	0
Minimum Load in Truck	3,188	2.1%	2	2
Loose Waste in Car	8,970	5.9%	4	4
Loose Waste in Truck	136,930	90.8%	54	70
Total	**150,775**	**100.0%**	**60**	**76**

C&D DELIVERIES AND SAMPLING TARGETS

C&D Waste is coded as such at the County Landfill. Table 2-4 summarizes the estimated C&D waste deliveries, sampling targets, and actual samples obtained. MSW Consultants was again able to obtain significantly more samples for this generator sector.

Table 2-4 C&D Waste Deliveries (cubic yards, 2005) and Sampling Targets

Landfill Account	Volume (CY)	Percent of Total	Sampling Targets	Actual Sample
C&D Waste coded as COMMERCIAL LOOSE [1]	49,798	23.6%	14	0
Compacted C&D [2]	7,833	3.7%	2	2
C&D Debris in Car	194	0.1%	0	0
Commercial C&D Waste	148,356	70.2%	42	72
C&D Debris in Truck	5,150	2.4%	2	2
Total	**211,331**	**100.0%**	**60**	**76**

[1] Estimated at 25 percent of total COMMERCIAL LOOSE for purposes of sampling plan development.

[2] No adjustment has been made for compaction based on limited ability to compact C&D debris.

We note that the fraction of C&D waste in COMMERCIAL LOOSE was unknown during development of the sampling plan. Although the gate survey (see the following section) validated the sampling plan, it was determined during the field data collection that is was not possible to screen incoming COMMERCIAL LOOSE vehicles to determine that they in fact contained C&D. For this reason, the targeted COMMERCIAL LOOSE samples were shifted to loads that were definitively recorded in the landfill accounting system as being C&D waste.

SAMPLING TARGET SUMMARY

Table 2-5 summarizes the targeted and the actual number of physical and visual samples obtained each season for each of the four waste generator classes targeted in the study.

Table 2-5 Proposed Sampling Targets vs Actual Sampled Targets by Generator Class

Generator Class	Targeted Samples	Actual Samples	Difference
Residential – Physical Sorts	30	31	+1
Commercial – Physical Sorts	40	39	-1
C&D Debris – Visual Estimates	60	76	+16
Self Haul – Visual Estimates	60	76	+16
Total	190	222	+32

As shown, MSW Consultants achieved or exceeded sampling targets for three of the four waste generator classes. Commercial waste generator sampling fell one sample shy of the target. This shortfall was due to the practical challenges associated with waste sampling. Specifically, on days the sorting team is in the field, it cannot be predicted the order and timing of the targeted incoming loads of waste. MSW Consultants made every effort to meet the detailed, stratified sampling targets as shown in Table 2-1 through 2-4, and in general succeeded in this effort. We do not believe the one sample shortfall in the commercial waste stream will significantly degrade the results of the analysis. Further, given the much higher inherent variation in the composition of C&D and self-haul wastes, we believe the extra samples obtained for these generator classes will improve the statistical validity of results for these sectors.

FIELD SAMPLING AND SORTING METHODS

Field sampling and sorting methods generally conformed with ASTM standards, refined based on the extensive experience of MSW Consultants in performing numerous similar studies. The following sections summarize field sampling and sorting procedures.

2. METHODOLOGY

LOAD SELECTION

For all four waste generator sectors, the MSW Consultants Field Supervisor remained in communication with the gate attendant(s) to obtain assistance in identifying the loads to be sampled. Each day, the Field Supervisor had a list of targeted deliveries. (For example, on Monday there may have been one Loveland truck, three GSI trucks, one Waste Management truck, etc.). Gate attendants were asked to notify the Field Supervisor when any of these deliveries arrived. The Field Supervisor attempted to take a sample from the targeted incoming loads, although retained freedom to exercise professional judgment in taking alternate loads based on timing and availability of the sort crew and landfill support personnel.

The Field Supervisor further interviewed the drivers of selected loads to obtain information such as origin of the load, waste generating sector, hauler, vehicle type and number, and other data. This information was noted on the vehicle selection form, along with a unique identifying number associated with that vehicle on that day. A summary of the physically sampled loads is shown as Exhibit 1.

We note that even though the County alerted its primary haulers that this study was taking place so that drivers were not caught by surprise, some of the drivers said they lost the Gate Ticket or did not want to divulge any information about the incoming load. In these instances, the sampling selection data was completed to the greatest extent possible.

SIZE OF PHYSICALLY SORTED AND VISUALLY SURVEYED SAMPLES

Consistent with industry literature, we attempted to take samples that weighed between 200 and 250 pounds for all manually-sorted samples. Table 2-6 below summarizes the average, maximum and minimum sample weights from the summer and winter seasons

Table 2-6 Sample Weight Summary

Generating Sector	Number of Samples	Number of Samples <200 Lbs	Minimum Sample Lbs	Maximum Sample Lbs	Average Sample Lbs
Residential	31	2	155	265	219
Commercial	39	2	170	558	253

As shown in Table 2-6, the average weights of the two seasonal sorts were 219 pounds for the residential and 253 pounds for the commercial sectors, both within or even slightly above the target sample sizes. We note that a total of four samples out of the 70 taken fell below the target sample weight. This reflects the inherent differences in density of tipped wastes. As described further below, samples were taken with the help of a loader taking a scoop from the tipped load. In instances where the wastes in a grab sample were especially "fluffy" (i.e., less dense), even a full bucket of waste may not have achieved the 200 pound target. MSW Consultants does not believe the small number of light samples will bias the results, and upon further analysis of these individual samples to confirm that none were clear outliers, we have opted to include them in the statistical analysis.

Visually surveyed samples consisted of the entire load. Load weights for self-haul and C&D waste may range from less than 100 pounds (for car and small truck loads) up to 10+ tons (for C&D loads containing a large fraction of cement block and other dense materials). Table 2-7 below summarizes the cubic yards (CY) and estimated weights for the self-haul and C&D generating sectors.

Table 2-7 Self-Haul and C&D Cubic Yardage and Weight Summary

Generating Sector	Number of Samples	Cubic Yardage			Tons		
		Min	Max	Avg	Min	Max	Avg
Self-Haul	76	0.3	30	6.6	0.1	11.5	1.3
C&D	76	1	40	10.8	0.06	12.9	3.4

As expected, C&D loads were larger on average than self-haul loads.

MATERIAL CATEGORIES

Material categories were selected to meet two main objectives. First, the categories were intended to provide meaningful breakdowns of the waste stream from the perspective of evaluating current and potential future source reduction, diversion and recycling programs. Second, the categories were established such that they could be aligned with the results of the 1998 Study for the purpose of evaluating changes in the waste stream.

A total of 45 material categories were ultimately defined for this study. The material categories, detailed definitions, and a mapping of 2006 Study to 1998 Study material categories is included as Appendix A.

TAKING SAMPLES FOR PHYSICAL SORTING

Selected loads of residential and commercial wastes were tipped in a designated area on the landfill face near the sorting area. From each selected load, a sample of waste was selected based on systematic "grabs" originating from the perimeter of the load. MSW Consultants uses a systematic grabbing methodology that pre-selects the location of the grab prior to tipping of the load. For example, if the tipped pile is viewed from the top as a clock face with 12:00 being the part of the load closest to the front of the truck, the first samples will be taken from 3 o'clock, 6 o'clock, 9 o'clock, 12 o'clock, and then from 1, 4, 7, and 10 o'clock, and so-on.

Once the area of the tipped load to be grabbed was selected, the Field Supervisor coordinated with a loader operator to take a grab sample of wastes from that point in the tipped load. The loader operator used the loader (both provided by Larimer County) to remove a sample of waste weighing at least 250 pounds. This sample was deposited on a tarp designated to receive samples. Each sample was labeled by its identifying number using brightly colored spray paint, and digitally photographed.

2. METHODOLOGY

PHYSICAL SORTING

Once the sample had been acquired and placed on a tarp, the material was manually sorted into the prescribed component categories. Plastic 18-gallon bins with sealed bottoms were used to contain the separated components.

Sorters were trained to specialize in certain material groups, with someone handling the paper categories, another the plastics, another the glass and metals, and so on. In this way, sorters became highly knowledgeable in a short period of time as to the definitions of individual material categories.

The Crew Chief monitored the bins as each sample was being sorted, requiring a re-sort of materials that were improperly classified. Open bins allowed the Crew Chief to see the material at all times. The Crew Chief also verified the sorting accuracy of each component during the weigh-out. The materials were sorted to particle size of 2-inches or less by hand, until no more than a small amount of homogeneous material remained. This layer of mixed 2-inch-minus material was allocated to the appropriate categories based on the best judgment of the Crew Chief—most often a combination of Other Paper, Other Organics, or Food Waste. The overall goal was to sort each sample directly into component categories in order to reduce the amount of indistinguishable fines or miscellaneous categories. Note that the sorting methodology included the use of a customized, sturdy framed sort table that has a removable screen sized at ½ inch. Small particles passing through the screen were swept into a separate container and recorded in their own material category called "Fines" (categorized under the Organics material group).

VISUAL SURVEYING

Visual surveying of a load of self-haul or C&D waste involved detailed volumetric measurements of the truck and load dimensions, followed by the systematic observation of the major material components in the tipped load. The basic steps to visual surveying are:

1. Measure the dimensions of the incoming load prior to tipping and (if possible) estimate the percent full of the vehicle.
2. Tip the load. If it is a large load, and if conditions permit, have a loader spread out the material so that it is possible to discern dense materials such as block, brick, and dirt that tend to sink to the bottom of the pile.
3. Make a first pass around the load marking the major material categories that are present in the load—cardboard, drywall, dimensional lumber, etc. Estimate the percentage of the load made up of these major materials. If possible, estimate of the yardage associated with this material.
4. Make a second pass around the load, noting the secondary material categories contained in the load. Estimate the percentage of the load made up of these materials. Because the MSW Consultants Field Supervisor conducting this study is highly experienced in visual surveying of C&D and Self Haul loads, this step also included estimating the actual weight, in pounds, of each of the material identified in the load. Volume and weight estimates will be reconciled in the QC process.

5. Validate that the estimated percentages sum to 100 percent, and that the estimated weight and volume of major material categories is realistic given the overall truck dimensions and volume.

Because some residential and commercial waste was included in self-haul and C&D waste, the field data form included a category for "Mixed MSW." Mixed MSW has been apportioned back into the self-haul and C&D composition estimates based on the composition of residential and commercial waste observed in the physical sorting.

DATA RECORDING

The weigh-out and data recording process is arguably the most critical process of the sort. The Crew Chief was singularly responsible for overseeing all weighing and data recording of each sample. Once each sample had been sorted, and fines swept from the table, the weigh-out was performed. Each bin containing sorted materials from the just-completed samples were carried over to a digital scale provided by MSW Consultants. Sorting laborers assisted with carrying and weighing the bins of sorted material, the Crew Chief recorded all data.

The Crew Chief used a waste composition data sheet to record the composition weights. Each data sheet containing the sorted weights of each sample was matched up against the Field Supervisor's sample sheet to assure accurate tracking of the samples each day.

Visual survey sheets were filled out by the Field Supervisor, who could easily match them up against the master sample sheet.

Data sheets were entered into a spreadsheet each evening to assure that sample weights were meeting targeted minimum levels, and that sample data appears to be reasonable.

CONCLUSION

Field data collection methods closely followed industry-standard procedures. With almost no precipitation during the field data collection events, MSW Consultants believes that external contamination from moisture was minimal to nil. Given the careful logistical management of the sample collection process, the field data collection was performed with no known problems. The resulting data meet the objective of being representative of disposed wastes within each of the four generator classes targeted in the study.

2. METHODOLOGY

This page intentionally left blank.

3. GATE SURVEY

INTRODUCTION

The Larimer County Landfill tracks incoming waste quantities based on several categories, including Loose Waste, Compacted Waste, C&D Debris, and a range of special wastes such as tires, rip-rap, and tree limbs. The landfill further tracks whether deliveries are in a car, a truck, or a commercial vehicle, as there are different state-imposed surcharges on each type of delivery vehicle. Table 3-1 summarizes the quantities of wastes received for calendar year 2006 based on the landfill's gatehouse coding system.

Table 3-1 2006 Incoming Waste Quantities [1]

Transaction Type	Material Description	Cubic Yards
MIN CAR	Loads delivered in a car that are less than ½ CY	2,481
MIN COMM	Loads delivered in a commercial non-compacting vehicle that are less than ½ CY	261
MIN TRK	Loads delivered in a pick-up truck that are less than ½ CY	2,427
LOOSE CAR	Loose waste delivered in a car	15,012
LOOSE COMM	Loose waste delivered in a commercial vehicle	129,047
XFERSTATION	Transfer trailers from Estes Park, Berthoud, or Wellington	56,425
LOOSE NO X	Commercial wastes with no disposal charge	1,418
LOOSE TRK	Loose waste delivered in a pick-up truck	120,641
ROADSIDE	Commercial waste from roadside cleaning	86
COMPACTED	Waste delivered in commercial compacting vehicles	263,781
COMPCT C&D	C&D Debris delivered in commercial compacting vehicles	592
C&D CAR	C&D delivered in a car	223
C&D COMM	C&D delivered in a commercial non-compacting vehicle	117,383
C&D TRK	C&D delivered in a pick-up truck	4,290
Totals [2]		**714,067**

[1] Source: Larimer County

[2] This table excludes Rip/Fill, Tree limbs, Animal carcasses, Non-friable asbestos, Tires, Appliances, and Auto bodies.

Given the transaction codes shown above, Larimer County landfill gate records are limited for two reasons. First, it is not possible to query the database in such a way as to subdivide deliveries by generator sector. Second, the landfill does not have scales and consequently all deliveries, whether loose or compacted, are recorded in cubic yards. Although the Landfill accounting software stores material densities and the corresponding weight estimate, the County reports waste deliveries based on volume.

Because of these limitations, a comprehensive survey of incoming vehicles was performed to better estimate the true proportion of material from the following four main generator classes:

- Residential (compactor trucks),
- Commercial,
- Construction and Demolition (C&D), and
- Self haul (personal cars and pick-up trucks).

METHODOLOGY

MSW Consultants conducted a gate survey of incoming vehicles over a one-week period from September 14 through September 20, 2006. The survey was performed from the time the facility opened until close (i.e., 7:00 am to 4:00 pm) each day during this period, except Sunday. Sunday deliveries were found to be predominantly self-haul and therefore did not need to be surveyed.

Based on a review of detailed gatehouse records, two delivery codes were targeted in the survey: COMPACTED WASTE and COMMERCIAL LOOSE waste. The MSW Consultants Surveyor remained in or outside the gate houses and interviewed drivers of incoming truckloads that were recorded as COMMERCIAL LOOSE or COMPACTED WASTE definitions (either by gate attendants or by the automated attendant). (Although out of scope, vehicles that were recorded as C&D COMM [Commercial C&D Waste] were also surveyed, primarily because the roll-off, dump, and other non-compacting vehicles that deliver C&D COMM are also the type of vehicle that typically deliver COMMERCIAL LOOSE.) Upon confirming that an incoming vehicle was among the two targeted classifications (primarily the compactor trucks and roll-offs), MSW Consultants staff interviewed the driver to determine the origin of the waste and the generator type. The data was recorded on a customized field data form that recorded the proportion, by volume, of the waste contained in that load that was (i) residential, (ii) commercial, (iii) C&D, or (iv) Other. The survey form also recorded the transaction/ticket number for each surveyed vehicle.

The Surveyor moved between the automated entry way and the two staffed entries to capture the majority of incoming COMPACTED and COMMERCIAL LOOSE loads. To overcome the potential for missing any incoming loads, MSW Consultants provided a survey form to the gate attendants in each gate house to supplement data collected by MSW Consultants during especially busy times. Table 3-2 summarizes the vehicles surveyed.

Table 3-2 Summary of Vehicles Surveyed

WASTE TYPE	Number of Vehicles	Number of Vehicles Surveyed	Percentage Surveyed
C&D COMM	243	184	75.7%
COMPACTED	265	252	95.1%
LOOSE COMM[1]	266	208	78.2%
Total	**774**	**644**	**83.2%**

[1] Excludes Transfer Trailers, which are also recorded as LOOSE COMM

A total of 664 incoming vehicles were surveyed during the 5 day period, or about 111 vehicles per day. Of the targeted loads, 75.7 percent of the C&D COMM, 95.1 percent of the COMPACTED and 78.2 percent of the LOOSE COMM were surveyed. The LOOSE COMM waste delivered in transfer trailers from a known origin were excluded from the survey.

Table 3-3 provides a parallel summary of the proportion of all incoming cubic yards that were surveyed. As shown, just shy of 90 percent of all incoming cubic yards were captured in the survey for all waste types. Although this is not perfect coverage, we believe it is sufficient to derive the estimated breakdown of incoming wastes by generator sector.

Table 3-3 Summary of Cubic Yards Surveyed

WASTE TYPE	Incoming Yardage	Yards Surveyed	Percentage Surveyed
C&D COMM	2,008	1,652	82.3%
COMPACTED	5,304	4,765	89.8%
LOOSE COMM[1]	2,497	2,183	87.4%
Total	**9,809**	**8,600**	**87.7%**

[1] Excludes Transfer Trailers, which are also recorded as LOOSE COMM

At the conclusion of the gate survey, Larimer County provided MSW Consultants with a complete data dump of all landfill gate transactions from that week, including ticket number, material volume, type of waste, gate attendant on duty, etc. MSW Consultants entered all data obtained in the gate survey and mapped the survey data to the facility transaction data. Once mapped, the two data sets provide a very detailed breakdown of the proportion of each incoming material type for the targeted week. Results of this process are contained in the following section.

3. GATE SURVEY

RESULTS

The surveyed field data was mapped to the ticket number of the accounting file submitted to MSW Consultants. Table 3-4 shows the total cubic yards in the various material categories delivered during the week of the survey.

Table 3-4 Gate Survey Results (Cubic Yards)

MATERIAL	Residential	Commercial	C&D	Other	Total
C&D COMM	75	108	1,458	11	1,652
COMPACTED	2,769	2,182	81	209	5,071
LOOSE COMM	368	1,145	462	209	2,183
Total	**3,212**	**3,434**	**2,001**	**260**	**8,906**

Table 3-5 reflects the percentage breakdown observed in the gate survey.

Table 3-5 Gate Survey Results (Percent by Volume)

MATERIAL	Residential	Commercial	C&D	Other	Total
C&D COMM	4.6%	6.5%	88.3%	0.7%	100.0%
COMPACTED	54.2%	44.1%	1.7%	0.8%	100.0%
LOOSE COMM	16.8%	52.4%	21.2%	9.6%	100.0%

As shown, COMPACTED waste was found during the week-long survey to be slightly more residential than commercial. LOOSE COMM was found to be predominantly waste from commercial generators, although a significant amount was found in the survey to be C&D waste. Although some of this may be the result of mis-classification of the load at the gate, the gate survey found that C&D is often mixed with commercial waste and therefore the entire load rightfully is classified as LOOSE COMM. Not surprisingly, C&D COMM waste was confirmed to be primarily C&D. "Other Waste" identified in the survey included limbs/land clearing, rip-rap, and the other categories of wastes tracked in the County's landfill accounting system.

ANNUAL PROJECTIONS

Table 3-6 below summarizes calendar year 2006 material volumes received at the landfill. This table shows the allocation of the various material categories tracked by the current accounting system.

Table 3-6 2006 Annual Waste Quantities (cubic yards) by Generating Sector, Raw Data [1]

Material	Residential	Commercial	Self Haul	C&D	Other	Annual Cubic Yards
MIN CAR	0	0	2,481	0	0	2,481
MIN COMM	0	261	0	0	0	261
MIN TRK	0	0	2,427	0	0	2,427
LOOSE CAR	0	0	15,012	0	0	15,012
LOOSE COMM	Unknown					129,047
XFERSTATION	Unknown					56,425
LOOSE NO X	0	1,418	0	0	0	1,418
LOOSE TRK	0	0	120,641	0	0	120,641
ROADSIDE	0	86	0	0	0	86
COMPACTED	Unknown					263,781
COMPCT C&D	0	0	0	592	0	592
C&D CAR	0	0	0	223	0	223
C&D COMM	0	0	0	117,383	0	117,383
C&D TRK	0	0	0	4,290	0	4,290
Totals [2]	**0**	**1,765**	**140,561**	**122,488**	**0**	**714,067**

[1] Source: Larimer County Landfill

[2] Excludes Rip/Fill, Rip/Fill F, Tree Car, Tree Comm, Tree Trk, Tree Disc, Tree Trunk, Tree Xmas, Animal carcasses, Non-friable asbestos, Tires, Appliances, and Auto bodies.

As shown in the table, the LOOSE COMM, XFERSTATION, and COMPACTED categories cannot be allocated to a generator type. MSW Consultants applied the results of the gate survey to allocate the LOOSE COMM and COMPACTED wastes to the appropriate generator class. Further, we assume that XFERSTATION loads contain a mix of residential, commercial, self haul and C&D waste roughly in proportion to the direct-haul quantities received at the Larimer County landfill. Based on these assumptions, Table 3-7 applies the results of the gate survey to allocate all wastes to the appropriate generator sector.

3. GATE SURVEY

Table 3-7 2006 Annual Waste Volume (cubic yards) by Generator, Allocated [1]

Material	Residential	Commercial	Self Haul	C&D	Other	Annual Cubic Yards
MIN CAR	0	0	2,481	0	0	2,481
MIN COMM	0	261	0	0	0	261
MIN TRK	0	0	2,427	0	0	2,427
LOOSE CAR	0	0	15,012	0	0	15,012
LOOSE COMM	21,739	67,669	0	27,302	12,337	129,047
LOOSE NO X	0	1,418	0	0	0	1,418
LOOSE TRK	0	0	120,641	0	0	120,641
ROADSIDE	0	86	0	0	0	86
COMPACTED	144,021	113,479	0	4,200	2,081	263,781
COMPCT C&D	0	0	0	592	0	592
C&D CAR	0	0		223	0	223
C&D COMM	5,358	7,646	0	103,598	782	117,384
C&D TRK	0	0		4,290	0	4,290
Subtotal [2]	*117,118*	*190,559*	*140,561*	*140,205*	*15,200*	*657,643*
Percent of Total	*28.3%*	*30.1%*	*19.7%*	*19.8%*	*2.2%*	*100.0%*
XFERSTATION	15,968	16,984	11,116	11,172	1,241	56,425
GRAND TOTAL	133,086	207,543	151,677	151,377	16,441	714,068

[1] Larimer County data allocated based on the results of the gate survey

[2] Excludes Rip/Fill, Rip/Fill F, Tree Car, Tree Comm, Tree Trk, Tree Disc, Tree Trunk, Tree Xmas, Animal carcasses, Non-friable asbestos, Tires, Appliances, and Auto bodies.

As shown, the Larimer County landfill received 714 thousand yards of waste in 2006. Of this amount 28.3 percent was residential waste delivered by commercial haulers, 30.1 percent was commercial waste delivered by commercial haulers, and 19.7 percent was delivered by self-haulers. C&D wastes made up 19.8 percent, and other wastes were 2.2 percent.

The composition of wastes from each of these generator sectors will be addressed in Section 4 of this report. The weighted average aggregate waste composition will be based on the weighting factors derived in this gate survey.

As a final step, MSW Consultants applied density estimates for the different waste types to convert Table 3-7 from volume to weight. These density estimates are based on other density data points available to MSW Consultants, Larimer County, the U.S. Environmental Protection Agency (EPA), as well as on truck body manufacturer specifications. The following densities were used to convert volume to weight:

- COMPACTED – 750 Lbs/CY

- COMPACTED C&D – 625 Lbs/CY
- XFERSTATION – 600 Lbs/CY
- C&D COM , C&D TRUCK, and C&D CAR – 325 Lbs/CY
- LOOSE COM and MIN COMM – 200 Lbs/CY
- MIN TRUCK, LOOSE NOX, LOOSE TRUCK, and ROADSIDE – 150 Lbs/CY
- MIN CAR and LOOSE CAR – 100 Lbs/CY

Table 3-8 applies these density factors to each type of waste to calculate the total weight of the incoming material categories.

Table 3-8 2006 Annual Waste Quantities (Tons) by Generator, Allocated [1]

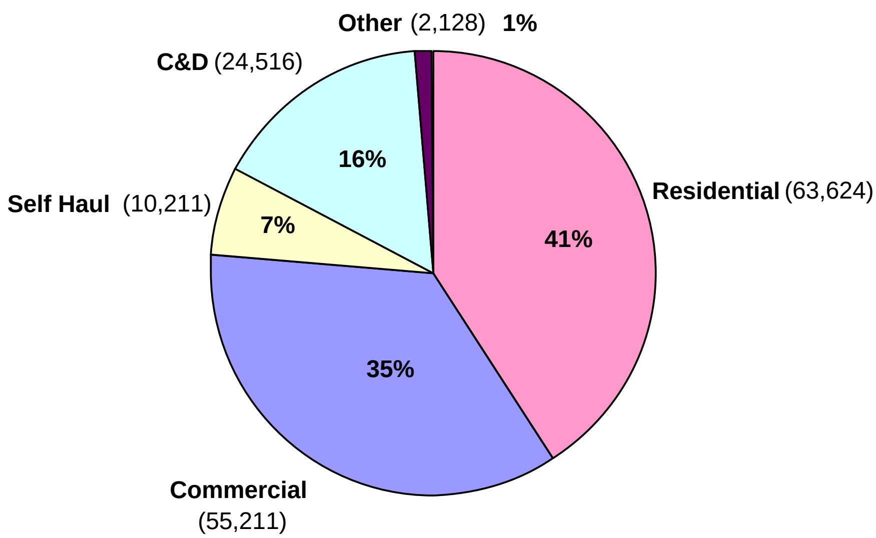
Material	Residential	Commercial	Self Haul	C&D	Other	Annual Tons
MIN CAR	0	0	124	0	0	124
MIN COMM	0	26	0	0	0	26
MIN TRK	0	0	182	0	0	182
LOOSE CAR	0	0	751	0	0	751
LOOSE COMM	2,174	6,767	0	2,730	1,234	12,905
XFERSTATION	9,242	7,282	0	270	134	16,927
LOOSE NO X	0	0	106	0	0	106
LOOSE TRK	0	0	9,048	0	0	9,048
ROADSIDE	0	0	0	0	6	6
COMPACTED	52,208	41,136	0	1,523	754	95,621
COMPCT C&D	0	0	0	185	0	185
C&D CAR	0	0	0	36	0	36
C&D COMM	0	0	0	19,075	0	19,075
C&D TRK	0	0	0	697	0	697
Total	**63,624**	**55,211**	**10,211**	**24,516**	**2,128**	**155,689**
Percentage	***41%***	***35%***	***7%***	***16%***	***1%***	***100%***

[1] Larimer County data allocated based on the results of the gate survey

[2] Excludes Rip/Fill, Rip/Fill F, Tree Car, Tree Comm, Tree Trk, Tree Disc, Tree Trunk, Tree Xmas, Animal carcasses, Non-friable asbestos, Tires, Appliances, and Auto bodies.

As shown, the Larimer County landfill was estimated to receive 155,689 tons of waste in 2006. Of this amount 41 percent by weight was Residential waste, 35 percent was Commercial waste, and 7 percent was delivered by Self-haulers. C&D wastes made up 16 percent, and Other Wastes were one percent. Figure 3-1 summarizes the relative contribution of disposed wastes (by weight) of each of the generator classes in Table 3-8. These percentages are used in Section 4 to aggregate the composition data by generator class.

Figure 3-1 2006 Annual Waste Quantities (Tons) by Generator



4. RESULTS

STATISTICAL MEASURES

This section presents the results of the study. The following statistical measures are used uniformly throughout the section:

- **Sample Mean:** For each generator class, the sample mean composition is the average of the weight-based percentage composition of the individual samples from that generator class. This value, while a good estimate, is unlikely to be identical to the population mean value. To better understand the meaningfulness of the sample mean, other statistical measures are needed.
- **Standard Deviation**: The standard deviation measures how widely values within the data set are dispersed from the sample mean. A higher standard deviation denotes higher variation in the underlying samples for each material.
- **Confidence Intervals**: The confidence intervals reflect the upper and lower range within which the population mean can be expected to fall. Confidence intervals require the following "inputs":
  - The "level of confidence", or how sure one wants to be that the interval being constructed will actually encompass the population mean;
  - The sample mean, around which the confidence interval will be constructed;
  - The sample standard deviation, which is used as a measure of the variability of the population from which the sample was obtained; and
  - The number of sampling units that comprised the sample (aka sample size).
- **Coefficient of Variance**: This measure was used in the 1998 Study, although has not been duplicated for the 2006 Study. Also called the *relative standard deviation*, this measure divides the standard deviation by the mean. In so doing, it enables a normalized comparison of variance among material categories that may appear in the waste stream in significantly different absolute terms. For example, comparing the standard deviations of Food Waste and Rubber/Leather is not meaningful, because there is a significant amount of Food Waste disposed and only trace amounts of Rubber/Leather. However, the coefficient of variance can be compared directly—the category with the larger coefficient has a more variable composition.

Throughout this section, confidence intervals have been calculated at a 90 percent level of confidence, meaning that we can be 90 percent sure that the population mean falls within the upper and lower confidence intervals shown. In general, as the number of samples increases, the width of the confidence intervals decreases, although the more variable the underlying waste stream composition, the less noticeable the improvement for adding incremental samples.

4. RESULTS

ADJUSTING FOR CONTAMINATION

Note that the results shown in this report have not been adjusted for contamination.

During the collection, tipping, and sorting of samples of residential and commercial wastes, moisture and particulate matter of some material categories cross-contaminate other material categories. For example, liquids in food waste may be absorbed by the various paper categories; broken glass particles may embed or adhere to foam plastics or textiles. Based on testing performed in other studies, the impact of contamination is minimal for many categories, but can be significant for some. The following categories from the 2006 Study are most likely to be impacted by moisture and particulate contamination:

- All of the grades of paper:
- Expanded Polystyrene;
- Plastic Film Bags;
- Other Rigid Plastic, which encompasses food and deli trays that may be heavily contaminated; and
- Other Aluminum, which often includes foil and tins that are heavily food-encrusted.

It was beyond the scope of this project to develop contamination correction factors for these material categories. However, readers should recognize that the annual quantities that are calculated in this section of the report overstate the actual quantity of these materials that are being disposed. Further, the annual quantities of food wastes and possibly certain other organic wastes (e.g., Yard Waste) would likely be greater than that shown, as much of the moisture that contaminates the paper likely originated from these organics. Had there been no cross-contamination of moisture and particulates, the disposed quantity of the more absorbent material categories would be at least marginally lower, and the disposed content of moisture-containing categories would have been marginally higher, than what is shown in this section.

AGGREGATION OF DATA BY GENERATOR SECTOR

As discussed in the previous section, a week-long gate survey was performed to develop a defensible breakdown of the incoming quantity of wastes from each of the four main generator sectors targeted in the study. Table 4-1 summarizes the annual wastes disposed by generator sector based on the results of the gate survey.

Table 4-1 Waste Disposal by Generator Sector

Sector	2006 Tons Disposed	Percent of Total
Residential	63,624	41.4%
Commercial	55,211	36.0%
Self-Haul	10,211	6.6%
C&D Debris	24,516	16.0%
Total	**153,562**	**100.0%**

Note: The gate survey also identified "Other" waste categories such as rip/fill, tree limbs, etc. For the purpose of developing weighting factors for the Residential, Commercial, Self-haul and C&D generator sectors, the Other category has been excluded and the remaining percentages re-calculated based on the sum of these four generator sectors. See Table 3-8 for details.

The percentages in the far right column of Table 4-1 are used as weighting factors to develop an aggregate composition of all waste delivered to the Larimer County Landfill.

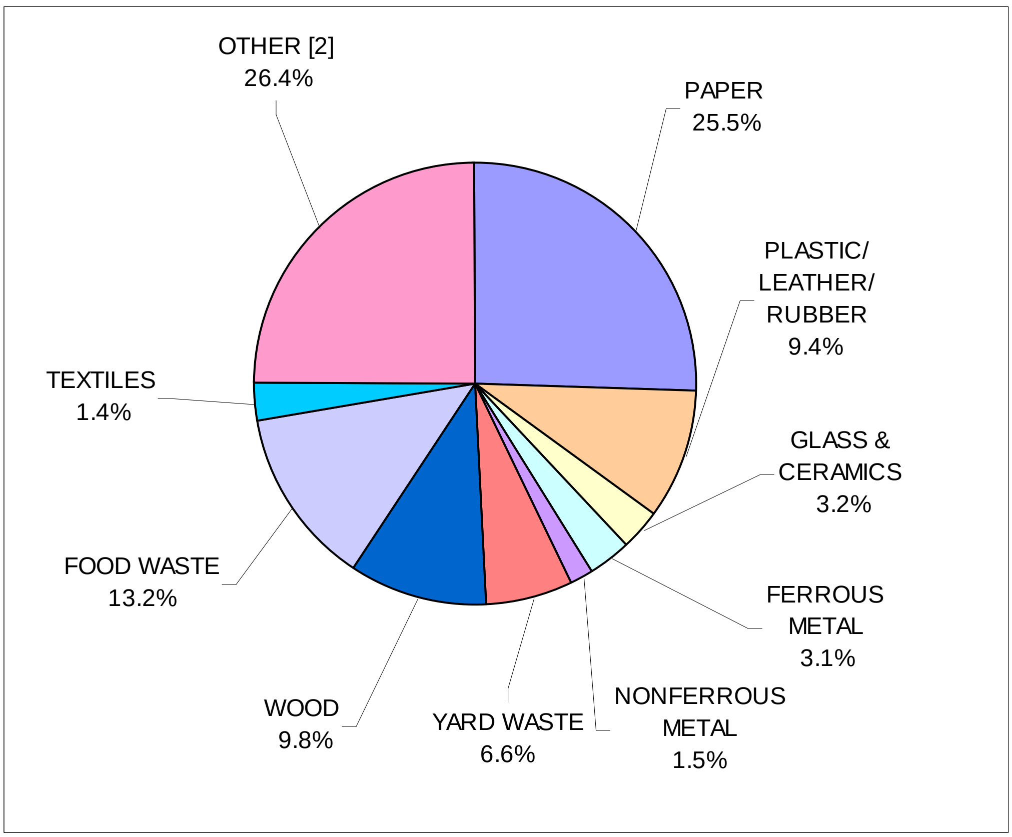
4. RESULTS

RESULTS

AGGREGATE COMPOSITION, ALL WASTE DELIVERIES

Figure 4-1 presents a graphical breakdown of the major material categories entering the Larimer County Landfill from the Residential, Commercial, Self-Haul, and C&D sectors. Note that these material groups have been defined to be directly comparable to the 1998 Study (discussed later in this section). As shown in the Figure, the Paper material group makes up over one quarter of the aggregate waste stream, while Food Waste is the single most prevalent material category. Although the "Other Waste" category is actually the largest material group shown in the Figure, this category comprises 14 different material categories and includes primarily materials generated from C&D activities, which accounts for the size of the group as a whole.

Figure 4-1 Aggregate Composition (Percent by Weight), All Wastes Delivered to Landfill [1]

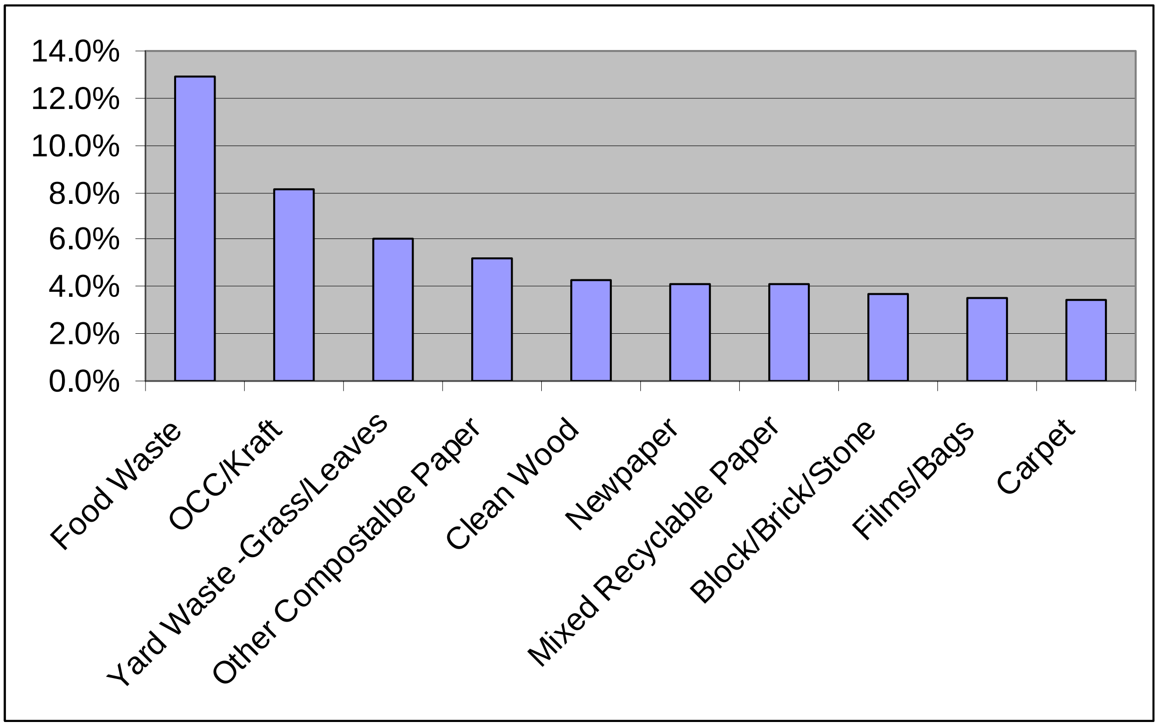


[1] Excludes rip-rap, tree limbs, and other homogeneous categories that are tracked separately in the landfill accounting system.

[2] OTHER waste includes C&D materials such as drywall, block/brick/stone, insulation, and asphalt roofing, and miscellaneous organics and inorganics not elsewhere classified including diapers/sanitary products, electronics, bulky items, carpet, tires, fines, and household hazardous waste (HHW).

Figure 4-2 shows the ten most prevalent individual material categories being disposed at the Larimer County Landfill. It is of definite interest that Corrugated Cardboard, Newspaper, Yard Waste, and even Mixed Paper are on the top ten list. These materials are generally easy to separate, and many municipalities offer separate collections for these materials. The appearance of these materials in the top ten may suggest opportunities for Larimer County to increase recycling and diversion somewhat significantly. Interestingly, all of the most prevalent disposed wastes are either compostable (Food Waste, Other Compostable Paper, Yard Waste) or recyclable (Carpet, Film Bags, Clean Wood). However, these wastes are at a minimum difficult or costly to separate, and at the current time there likely is no local market that can accept these materials. In the short term, therefore, many of these materials do not offer significant potential for diversion, although diversion of at least some of these materials may be a longer term opportunity.

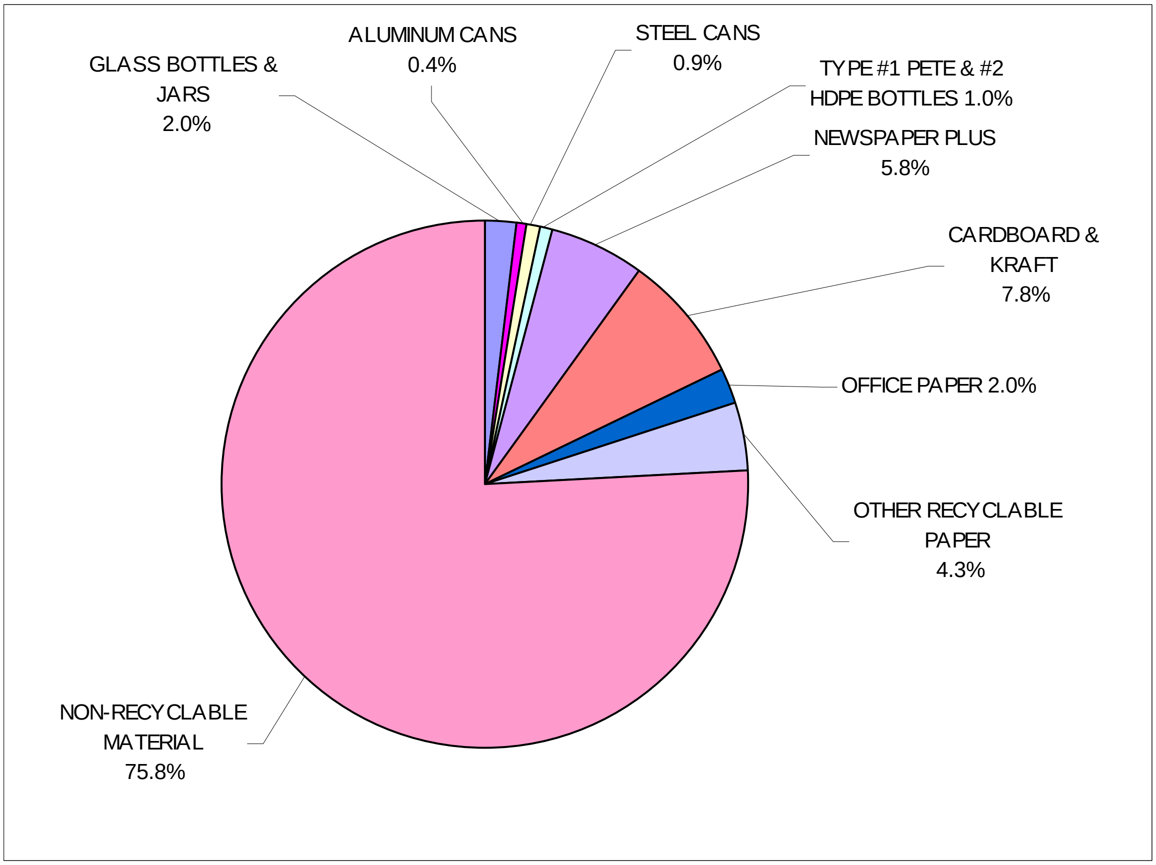
Figure 4-2 Ten Most Prevalent Material Categories (Percent by Weight), Aggregate



4. RESULTS

Figure 4-3 shows the breakdown between recyclable materials and non-recyclable materials. The recyclable materials shown in the Figure are specifically those that are included in the program description and educational materials on the County's website. The occurrence of these targeted recyclables in the aggregate waste stream is certainly caused by the incidence of these materials in the commercial, self-haul and/or C&D waste stream. However, some of the disposed recyclables were generated in the residential waste stream as well.

Figure 4-3. Prevalence of Recyclable Materials in Aggregate Disposed Wastes (Percent by Weight)



As shown in Figure 4-3, this study found that over 24 percent of disposed wastes going into the Larimer County landfill could potentially be recycled (unadjusted for source contamination of recyclable material). The largest recyclable material categories in the disposed waste stream include corrugated cardboard/Kraft paper, newspapers (including inserts), and mixed paper (shown below as Other Recyclable Paper).

Conversely, the study found that almost 76 percent of disposed waste is comprised of materials for which there are no local recycling programs. Although the Figure above labels these materials as "non-recyclable," this label applies only because markets for additional recycled materials have not yet developed in Larimer County. Over time, it is expected that there would be opportunities to increase recycling of new materials that are currently being disposed.

Aggregate waste composition data for the County in detailed tabular format, including statistical measures of standard deviation and 90 percent confidence intervals, is contained in Exhibit 2.

COMPARISON OF COMPOSITION BY GENERATOR CLASS

Table 4-2 compares the mean composition of wastes by generator class for the major material groups. There are several items of interest to be seen in this table:

- Residential and Commercial wastes are reasonably similar;
- Residential and Commercial wastes contain a diverse mix of materials encompassing all of the major material groups;
- Self haul and C&D wastes are much more limited in the materials disposed, and their composition differs significantly from Residential and Commercial waste;
- Self-haul wastes contain a significant fraction of Wood and Other waste, the latter of which is largely made up of C&D material categories;
- C&D Debris contains significant amounts of green and woody wastes associated with land clearing, as well as Other waste (i.e., the C&D material categories).

Table 4-2 Comparison of Waste Composition By Generator Class

Material Group	Residential	Commercial	Self-Haul	C&D
Paper	31.4%	31.6%	13.9%	1.0%
Plastic/Rubber/Leather	10.6%	11.2%	4.5%	0.4%
Glass	4.8%	2.7%	2.8%	3.9%
Ferrous Metal	3.0%	3.5%	2.9%	2.5%
Non-ferrous Metal	1.7%	2.0%	0.4%	0.6%
Yard/Land Clearing	8.4%	6.3%	9.5%	27.2%
Wood	3.0%	8.9%	15.0%	1.6%
Food Waste	17.4%	15.9%	0.3%	0.1%
Textiles	2.4%	1.0%	0.3%	0.0%
Other [1]	17.3%	16.9%	48.7%	62.8%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

[1] OTHER waste includes C&D materials such as drywall, block/brick/stone, insulation, and asphalt roofing, and miscellaneous organics and inorganics not elsewhere classified including diapers/sanitary products, electronics, bulky items, carpet, tires, fines, and household hazardous waste (HHW).

Detailed results for the Residential, Commercial, Self-haul and C&D generator classes are shown in Exhibits 3, 4, 5, and 6.

Table 4-3 compares the top 10 individual materials found in the disposed waste stream of each generator sector.

Table 4-3 Comparison of Top 10 Most Prevalent by Generator Sector

Rank	Residential		Commercial		Self-haul		C&D	
1	Food Waste	17.4%	Food Waste	15.9%	Bulky Items	15.8%	Drywall	15.1%
2	Yard Waste	8.0%	OCC/Kraft	13.6%	Yard Waste	9.5%	Asphalt Roofing	14.7%
3	Non Recyclable Paper	7.7%	Yard Waste	6.3%	Other Inorganics	9.1%	Carpet	11.8%
4	Mixed Recyc Paper	6.6%	Non Recyc Paper	5.5%	Carpet	8.0%	Block/Brick/Stone	11.2%
5	Newspaper	6.5%	Film/Bags	4.5%	Clean Wood	7.7%	Clean Wood	10.9%
6	OCC/Kraft	6.0%	Newspaper	4.1%	Clean Wood Block/Brick/Stone	5.8%	Other Wood	10.3%
7	Diapers/Sanitary Products	4.9%	Mixed Recyc Paper	3.6%	OCC/Kraft	4.4%	Painted/Stained Wood	6.0%
8	Films/Bags	4.5%	Clean Wood	3.5%	Mixed Recyc Paper	4.1%	Other Inorganics	5.4%
9	Other Rigid Plastic	3.2%	High Grade Paper	3.5%	Painted/Stained Wood	3.7%	Other/Broken Glass	3.9%
10	Fines	3.1%	Other Rigid Plastic	3.2%	Asphalt Roofing	3.6%	Other Ferrous Metal	2.4%
Top 10		68.0%		63.9%		71.1%		91.8%

COMPARISON WITH 1998 WASTE COMPOSITION STUDY

The 1998 Study was the first attempt made by the County to evaluate the composition of disposed wastes. This section compares the results of the 2006 Study with the original 1998 Study.

Although it is beyond the scope of this project to research and document the potential differences in methodology and/or outcome between the two studies, we offer the following observations that may prevent a perfect comparison of the results:

- **Smaller number of samples in 1998 Study**: The 1998 Study captured 36 Residential samples, 24 Commercial samples, and 12 Self-haul samples. While the Residential sample size is comparable to the 2006 study and should be sufficient to generate reasonable results, it is somewhat likely that the Commercial, and highly likely that the Self-haul sample sizes were insufficient to eliminate the potential for one or more outlier samples to bias the results;
- **Limited material categories in 1998 Study**: The 1998 Study divided the waste stream into 10 material categories. The categories that were selected, while meaningful in identifying macro-level composition of the waste streams, were relatively limited. The

2006 Study utilized a significantly expanded list of material categories, while allowing for results to be mapped to the 1998 Study material categories for direct comparison;

- **Four-season v. Two-season field data collection**: The 1998 Study included a total of four field data collection events, one each in the Spring, Summer, Fall and Winter. For this reason, it is likely that the 1998 Study effectively captured seasonal variation that occurs in waste composition (e.g., an increase in beverage containers being disposed in the hotter summer months; an increase in yard waste disposal in the spring and fall). The 2006 Study captured only two seasons of data—summer and winter—so there is greater potential that the 2006 Study did not fully capture the impact of spring or fall waste composition trends (especially leaf and yard waste generation).
- **Weekly sampling coverage**: The 1998 Study targeted three days of sorting in each of the four seasons, while the 2006 Study encompassed a full week of sampling in each season. In general, the full week of sampling is preferable to assure that representative samples are captured from all geographic areas of the County.
- **Separate Classification of C&D**: The 2006 Study definitively separates C&D wastes and performs a separate composition analysis of these wastes. It is not clear to what extent the 1998 Study segregated commercial and C&D loads, although notations regarding the random sampling of asphalt shingle loads in the commercial stream suggests that the 1998 Study likely applied a different definition of the generator sectors than were used in the 2006 Study.
- **Sampling Strategy**: The 1998 Study used pure random sampling to acquire and sort samples from incoming truckloads. Based on significant up-front analysis of gatehouse data, and subsequently validated based on a gate survey, the 2006 Study utilized stratified random sampling to assure that samples aligned with known delivery patterns.

Not all of these differences in methodology may meaningfully prevent a comparison of the 1998 and 2006 Study results. At a minimum, though, it appears likely that the most "apples to apples" comparison of results is within the residential stream. Comparison of self haul and commercial results between the two studies may be somewhat limited.

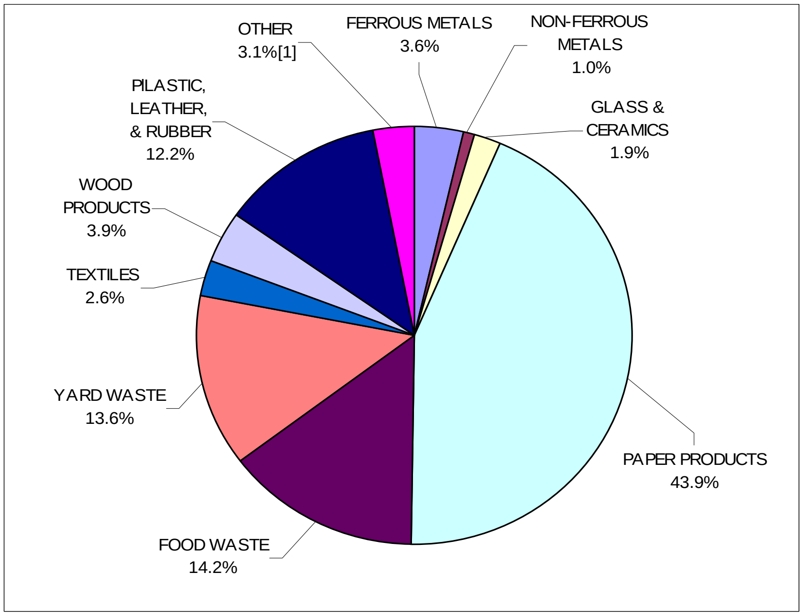
The remaining figures in this section provide a graphical comparison of the 1998 and 2006 Study results:

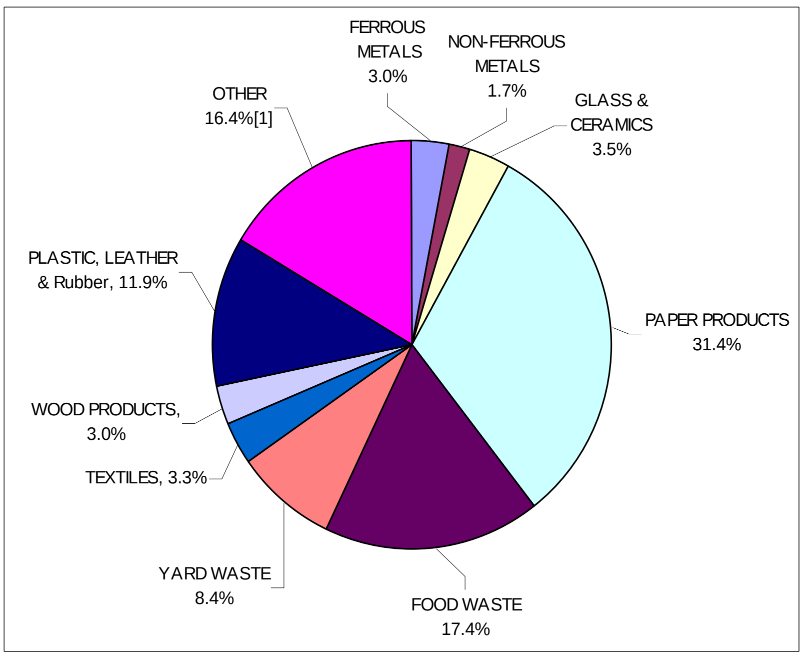
- Figure 4-4 compares the respective composition of 1998 and 2006 *residential* waste.
- Figure 4-5 compares the 1998 and 2006 *commercial* waste composition, and
- Figures 4-6 compares the *self-haul* waste composition in 1998 and 2006.

Readers will note differences in the waste stream by comparing the relative size of each pie piece in the graphs. Although it was beyond the scope of this study to investigate the reason for changes in the waste stream, we make some limited observations (see following pages). For those interested in more detail, a statistical comparison of the 1998 and 2006 results, containing both the mean composition as well as confidence intervals, is contained in Exhibit 7.

4. RESULTS

Figure 4-4 Comparison of 1998 (top) and 2006 (bottom) Residential Waste Composition

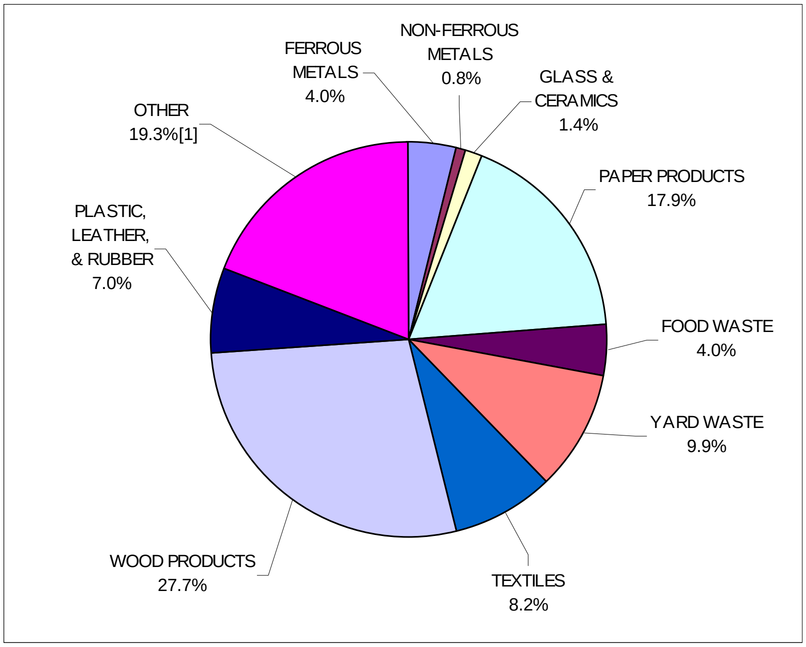


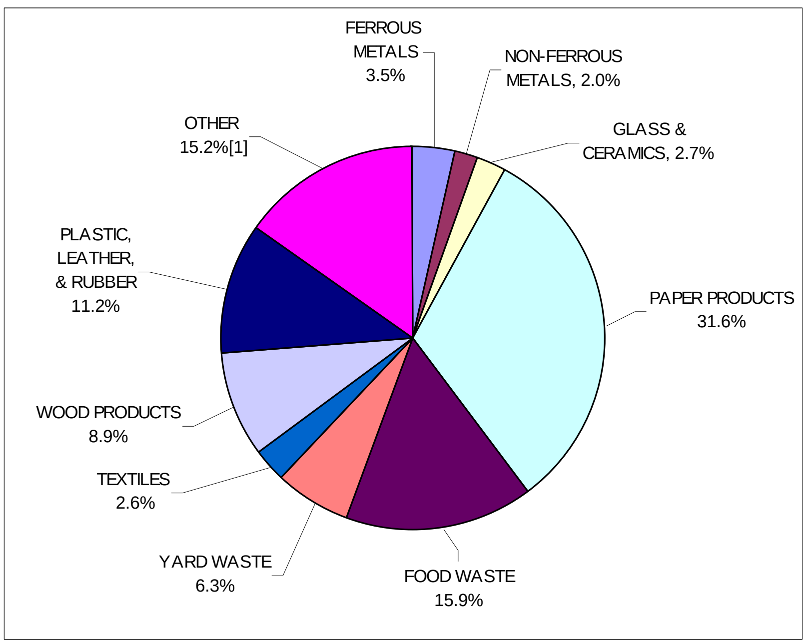


[1] OTHER waste includes C&D materials such as drywall, block/brick/stone, insulation, and asphalt roofing, and miscellaneous organics and inorganics not elsewhere classified including diapers/sanitary products, electronics, bulky items, carpet, tires, fines, and household hazardous waste (HHW).

These results suggest that there have been significant changes in the residential disposed waste stream. First, the fraction of paper has evidently decreased significantly. To some degree this is not surprising, as recovered paper markets were extremely poor through much of the 1990s, and have been much better in recent years. Differences in other categories are harder to explain.

Figure 4-5 Comparison of 1998 (top) and 2006 (bottom) Commercial Waste Composition



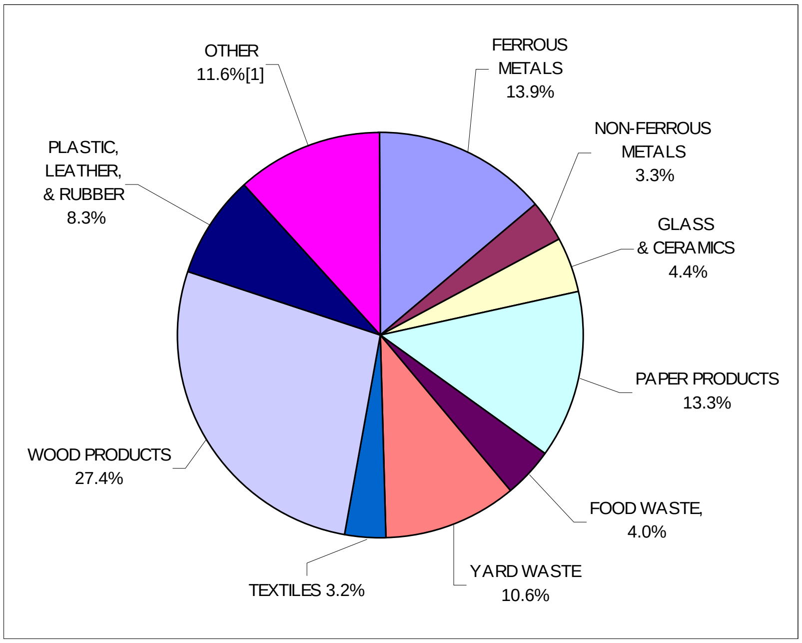


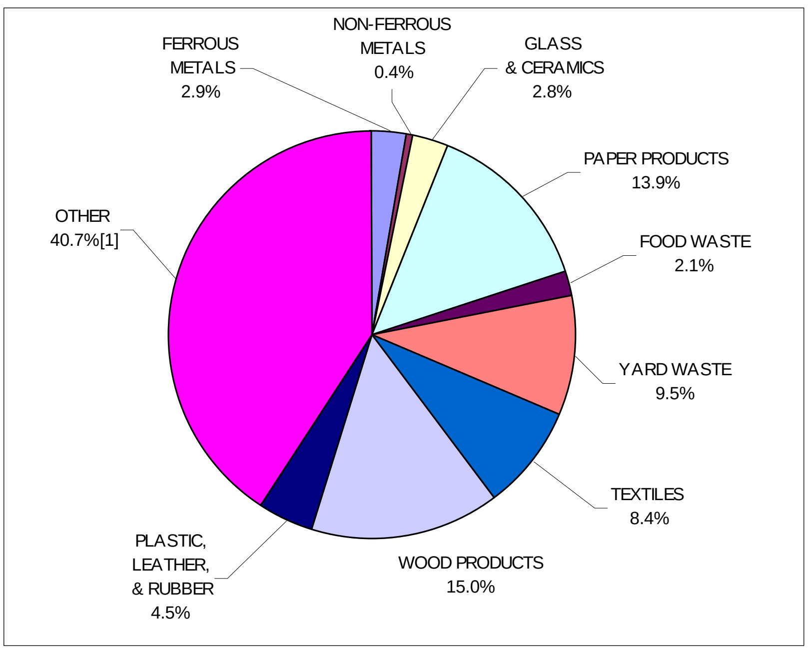
[1] OTHER waste includes C&D materials such as drywall, block/brick/stone, insulation, and asphalt roofing, and miscellaneous organics and inorganics not elsewhere classified including diapers/sanitary products, electronics, bulky items, carpet, tires, fines, and household hazardous waste (HHW).

The comparison of the commercial composition results suggests that the definition of the commercial sector differed in the 1998 and 2006 Studies. The significantly greater incidence of wood in the 1998 Study suggests certain loads that would have been characterized as C&D in the 2006 Study may have been included as commercial in the 1998 Study.

4. RESULTS

Figure 4-6 Comparison of 1998 (top) and 2006 (bottom) Self Haul Waste Composition





[1] OTHER waste includes C&D materials such as drywall, block/brick/stone, insulation, and asphalt roofing, and miscellaneous organics and inorganics not elsewhere classified including diapers/sanitary products, electronics, bulky items, carpet, tires, fines, and household hazardous waste (HHW).

Once again, a comparison of the 1998 and 2006 Study results for self haul waste suggest that a different definition of the self haul generator sector may have been applied. However, it must also be noted that the very small sample size of self haul samples in the 1998 Study resulted in extremely wide confidence intervals, making comparison difficult (see Exhibit 7).

Exhibit 1: Summary of Physical Sample Loads

Summer Season Sort

Sample Number	Date	Sample Type	Time of Delivery	Hauler	Vehicle Type	Generator Type	Origin of Waste
1	9/11/06	Physical	8:00	GSI	Front Load	Commercial	Fort Collins
2	9/11/06	Physical	8:50	WM	Front Load	Commercial	Fort Collins
3	9/11/06	Physical	8:55	GSI	Rear Load	Commercial	Fort Collins
4	9/11/06	Physical	9:50	S&S	Rear Load	Commercial	Loveland
5	9/11/06	Physical	10:10	GSI	Rear Load	Commercial	Fort Collins
6	9/11/06	Physical	10:10	Dick's	Rear Load	Commercial	Fort Collins
7	9/11/06	Physical	10:30	Ram	Rear Load	Residential	Fort Collins
8	9/11/06	Physical	11:10	Dick's	Rear Load	Residential	Fort Collins
9	9/11/06	Physical	12:18	Loveland	Front Load	Residential	Loveland
10	9/11/06	Physical	13:00	GSI	Rear Load	Residential	Fort Collins
11	9/11/06	Physical	15:15	GSI	Front Load	Residential	Fort Collins
12	9/12/06	Physical	9:07	WM	Front Load	Commercial	South Fort Collins
13	9/12/06	Physical	9:07	GSI	Rear Load	Commercial	Loveland
14	9/12/06	Physical	9:35	GSI	Front Load	Commercial	Fort Collins
15	9/12/06	Physical	10:07	CSU	Front Load	Commercial	CSU
16	9/12/06	Physical	10:55	Ram	Rear Load	Residential	Fort Collins
17	9/12/06	Physical	11:00	GSI	Rear Load	Commercial	Wellington
18	9/12/06	Physical	11:30	GSI	Rear Load	Residential	Fort Collins
19	9/12/06	Physical	12:30	Loveland	Front Load	Residential	City of Loveland
20	9/12/06	Physical	12:40	Ram	Rear Load	Commercial	Fort Collins
21	9/12/06	Physical	13:15	Ram	Rear Load	Residential	Fort Collins CSU North
22	9/12/06	Physical	15:00	Loveland	Front Load	Residential	Loveland
23	9/13/06	Physical		Loveland	Rear Load	Residential	Loveland Apartment
24	9/13/06	Physical	8:50	GSI	Front Load	Commercial	Fort Collins
25	9/13/06	Physical	9:55	GSI	Rear Load	Residential	Fort Collins
26	9/13/06	Physical	10:40	S&S	Rear Load	Commercial	Loveland
27	9/13/06	Physical	10:40	GSI	Front Load	Commercial	Fort Collins
28	9/13/06	Physical	11:10	Ram	Rear Load	Commercial	Fort Collins
29	9/13/06	Physical	11:20	GSI	Front Load	Residential	Fort Collins
30	9/13/06	Physical	11:30	Mike's	RO	Commercial	Fort Collins
31	9/13/06	Physical	12:30	Shroder Ro	Trailer	Commercial	Fort Collins
32	9/13/06	Physical	12:40	GSI	Rear Load	Residential	Fort Collins
33	9/13/06	Physical	13:30	RAM	Rear Load	Residential	Fort Collins
34	9/13/06	Physical	13:50	GSI	Rear Load	Residential	Fort Collins
35	9/13/06	Physical	14:30		RO	Commercial	Fort Collins

Exhibit 1: Summary of Physical Sample Loads

Winter Season Sort

Sample Number	Date	Sample Type	Time of Delivery	Hauler	Vehicle Type	Generator Type	Origin of Waste
1	12/5/06	Physical	8:25	CSU	Front Load	Commercial	CSU
2	12/5/06	Physical	9:45	Gullage	Rear Load	Commercial	Fort Collins
3	12/5/06	Physical	11:00	GSI	Rear Load	Commercial	Fort Collins
4	12/5/06	Physical	11:30	WM	Front Load	Commercial	Fort Collins
5	12/5/06	Physical	12:00	GSI	SL	Residential	Fort Collins
6	12/5/06	Physical	13:00	Loveland	Front Load	Residential	Fort Collins South
7	12/5/06	Physical	13:15	RAM	Rear Load	Residential	Fort Collins
8	12/5/06	Physical	14:20	GSI	Rear Load	Residential	Fort Collins
9	12/6/06	Physical	9:20	GSI	Front Load	Commercial	Fort Collins
10	12/6/06	Physical	9:40	GSI	Rear Load	Commercial	
11	12/6/06	Physical	10:45	RAM	SL	Residential	Fort Collins
12	12/6/06	Physical	10:50	GSI	SL	Residential	Fort Collins
13	12/6/06	Physical	11:30	Dick's	Rear Load	Commercial	Fort Collins
14	12/6/06	Physical	11:30	Dick's	Rear Load	Residential	Fort Collins
15	12/6/06	Physical	15:30	RAM	Rear Load	Residential	Fort Collins
16	12/7/06	Physical	9:00	WM	Front Load	Commercial	Fort Collins
17	12/7/06	Physical	9:10	WM	Front Load	Commercial	Fort Collins
18	12/7/06	Physical	9:45	United	Front Load	Residential	BertLoud
19	12/7/06	Physical	10:00	RAM	Rear Load	Commercial	Fort Collins
20	12/7/06	Physical	10:15	GSI	Rear Load	Commercial	Fort Collins/Loveland
21	12/7/06	Physical	10:30	WM	Front Load	Commercial	Loveland
22	12/7/06	Physical	11:30	GSI	Rear Load	Commercial	Loveland-South
23	12/7/06	Physical	11:40	GSI	Front Load	Commercial	All Over
24	12/7/06	Physical	12:15	WM	Front Load	Commercial	Loveland
25	12/7/06	Physical	12:30	Loveland	Rear Load	Residential	Loveland
26	12/7/06	Physical	13:50	Loveland	Front Load	Residential	Loveland
27	12/7/06	Physical	14:30	Loveland	Front Load	Residential	Loveland
28	12/7/06	Physical	15:50	GSI	Rear Load	Residential	Fort Collins
29	12/7/06	Physical	15:15	Loveland	Front Load	Residential	Loveland
30	12/8/06	Physical	9:00	GSI	Front Load	Commercial	Fort Collins
31	12/8/06	Physical	9:20	GSI	Front Load	Commercial	South Fort Collins
32	12/8/06	Physical	10:00	WM	Front Load	Commercial	Loveland
33	12/8/06	Physical	10:20	Dick's	Rear Load	Residential	Outside Ft. Collins
34	12/8/06	Physical	10:35	Dick's	Front Load	Commercial	Fort Collins
35	12/8/06	Physical	11:40	S&S	Front Load	Commercial	BertLoud

Exhibit 2: Aggregate Results

			Weighted Data				2006
			Annual Average	Standard Deviation	Confidence Intrerval Lower	Confidence Intrerval Upper	Estimated Quantity
		Material Categories					**152,933**
PAPER	1	OCC/Kraft	7.8%	13.8%	6.3%	9.3%	11,888
	2	Newpaper	4.3%	14.3%	2.7%	5.9%	6,560
	3	Magazines/Glossy	1.5%	19.3%	0.0%	3.6%	2,296
	4	High Grade Paper	2.0%	7.1%	1.3%	2.8%	3,124
	5	Polycoated/Aseptic Containers	0.2%	1.1%	0.1%	0.3%	307
	6	Mixed (Other Recyclable)	4.3%	10.9%	3.1%	5.5%	6,600
	7	Other Paper (Non Recyclable)	5.4%	7.1%	4.6%	6.2%	8,223
		Subtotal	25.5%	29.9%	22.2%	28.8%	38,998
PLASTICS	8	#1 PET Bottles/Jars	0.6%	7.9%	0.0%	1.5%	933
	9	#2 HDPE Bottles/Jars	0.4%	37.2%	0.0%	4.6%	672
	10	#3 - 7 Bottles/Jars	0.4%	1.1%	0.3%	0.6%	673
	11	Expanded Polystyrene	0.6%	1.4%	0.4%	0.7%	888
	12	Films/Bags	3.5%	5.7%	2.9%	4.2%	5,409
	13	Other Ridged Plastic	2.7%	2.5%	2.5%	3.0%	4,189
		Subtotal	8.3%	9.4%	7.3%	9.4%	12,766
GLASS	14	Clear Glass	0.9%	13.6%	0.0%	2.4%	1,328
	15	Green Glass	0.2%	13.9%	0.0%	1.8%	374
	16	Brown Glass	0.9%	2.2%	0.6%	1.1%	1,352
	17	Other Glass/Broken Glass	1.2%	4.9%	0.7%	1.8%	1,878
		Subtotal	3.2%	9.4%	2.2%	4.3%	4,933
METALS	18	Ferrous Cans	0.9%	16.1%	0.0%	2.6%	1,314
	19	Other Ferrous Metals	1.6%	6.0%	0.9%	2.3%	2,450
	20	Aluminum Cans	0.4%	0.8%	0.3%	0.5%	594
	21	Other Aluminum	0.5%	7.4%	0.0%	1.3%	725
	22	Other Non-Ferrous	0.7%	2.7%	0.4%	1.0%	1,024
	23	Appliances	0.6%	4.3%	0.1%	1.1%	906
		Subtotal	4.6%	6.7%	3.8%	5.3%	7,013
ORGANICS	24	Food Waste	13.2%	22.6%	10.7%	15.7%	20,137
	25	Diapers/Sanitary Products	2.3%	13.7%	0.8%	3.9%	3,581
	26	Textiles	1.4%	7.3%	0.6%	2.2%	2,115
	26A	Rubber/Leather	1.0%	2.9%	0.7%	1.3%	1,562
	27	Yard Waste -Grass/Leaves	6.2%	8.0%	5.4%	7.1%	9,529
	28	Land Clearing	0.4%	4.6%	0.0%	0.9%	592
	29	Clean Wood	4.1%	10.9%	2.9%	5.3%	6,334
	30	Painted/Stained Wood	2.6%	7.0%	1.8%	3.4%	3,962
	31	Other Wood	3.0%	12.0%	1.7%	4.3%	4,616
	32	Fines	2.3%	15.2%	0.6%	4.0%	3,520
	33	Other Organics	1.9%	7.2%	1.1%	2.7%	2,920
		Subtotal	38.5%	31.9%	35.0%	42.0%	58,867
INORGANICS	34	Carpet	3.3%	8.1%	2.4%	4.2%	5,109
	35	Drywall	2.6%	14.0%	1.1%	4.2%	4,010
	36	Block/Brick/Stone	3.5%	11.9%	2.2%	4.8%	5,371
	37	Insulation	0.3%	3.8%	0.0%	0.7%	430
	38	Asphalt Roofing	3.1%	11.2%	1.9%	4.4%	4,810
	39	Other C&D Material	1.1%	8.5%	0.2%	2.1%	1,718
	40	Electronics	1.3%	9.1%	0.3%	2.3%	1,978
	41	Bulky Items	1.5%	0.9%	1.4%	1.6%	2,368
	42	Tires	0.2%	10.0%	0.0%	1.3%	283
	43	Other Inorganics	2.0%	9.1%	1.0%	3.0%	3,094
	44	Hazardous Material	0.8%	2.8%	0.5%	1.1%	1,186
		Subtotal	19.8%	18.2%	17.8%	21.9%	30,357
		GRAND TOTAL	100.0%				152,933

Exhibit 3: Residential Results

		Materials	Average Percent	Standard Deviation	90%Conf. Interval Lower	Upper	Annual Tons
PAPER	1	OCC/Kraft	6.0%	5.7%	4.4%	7.6%	3,817
	2	Newpaper	6.5%	6.5%	4.7%	8.4%	4,164
	3	Magazines/Glossy	2.8%	2.8%	2.0%	3.6%	1,773
	4	High Grade Paper	1.6%	2.0%	1.0%	2.2%	1,007
	5	Polycoated/Aseptic Containers	0.2%	0.4%	0.1%	0.4%	148
	6	Mixed (Other Recyclable)	6.6%	3.9%	5.4%	7.7%	4,169
	7	Other Paper (Non Recyclable)	7.7%	2.4%	7.0%	8.4%	4,926
		Subtotal	31.4%	9.9%	28.6%	34.3%	20,004
PLASTIC	8	#1 PET Bottles/Jars	0.8%	0.4%	0.7%	1.0%	540
	9	#2 HDPE Bottles/Jars	0.7%	0.6%	0.5%	0.9%	424
	10	#3 - 7 Bottles/Jars	0.8%	0.9%	0.5%	1.0%	499
	11	Expanded Polystyrene	0.6%	0.4%	0.4%	0.7%	352
	12	Films/Bags	4.5%	1.6%	4.0%	5.0%	2,861
	13	Other Ridged Plastic	3.2%	1.6%	2.8%	3.7%	2,053
		Subtotal	10.6%	2.9%	9.7%	11.4%	6,729
GLASS	14	Clear Glass	1.4%	1.0%	1.2%	1.7%	921
	15	Green Glass	0.3%	0.4%	0.2%	0.5%	206
	16	Brown Glass	1.4%	1.7%	0.9%	1.8%	861
	17	Other Glass/Broken Glass	0.4%	0.5%	0.2%	0.5%	228
		Subtotal	3.5%	2.6%	2.7%	4.2%	2,217
METALS	18	Ferrous Cans	1.4%	0.8%	1.1%	1.6%	875
	19	Other Ferrous Metals	0.9%	1.4%	0.5%	1.3%	564
	20	Aluminum Cans	0.7%	0.5%	0.5%	0.8%	429
	21	Other Aluminum	0.5%	0.8%	0.3%	0.7%	311
	22	Other Non-Ferrous	0.5%	1.0%	0.2%	0.8%	327
	23	Appliances	0.7%	3.1%	0.0%	1.6%	438
		Subtotal	4.6%	3.2%	3.7%	5.5%	2,944
ORANICS	24	Food Waste	17.4%	9.1%	14.8%	20.1%	11,097
	25	Diapers/Sanitary Products	4.9%	4.0%	3.8%	6.1%	3,125
	26	Textiles/Rubber/Leather	2.4%	2.0%	1.8%	3.0%	1,521
	26A	Rubber/Leather	1.4%	1.8%	0.8%	1.9%	862
	27	Yard Waste -Grass/Leaves	8.0%	10.4%	5.0%	11.0%	5,085
	28	Yard Waste - Stumps/Logs	0.4%	1.3%	0.0%	0.8%	253
	29	Clean Wood	1.5%	4.6%	0.2%	2.9%	982
	30	Painted/Stained Wood	1.1%	3.4%	0.1%	2.1%	690
	31	Other Wood	0.4%	1.0%	0.1%	0.7%	246
	32	Fines	3.1%	1.5%	2.7%	3.6%	1,989
	33	Other Organics	2.7%	2.8%	1.9%	3.4%	1,687
		Subtotal	43.3%	11.4%	40.0%	46.5%	27,536
INORGANICS	34	Carpet	0.9%	2.2%	0.3%	1.5%	563
	35	Drywall	0.2%	0.8%	0.0%	0.4%	121
	36	Block/Brick/Stone	0.7%	2.0%	0.2%	1.3%	470
	37	Insulation	0.0%	0.1%	0.0%	0.0%	8
	38	Asphalt Roofing	0.0%	0.1%	0.0%	0.1%	22
	39	Other C&D Material	0.8%	1.6%	0.3%	1.2%	499
	40	Electronics	2.2%	5.4%	0.6%	3.7%	1,368
	41	Furniture	0.4%	2.3%	0.0%	1.0%	257
	42	Tires	0.0%	0.0%	0.0%	0.0%	0
	43	Other Inorganic	0.6%	1.5%	0.2%	1.1%	405
	44	Other Hazardous Material	0.8%	1.0%	0.5%	1.0%	481
		Subtotal	6.6%	7.1%	4.6%	8.6%	4,194
		TOTAL	100.0%				63,624

Exhibit 4: Commercial Results

		Materials	Average Percent	Standard Deviation	90%Conf. Interval Lower	90%Conf. Interval Upper	Annual Tons
PAPER	1	OCC/Kraft	13.6%	11.9%	10.4%	16.9%	7,533
	2	Newpaper	4.1%	10.7%	1.2%	7.0%	2,278
	3	Magazines/Glossy	0.9%	1.1%	0.6%	1.2%	493
	4	High Grade Paper	3.5%	10.9%	0.5%	6.4%	1,925
	5	Polycoated/Aseptic Containers	0.3%	0.6%	0.1%	0.4%	156
	6	Mixed (Other Recyclable)	3.6%	2.7%	2.9%	4.4%	1,993
	7	Other Paper (Non Recyclable)	5.5%	4.4%	4.3%	6.7%	3,049
		Subtotal	31.6%	18.0%	26.7%	36.4%	17,428
PLASTIC	8	#1 PET Bottles/Jars	0.7%	0.6%	0.5%	0.9%	384
	9	#2 HDPE Bottles/Jars	0.4%	0.5%	0.3%	0.6%	240
	10	#3 - 7 Bottles/Jars	0.3%	0.4%	0.2%	0.4%	166
	11	Expanded Polystyrene	0.9%	1.3%	0.5%	1.2%	474
	12	Films/Bags	4.5%	3.6%	3.5%	5.5%	2,482
	13	Other Ridged Plastic	3.2%	2.7%	2.5%	4.0%	1,774
		Subtotal	10.0%	6.3%	8.3%	11.7%	5,520
GLASS	14	Clear Glass	0.7%	0.8%	0.5%	0.9%	391
	15	Green Glass	0.3%	1.2%	0.0%	0.6%	164
	16	Brown Glass	0.8%	1.6%	0.4%	1.3%	464
	17	Other Glass/Broken Glass	0.9%	3.2%	0.0%	1.7%	473
		Subtotal	2.7%	4.1%	1.6%	3.8%	1,493
METALS	18	Ferrous Cans	0.8%	0.9%	0.5%	1.0%	424
	19	Other Ferrous Metals	1.9%	2.9%	1.1%	2.7%	1,043
	20	Aluminum Cans	0.3%	0.3%	0.2%	0.4%	157
	21	Other Aluminum	0.6%	1.3%	0.2%	0.9%	325
	22	Other Non-Ferrous	1.1%	3.2%	0.3%	2.0%	619
	23	Appliances	0.8%	3.8%	0.0%	1.8%	454
		Subtotal	5.5%	5.5%	4.0%	7.0%	3,022
ORANICS	24	Food Waste	15.9%	14.6%	12.0%	19.9%	8,801
	25	Diapers/Sanitary Products	0.7%	2.1%	0.2%	1.3%	405
	26	Textiles	1.0%	2.1%	0.4%	1.6%	541
	26A	Rubber/Leather	1.2%	2.1%	0.6%	1.8%	675
	27	Yard Waste -Grass/Leaves	6.3%	12.1%	3.1%	9.6%	3,490
	28	Yard Waste - Stumps/Logs	0.0%	0.0%	0.0%	0.0%	0
	29	Clean Wood	3.5%	8.7%	1.2%	5.9%	1,939
	30	Painted/Stained Wood	2.6%	6.4%	0.9%	4.3%	1,439
	31	Other Wood	2.8%	6.4%	1.1%	4.6%	1,556
	32	Fines	2.7%	3.6%	1.7%	3.7%	1,495
	33	Other Organics	1.6%	4.7%	0.3%	2.9%	873
		Subtotal	38.4%	18.3%	33.5%	43.4%	21,215
INORGANICS	34	Carpet	1.6%	5.8%	0.1%	3.2%	899
	35	Drywall	0.1%	0.6%	0.0%	0.3%	78
	36	Block/Brick/Stone	2.9%	8.2%	0.7%	5.1%	1,609
	37	Insulation	0.0%	0.0%	0.0%	0.0%	1
	38	Asphalt Roofing	1.5%	8.7%	0.0%	3.9%	833
	39	Other C&D Material	1.7%	4.3%	0.5%	2.8%	919
	40	Electronics	0.6%	1.8%	0.2%	1.1%	355
	41	Furniture	0.7%	4.5%	0.0%	2.0%	401
	42	Tires	0.5%	2.2%	0.0%	1.1%	268
	43	Other Inorganic	0.9%	4.1%	0.0%	2.0%	484
	44	Other Hazardous Material	1.2%	2.6%	0.5%	2.0%	686
		Subtotal	11.8%	14.8%	7.8%	15.8%	6,533
		Total	100.0%				55,211

Exhibit 5: Self-Haul Results

		Materials	Adjusted Average Percent	Adjusted Standard Deviation	Adjusted 90%Conf. Interval Lower	Adjusted 90%Conf. Interval Upper	Annual Tons 2006
PAPER	1	OCC/Kraft	4.4%	16.2%	1.4%	7.5%	425
	2	Newspaper	1.2%	8.2%	0.0%	2.7%	111
	3	Magazines/Glossy	0.3%	0.7%	0.2%	0.4%	28
	4	High Grade Paper	1.9%	4.5%	0.0%	4.4%	186
	5	Polycoated/Aseptic Containers	0.0%	0.1%	0.0%	0.0%	2
	6	Mixed (Other Recyclable)	4.1%	14.8%	1.3%	6.9%	392
	7	Other Paper (Non Recyclable)	1.9%	9.6%	0.1%	3.7%	182
		Subtotal	13.8%	33.0%	7.6%	20.1%	1,326
PLASTIC	8	#1 PET Bottles/Jars	0.1%	0.2%	0.0%	0.2%	9
	9	#2 HDPE Bottles/Jars	0.1%	0.2%	0.0%	0.1%	7
	10	#3 - 7 Bottles/Jars	0.1%	0.2%	0.0%	0.1%	8
	11	Expanded Polystyrene	0.3%	1.4%	0.0%	0.6%	28
	12	Films/Bags	0.5%	2.9%	0.0%	1.1%	49
	13	Other Ridged Plastic	3.3%	11.0%	1.3%	5.4%	319
		Subtotal	4.4%	13.4%	1.8%	6.9%	419
GLASS	14	Clear Glass	0.2%	0.4%	0.1%	0.2%	15
	15	Green Glass	0.0%	0.1%	0.0%	0.0%	3
	16	Brown Glass	0.3%	2.4%	0.0%	0.7%	26
	17	Other Glass/Broken Glass	2.4%	12.2%	0.1%	4.7%	232
		Subtotal	2.9%	13.8%	0.3%	5.5%	276
METAL	18	Ferrous Cans	0.1%	0.3%	0.1%	0.2%	14
	19	Other Ferrous Metals	2.6%	8.8%	0.9%	4.2%	247
	20	Aluminum Cans	0.1%	0.6%	0.0%	0.2%	7
	21	Other Aluminum	0.2%	0.4%	0.0%	0.3%	17
	22	Other Non-Ferrous	0.2%	0.4%	0.0%	0.4%	16
	23	Appliances	0.1%	0.2%	0.0%	0.2%	8
		Subtotal	3.2%	10.6%	1.2%	5.2%	307
ORANICS	24	Food Waste	2.2%	19.3%	0.0%	5.9%	212
	25	Diapers/Sanitary Products	0.5%	1.2%	0.3%	0.7%	49
	26	Textiles	0.5%	2.2%	0.1%	0.9%	45
	26A	Rubber/Leather	0.2%	0.5%	0.0%	0.5%	21
	27	Yard Waste -Grass/Leaves	9.5%	25.5%	4.7%	14.3%	910
	28	Land Clearing	0.2%	0.4%	0.0%	0.4%	17
	29	Clean Wood	7.7%	22.6%	3.5%	12.0%	741
	30	Painted/Stained Wood	3.7%	11.4%	1.6%	5.9%	355
	31	Other Wood	2.9%	7.9%	1.4%	4.4%	277
	32	Fines	0.3%	0.8%	0.2%	0.5%	32
	33	Other Organics	1.9%	13.6%	0.0%	4.5%	183
		Subtotal	29.7%	39.8%	22.2%	37.2%	2,843
INORGANICS	34	Carpet	8.0%	24.8%	3.3%	12.6%	762
	35	Drywall	1.0%	9.1%	0.0%	2.8%	100
	36	Block/Brick/Stone	5.8%	21.9%	1.7%	9.9%	556
	37	Insulation	0.1%	0.3%	0.0%	0.4%	13
	38	Asphalt Roofing	3.6%	14.5%	0.8%	6.3%	342
	39	Other C&D Material	0.1%	0.2%	0.0%	0.1%	8
	40	Electronics	2.4%	12.9%	0.0%	4.8%	225
	41	Bulky Items	15.8%	33.8%	9.4%	22.2%	1,514
	42	Tires	0.1%	0.2%	0.0%	0.3%	10
	43	Other Inorganic	9.1%	23.6%	4.6%	13.5%	871
	44	Other Hazardous Material	0.1%	0.2%	0.0%	0.2%	8
		Subtotal	46.0%	43.5%	37.8%	54.2%	4,411
		TOTAL	100.0%				9,582

Exhibit 6: C&D Results

		Materials	Adjusted Average Percent	Adjusted Standard Deviation	Adjusted 90%Conf. Interval Lower	Adjusted 90%Conf. Interval Upper	Annual Tons
PAPER	1	OCC/Kraft	0.5%	1.4%	0.2%	0.7%	113
	2	Newspaper	0.0%	0.0%	0.0%	0.0%	7
	3	Magazines/Glossy	0.0%	0.0%	0.0%	0.0%	1
	4	High Grade Paper	0.0%	0.0%	0.0%	0.0%	6
	5	Polycoated/Aseptic Containers	0.0%	0.0%	0.0%	0.0%	0
	6	Mixed (Other Recyclable)	0.2%	0.0%	0.0%	0.4%	46
	7	Other Paper (Non Recyclable)	0.3%	1.1%	0.1%	0.5%	65
		Subtotal	1.0%	3.1%	0.4%	1.6%	239
PLASTIC	8	#1 PET Bottles/Jars	0.0%	0.0%	0.0%	0.0%	1
	9	#2 HDPE Bottles/Jars	0.0%	0.0%	0.0%	0.0%	2
	10	#3 - 7 Bottles/Jars	0.0%	0.0%	0.0%	0.0%	1
	11	Expanded Polystyrene	0.1%	1.2%	0.0%	0.4%	35
	12	Films/Bags	0.1%	0.4%	0.0%	0.2%	17
	13	Other Ridged Plastic	0.2%	0.7%	0.0%	0.3%	43
		Subtotal	0.4%	1.6%	0.1%	0.7%	98
GLASS	14	Clear Glass	0.0%	0.0%	0.0%	0.0%	1
	15	Green Glass	0.0%	0.0%	0.0%	0.0%	0
	16	Brown Glass	0.0%	0.0%	0.0%	0.0%	1
	17	Other Glass/Broken Glass	3.9%	15.8%	0.9%	6.8%	944
		Subtotal	3.9%	15.8%	0.9%	6.8%	947
METAL	18	Ferrous Cans	0.0%	0.0%	0.0%	0.0%	2
	19	Other Ferrous Metals	2.4%	6.4%	1.2%	3.6%	596
	20	Aluminum Cans	0.0%	0.0%	0.0%	0.0%	0
	21	Other Aluminum	0.3%	1.7%	0.0%	0.6%	72
	22	Other Non-Ferrous	0.3%	1.5%	0.0%	0.5%	63
	23	Appliances	0.0%	0.2%	0.0%	0.1%	6
		Subtotal	3.0%	7.5%	1.6%	4.4%	740
ORANICS	24	Food Waste	0.1%	0.0%	0.0%	0.2%	27
	25	Diapers/Sanitary Products	0.0%	0.0%	0.0%	0.0%	1
	26	Textiles	0.0%	0.0%	0.0%	0.1%	8
	26A	Rubber/Leather	0.0%	0.1%	0.0%	0.0%	3
	27	Yard Waste -Grass/Leaves	0.2%	0.0%	0.1%	0.3%	44
	28	Land Clearing	1.3%	11.5%	0.0%	3.5%	322
	29	Clean Wood	10.9%	21.0%	6.9%	14.9%	2,671
	30	Painted/Stained Wood	6.0%	17.1%	2.8%	9.2%	1,478
	31	Other Wood	10.3%	25.5%	5.5%	15.2%	2,537
	32	Fines	0.0%	0.0%	0.0%	0.0%	5
	33	Other Organics	0.7%	4.8%	0.0%	1.6%	177
		Subtotal	29.7%	33.9%	23.3%	36.1%	7,273
INORGANICS	34	Carpet	11.8%	25.7%	6.9%	16.6%	2,886
	35	Drywall	15.1%	32.7%	9.0%	21.3%	3,710
	36	Block/Brick/Stone	11.2%	26.7%	6.1%	16.2%	2,737
	37	Insulation	1.7%	11.4%	0.0%	3.8%	407
	38	Asphalt Roofing	14.7%	31.7%	8.8%	20.7%	3,613
	39	Other C&D Material	1.2%	10.4%	0.0%	3.2%	292
	40	Electronics	0.1%	0.7%	0.0%	0.2%	29
	41	Bulky Items	0.8%	4.6%	0.0%	1.7%	195
	42	Tires	0.0%	0.0%	0.0%	0.1%	6
	43	Other Inorganic	5.4%	19.3%	1.8%	9.1%	1,334
	44	Other Hazardous Material	0.0%	0.0%	0.0%	0.1%	11
		Subtotal	62.1%	37.8%	55.0%	69.2%	15,219
		TOTAL	100.0%				24,516

Exhibit 7: Comparison of 1998 and 2006 Study Results

Residential Waste

Material Group	1998 Study			2006 Study			Difference
	Lower	Mean	Upper	Lower	Mean	Upper	
FERROUS METALS	2.2%	3.6%	5.0%	2.0%	3.0%	3.9%	0.6%
NON-FERROUS METALS	0.8%	1.0%	1.2%	1.3%	1.7%	2.1%	-0.7%
GLASS & CERAMICS	1.4%	1.9%	2.4%	2.7%	3.5%	4.2%	-1.6%
PAPER PRODUCTS	40.8%	43.9%	47.1%	28.6%	31.4%	34.3%	12.5%
FOOD WASTE	11.9%	14.2%	16.5%	14.8%	17.4%	20.1%	-3.2%
YARD WASTE	9.0%	13.6%	18.1%	5.3%	8.4%	11.5%	5.2%
TEXTILES	1.8%	2.6%	3.3%	2.4%	3.3%	4.2%	-0.7%
WOOD PRODUCTS	2.3%	3.9%	5.5%	1.4%	3.0%	4.6%	0.9%
PLASTIC, LEATHER, 7 RUBBER	10.7%	12.2%	13.7%	11.0%	11.9%	12.9%	0.3%
OTHER	2.1%	3.1%	4.2%	13.8%	16.4%	19.0%	-13.3%
TOTAL		**100%**			**100%**		

Commercial Waste

Material Group	1998 Study			2006 Study			Difference
	Lower	Mean	Upper	Lower	Mean	Upper	
FERROUS METALS	2.4%	4.0%	5.5%	2.2%	3.5%	4.8%	0.5%
NON-FERROUS METALS	0.5%	0.8%	1.1%	1.1%	2.0%	2.9%	-1.2%
GLASS & CERAMICS	0.7%	1.4%	2.1%	1.6%	2.7%	3.8%	-1.3%
PAPER PRODUCTS	11.1%	17.9%	24.6%	26.7%	31.6%	36.4%	-13.7%
FOOD WASTE	1.8%	4.0%	6.1%	12.0%	15.9%	19.9%	-12.0%
YARD WASTE	1.8%	9.9%	18.0%	3.1%	6.3%	9.6%	3.6%
TEXTILES	3.9%	8.2%	12.6%	0.9%	2.6%	4.3%	5.6%
WOOD PRODUCTS	17.8%	27.7%	37.6%	5.3%	8.9%	12.6%	18.8%
PLASTIC, LEATHER, & RUBBER	4.6%	7.0%	9.3%	9.4%	11.2%	13.0%	-4.3%
OTHER	9.8%	19.3%	28.7%	11.3%	15.2%	19.1%	4.0%
TOTAL		**100%**			**100%**		

Self-Haul Waste

Material Group	1998 Study			2006 Study			Difference
	Lower	Mean	Upper	Lower	Mean	Upper	
FERROUS METALS	4.3%	13.9%	23.5%	1.0%	2.9%	4.7%	11.1%
NON-FERROUS METALS	1.3%	3.3%	5.4%	0.0%	0.4%	0.9%	2.9%
GLASS & CERAMICS	2.2%	4.4%	6.6%	0.3%	2.8%	5.3%	1.6%
PAPER PRODUCTS	6.5%	13.3%	20.0%	7.6%	13.9%	20.1%	-0.6%
FOOD WASTE	0.7%	4.0%	7.3%	0.0%	2.1%	5.4%	1.9%
YARD WASTE	0.0%	10.6%	23.4%	4.7%	9.5%	14.2%	1.2%
TEXTILES	1.2%	3.2%	5.2%	3.6%	8.4%	13.1%	-5.1%
WOOD PRODUCTS	15.4%	27.4%	39.4%	9.7%	15.0%	20.2%	12.4%
PLASTIC, LEATHER, & RUBBER	6.0%	8.3%	10.5%	2.0%	4.5%	7.1%	3.8%
OTHER	2.8%	11.6%	20.4%	32.3%	40.7%	49.1%	-29.1%
TOTAL		**100%**			**100%**		

C&D Debris (not performed in 1998 Study)

Material Group	2006 Study		
	Lower	Mean	Upper
FERROUS METALS	1.2%	3.5%	1.2%
NON-FERROUS METALS	0.5%	2.0%	0.1%
GLASS & CERAMICS	3.3%	2.7%	0.6%
PAPER PRODUCTS	0.4%	31.6%	0.5%
FOOD WASTE	0.1%	15.9%	0.0%
YARD WASTE	3.1%	6.3%	0.0%
TEXTILES	0.0%	2.6%	0.0%
WOOD PRODUCTS	5.1%	8.9%	22.2%
PLASTIC, LEATHER, & RUBBER	0.4%	11.2%	0.0%
OTHER	7.0%	15.2%	55.8%
TOTAL		**100%**	

Appendix Appendix A: Material Definitions

Material Categories			Description	Recyclable [1]
Paper	1	Corrugated Cardboard	Paperboard containers consisting of Kraft (brown) linerboard with corrugated (fluted medium) fillings. Includes yellow and waxed corrugated boxes and Kraft paper such as bags or wrapping paper. Does not include non-corrugated paperboard products such as cereal, shoe, or gift boxes.	Yes
	2	Newspaper	Consists of all paper products printed on daily or weekly newspapers, advertising, catalogs, and other similar items. Publications can be one color (e.g., black and white) or multicolor.	Yes
	3	Magazines/Catalogs	Publications which are printed on glossy paper. This does not include magazines, catalogs, etc., which do not consist of glossy paper throughout (e.g., comic books.)	
	4	Office/Computer Paper	High grade ledger paper, such as typing and copy paper. Computer paper includes outputs from printers that may have green bars.	Yes
	5	Polycoated / Aseptic Containers	Aseptic juice boxes and gable top cartons.	
	6	Mixed (Other Recyclable)	All other recyclable paper not covered such as non-corrugated paperboard boxes, direct mail, and books.	Yes
	7	Other Paper (Non-Recyclable)	All products not covered by the above categories, including soiled and unsoiled tissues, paper towels, napkins, file folders, carbonless paper forms, and tissue (tracing) paper.	
Plastics	8	#1 PET Bottles	Clear or colored blow molded plastic bottles (i.e., with a narrow neck) labeled #1 PET.	Yes
	9	#2 HDPE Bottles	Natural or pigmented blow molded plastic bottles (i.e., with a narrow neck) labeled #2 HDPE.	Yes
	10	#3 - 7 Bottles	Blow molded bottles labeled #3, #4, #5 or #7.	
	11	Expanded Polystyrene	Expanded foam packaging, trays or containers labeled #6 PS. Includes foam polystyrene cups and food service containers (i.e., "clamshells") as well as clean service containers and packing "peanuts".	
	12	Films/Bags	Linear, translucent to opaque films/bags, such as grocery bags, dry film, trash and garbage bags.	
	13	Other Ridge Plastic	Rigid plastic not elsewhere classified. Includes plastic tubs, cups, trays, straws, and cutlery. Unmarked plastics such as materials made of multi-composite materials that may contain more than one type of plastic and/or metal, and all other plastics not otherwise described including items such as toys.	

Appendix Appendix A: Material Definitions

Material Categories			Description	Recyclable [1]
Glass	14	Clear Glass	Clear glass food and beverage containers.	Yes
Glass	15	Green Glass	Green Glass food and beverage containers.	Yes
Glass	16	Brown Glass	Brown glass food and beverage containers.	Yes
Glass	17	Other Glass	Includes a variety of miscellaneous glass products such as mirrors, leaded crystal, eyeglasses, and blown glass such as light bulbs, auto glass, windows, TV tubes heat resistant cookware (Pyrex), pottery, and drinking glasses.	
Metals	18	Steel Cans	Fabricated, magnetizable metal containers such as steel or bimetal designed to hold food or beverage products such as soups, vegetables, pet food and juices. Includes two piece containers with aluminum tops.	Yes
Metals	19	Other Ferrous Metals	Ferrous and alloyed ferrous scrap materials originated from residential commercial, or institutional sources which are attracted to a magnet. This category includes wire coat hangers, aerosol cans, and auto parts.	
Metals	20	Aluminum Cans	Aluminum containers used for holding beverages	Yes
Metals	21	Other Aluminum	This category includes all other aluminum products such as lawn chairs, tables, carts, house siding, rain gutters, window frames, cookware, flatware, aluminum foil, other miscellaneous utensils, and die cast aluminum auto or machine parts.	
Metals	22	Other Non-Ferrous	Non-magnetic metals such as brass, bronze, silver, lead copper, and zinc. Stainless steel house wares are also part of this category.	
Metals	23	Appliances	Stoves, refrigerators, dishwashers and all other large and small household appliances including fragments.	
Organics	24	Food Waste	Putrescible organic materials which are the by-products of activities connected with the growing, preparation, cooking, processing, or consumption of food by human beings or domesticated animals.	
Organics	25	Diapers/Sanitary Products	Diapers and sanitary products.	
Organics	26	Textiles	Fabric materials including natural and synthetic fibers such as cotton, wool, silk, nylon, rayon, or polyester; and Products included within this category would be woven clothing, curtains, stuffed toys, pillows, rags, and upholstery.	
Organics	26A	Rubber/Leather	Materials consisting of natural or synthetic rubber and leather. Products included within this category would be belts, handbags, wallets, and mixed items such as footwear.	
Organics	27	Yard Waste	Grass clippings, leaves, brush and prunings.	
Organics	28	Land Clearing	Logs, stumps, trunks, and limbs	
Organics	29	Clean Wood	Unpainted or unfinished (saw cut) lengths of wood from building structures, furniture or vehicles (e.g., cars, boats), pallets and creates.	

Appendix Appendix A: Material Definitions

Material Categories			Description	Recyclable [1]
Organics	30	Painted/Stained /Treated/MfgWood	Painted or stained lengths of wood from construction or woodworking activities, particle board, OSB, plywood, and treated wood	
	31	Other Wood	Other wood products not elsewhere classified. Includes house wares (spoons, bowls), decorative objects, small furnishings, sawdust, and small animal bedding.	
	32	Fines	Any materials passing through the 1/2 inch screen on the sorting table that cannot be categorized.	
	33	Other Organics	All other organic material not otherwise described, including substances such as feces, lint, vacuum bags, and animal litter.	
Inorganic	34	Carpet	Man made fibrous carpets, rugs or padding from residential or commercial buildings, including carpet backing.	
	35	Drywall	Also called sheetrock or gypsum wallboard.	
	36	Block/Brick/Stone	Concrete, brick, stones, cut stone, cement, and rocks	
	37	Insulation	Fiberglass and other inorganic insulation	
	38	Asphalt Roofing	Asphalt shingles or tar paper.	
	39	Other C&D Material	Ceiling tiles, dirt, dust or ash generated from construction and demolition activities. PVC pipe, 5-gallon HDPE buckets, HVAC ducting, and other related C&D material.	
	40	Electronics	Any item that contains a circuit board including, televisions, radio, stereo, computer, and CRT.	
	41	Bulky Items	Chairs, couches, mattresses, desks, and other oversized items made of multiple materials.	
	42	Tires	Solid or pneumatic rubber or steel belted tires.	
	43	Other Inorganic	Other inorganic items not elsewhere classified.	
	44	Hazardous Material	This category includes paints/solvents, flammable liquids, pesticides, corrosives, medical wastes and any other hazardous material not otherwise described.	

[1] These are the materials targeted for recycling in Larimer County's public education information.

Appendix A: Mapping of Material Categories Between 1998 and 2006 Studies

1998 Material Categories			2006 Separated Material Categories
Ferrous Metals	Soup Cans, Scrap Steel, and Auto Parts	18	Steel Cans
		19	Other Ferrous Metals
		23	Appliances
Non-Ferrous Metals	Aluminum Cans/Foil, Electrical Wire, Scrap Metal	20	Aluminum Cans
		21	Other Aluminum
		22	Other Non-Ferrous
Glass & Ceramics	Bottles, Dishes, Etc.	14	Clear Glass
		15	Green Glass
		16	Brown Glass
		17	Other Glass
Paper Products	Junk Mail, Newspaper, Magazines, Cereal Boxes and Cardboard	1	Corrugated Cardboard
		2	Newspaper
		3	Magazines/Catalogs
		4	Office/Computer Paper
		5	Polycoated / Aseptic Containers
		6	Mixed (Other Recyclable)
		7	Other Paper (Non-Recyclable)
Food Waste	Food Waste	24	Food Waste
Yard Waste	Yard Waste	27	Yard Waste
		28	Land Clearing
Textiles	Textiles	26	Textiles
Wood Products	Lumber, Funiture, Etc.	29	Clean Wood
		30	Painted/Stained /Treated/MfgWood
		31	Other Wood
Plastic, Leather & Rubber	Plastic Bags, Plastic Containers, Toys, and Shoes	8	#1 PET Bottles
		9	#2 HDPE Bottles
		10	#3 - 7 Bottles
		11	Expanded Polystyrene
		12	Films/Bags
		13	Other Ridge Plastic
		26A	Rubber/Leather
Other Waste	Rock, Brick, Concrete, Dirts, Drywall, Asphalt Shingles, Flashlight Batteries, Etc.	35	Drywall
		36	Block/Brick/Stone
		37	Insulation
		38	Asphalt Roofing
		39	Other C&D Material
		40	Electronics
		41	Bulky Items
		25	Diapers/Sanitary Products
		34	Carpet
		42	Tires
		43	Other Inorganic
		32	Fines
		33	Other Organics
		44	Hazardous Material

Appendix D

Fort Collins 2014 Waste Reduction and Recycling Annual Report

R3

2014 FORT COLLINS WASTE REDUCTION & RECYCLING REPORT

Community Diversion Rate

A diversion rate compares the amount of material that was recycled or composted compared to the total waste generated by the community. It is useful for tracking trends in the community related to waste generation.

Fort Collins' overall Community-wide Diversion Rate (which includes all residential, commercial and industrially-generated trash and recyclable materials) increased from 62.5% in 2013 to 68.4% in 2014. The Industrial Diversion Rate – exclusive of residential/commercially generated discards – increased from 76.0% in 2012 to 81.7% in 2013. The combined residential and commercial waste diversion rate (which may be thought of as Non-Industrial Diversion) increased from 43.4% in 2013 to 44.8% in 2014.

Based on the 2014 population of 155,400 residents, Fort Collins generated 4.88 pounds of landfill-bound material (trash) per capita per day (in 2013, per capita trash measured 4.85 pounds per day).

FIGURE 1 – CHANGE IN MATERIALS GENERATED FROM 2013-2014

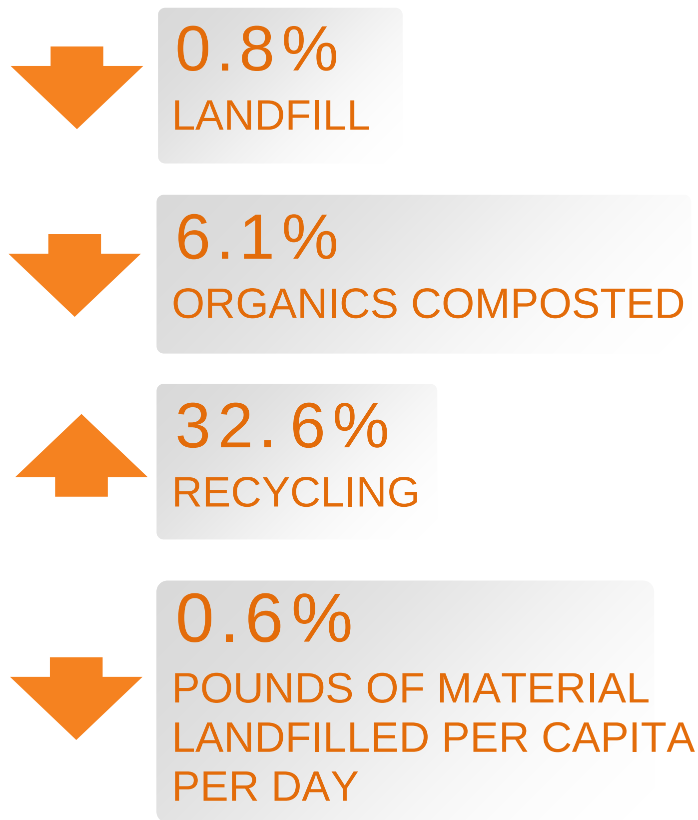
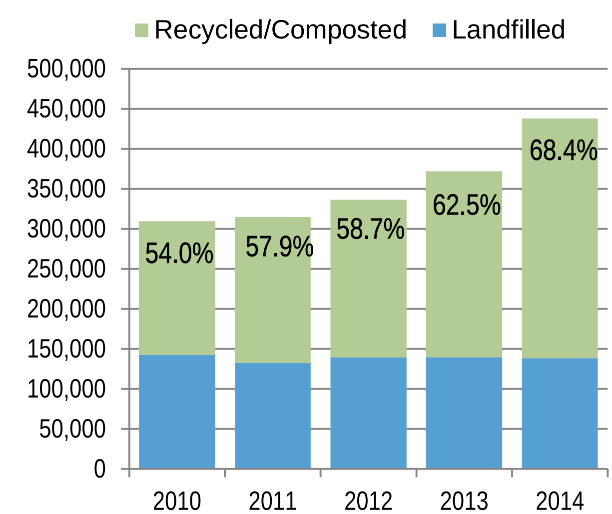


FIGURE 2 – COMMUNITY DIVERSION RATES



By The Numbers

COMMUNITY-WIDE

- landfill down 0.8%, organics composted down 6.1%, recycling up 32.6%

INDUSTRIAL

- landfill down 1.9%, organics composted down 6.3%, recycling up 42.8%

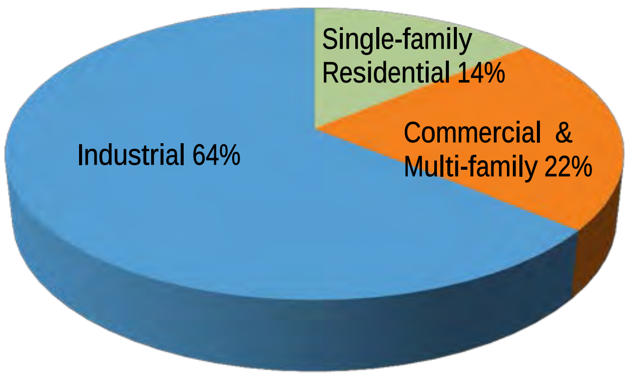
RESIDENTIAL-ONLY
(excluding commercial and industrial)

- landfill down 5.4%, organics composted up 10.5% recycling up 5.9%

COMMERCIAL-ONLY
(excluding residential and industrial)

- landfill up 4.3%, organics composted down 26.3%, recycling up 0.4%

FIGURE 3 - PERCENTAGE OF TOTAL COMMUNITY WASTE AND RECYCLING GENERATION BY SECTOR FOR 2013



Community Diversion Rate Drivers

The community diversion rate increased by 5.9 percentage points from 2013 to 2014, which is a significant increase for the second year in a row. Diversion rates rarely change that dramatically, especially two years in a row (there was also a significant increase in the diversion rate from 2012-2013). Like the 2012-2013 change, the increased diversion rate in 2014 is due primarily to an increase in recycling of asphalt and dirt at the City's Crushing Facility on Hoffman Mill Rd. While some of the increase in materials recycled at the City's Crushing Facility is due to an increase in construction activity in the community overall as well as a continuing improvement in the economy, a significant increase was due to a unique situation that arose in 2014 (described in detail in the City Crushing Facility section). It seems quite likely that a decrease in the community diversion rate would be anticipated for 2015, since the spike in dirt recycled in 2014 was possibly an anomaly.

Otherwise, landfill rates held steady for the community as a whole, and composting of yard waste increased slightly due to increased participation across the community.

City of Fort Collins Crushing Facility

The City of Fort Collins operates a Crushing Facility at 1380 Hoffman Mill Road, accepting concrete, asphalt, and clean dirt. The concrete and asphalt are then crushed and sold for use as road base, and dirt is sold for use as fill dirt.
One of the reasons for the unusual amount of dirt recycling reported in 2014 at the City's Crushing Facility is a unique data tracking aspect to the site. Unlike many locations that track incoming materials, the City's Crushing Facility primarily tracks outgoing materials as they are sold. (Incoming materials aren't tracked as closely because many loads of materials are delivered to the site after the scale house is closed.)

Over the years, the Crushing Facility had accumulated a significant amount of dirt, which was so substantial the site had refused new deliveries of dirt for eight months. In 2014, two construction projects in Fort Collins, the Woodward headquarters construction and Foothills Mall demolition / re-building, used all the historical pile. Since it is not clear exactly when in the past this dirt was delivered, it is included in the 2014 Community Diversion Rate calculations. It is important to note that this is a one-time occurrence, though, and it's quite likely that a decrease will occur in the Community Diversion Rate for 2015 since it will not include this one-time use of many tons of dirt.

The increase in Fort Collins' Community Diversion rate is due primarily to concrete, asphalt, and dirt recycling at the City's Crushing Facility.

For decades, the City has been operating the Crushing Facility on rented land on Hoffman Mill Road, and in 2014 opted to invest in the future of this important service by purchasing the land. This ensures the location can continue to be utilized for recycling significant amounts of concrete, asphalt and dirt and generating savings for the City's Streets operations. (The Streets Department makes extensive use of recycled asphalt in its own road construction and repair projects.) In addition, the City is assessing options for additional recycling opportunities on the site for materials generated by other municipal operations.

Municipal Self-Haul to Landfill Continues to Decrease

Through projects such as the Fort Collins Utility's soils recovery project, the City continues to decrease the amount of material it self-hauls to the landfill. From 2012 to 2014, the amount of material from municipal operations that was taken to the landfill for disposal was cut by 50%.

Plastic Bag Ordinance

In 2014, the Fort Collins City Council considered and then passed an ordinance that would have required merchants in Fort Collins to charge $0.05 / bag for single-use plastic and paper bags, with the merchants retaining all revenue generated. This would have impacted the 50 million disposable shopping bags estimated to be generated in Fort Collins each year. After the ordinance was passed, a citizen petition generated enough signatures for the City Council to either place the item on the ballot or repeal the ordinance. The plastic bag ordinance was repealed, and at the same time, City Council passed a resolution that reconfirmed their commitment to zero waste goals.

WRAP (Waste Reduction & Recycling Assistance Program)

The Waste Reduction and Recycling Assistance Program (WRAP) continued to grow in 2014. WRAP provides resources to apartment complexes and businesses in Fort Collins to start or improve their recycling programs. Since its inception in early 2012, over 13,000 residents or employees have been impacted by WRAP. In 2014, WRAP reached over 2,200 individuals, of whom over 1,700 have new access to recycling.

Also in 2014, the City's popular recycling guidelines and information poster was translated into Spanish for greater accessibility to Spanish-speaking residents.

Recycling at Foothills Mall Reconstruction Project

A project that received Urban Renewal financing assistance from the City, redevelopment of the old Foothills Mall, was successful at diverting significant quantities of concrete, asphalt, wood debris, and metals from being landfilled during 2014. The City's agreement with Alberta Development Partners called for a 100% diversion rate of concrete, rock, asphalt, dirt, bricks and metal, and a 70% diversion rate for all other materials. With extra care taken to apply deconstruction practices where possible, and to repurpose excavated soils on-site, the developer was able to optimize recovery rates. Alberta invited CSU's Institute for the Built Environment to participate in observing and to provide input; IBE documented an average rate of 76% diversion and reported a number of interesting case studies, such as wood flooring salvaged from the old mall used by local craftsmen to make furniture.

Foothills Mall reconstruction recycled 76% of the material generated by the project.

Impact from Landfill Ban on Cardboard

In 2014, City staff continued to conduct extensive outreach and education about the ban on disposal of cardboard in the waste stream, which was passed in March 2013. In addition to traditional methods such as advertisements, social media, and presentations, City staff conducted a 6-week door-to-door outreach campaign, reaching over 300 local businesses. Staff shared information about the City's cardboard ordinance as well as information about WRAP (Waste Reduction and Recycling Assistance Program), which provides recycling assistance and incentives to start recycling.

The cardboard ordinance has had a noticeable impact in Fort Collins. From 2012 to 2014, single-stream recycling increased 11% for residents and 14% for businesses in Fort Collins. (The majority of cardboard is recycled in "single-stream recycling" along with other recyclable materials.) Comparatively, landfill rates only increased 2% for residents and 8% for businesses during that time. In addition, cardboard collected by itself from businesses increased 28% from 2012-2014, and cardboard collected at the City's recycling drop-off center increased 15% during the same time. It is quite possible that these increases are due at least in part to the City's ban on disposal of cardboard in the waste stream.

Trash and Recycling Cart Sizes

The residents of Fort Collins continued to reduce the size of their trash cans and increase the size of their recycling carts. The number of residents with a 96-gallon trash cart reduced by 4%, while the number of residents using a 32-gallon cart increased by 4%. Overall, 36% of residents subscribed to 32-gallon trash cart service, 36% to the 64-gallon, and 27% to the 96-gallon service, with 1% using intermittent trash service via pre-paid bags.

Ten percent more residents started using a 96-gallon cart for recycling in 2014 than in the year before, and the community also saw a 10% decrease in use of the outdated 18-gallon recycle tubs. Overall, 77% of Fort Collins residents recycled in a 64- or 96-gallon cart and 23% used 18-gallon tubs.

Over a third of local residents now subscribe to the smallest trash can size, and over three-quarters of Fort Collins residents now use large 64- or 96-gallon carts to recycle.

Definitions

Non-industrial diversion rate: includes waste generated by single-family residential, multi-family residential and commercial sectors.

Industrial diversion rate: includes materials such as waste generated by City government's operations, concrete and asphalt recycled at crushing facilities, construction and demolition waste, brewery wastes, and biosolids that were land-applied.

Community diversion rate: the combined total of industrial and non-industrial wastes – provides an overall view of waste generation and waste diversion for the entire community.

Note about *Alternative Daily Cover*: Fort Collins does not include materials used for alternative daily cover at the landfill as recycling or diversion.

Report Prepared By

City of Fort Collins Environmental Services

Caroline Mitchell, Environmental Planner
Environmental Services
City of Fort Collins
970-221-6288
cmitchell@fcgov.com
fcgov.com/recycling

Appendix E

Fort Collins Study: Pineridge Distributed Generation Alternatives Study

Draft Report

Pineridge Distributed Generation Alternatives Study

City of Fort Collins, Colorado

October 2011

SAIC

Draft Report

Pineridge Distributed Generation Alternatives Study

City of Fort Collins, Colorado

October 2011

SAIC®

Pineridge Distributed Generation Alternatives Study

City of Fort Collins, Colorado

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

Peak Load Reduction Requirements

If existing and projected Cities' loads can be reduced and limited to 550 megawatt ("MW"), the proposed 230-kilovolt ("kV") line may not be required. This past summer (2011) a peak load reduction of up to 70 MW in the Loveland area and 15 MW in the Fort Collins Harmony Substation area for approximately 178 hours would have been required to meet this criteria. Additional peak load reduction in these areas will be required to offset the projected 2.75 percent annual load increases. Technologies can be used to reduce peak loads by utilizing distributed generation, to serve load locally instead of through the transmission system, and peak load reduction techniques that directly control customer loads or economically incentivize the customer to reduce loads during peak hours.

Table ES-1 summarizes the distributed generation and load reduction or load shifting technologies discussed in this report. High-level planning assumptions are used to attempt the quantify a potential capacity reduction and cost of each technology, assuming a peak load reduction of 85 MW for 178 hours/year, as well as the likely schedule required to implement it. None of these technologies could be implemented in time to resolve the transmission issues anticipated next summer without the Dickson-Horseshoe 230-kV line and it is doubtful that any single solution could achieve the desired load reduction in a reasonable time period, but a combination of technologies could provide significant benefit. Costs on most of these technologies are still substantially higher than traditional peak generation resources that provide comparable peak power at a cost of approximately $650 per kilowattt("kW") and $1,300,000 ongoing annual operating costs.

Table ES-1
Summary of Peak Load Reduction Options

Peak Load Reduction Options	Type	MW	MW at Peak Hour	Cost/ kW	Total Cost	Ongoing Annual Costs	Site Availability	Installation Timeframe (Mo)	Notes
Municipal Solid Waste	Generation	14	14	$ 4,500	$ 63M	$ 5M	Larimer County Landfill	24 Mo	Solid waste burned to generate electricity
Biomass	Generation	35	35	$ 4,500	$ 157M	$ 5M	Horseshoe Substation biomass location	24 Mo	Biomass burned to generate electricity
Solar PV w/ Battery Storage	Generation	85	85	$ 5,410	$ 460M	$10M	Requires 400+ acres	18 Mo+	Battery storage required to shift the timing of electricity put onto the grid to peak hours.
Solar Thermal Electric	Generation	85	85	$ 4,000	$ 340M	$6M	Requires 500+ acres	24 Mo	Molten salt storage creates steam to generate electricity at any time of day including peaks.
Gas Turbines	Generation	95	95	$ 1,000	$95.5M	$3M	Minimum of 15 acres	24 - 36 Mo	Only included EPC costs and add 15 percent for owner's costs
Fuel Cells	Generation	85	85	$ 8,000	$ 680M	$ 1M	TBD. Requires survey for natural gas fuel and location	24 - 36 Mo	New technologies at cutting edge, may or may not be available by next summer in sufficient quantities.
Combined Heat and Power	Generation	100	100	$ 1,350	$ 135M	$5M	Minimum of 15 acres	24 Mo	Major long lead equipment (CT and STG) needs to procured prior to EPC Contract. Only included EPC costs and add 15 percent for owner's costs
Emergency Gen Sets in Area	Load Reduction	12.5	10	$ 52	$ 518K	$ 500k to $700k	Requires existing diesel back-up generators	6 - 12 Mo	Performing back-up generator tests and running during peak hours .

Peak Load Reduction Options	Type	MW	MW at Peak Hour	Cost/ kW	Total Cost	Ongoing Annual Costs	Site Availability	Installation Timeframe (Mo)	Notes
Smart Meters w/ TOU Rates	Load Reduction/ Shifting	85	85	$ 100	$ 8.5M	$ .85 M	Cost to install 30k Loveland residential and commercial electric meters only. Does not include cost for 65k meters in Fort Collins		Install smart meters in Loveland commercial and residential properties. Use higher rate band during 4 p.m. to 8 p.m. in both Loveland and Fort Collins to lower peak usage.
Community Energy Storage (CES)	Load Shifting	135	21	$ 12,500	$ 265M	$ 5.3M	TBD. Requires 2,650 locations	24 - 36 Mo	Batteries provide home backup and can send power to the grid during peak hours
Hybrid Ice Air Conditioning	Load Shifting	46	46	$ 1,700	$ 76M	$ 1.5M	1/4 to 1/3 of buildings	24 Mo	2500 (+- 30%) ice systems to install. Operates 800 hours/yr. during peaks. Local production facilities could be built between Loveland and Fort Collins, good for local economy and shorten delivery/installation timeframes.

Section 1
LOAD GROWTH AND CONTINGENCY REQUIREMENTS

1.1 Load Growth

Platte River Power Authority ("Platte River") is responsible for designing and operating the electric transmission system that serves the cities of Estes Park, Fort Collins, Longmont, and Loveland (the "Cities"). Electric systems are designed to serve peak load, which is when the instantaneous MW demand is the highest. In the northern Front Range Colorado area, it typically occurs between 4 PM and 6 PM on a summer weekday when business and residential cooling requirements and evening activities overlap.

The combined actual peak load of the four cities in 2011 was approximately 640 MW as shown in Table 1-1. Under more extreme summer weather, the 2011 load was forecasted at 671 MW. Loads are projected to increase to 687 MW by 2012, and increase about 2.75 percent per year to 2020.

Table 1-1
Summer 2011 Platte River Loads
7/18/2011

City	MW
Estes Park	17
Fort Collins	292
Longmont	175
Loveland	140
Praxair	16
Total	640

Traditionally, transmission planning has been reactive to load growth. Planners project the peak load at each substation for 10 to 20 years in the future and determine what transmission upgrades are required to serve that load. Projected load growth is based on population and economic forecasts and historic correlation between these factors and peak electric system loads, factoring in weather conditions. Another solution that is beginning to be considered is to control and limit the peak load growth that the transmission system is required to serve by utilizing distributed generation and/or peak load reduction technologies in specific areas.

1.2 Transmission Contingency Requirements

The North American Electric Reliability Corporation ("NERC") Transmission Planning standards require transmission owners and operators to conduct power flow studies in order to effectively demonstrate the reliability of the electric system under contingency situations, such as loss of a transmission line. In performing these extensive contingency analyses, the effect of an outaged facility on the rest of the transmission system is evaluated under a variety of system loading conditions, transmission configurations, and generation dispatch patterns. If studies determine that loss of a transmission element overloads another element or causes an unacceptable reduction in voltage, the transmission utility must upgrade the system to prevent this from happening, effectively requiring redundant supplies to most substations. If upgrades are not completed in time to prevent the overloads, the transmission operator must develop a mitigation plan for potential contingencies.

Both Platte River and Western Area Power Authority ("Western") own and operate 115-kV and/or 230-kV lines that serve the Cities. The 230-kV lines can deliver twice as much power as the 115-kV lines using the same size conductors, but require taller poles and more distance between the wires.

Two transmission lines connect the cities of Fort Collins and Loveland to generation resources north and south of the cities. On the east side of the cities is a Platte River 230-kV line capable of serving approximately 472 MW. On the west side of the cities is a Western 115-kV line capable of serving approximately 109 MW peak load. Other 115-kV lines serve Loveland from the east and the south.

The Cities have grown over the past decade and peak load has increased to the point that the 115-kV lines are not sufficient to provide the required redundancy to Fort Collins, Longmont, and Loveland. Current system planning studies, as well as 10-year transmission planning studies conducted in 2004, have conclusively demonstrated the urgent need to provide additional capacity between Fort Collins and Loveland to address the contingency loss of the existing 230-kV line between the two cities when the combined city loads exceeds 550 MW. In 2004, Platte River considered several alternatives and determined the most economical solution was to build a 230-kV circuit (Dixon Creek Substation to Horseshoe Substation).

In addition, the Colorado Coordinated Planning Group, which is a statewide consortium (including Tri-State and Xcel Energy) have collectively concluded that the Dixon Creek – Horseshoe 230-kV circuit is an appropriate transmission solution for the area. With the load growth existing in the upper portion of the Front Range from Colorado Springs toward the Wyoming border, future transmission improvements are scheduled to take place from Southern Wyoming to Northern Colorado in order to accommodate the expanded import capability from the generation resources north of the Colorado border. The scheduled improvements will have an effect of increased power flows through the eastern part of Colorado in the Front Range. Over 70 percent of the state's load exists between Fort Collins and Colorado Springs within 40 miles of either side of Interstate 25; thus, the proposed parallel 230-kV transmission lines will also serve to boost the overall system reliability of customers outside of the Larimer County load territory.

Platte River has constructed additional 230-kV lines to Fort Collins and Longmont, and is in the process of completing a 230-kV line to serve Loveland. The two segments of this comprehensive 230-kV upgrade north of Horseshoe Substation and west of Trilby Substation have already been completed and the section south of Dixon Creek Substation through Pineridge Natural Area is the last phase in preparation for the anticipated summer 2012 loading conditions in the Loveland area. The last section in question will aid in alleviating the 115-kV circuit contingency loading with 345-kV and 230-kV circuit outages to the east and north of the Fort Collins/Loveland area. By leaving the remaining Dixon Creek – Horsetooth segment at 115-kV, the 230-kV circuit capability of the two previously upgraded 115-kV circuits will not be realized and Platte River will not be able to provide transmission reliability per NERC standards when the Cities' loads exceed 550 MW, which they did for 178 hours during 2011 as of August 22nd.

1.3 Peak Load Reduction

If existing and projected Cities' loads can be reduced and limited to 550 MW, the proposed 230-kV line may not be required. Figure 1-1 illustrates the days, times, and amounts that system load has exceeded 550 MW from June through August 2011.

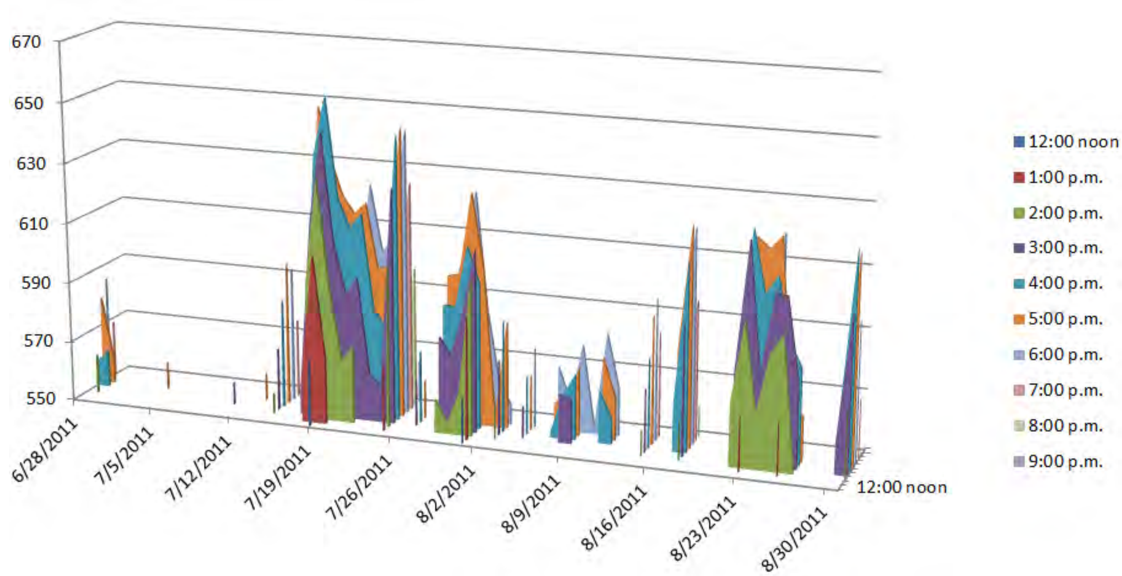


Figure 1-1. Platte River Peak Hours Above 550 MW, 5/28/11 – 8/30/11

According to Platte River's load flow analysis, this past summer (2011) a peak load reduction of up to 70 MW in the Loveland area and 15 MW in the Fort Collins Harmony Substation area would have been necessary to avoid equipment overloads during a single contingency outage scenario. Additional peak load reduction in these areas will be required to offset the projected 2.75 percent annual load increases. The following section describes potential technologies that can be used to reduce peak loads by utilizing distributed generation to serve load locally instead of through the transmission system, and peak load reduction techniques that directly control customer loads or economically incentivize the customer to reduce loads during peak hours.

Section 2
POTENTIAL TECHNOLOGIES

2.1 Distributed Generation Options

2.1.1 Waste Diversion

For the purposes of this discussion, we will focus on waste-to-energy facilities fueled by municipal solid waste ("MSW") or biomass. Waste-to-energy is the process where MSW or biomass is used as a fuel to heat tubes of water in a boiler. The high temperatures produced by burning the waste convert the water into steam, which is then used to drive a steam turbine generator that produces electricity. The resulting ash must be landfilled, but the waste volume is reduced by approximately 90 percent.

Municipal Solid Waste

Based on information provided by the Larimer County Landfill (the "Landfill"), which is jointly owned by Larimer County (25 percent), the City of Fort Collins (50 percent), and the City of Loveland (25 percent), the Landfill receives approximately 600 tons per day ("TPD") of MSW. The estimated useful life of the Landfill is 2027. Larimer County has purchased land near Wellington for possible use as a future solid waste management site. Until needed by the Solid Waste Department, the property will be managed by the Larimer County Parks and Open Lands Department.

The following is a planning level capital cost estimate on the cost of building a waste-to-energy facility south of the Horseshoe Substation based on the following assumptions:

- 600 TPD of MSW available for the waste-to-energy facility to be located within the city of Loveland (187,200 tons per year ("TPY"))
- The MSW is contracted under long-term contracts to the city of Loveland in the amount of 187,000 tons per year to the waste-to-energy facility
- 600 kilowatt-hours per ton of MSW
- 8,000 hours of operation per year
- $4,500 per kilowatt ("kW") installed cost
- 24-month construction schedule after environmental permitting is completed and environmental permitting could take as long as two years to complete
- Facility site available
- Non-fuel operations and maintenance ("O&M") costs are not included but would range from approximately fixed $10/kW month and variable $0.04 per kilowatt-hour ("kWh")

Using the assumptions above, the waste-to-energy facility could generate approximately 14 megawatts ("MW") at a cost of approximately $63,000,000.

Biomass

Biomass is plant matter that can be used to generate electricity with steam turbines & gasifiers or produce heat, usually by direct combustion. Wood energy is derived both from direct use of harvested wood as a fuel and from wood waste streams. Examples include forest residues (such as dead trees, branches and tree stumps), yard clippings, wood chips and even municipal solid waste. Industrial biomass can be grown from numerous types of plants, including miscanthus, switchgrass, hemp, corn, poplar, willow, sorghum, sugarcane, and a variety of tree species, ranging from eucalyptus to oil palm (palm oil).

The following is a planning level capital cost estimate on the cost of building a biomass facility that produces electricity south of the Horseshoe Substation based on the following assumptions:

- 467,000 TPY of biomass available for the biomass facility
- The 467,000 TPY of biomass is under long-term contracts with the city of Loveland
- $25 per green ton of biomass delivered to the biomass facility
- 600 kilowatt-hours per ton of biomass
- 40 percent moisture in the biomass
- 8,000 hours of operation per year
- $4,500 per kW installed cost
- 24-month construction schedule after environmental permitting is completed, and environmental permitting could take as long as 18 months to complete
- Facility site available
- Non-fuel O&M costs are not included but would range from approximately fixed $10/kW month and variable $0.04 per kWh
- 35 MW capacity

Using the assumptions above, the biomass facility would cost approximately $157,000,000.

2.1.2 Solar Photovoltaic

The goal for this project is to reduce the peak hour electric load or increase electric generation in Loveland and Fort Collins by 85 MW to meet the peak summer demand. There are many kinds of solar photovoltaic ("PV") technologies, including monocrystalline multicrystalline, thin film, and concentrated solar using dish engines.

But the inherent issue with using PV panels for this particular application however, is that electricity would need to be stored during the day for use on cloudy days and for use during peak hours, defined as 4:00 p.m. through 8:00 p.m. This is well after the sun has peaked for solar PV generation so there is a mis-alignment in terms of when electricity is generated by solar panels and when it is required. If a suitable storage system can be provided at reasonable cost, then the use of solar PV energy might be appropriate.

Here is an example of a solar farm providing the equivalent of 85 MW of power for four hours per day [140 megawatt hours ("MWh") total] by storing the daily solar energy in batteries and discharging it during the peak hours.

Solar PV solution assumptions:

- 79 MW of solar panels near Loveland
- Sufficient space, 500 acres
- Land cost is not included in kW cost estimate
- Location is within ¼ mile of a transmission line with available capacity
- Solar Radiance is 5.39 kWh/sq m/day (this is the kilowatt hours per square meter per day, or Solar Insolation, representing the intensity and duration of the sun during an average day in Loveland)
- System Efficiency = 80 percent (due to wiring and inverter losses etc.)
- Includes 500 MWh of batteries for one day's worth of storage
- Assumes batteries discharge less than 80 percent to maintain battery life
- Batteries discharge up to four hours per occurrence during peak hours
- Installation cost for solar and batteries $530M total or $6,215/kW
- Ongoing annual cost for property tax and maintenance approximately $10M

Note that this system would require a minimum of one day's worth of battery storage, or four hours, to fill in during the peak hours. Utility scale NaS(Sodium Sulfur) batteries are costly so Lithium ion batteries at $425/kWh have been assumed.

Solar thermal electric technology, also known as concentrated solar power ("CSP") with thermal energy storage ("TES") however may be able to solve the problem of storage too, so electricity can be generated during peak hours and discharged during peak load hours as described next.

2.1.3 Solar Thermal Electric

CSP systems use mirrors to concentrate sunlight and heat a working fluid. The fluid is then used to drive a steam turbine and generate electricity. Various CSP technologies are available and distinguished by how the heat is collected and subsequently used to create electricity.

Parabolic Trough

Parabolic trough systems use rows of parabolic concentrating mirror assemblies (the "trough") arranged from north to south on a given plant site to enable tracking the east-west motion of the sun. The mirrors concentrate sunlight onto a tube, through which synthetic oil passes, and the oil is heated to approximately 750 degrees Fahrenheit ("°F"). The heated oil then passes through a series of heat exchangers to generate steam, which is subsequently used in a steam turbine to generate electricity.

Thermal Energy Storage

CSP systems using molten salt as the heat transfer fluid, can be integrated with TES systems to store thermal energy for later use to generate steam. In a trough plant, the fluid collects solar energy heat as it circulates through the solar field, then passes through a boiler to drive the steam turbine. Molten salt is stored in large insulated concrete tanks or vats so that during cloudy days or peak periods it can be sent to the steam turbine to generate electricity as required. The larger the tanks, the more energy can be stored to make it through longer stretches of cloudy days.

The potential operational benefits of solar thermal with storage are great however. CSP with TES has the potential for 24-hour operation which would allow solar thermal energy to shave peak loads in Fort Collins and Loveland, assuming sufficient land can be found for the facilities. Most PV and CSP systems require between 4 and 10 acres per peak MW of output and for effective deployment, the land must be largely flat, preferably with less than a two percent grade.

The approximate costs for a concentrated solar power "trough" system with storage are as follows:

- Two days of 4-hour 85 MW peak loads
- Costs in the $4,000/kW range
- Total cost $340M
- Longer storage requirements would increase the molten salt volumes required and increase cost
- Requires approximately 500+ acres; the cost of land is not included

2.1.4 Gas Turbines

Gas turbines are used quite commonly to generate electricity. For example, the LM6000 gas turbine manufactured by General Electric ("GE") provides 54,610 shaft horsepower (40,700 kW) from either end of the low-pressure rotor system, which rotates at 3,600 rotations per minute. This twin spool design with the low-pressure turbine operating at 60 Hertz eliminates the need for a conventional power turbine. Its high efficiency and installation flexibility make it ideal also for a wide variety of utility power generation and industrial applications, especially peaker and cogeneration plants.

The GE LM6000 PC is rated to provide more than 43 MW with a thermal efficiency of around 42 percent lower heating value ("LHV") at ISO ambient conditions (59°F, sea level, and 60 percent relative humidity). With options, this can be increased to around 50 MW rated power.

This unit has applications in power generation for combined cycle or peak power. Other applications include combined heat & power for industrial & independent power producers.

Typical users:

- Hospitals
- Airports
- Pulp and paper, cement, mining plants
- Gas pipelines, refineries, gas production
- Utilities
- Cruise ships and fast ferries

The overall EPC costs for a simple-cycle ("SC") plant in northern Colorado is estimated at $930 kW to $1,000 kW. This cost has an accuracy level of +30 to -15 percent and is based on present day 2011 dollars and does not include escalation and owner's costs, which is discussed below.

Many factors can impact the EPC price of a facility including: size, site ambient conditions, delivery voltage, fuel supply pressure, use of secondary or tertiary fuels, type of heat rejection system, emissions control equipment, indoor versus outdoor installations, type of wastewater treatment, conditions of the site, date of contract, project location schedule acceleration of schedule and others.

These costs are based on specific set of conditions listed below:

- Size: 45 MW
- Two GE LM6000's
- Natural gas only
- Project location: Northern Colorado
- Performance assumed to be at ISO ambient conditions
- Delivery voltage: 69 kV
- Outdoor equipment

In addition to the variations in the EPC costs, other highly variable project costs are also incurred. These costs, which are not typically directly associated with the EPC contract, are referred to as owner indirect and other costs. These costs may include the following:

- Electrical interconnection costs to install transmission lines or upgrade the existing utility system
- Fuel interconnection costs
- Permitting fees
- Development fees (preliminary engineering, preparation and negotiation of contracts, and other legal and professional fees)

- Taxes or payments in lieu of taxes
- Financing fees including interest during construction, legal fees, lender fees, and insurance (i.e. efficacy insurance)
- Other site or regional related costs

Based on our experience reviewing projects for financing, these fees can be 15 percent, or higher, of the EPC costs which are not included in the cost above.

The overall construction schedule is approximately 18 to 20 months from the award of the EPC contract to commercial operation of the plant. Included in this time frame is detailed design, balance of plant procurement, construction, and commissioning. Permitting and project development would have to start one to two years prior to the award of the EPC contract. Generally, however, a 90 MW SC plants in development today can be constructed in approximately two to three years which includes permitting, long lead procurement, construction, and commissioning.

2.1.5 Fuel Cells

New technologies that may be considered include the fuel cell which takes natural gas (methane) and water, in a chemical process, generates electricity, heat, and releases less pollutants than even burning natural gas in a gas turbine. Such systems are fairly new when it applies to providing electricity for a building or home. These systems make little or noise, so have an advantage in areas where noisy generation plants would be unwelcome.

Planning level costs for the Bloom Energy solid oxide fuel cell (“SOFC”) are as follows:

- One-time installation fees are in the $7,000 to $12,000/kW range after government and other state incentives; we’ll use $8,000/kW for large installations
- Figures include warranty costs recommended since the fuel cell stack will need replacement in five to ten years
- Cost for 85 MW system is approximately $680,000,000
- Cost for natural gas to generate 85 MW for 178 hours is around $6,000/hour or $1M annually
- Installation time frame is 24 - 36 months

2.1.6 Combined Heat and Power

Combined heat and power (“CHP”) facilities, also known as “cogeneration” plants are typically electric power plants that use their own waste heat to warm nearby buildings, heat water, warm greenhouses or warehouses, or for other practical purposes, instead of just disposing of the heat.

The facility that generates electricity must be near where the waste heat can be put to good use. CHP systems are able to increase the total energy utilization of primary energy sources and because it is usually cost effective, CHP is steadily gaining popularity in all sectors of the energy economy due to rising fossil fuel costs and concerns over the environment from greenhouse gasses and global warming.

Traditional power plants are roughly 30 percent efficient when generating electricity. A CHP system however generates the electricity, and then uses remaining heat for hot water or space heating, achieving efficiencies up to 80 percent or more.

For the Loveland area, it would be good to survey the existing power generating plants, and nearby industries to determine if there are any facilities that might be able to benefit nearby companies with their waste heat. Perhaps a mutually beneficial arrangement can be made, which lowers overall electrical demand, and reducing the base electrical load.

The overall engineering, procurement and construction ("EPC") costs for a combined-cycle ("CC") plant in northern Colorado is estimated at $1,300 kW to $1,400 kW. This cost has an accuracy level of +30 to – 15 percent based on present day 2011 dollars and does not include escalation and owner's costs, which is discussed below.

Many factors can impact the EPC price of a facility including: size, site ambient conditions, delivery voltage, fuel supply pressure, use of secondary or tertiary fuels, type of heat rejection system, emissions control equipment, indoor versus outdoor installations, type of wastewater treatment, conditions of the site, date of contract, project location schedule acceleration of schedule and others.

These costs are based on specific set of conditions listed below:

- Size: 100 MW
- 1 – PG7121EA
- 1 – 30 MW Steam Turbine Generator
- Natural gas only
- Project location: Northern Colorado
- Performance assumed to be at ISO ambient conditions
- Delivery voltage: 69 kV
- Outdoor equipment

In addition to the variations in the EPC costs, other highly variable project costs are also incurred. These costs, which are not typically directly associated with the EPC contract, are referred to as owner indirect and other costs. These costs may include the following:

- Electrical interconnection costs to install transmission lines or upgrade the existing utility system
- Fuel interconnection costs
- Permitting fees
- Development fees (preliminary engineering, preparation and negotiation of contracts, and other legal and professional fees)

- Taxes or payments in lieu of taxes
- Financing fees including interest during construction, legal fees, lender fees, and insurance (i.e. efficacy insurance)
- Other site or regional related costs

Based on our experience reviewing projects for financing, these fees can be 15 percent, or higher, of the EPC costs which are not included in the cost above.

The overall construction schedule is approximately 20 to 24 months from the award of the EPC contract to commercial operation of the plant. Included in this time frame is detailed design, balance of plant procurement, construction, and commissioning. Permitting and project development would have to start one to two years prior to the award of the EPC contract. Generally, however, a 100 MW CC plants in development today can be constructed in approximately two and a half to four years which includes permitting, long lead procurement, construction, and commissioning.

2.2 Load Reduction and Load Shifting Options

2.2.1 Emergency Gen Sets in Area

A Load Reduction Management System ("LRMS") can be implemented to control the operation of back-up diesel generators that supply emergency power to water and sewer system pumps and pumping stations operated by the water authority and other municipal agencies, hospitals, and possibly cooperating corporate entities in the Fort Collins and Loveland area. During peak loads, the back-up generators would be brought online to power the back-up water and wastewater pumps, or provide back-up power to the operation, temporarily reducing the load on the grid. When peak periods are over, the pumps and buildings would be brought back online and the back-up generators turned off. This option is possible only if there are sufficient back-up diesel generators that can be used. We are assuming 20 units may be available between businesses, hospitals, and municipalities in Fort Collins and Loveland, which will reduce load on the grid by approximately 10 MW.

To insure this is a feasible option, an inventory should be taken of the companies, electric, water and power authority to determine the number of "gen sets" (back-up generators) that might be available for this approach. If feasible, then information on gen set manufacturer, model, capacity, control panel model, and the transfer switch make and model would be required.

For the dispatch of existing back-up generators, a remotely controlled interface unit must be installed at the stand-by generator. When the control unit receives a command to start, it will send a signal to the generator to engage the existing automatic transfer switch to operate, simulating an outage has occurred. This operation will cause the generator to start and transfer the appropriate loads to back-up generator and is a relatively simple task assuming that the interface to the generator is straight forward, depending upon the make and model.

If there is an issue with turning off water pumps temporarily during a forced back-up connection, then the transfer switch must be replaced with a “closed” transition transfer switch which will eliminate the problem but at an additional cost. Frequent dispatch may also have other issues as well such as restrictions or permit limits on run time, air pollution limits, operational issues due to water back flows, etc. In addition, deep wells may have issues with the water flowing in reverse direction when the pumps are temporarily turned off and would require a longer time delay before restarting the pumps.

Along with remote control, the diesel back-up generators would also be monitored for critical start/stop, fuel level, electric output, and other operational conditions depending upon the age, make and model of the generator, control panel, and transfer switch. Since most back-up generators are tested on a regular basis anyway, monitoring them and controlling them remotely would eliminate the truck rolls and labor costs to manually test each of the backup generators.

To reduce load by 85 MW, a significant number of back-up generators in the range of 850 would need to be turned on. There will not be nearly enough to cover the entire 85 MW requirement between Fort Collins and Loveland but 20 units seems to be a reasonable number, with an average generator rating of 625 kW.

Assumptions:

- 10 MW of peak demand load to be reduced 178 hours per year.
- The average diesel back-up generator rating is 625 kW (ranges from 10 kW to 2,000 kW).
- Current installed generators are made by major vendors like Caterpillar, Onan, Generac, Cummins etc. and transfer switches are capable of being remotely managed within reasonable complexities.
- Generator output is 80 percent of rated load. Generating 10 MW would require approximately 20 diesel generators (10 MW/625 kW/.80 = 20); no environmental issues would prohibit diesel operation.
- 75 percent of the generators use open transfer switches allowing standard stand-alone remote terminal units (“RTUs”) for remote control.
- 25 percent of the generators use closed transition transfer switches providing no interruption in power to the pump when switching to backup.
- 80 percent of diesel generator sites have Internet access for remote management/control.
- 15 percent of diesel generator sites require cellular access for remote management/control.
- Five percent of diesel generator sites require satellite access for remote management/control.
- Remote monitoring, management and control would require fully integrated demand management system.

- Includes integration into Supervisory Control and Data Acquisition (“SCADA”) or Smart Grid applications.
- Installed cost is approximately $518,000.
- Or $52/kW using existing back-up diesel generators.
- Installation timeframe would be approximately 6 to 12 months.

On-going cost of diesel fuel should also be considered in this scenario, which could cost up to $600,000 per year to generate 10 MW for 178 hours, depending upon the price for diesel fuel. These ongoing costs however would be reduced or eliminated since a portion of this fuel expense would have been paid for to run regularly scheduled backup generator tests anyway. It is not uncommon to run monthly tests for a good portion of the day. In this scenario, running backup tests during peak hours would help reduce the utility’s peak loads, something the utility could make attractive to the companies with backup generators by offering incentives.

2.2.2 Advanced Metering Infrastructure and Automatic Meter Reading

In early 2012 Fort Collins will begin rolling out an Advanced Metering Infrastructure (“AMI”) system to 55,000 residential housing units and 10,000 commercial buildings. One advantage of having AMI is that the utility can offer various rate packages based on rate bands, Time Of Use (“TOU”) rates, variable pricing and other services based on the technology. Various pricing bands during the day can motivate customers to consume or not to consume electricity. If Fort Collins were to install the meters and then implement pricing for peak hours, off-peak hours, and variable rate hours, it will see a reduction in demand during the peak hour rate band. As an example, if the higher cost peak rate band were set for 4:00 p.m. until 8:00 p.m. the utility is very likely to see a reduction in demand during those hours.

Loveland does not have a smart grid plan but in a first phase, if they were to install an Automatic Meter Reading system (“AMR”) in residential and commercial accounts, it could be done fairly easily without having to build a data communications network back to the utility command center. In the first phase, Meter Readers could drive by and wirelessly collect interval data from the meters for billing purposes. The implementation of the AMR however would allow Loveland to incorporate various rate plans like Fort Collins. Then as financing and design efforts proceed, eventually convert to a fully automatic meter infrastructure if they so desire. Reducing peak hour usage however could be accomplished.

- 30,000 electric smart meters could be installed in Loveland (4,615 commercial, 25,385 residential)
- Cost per meter installed approximately $265 each on average
- On-going cost to read meters w/ AMR approximately $2 per month each
- Total Cost to install: $7,950,000
- Installed cost is $115/kW

- Both utilities use peak rates between 4:00 p.m. and 8:00 p.m. with exact TOU hours to be determined
- Potential is provided for Fort Collins and Loveland to potentially reduce substantial demand during peak hours

2.2.3 Community Energy Storage

Community Energy Storage ("CES") consists of a large battery back-up system installed by the utility in neighborhoods, that serves several houses, typically associated with neighborhood transformers at the grid edge. If CES units were installed in the Loveland and Fort Collins area, the utility could use them as a kind of buffer, to feed electric power into the grid during peak hours, and fill them up with low cost electricity during off-peak hours.

The first installation of CES systems recently began in the U.S. providing back-up power to an average of four homes per CES unit. These units will also be used to reduce electrical load by powering homes during periods of peak energy consumption, with the overall process managed through a "control hub," at the nearby sub-station.

Each of these CES battery units for Loveland and Fort Collins will be sized at 50 kWh to handle the back-up requirements. Depending on the day and time of the outage, and remaining power in each battery, each CES unit can supply up to four hours of back-up power to each of four houses depending on the level of battery charge, time of day, and actual load. Note that back-up times will increase when neighbors are aware they are on back-up power.

Besides shortening or eliminating the amount of time a customer is without power, CES units can also be used to supply energy to the houses during peak electrical periods, say between 4 p.m. to 8 p.m., on hot summer days when air conditioners are running on high. With a CES unit feeding power to the houses during these peak times, the overall load on the electric grid is reduced. By relieving the strain on the electric system during these peak periods, the utility can reduce the price of electricity at those times, and in general delay the need for future power plants or transmission lines which helps lower overall energy costs.

Once qualified properties are selected for the location of CES battery systems, the installation process takes about three days for each CES, which is usually located next to an existing pad mounted neighborhood transformer.

The following is a planning level capital cost estimate to install 2,650 x 50 kWh CES battery systems, a total of 135 MWh storage capacity and 21 MW output based on the following assumptions:

- Size of each CES battery is 50 kWh.
- Each transformer supports on average four homes with an average total load of 8 kW (2 kW per house).
- CES provides power for those four homes an average of four hours per occurrence (outage).

- Batteries are used during 178 hours of annual peak period load.
- Charging of batteries occurs during off-peak periods at times of lowest electrical cost.
- CES would conservatively be discharged only up to 64 percent per occurrence to maintain long-term battery life.
- Discharging 2650 CES units x 8 kW = 21 MW.
- $12,500/kW is the installed cost based on output.
- Energy cost savings should also be considered. If the price difference between off-peak (when battery is "filled") and peak (when battery is discharged) is $.10/kW then savings to the utility will be $.10 x 8 kW x 2,650 CES units = $7,281 per year.
- Installation of 2,650 CES units will take approximately 36 months after permitting is completed.
- Maintenance costs are not included in above.
- This assumes there are actually enough locations to actually install the quantity of batteries proposed. Such a study would need to be completed first.

Utilizing the assumptions above, the CES capability could be engineered to reduce load by approximately 21 MW during 178 peak hours for an installation cost of approximately $265,000,000. Cost savings due to keeping homes on back-up power has not been factored in for items like reduced food spoilage, basement flooding prevented, or increased personal health and safety etc.

Upfront costs for CES are determined mainly by the size of the battery. As installations increase in the future, battery costs will continue to drop due to volumes of scale. And when re-cycled batteries can be incorporated into the vendor products, there will be significant cost reductions in this technology.

2.2.4 Hybrid Ice Air Conditioning

During summer month peak hours, one of the largest consumers of electricity, if not the largest load is air conditioning. Approximately 30 percent to 40 percent of a building's load on a hot day may be used for this purpose. In Loveland and Fort Collins, reducing air conditioning load during the critical 4:00 p.m. to 8:00 p.m. peak hours could be accomplished using hybrid "ice and electric" air conditioning technology, reducing the electric load substantially when needed the most.

These hybrid systems are typically installed on the roofs of large residential and commercial structures, and connected to existing air conditioners. They create ice during the low cost, off-peak hours and use the ice later during the hot afternoon and evening peak periods for cooling purposes. Some new air conditioning models from manufacturers like Carrier/Trane are built with a ready-made "ice coil" and can easily be connected to one of these hybrid ice storage units, making installation very simple. Other air conditioners can't be converted, or due to location, space or power constraints cannot be converted. Other air conditioning systems require slight modifications but can be upgraded to accept the connection. Overall, about one third of them can be converted.

One approach to implementing such a program could be for the utility to install such units at no cost, to motivate building owners to participate. Not only would owners of hybrid air conditioning systems see annual electrical cost savings in the 10–20 percent range, but the utility would see a reduced load during the critical peak periods and could control the systems.

Based on the last 10 years of data for the area, and an analysis by the hybrid air conditioning company

- The Average Peak Day is July 19th
- Average Peak Hour is 4:45 p.m.to 5:45 p.m.
- Combined peak summer load is 461 MW for both Loveland and Fort Collins
- Portions of peak load due to air conditioning is assumed to be 30 percent
- 33 percent of AC sites can accept an ice air conditioner
- Potential MW reduction is 46 MW or 10 percent of the summer peak load split between Loveland with 16 MW and Fort Collins 30 MW respectively
- Requires 2,514 (plus or minus 30 percent) ice air conditioners with direct load control
- Installed cost is $76M
- Cost is $1,700/kW
- Plus 2 percent annual maintenance or $1.5M/year

2.3 Renewable Incentives

2.3.1 Renewable Energy Credits (RECs)

When an organization reduces its emissions of greenhouse gases and other pollutants through energy efficiency and renewable energy projects, those reductions have financial value. Companies, utilities, governments, and others are willing to purchase those emissions reductions to either voluntarily offset their own emissions or satisfy government mandates that they do so. For example, roughly half the states in the U.S. have adopted renewable portfolio standards (“RPS”) that require utilities to generate a percentage of their power from renewable resources. Utilities can meet these requirements by either producing electricity from wind turbines, solar power or other renewable resources, or by purchasing RECs from organizations that do.

Some companies do not want to own the renewable energy assets Those who cannot participate, may choose to enter into a power purchase agreement which allows a third party to install and own renewable facilities on the company’s property.

The third party takes full advantage of the federal tax reductions, accelerated depreciation, state incentives, local incentives, and utility incentives. In turn it sells power back to the original company at a reduced rate. The third party can also own the RECs generated by owning the renewable energy resources and can either provide them to the organization which is hosting the project or can sell them on the open market.

2.3.2 Incentives

There are various incentives for renewable energy based on technology, state, utility, and special interest groups. The tax incentive with the largest impact on renewables for individuals and companies has been the Federal Tax Credit, now extended to 2017, providing up to 30 percent off the gross cost to install renewable energy systems along with the Modified Accelerated Cost Recovery System ("MACRS") allowing accelerated 5-year depreciation of such assets. Table 2-1 summarizes some of the types of incentives available in Colorado. Details on some of the specific programs follows.

Table 2-1
Summary of Colorado Incentives

Incentive	Description
3rd Party Solar Power Purchase Agreement Policies	Colorado Power Purchase Agreement Senate Bill 09-051; PUC Decision C09-0990 described at http://www.dora.state.co.us/puc/docketsdecisions/decisions/2009/C09-0990_08R-424E.pdf
Energy Efficient Resource Standards	Electricity sales and demand reduction of 5% of 2006 numbers by 2018 (statutory requirement); natural gas savings requirements vary by utility
Grant Programs for Renewables	State, Utility, Local, Private programs
Interconnection Policies	10,000 kW system capacity limit in Colorado
Loan Programs for Renewables	State programs plus other
Net Metering Policies	IOUs no limit, co-ops & municipals 10kW/25kW
PACE (Property Assessed Clean Energy) Financing Policies	Property tax Assessed Clean Energy Programs
Property Tax Incentives for Renewables	Some State Exemptions or special assessments
Rebate Programs for Renewables	State, Utility, Local, Non profit
Renewable Portfolio Standard Policies	30% by 2020 (IOUs) 10% by 2020 (co-ops & large municipals)
Renewable Portfolio Standard Policies with Solar/Distributed Generation Provisions	Colorado: 3% DG by 2020 1.5% customer-sited by 2020
Sales Tax Incentives for Renewables	State exemption + local gov (option) authorized to offer exemption or deduction

Colorado Property Tax Exemption for Residential Renewable Energy Equipment

For Colorado property taxation purposes, renewable energy systems as defined under § 40-1-102 (11), C.R.S., that are used to produce two (2) megawatts or less of electricity are classified as personal property and assessed by the county assessor. The following are examples of renewable energy systems (property): photovoltaics (solar), hydroelectric, and wind turbine property. A description of this program can be found at http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CO188F&re=1&ee=1

Colorado Renewable Energy Property Tax Assessment

Colorado Renewable Energy Property Tax Assessment based on Senate Bill 177, enacted in April of 2009, allows for large-scale solar facilities (2 MW or larger) installed on or after January 1, 2009, to follow the same method for property tax assessments as wind-energy facilities. Wind facilities in operation prior to June 1, 2006, and solar facilities installed prior to January 1, 2009, are assessed using the same method as other renewables. In 2010, Senate Bills 174, 177, and 19, respectively, extended this methodology to equipment used to produce electricity from geothermal, biomass, and certain hydro resources. See more at http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CO46F&re=1&ee=1

Colorado Sales and Use Tax Exemption for Renewable Energy Equipment

Colorado exempts from the state's sales and use tax all sales, storage, and use of components used in the production of alternating current electricity from a renewable energy source. Effective July 1, 2009, through July 1, 2017, all sales, storage, and use of components used in solar thermal systems are also exempt from the state's sales and use tax. The exemption for systems which produce electricity from a renewable resource includes but is not limited to PV systems, solar thermal-electric systems, small wind systems, biomass systems, or geothermal systems. See more at http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CO160F&re=1&ee=1

Colorado Local Option for – Sales and Use Tax Exemption for Renewable Energy Systems for Solar Water Heat, Solar Thermal Electric, Photovoltaics, Wind, Biomass, Geothermal Electric, Other Renewables

Colorado enacted legislation in April 2007 (SB 145) to authorize counties and municipalities to offer property or sales tax rebates or credits to residential and commercial property owners who install renewable energy systems on their property. HB 1126 of May 2009 added solar thermal (non-electric) systems to the list of renewable energy equipment eligible for the sales and use tax exemption, and expires in 2017. See more at http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CO50F&re=1&ee=1

Feed-In-Tariff

A Feed-In-Tariff ("FIT") is a contract that utilities sponsor, whereby other companies and individuals generate electricity and sell the power at specified rates back to the utility. The advantage of a FIT is that a person or company can set up an alternative energy system and sell power to the utility without having certain limitations, like in a net metering agreement. (A net metering plan typically limits the amount of electricity one can sell back to a utility by what that person or entity consumes, at or below the consumer rate.)

A FIT has fewer restrictions and it sets specific kWh rates that the utility will pay over a period of time like 10 or 15 years for solar, biomass, or wind generated electricity.

Such timeframes help developers recoup the cost of the investment. Recent FITS in the US were announced by Northern Indiana Power Company in June and were sold out in a matter of weeks, and the Oregon FIT was sold out 45 minutes after it was released, due to its generous solar rates.
See http://solaroregon.org/residential-solar/steps-to-solar/solar-electric/feed-in-tariff and
http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=IN79F&re=1&ee=0

2.4 Summary

Table 2-1 summarizes the distributed generation and load reduction or load shifting technologies discussed in this report. High-level planning assumptions are used to attempt the quantify a potential capacity reduction and cost of each technology, assuming a peak load reduction of up to 85 MW for 178 hours/year (based on Platte River's estimate as of August 22nd), as well as the likely schedule required to implement it. None of these technologies could be implemented in time to resolve the transmission issues anticipated next summer without the Dixon Creek-Horseshoe 230-kV line, and it is doubtful that any single solution could achieve the desired load reduction in a reasonable time period. However, a combination of technologies could provide significant benefit.

Table 2-2
Summary of Peak Load Reduction Options

Peak Load Reduction Options	Type	MW	MW at Peak Hour	Cost/ kW	Total Cost	Ongoing Annual Costs	Site Availability	Installation Timeframe (Mo)	Notes
Municipal Solid Waste	Generation	14	14	$ 4,500	$ 63M	$ 5M	Larimer County Landfill	24 mo	Solid waste burned to generate electricity
Biomass	Generation	35	35	$ 4,500	$ 157M	$ 5M	Horseshoe Substation biomass location	24 mo	Biomass burned to generate electricity
Solar PV w/ Battery Storage	Generation	85	85	$ 5,410	$ 460M	$ 10M	Requires 400+ acres	18 Mo+	Battery storage required to shift the timing of electricity put onto the grid to peak hours.
Solar Thermal Electric	Generation	85	85	$ 4,000	$ 340M	$ 6M	Requires 500+ acres	24 Mo	Molten salt storage creates steam to generate electricity at any time of day including peaks.
Gas Turbines	Generation	95	95	$ 1,000	$95.5M	$ 3M	Minimum of 15 acres	24 - 36 Mo	Only included EPC costs and add 15 percent for owner's costs
Fuel Cells	Generation	85	85	$ 8,000	$ 680M	$ 1M	TBD. Requires survey for natural gas fuel and location	24 - 36 Mo	New technologies at cutting edge, may or may not be available by next summer in sufficient quantities.
Combined Heat and Power	Generation	100	100	$ 1,350	$ 135M	$ 5M	Minimum of 15 acres	24 Mo	Major long lead equipment (CT and STG) needs to procured prior to EPC Contract. Only included EPC costs and add 15 percent for owner's costs
Emergency Gen Sets in Area	Load Reduction	12.5	10	$ 52	$ 518K	$ 500k to $700k	Requires existing diesel back-up generators	6 - 12 Mo	Performing back-up generator tests and running during peak hours .

Peak Load Reduction Options	Type	MW	MW at Peak Hour	Cost/ kW	Total Cost	Ongoing Annual Costs	Site Availability	Installation Timeframe (Mo)	Notes
AMI w/ TOU Rates	Load Reduction/ Shifting	85	85	$ 100	$ 8.5M	$ .85 M	Cost to install 30k Loveland residential and commercial electric meters only. Does not include cost for 65k meters in Fort Collins		Install smart meters in Loveland commercial and residential properties. Use higher rate band during 4 p.m. to 8 p.m. in both Loveland and Fort Collins to lower peak usage.
Community Energy Storage (CES)	Load Shifting	135	21	$ 12,500	$ 265M	$ 5.3M	TBD. Requires 2,650 locations	24 - 36 Mo	Batteries provide home backup and can send power to the grid during peak hours
Hybrid Ice Air Conditioning	Load Shifting	46	46	$ 1,700	$ 76M	$ 1.5M	1/4 to 1/3 of buildings	24 Mo	2500 (+- 30%) ice systems to install. Operates 800 hours/yr. during peaks. Local production facilities could be built between Loveland and Fort Collins, good for local economy and shorten delivery/installation timeframes.

Appendix C
Stakeholder Presentations (1-7)

This page intentionally left blank.

Aaron Mortensen

Budweiser

Work aaron.mortensen@anheuser-busch.com

Alice Reuman

Estes Women voters

Work reumana3@gmail.com

Angie McClanahan

Broadcom

Work no email

April Getchius

Timnath

Work agetchius@timnathgov.com

Ben Aste

Uncle Bennys

Work unclebennys@hotmail.com

Bob Brinkman

Brinkman Construction

Work mark.christensen@brinkmanpartners.com

Bob Mann

FtC Nat Res Adv Bd

Work rjm@shadowcliff.org

Brent Hildebrand

Alpine Waste

Work bhildebrand@alpinewaste.com

Bridget Johnson

Green Girl
University of Northern Colorado
Owner, Green Girl Recycling

Work bridget@greengirlrecycling.com

Brittany Evans

Clear Intentions
Clear Intentions

Work bevans@clearintentions.glass

Caroline Mitchell

City FtC

Work cmitchell@fcgov.com

Charles Kamenides

Longmont

Work charles.kamenides@longmontcolorado.gov

Chris Carey

Estes Lodging

Work gmestespark@ledgestonehospitality.com

Corkie Odell

Odell Brewing

Work Coreyodell@odellbrewing.com

Craig McComie

WY
State of WY - DEQ

Work craig.mcomie@wyo.gov

Dan Garvin

CO Iron Metal

Work dangarvin@coloradoironmetal.com

Dan Gudgel

Front Range Landfill

Work dang@wasteconnections.com

Dan Matsch

Ecocycle

Work dan@ecocycle.org

Danny Basch

RMNP

Work danny_basch@NPS.gov

David May

FtC Chamber

Work davidmay@fcchamber.org

David Snapp

CDPHE

Work david.snapp@dphe.state.co.us

Debbie Seidman

Platte River Power

Work seidmand@prpa.org

Frank Lancaster

Town Estes

Work flancaster@estes.org

Gail Meisner

Lar Cnty Ag Adv

Work gmeisner@skybeam.com

Gail Thompson

Owens Ill Glass Co

Work gail.thompson@o-i.com

Honore Depew

FtC

Work hdepew@fcgov.com

Hunter Buffington

FtC Sustainability

Work everybodylovessauce@gmail.com

Resourceologist.com http://resourceologist.com/
Sauce Website http://www.everybodylovessauce.com

James Gaspard

Biochar Now

Work james.gaspard@biocharnow.com

Jane Abels

janeabels@gmail.com

Jane Abels

Lar Cnty Env Adv
Colorado State University
Environmental Coordination Specialist, Larimer County

Work sbayard@larimer.org
bayardsh@co.larimer.co.us
bayardsh@larimer.org

Janice Oldmyer

IT Refresh

Work Joldemeyer@onsiteelectronicsrecycling.com

Jason Graham

FtC Water Reclamation

Work jgraham@fcgov.com

Jenn Vervier

New Belgium

Work declined

Jennifer Baker

jbaker@berthoud.org

Jim Gerek

Lar Cnty Env Adv
Colorado State University
Environmental Coordination Specialist, Larimer County

Work sbayard@larimer.org
bayardsh@co.larimer.co.us
bayardsh@larimer.org

John and Trudy Holcombe

Poudre School

Work jholcomb@psdschools.org
Home ttrimbath@psdschools.org

John Drigot

PVH UC Health

Work john.drigot@uchealth.org

Jon Haukaas

FtC Utilities

Work jhaukaas@fcgov.com

Notes jhaukaas@fcgov.com

JP Puma

Ram Waste

Work declined

Judi Smith

Work rrrcyc2se@gmail.com

Judy Smith

Estes Women Voters

Work judy@smithsignstudio.com

Julie Wilson

FRCC

Work julie.wilson@frontrange.edu

Kari Gallegos

GSI

Work kari@gsiwaste.com

Kelly Stewart

kstewart@newbelgium.com

Kelly Unger

Windsor

Work Kunger@windsorgov.com

Kelly Wilkerson

YMCA Rockies

Work kwilkerson@ymcarockies.org

Kent Pently

A1 Organics

Work scottpexton@a1organics.com

Kirby Hazelton

Estes Partner Commerce

Work draeward@yahoo.com
Home Kim.trees@yahoo.com

Kristen Battige

Thompson V School

Work Kristen.battige@thompsonschools.org

Laurie Johnson

CO Assn for Recycling

Work laurie@CAFR.org

Mark Cooper

YMCA Rockies

Work mcooper@ymcarockies.org

Martin Nelson

Lar Cnty Env Adv
Colorado State University
Environmental Coordination Specialist, Larimer County

Work sbayard@larimer.org
bayardsh@co.larimer.co.us
bayardsh@larimer.org

---

martin nelson

geomnelson@gmail.com

Matt Gallegos

GSI

Matt@mywasteco.com

Matt Theriault

Cheyenne Chamber

Work mtheriault@cheyennecity.org

Matthew Crance

All Recycling

Work mcrance@allrecyclinginc.com

Mindy McCloughan

Lvld Chamber

Work mmccloughan@loveland.org

Mick Mercer

City Lvld

Work mick.mercer@cityofloveland.org

Mike Hart

Berthoud

Work mhart@berthoud.org

Nancy DuTeau

FtC Nat Res Adv Bd

Work nduteau@ardeasolutions.com

Neil Kaufman

Natl Cent for Crafsmanship

Work neil@nccraftsmanship.org

Richard Alper

Lar Cnty Env Adv
Colorado State University
Environmental Coordination Specialist, Larimer County

Work sbayard@larimer.org
bayardsh@co.larimer.co.us
bayardsh@larimer.org

Richard S Alper

rsalperesq@aol.com

Richard Seaworth

Lar Cnty Ag Adv
owner, farmer

Work rseaworth@gmail.com

Roger Hageman

Hageman Earth Cycle

Work roger@hecinc.net

Ron Gilkerson

Rcgilkerson@gmail.com

Roy Lauicello

Johnstown

Work declined

Scott McDonald

McDonald Farms

Work mcfarms2@aol.com

Scott Mercer

Waste Management

Work smercer@wm.com

Sean Jurgens

Estes Lodging

Work sean@qualityinnestespark.com

Sheela Backen

CSU

Work sheela.backen@colostate.edu

Sid Doering

Doering Waste

Work sdoeringdisposal@gmail.com

Stephen Gillette

Solid Waste Director

gilletsw@co.larimer.co.us
gilletsw@larimer.org
sgillette@larimer.org

Mobile 970.481.5321
Work 5762
Work Fax (970)498-5780
Work 970-498-5762

Steve Kaplan

Estes women voters

Work stevebkaplan@centurylink.net

Steve Kaplan

Work stevebkaplan@centurylink.net

Susan Gordon

City FtC

Work sgordon@fcgov.com

Susanne Cordery

CSU

Work susanne.cordery@colostate.edu

Sybil Sharvell

CSU

Work sybil.sharvelle@colostate.edu

Tim Close

Work tim.close@bannerhealth.com

Todd Blomstrom

tblomstrom@larimer.org
blomstta@co.larimer.co.us
blomstta@larimer.org

Todd Loose

Waste Not

Work tloose@waste-not.com

Todd Noe

Waste Management

Work tnoe2@wm.com

Tom LaPoint

Poudre Can Sierra Club

Work tnplapoint@msn.com

Tom LaPoint

Work tnplapoint@msn.com

Tyler Bandemer

City Lvld

Work tyler.bandemer@cityofloveland.org

William Karspeck

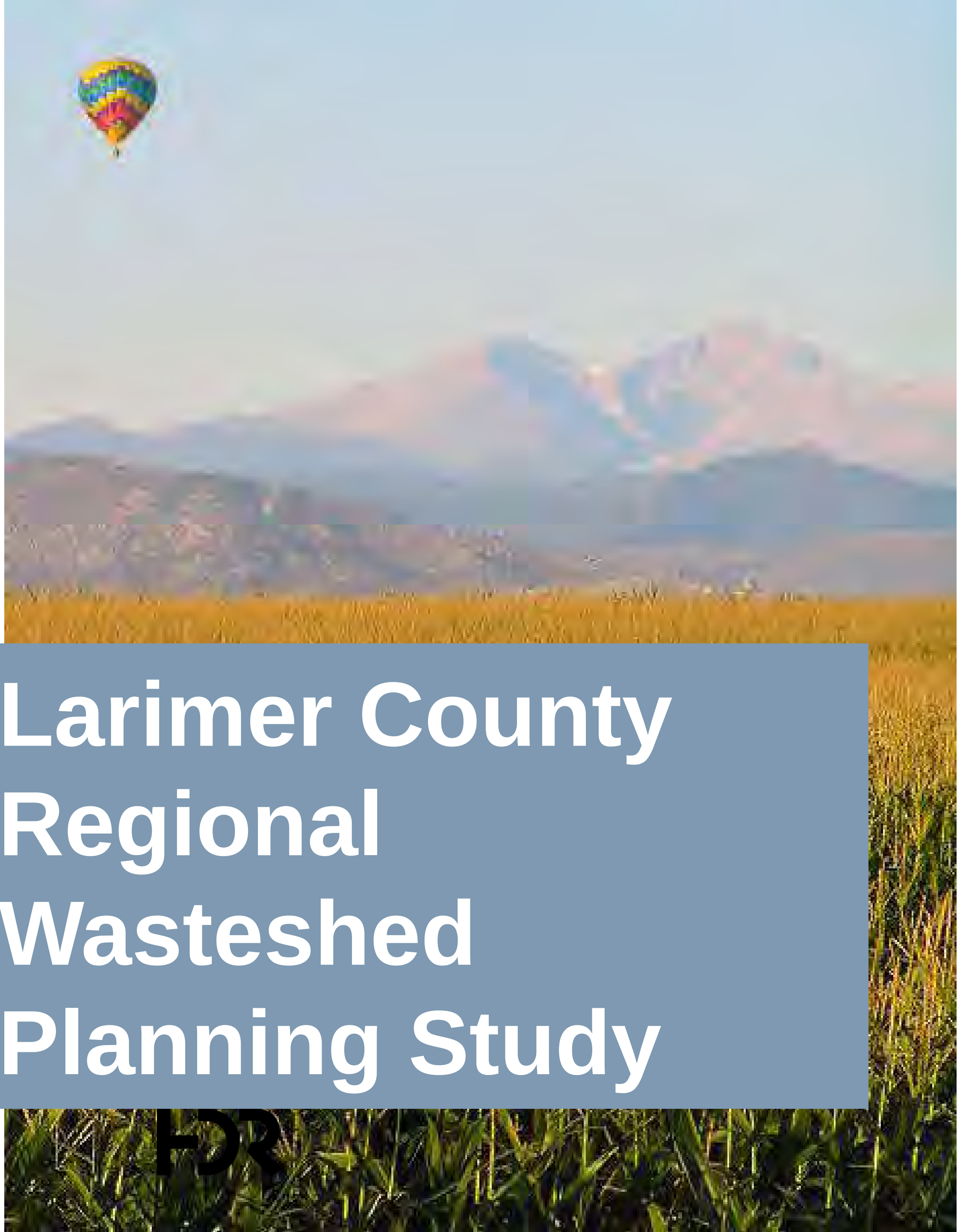
wkarspeck@berthoud.org

Zach Wilson

Purpose Brewing

Work z@1933brewing.com

This page intentionally left blank.



Larimer County Regional Wasteshed Planning Study

Stakeholder Meeting #1: Orientation

May 31, 2017

Coalition Charter

As stewards of the public trust, the charter and charge of the North Front Range Regional Wasteshed Coalition is to responsibly address current solid waste management and resource recovery needs of the region, while considering infrastructure and policy that will meet community needs in the future.

LARIMER COUNTY
COMMITTED TO EXCELLENCE

City of Fort Collins

City of Loveland

EP

Solid Waste Challenges

Increasing Volume of Solid Waste Material

Need for Consistent Goals and Programs

Anticipated Closure of County Landfill

Balancing Economic, Environmental and Social Costs

Coalition History

2015

- Coalition Formed
- Initial Planning Began
- Stakeholder Forum

2016

- County-wide Survey
- Spring & Fall Waste Characterization Study
- Phase 1 Study Complete
- Four (4) Public Forums

2017

- Formulated Broader Planning Process
- Phase 2 Scope of Work
- Hired Consultant
- Formed Phase 2 Stakeholder Group

Policy Advisory Committee

1. Define Coalition Objectives & Provide Strategic Direction
2. Establish Attainable Goals for Solid Waste, Recycling and HHW Management
3. Evaluate Alternatives and Recommendations from TAC
4. Establish Unified Vision for Future Solid Waste Practices and Infrastructure

Larimer County

» Steve Johnson

City of Fort Collins

» Wade Troxell

» Ross Cunniff

City of Loveland

» Leah Johnson

Town of Estes Park

» Wendy Koenig

Technical Advisory Committee

1. Evaluates Existing and Future Wasteshed Service Demands
2. Collects and Review Technical and Financial Data
3. Identifies Potential Alternatives for Solid Waste Management
4. Conducts Studies and Prepares Summary Reports
5. Provides Technical and Financial Recommendations to Policy Committee

Larimer County

» Todd Blomstrom

» Stephen Gillette

» Ron Gilkerson

City of Fort Collins

» Honore Depew

» Susan Gordon

» Caroline Mitchell

City of Loveland

» Mick Mercer

» Tyler Bandemer

Town of Estes Park

» Frank Lancaster

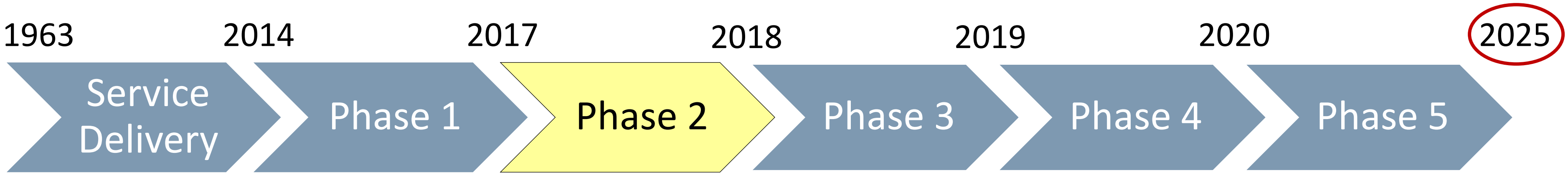
Facilitation

» Martin Carsasson - CSU

Stakeholder Group

1. Represents the citizens, businesses, institutions, and private solid waste companies
2. Provides comments and suggestions to TAC throughout the scope of work
3. Ensures alignment with community and business expectations
4. Ensures coordination with private sector solid waste companies
5. Contributes to independent review of process and conclusions

Five Phases



<u>Project Phases</u>

Phase 1 Foundation & Direction (R3 Document)

Phase 2 Program Development

- Unified Goals & Objectives
- Market & Triple Bottom Line Analysis
- Infrastructure Feasibility & Options

Phase 3 Unified Programs

- Policies, Education, Ordinance, Diversion Programs
- Long Term Governance

Phase 4 Framework for Infrastructure

- Financial and Funding Mechanisms
- Formation of Public-Private Partnerships (P3s)

Phase 5 Infrastructure Delivery

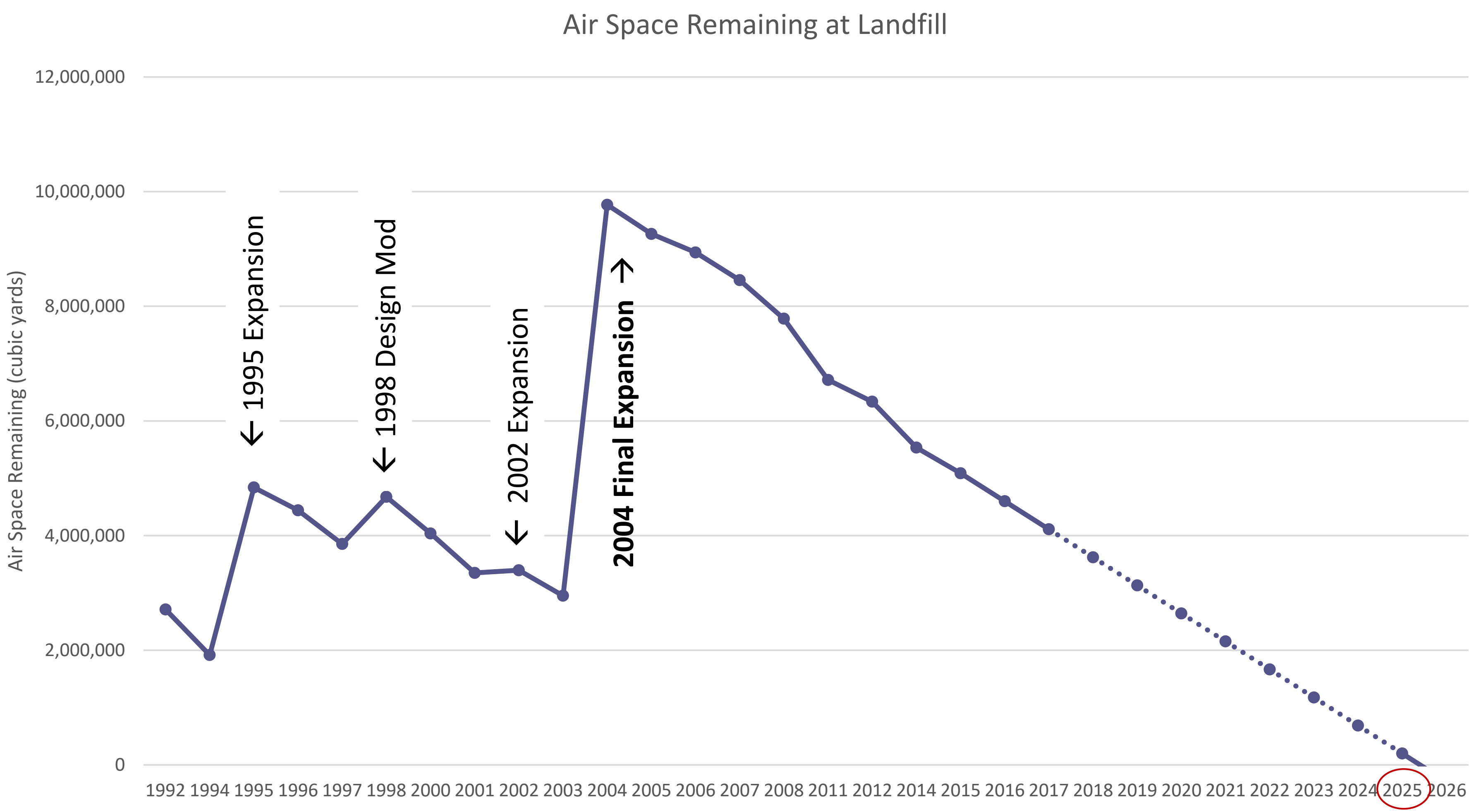
- Project Design and Procurement
- Construction and Commissioning

Regional Solid Waste System

Larimer County Landfill

- Commercial/Haulers: ~60% Fort Collins residential solid waste stream
- Municipal Services: ~95% Fort Loveland residential solid waste stream
- Residential – cars, trailers, pickups
- Operates as an Enterprise Fund

Airspace Remaining at Landfill



County Solid Waste Services

Recycling Center (Public-Private Partnership)
- Single stream recycling and electronic waste
- Processing 38,000 tons per year

Household Hazardous
- Paints, solvents, chemicals, batteries
- 20,000 visitors per year

Public Education Center
- Educational Programs
- 3,200 visitors

Organic Material Diversion and Processing
- Phase 1 – Commercial (2017)
- Phase 2 – Residential (2018)

County Transfer Stations
- Estes Park
- Wellington
- Berthoud
- Red Feather

City Solid Waste Services

Loveland Residential Solid Waste Collection Services

- » Household Trash Services
- » Household Recycling
- » Household Yard Waste

Loveland Recycling Center

- » Material Recycling
- » Yard and Raw Wood Waste
- » Other material drop-off

Fort Collins Collection Programs

- » Private Solid Waste Haulers
- » Several Proactive Environmental Programs
- » Public Education Programs

Fort Collins Timberline Recycling Center

- » Recycling Drop-off
- » Hard to Recycle Materials

Phase 1 Findings & Future Direction

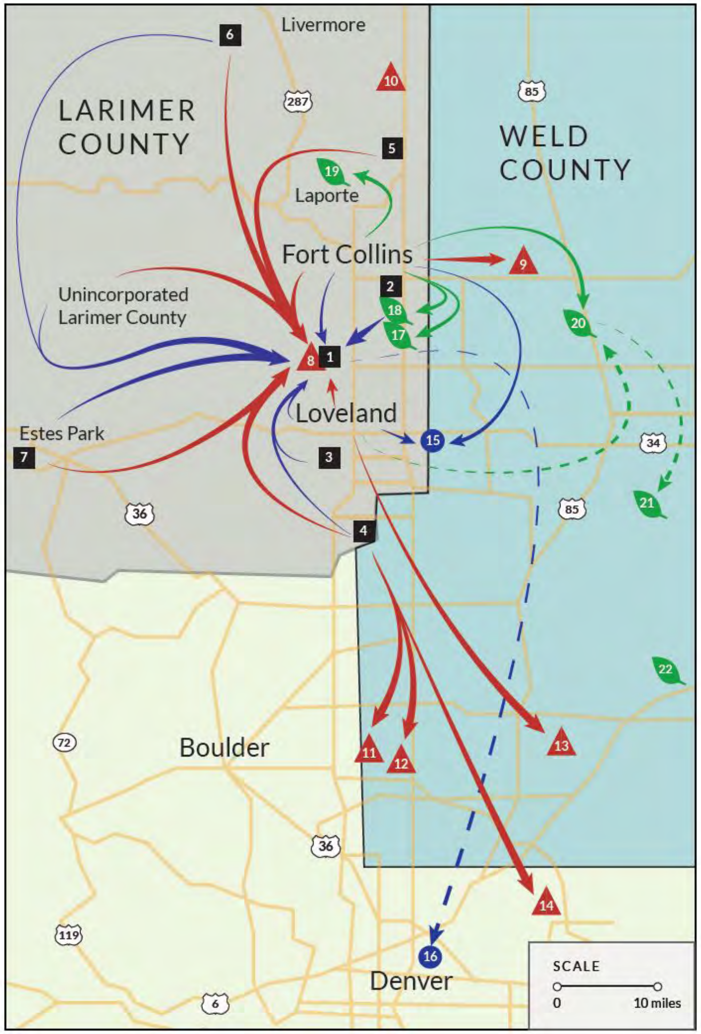
What is a Wasteshed?

waste shed

ˈwāstəˌSHedˈ

noun

1. An area that shares common rules and mean:



Phase 1 Study


R3 CONSULTING GROUP, INC.
RESOURCES · RESPECT · RESPONSIBILITY

FINAL REPORT

Regional Wasteshed Planning Study

LARIMER COUNTY
COMMITTED TO EXCELLENCE
City of Fort Collins
EP
City of Loveland

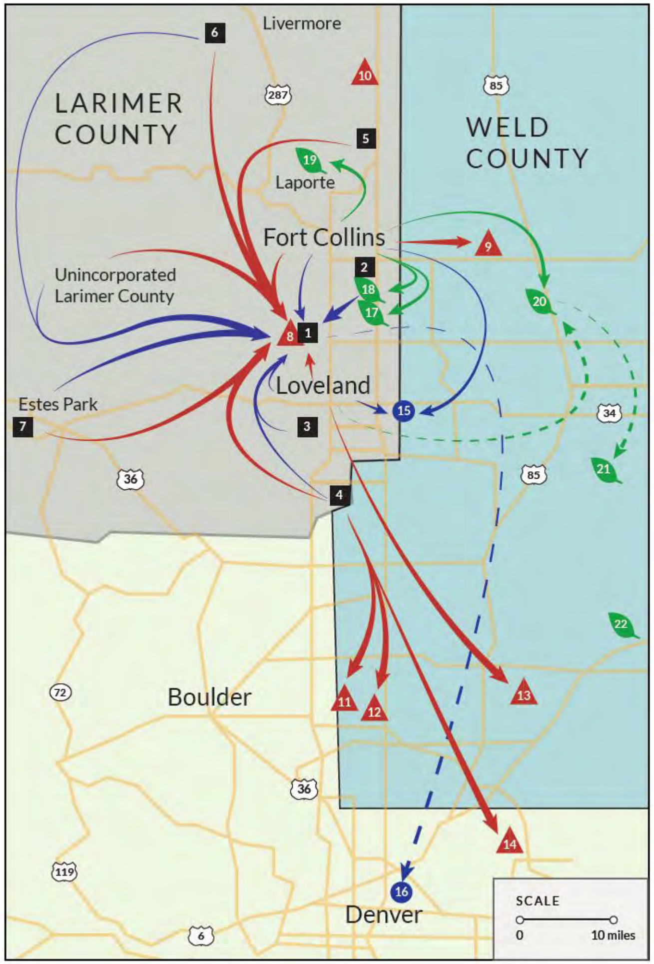
SUBMITTED TO:

The North Front Range Wasteshed Planning Coalition

July 15, 2016

Phase 1 Study

» A **loosely connected**, **highly dependent** system.



Phase 1 Study

Main Sections of Report

» Current Conditions

» Current and Future Waste Handling

» Opportunities Assessment

» Feasible Options

» Funding Approaches

Phase 1 Study

Feasible Options

- Status Quo
- Central Transfer Station
- New County Landfill
- Material Recovery Facility
- Organics Composting Facility
- C&D Processing Facility
- Waste-to-Energy Facilities

Goals & Objectives

Supporting Factors for all Goals to be Achievable

» Not one element (economics, environment or social) can be maximized; there needs to be balance among the three to achieve a realistic diversion goal

» Everyone has to have a voice and be treated fairly (key stakeholders, the private sector and the public)

» Diversion goals and policy need to be supported by the PAC and then be enacted consistently across all local agencies

» Equal opportunity for resource recovery, compared to a landfill, which is convenient and cost effective

» In order to determine realistic outcomes, there needs to be consistent policy, effective two-way communication and an inventory and assessment of current infrastructure and resources (human capital and funding).

4 Goals

1. Establish a comprehensive, regional solid waste management system that is implemented in an economically, environmentally and socially sustainable manner

2. Provide a comprehensive materials management and disposal system and facilities that reflect the needs and desires of its users.

3. Develop a diversion goal that is adopted and implemented by all municipalities in the Wasteshed.

4. Develop a strong public education and outreach program that is consistent across all municipalities.

Goal #1

Establish a comprehensive, regional solid waste management system that is implemented in an economically, environmentally and socially sustainable manner.

Objectives

- » Upon completion of the Phase 2 Study in 2018, the Coalition has identified and documented specific solid waste programs, facilities and infrastructure that deliver the optimum balance between economic, environmental and social costs.
- » The proposed solid waste system addresses future customer service demands in the region over the next 40 years or more, and provides long-term funding to address capital and operating costs.
- » Coalition members are prepared to begin implementing solid waste programs and constructing solid waste facilities and infrastructure by January 2020.

Goal #2

Provide a comprehensive materials management and disposal system and facilities that reflect the needs and desires of its users.

Objectives

» The development of solid waste programs and facilities shall utilize a comprehensive approach for materials management, reuse, recycling and disposal, throughout their life cycle to conserve resources, lower costs and reduce environmental impacts.

» The next generation of solid waste programs and facilities provides solid waste management services at affordable rates, and customer costs are competitive compared to national and regional averages.

» New solid waste programs and facilities result in the increasing application of innovative technologies and produce a substantial reduction in the amount of material being transferred to landfills.

» New solid waste programs and facilities are convenient and accessible for citizens, customers and private solid waste haulers in the County.

Goal #3

Develop a diversion goal that is adopted and implemented by all municipalities in the Wasteshed.

Objectives

- The Coalition establishes consistent definitions and methods for measuring the rate of solid waste diversion within the wasteshed by the year 2019 and supported by streamlined and consistent data.
- Solid waste diversion is evaluated on a three-year recurring cycle beginning in the year 2020.
- The Policy Advisory Committee and private solid waste representatives review the results of solid waste diversion evaluation, current diversion programs, and unified diversion goals on an annual basis to identify potential program adjustments.
- Municipalities implement consistent regulatory measures to support solid waste diversion efforts by the year 2024 and emphasize a solid waste system focused on diversion.

Goal #4

Develop a strong public education and outreach program that is consistent across all municipalities.

Objectives

» Public education and outreach programs convey a consistent message and effectively influence the behavior of citizens regarding the reduction, reuse and recycling of materials that would otherwise be destined for landfill disposal.

» Educational activities create an effective vision for the community and environmental benefits of reducing, reusing and recycling materials.

» Public education materials convey consistent standards for recycling and solid waste diversion within all municipalities.

» Municipal and private solid waste company representatives meet on a routine basis to coordinate solid waste educational programs and outreach efforts.

Next Steps

Schedule of Future Meetings

- **Stakeholder Meeting #1**: May 31
  - Orientation
- **Stakeholder Meeting #2**: June 28
  - Emerging Technologies & Management
- **Stakeholder Meeting #3**: (Date TBD)
  - Infrastructure Options
- **Stakeholder Meeting #4**: (Date TBD)
  - Sustainable Return on Investment
- **Stakeholder Meeting #5**: (Date TBD)
  - Economic & Market Analysis

Feedback

Questions

1. Does the proposed study process appear to be logical and well planned?

2. Do the Goals & Objectives reflect a high level, logical summary to effectively guide the planning process?

3. Any suggestions on the process?

This page intentionally left blank.

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #2:

Emerging Technologies

June 28, 2017

Today's Agenda

I. Welcome and Opening Remarks
II. Status of Draft Goals and Objectives
III. Emerging Technologies Overview
IV. Larimer County 2016 Waste Characterization Study
V. Infrastructure Options from 2016 Planning Study
VI. Additional Emerging Technologies Infrastructure Options
VII. Stakeholder Feedback
VIII. Next Steps

LARIMER COUNTY
COMMITTED TO EXCELLENCE

City of Fort Collins

City of Loveland

Status of Draft Goals & Objectives

- Comments are still being received and compiled for review and consideration.
- Policy Advisory Committee has reviewed and will be providing additional comments.
- Survey monkey comments to close July 10, 2017.
- Once all comments are received and reviewed, adjustments will be made and final goals and objectives will be prepared and presented at the next Stakeholder Meeting.
- A frequently asked questions list will be prepared based on comments received.

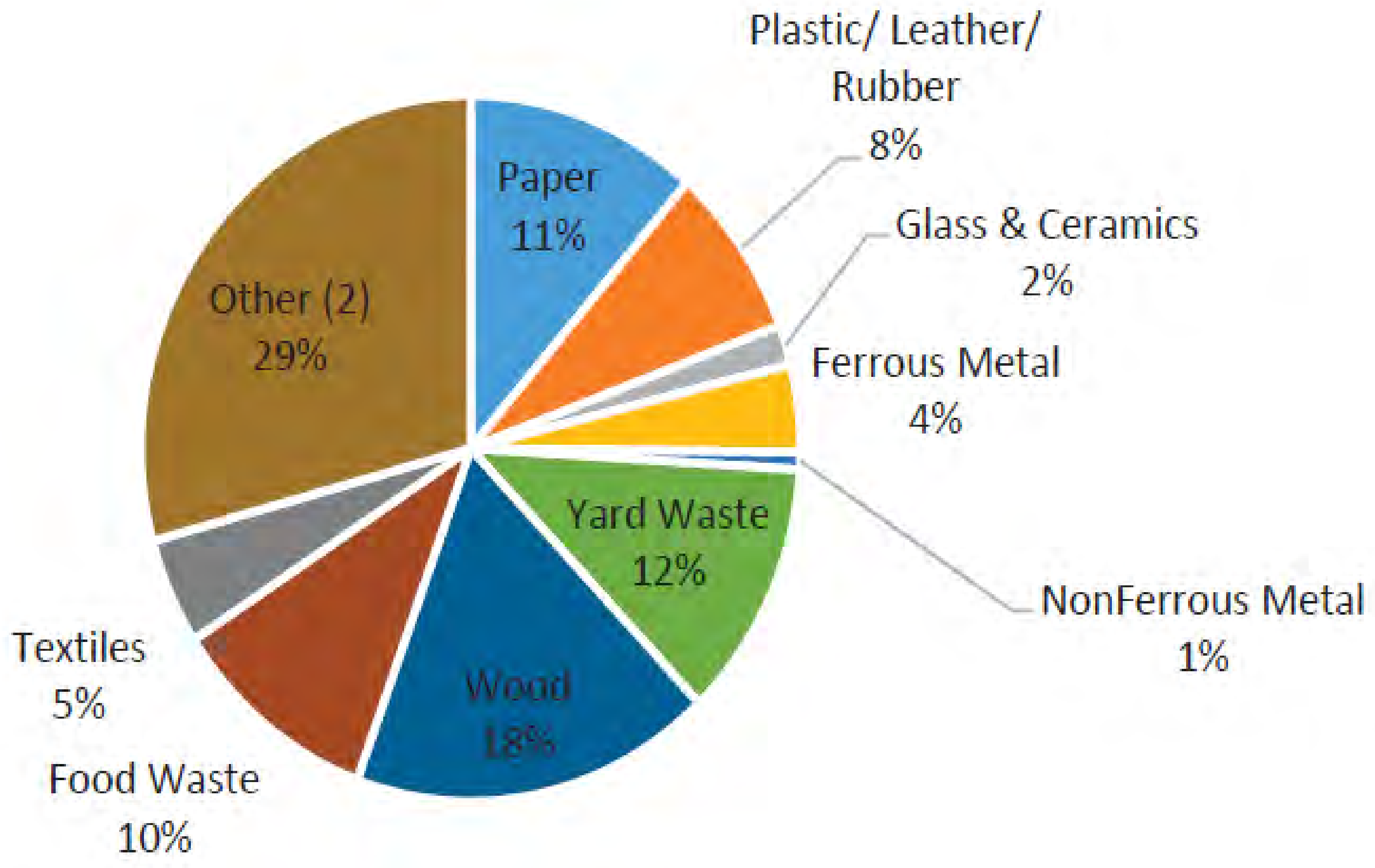
- https://www.surveymonkey.com/r/LarimerCoWasteGoalsandObjectives
- www.NFRWasteshed.com

Emerging Technologies Overview

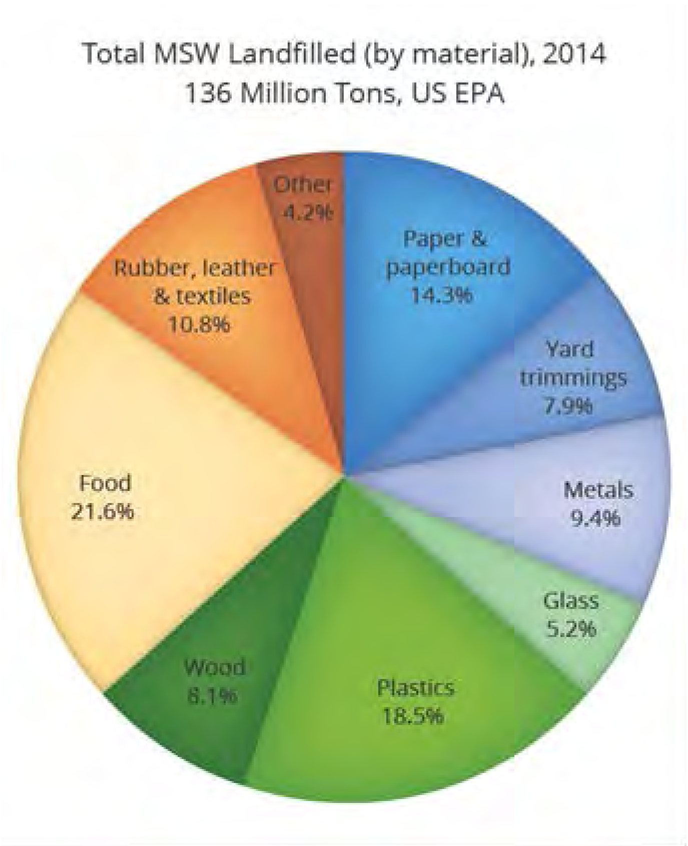
- The North Front Range Wasteshed Coalition has a variety of recycling, disposal, and diversion based solid waste management options in preparation for the closure of the Larimer County Landfill.
- Researched emerging and alternative technologies that may positively affect waste diversion rates, facility design and other factors within the Wasteshed.
- Considered additional infrastructure options for further analysis that have been successfully implemented in other communities.

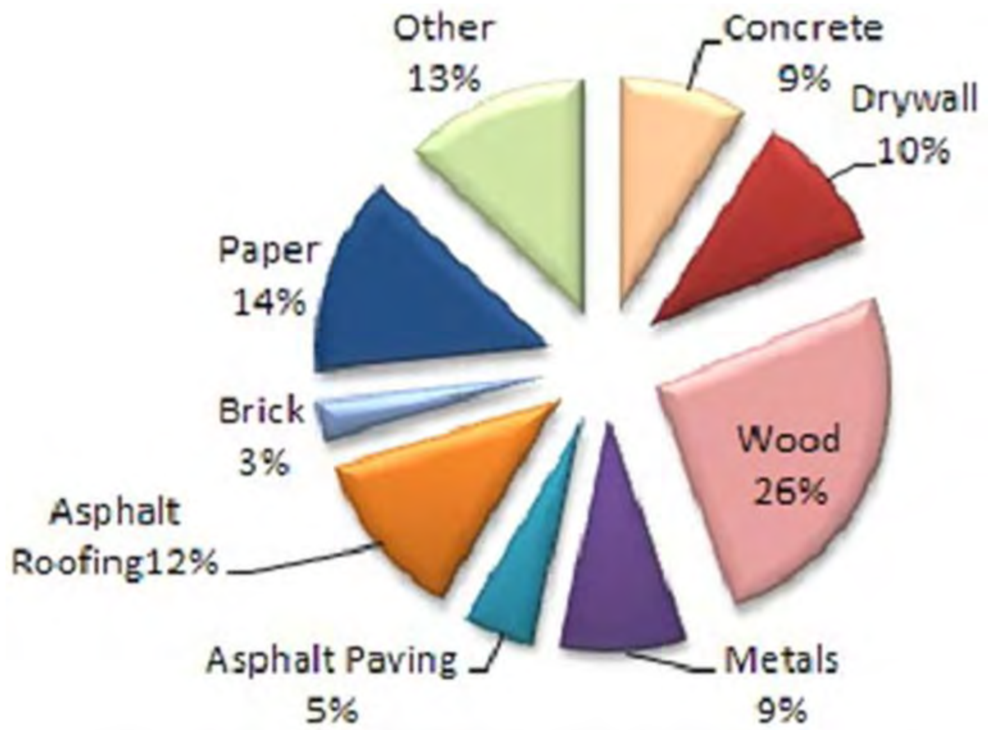
Larimer Co. 2016 Waste Composition & Characterization Analysis

Percent by Weight, All Wastes Delivered to Landfill (Other = construction and demolition debris and other materials)



Typical MSW and C&D Waste Stream Composition





Infrastructure Options for Consideration
2016 Planning Study

Status Quo

Central Transfer Station

New County Landfill

Material Recovery Facility (Clean)

Yard Waste Organics Processing Facility

C&D Processing Facility

Energy from Waste Facility (Direct Combustion)

Status Quo

- No Action is taken upon closure of the Larimer County Landfill.
- No additional facilities are constructed to handle or recycle waste.
- Waste would most likely be directed to out of county landfill.
- Phase 1 Study – 1.4 ton per person per year

Benefits:

- No funds expended for construction of facilities.
- The property purchased for a new landfill becomes available for other uses.

Drawbacks:

- Costs increase for disposal due to increased travel distances.
- Landfill receives approximately 60% of total County MSW at competitive rates.
- Self-haul customers would not have easy access to disposal in the more populated areas.

Central Transfer Station

A Transfer Station is a permanent, fixed, supplemental collection and transportation facility, used by persons and route collection vehicles to deposit collected solid waste from off-site into a larger transfer vehicle for transport to a solid waste handling facility.

Transfer stations:

- » Increase efficiencies
- » Lower collection costs
- » Reduce fuel consumption
- » Improve air quality
- » Enhance road safety

New County Landfill

The current Larimer County Landfill is forecasted to close in 2025.

Larimer County owns 640 acres available as a potential landfill.

Potential multi-functional facility for a comprehensive and integrated solid waste system.

A New Landfill:

» Allows monitoring of waste disposal.

» Is regulated for environmental compliance.

» Keeps revenues generated in county.

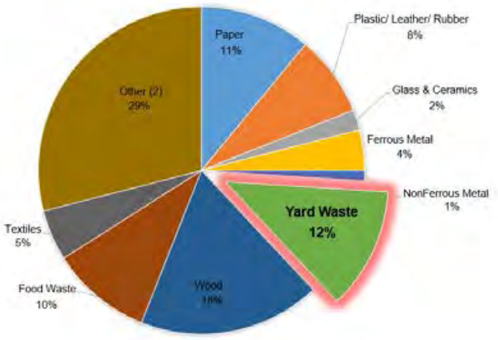
» Is part of a comprehensive approach for handling MSW.

Materials Recovery Facility (Clean)

- Facility that receives, separates and prepares recyclable materials for marketing to end-user manufacturers.
- Accepts single stream, source separated recyclables from curbside collection.
- Increases diversion of recyclable materials.
- Extends the life of landfills through diversion of wastes.
- Can be tailored to local conditions and markets.

Yard Waste Organics Processing Facility

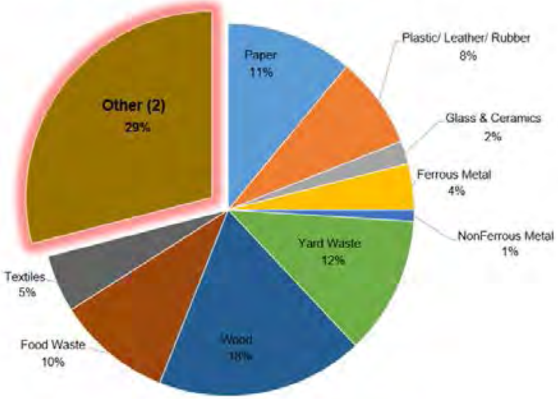
- Yard waste is source separated and composts through a natural process that converts the organic material into a stable rich soil amendment.
- Aerobic composting places organics into windrows that aerate through turning the piles by machine introducing oxygen and moisture.
- Aerated composting introduces fresh air into the covered pile through pipes to speed up the process.
- Yard waste accounts for 12% of the waste disposed at the Larimer County Landfill.
- Bulking agent for other technologies.



Construction & Demolition (C&D) Processing Facility

- Processes materials from mixed loads of C&D debris for reuse, recycling, and/or composting.
- Extract wood, metal, film plastic sheeting, concrete and other construction related material.
- Recovery of these materials can significantly increase the waste tonnage diverted.
- Removal of bulky materials allows for better recovery of fines and organics.

FIGURE 4-1: AGGREGATE COMPOSITION (PERCENT BY WEIGHT), ALL WASTES DELIVERED TO LANDFILL



Energy From Waste Facility – Direct Combustion

Energy From Waste is the process of generating energy in the form of electricity and/or heat from the primary treatment and combustion of waste.

- Over 80 facilities in operation.
- Handles the entire MSW waste stream.
- Processing capacity of up to 3,000 tpd.
- Has a facility life of over 25 years.
- Produces energy for market.

Additional Emerging Technologies Infrastructure Options

Mixed Waste Processing – Dirty MRF

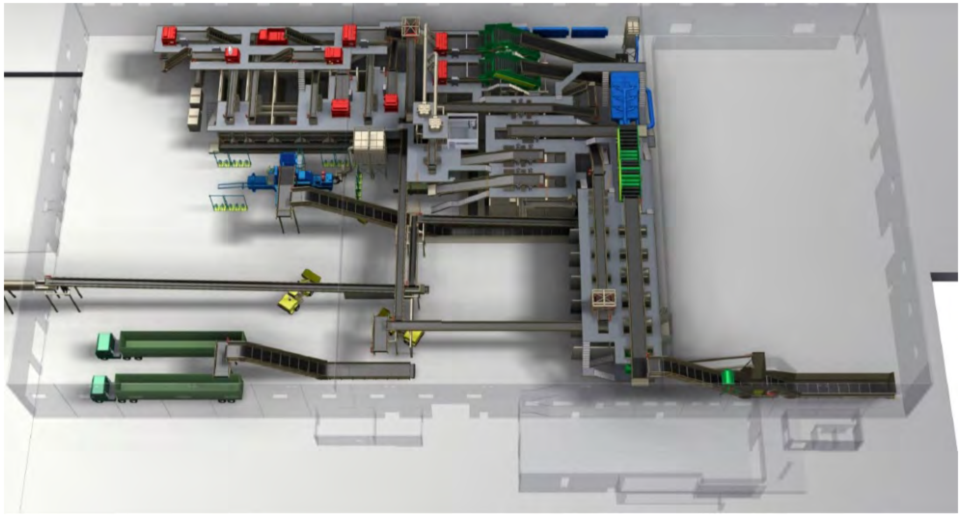
A type of MRF - takes a mixed MSW stream, referred to as a “Mixed Waste Processing Facility” or as a “Dirty” MRF

Mixed Solid Waste from residential &/or commercial vehicles

Materials sorted

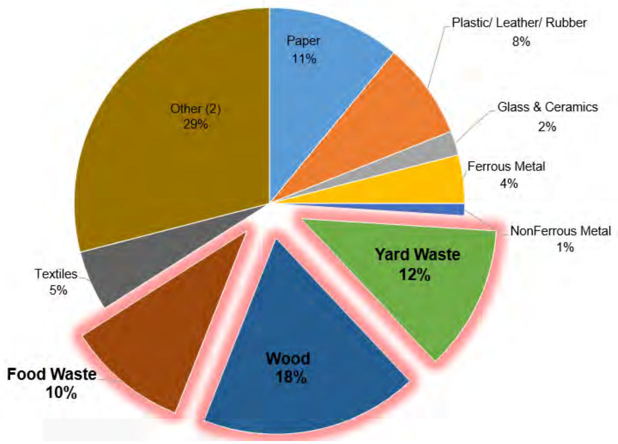
Materials processed (through multi-staged screens) to separate fiber, plastic, metal, glass containers, & small contaminants

- Approximately 6-12 facilities in operation.
- Handles entire waste stream.
- Can process up to 1,500 tpd.
- Requires capital equipment to operate.
- Equipment and manual labor used to sort materials.



Aerobic Composting Including Food Waste

- Ideally suited to process mixed green waste and yard waste.
- If an effective food waste collection system is developed, diversion can be increased further.
- Larimer County's total organics (yard waste, wood, food waste) is about 40% of the waste stream.
- Creates useable compost and increases diversion rates.



Anaerobic Digestion

Anaerobic digestion is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen. One of the end products is biogas, which is combusted to generate electricity and heat, or can be processed into renewable natural gas and transportation fuels.

- About 5 facilities operating.
- Can treat only the organic portion of MSW.
- Has a processing capacity of up to 300 tpd.
- Diverts materials from landfilling.

Refuse Derived Fuel (RDF) Processing

An RDF processing system prepares MSW by using separating, shredding, screening, air classifying and other equipment to produce a fuel product, such as coarse shred, fluff or pellets for thermal processing that requires a feedstock.

- 20-30 RDF Facilities operating.
- Has a facility life of 20-30 years.
- Has a processing capacity of 1,000 tpd.
- Diverts materials from landfilling.

Technologies Ruled Out

To meet the need of a solution after about 2025 for disposal for Larimer County, a developed technology is necessary. The technologies which are the least developed and therefore not recommended for further consideration include:

- Plasma Arc Gasification
- Pyrolysis
- Waste to Fuels
- Hydrolysis
- Catalytic and Thermal Depolymerization
- Autoclaving
- Gasification
- Mechanical Biological Treatment

Selected Infrastructure Options for Evaluation

- Status Quo
- Central Transfer Station
- New County Landfill
- Material Recovery Facility (Clean)
- Yard Waste Organics Processing Facility
- C&D Processing Facility
- Energy from Waste Facility (Direct Combustion)
- Mixed Waste Processing (Dirty MRF)
- Aerobic Composting Including Food Waste
- Anaerobic Digestion
- Refuse Derived Fuel (RDF) Processing

Successful Waste Management Practices

Simcoe Co, Canada	Lancaster County, Pennsylvania	Monterey, California	Yakima County, Washington	Wake County, North Carolina
Landfill	Landfill	Landfill	Landfill	Landfill
Transfer Station	Transfer Station	-	Transfer Station	Transfer Station
MRF	MRF	MRF	MRF	MRF
Compost	-	Compost	Compost	Compost
Anaerobic Digestion	-	Anaerobic Digestion	-	LFGTE
LFGTE	-	LFGTE	-	-
-	EFW	-	-	-
-	C&D Recycling	-	-	-
0.5 tn/capita	0.61 tn/capita	0.85 tn/capita	0.96 tn/capita	1.0 tn/capita

Larimer Co. – 1.4 tn/capita

Stakeholder Feedback

Stakeholder Feedback: Question 1

1. Do the infrastructure technologies presented contribute to achieving the Goals & Objectives reviewed in the first Stakeholder meeting?

Stakeholder Feedback: Question 2

2. Have we identified all appropriate infrastructure technologies that relate to the North Front Range Wasteshed, before beginning the evaluation process?

Stakeholder Feedback: Question 3

3. Do the infrastructure technologies discussed today generally align with business and community expectations?

Next Steps

Stakeholder Meetings

- **Stakeholder Meeting #3**: August 2nd
  - Solid Waste Volumes & Finalizing Goals and Objectives
- **Stakeholder Meeting #4**: (Date TBD)
  - Sustainable Return on Investment
- **Stakeholder Meeting #5**: (Date TBD)
  - Economic & Market Analysis

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #3: Solid Waste Volumes

August 2, 2017

Today's Agenda

I. Welcome and Opening Remarks

II. Final Goals & Objectives

III. Solid Waste Volumes

IV. Population Zones

V. SROI - Infrastructure Options

VI. Stakeholder Feedback

VII. Next Steps

Final Goals & Objectives

Goal #1

ESTABLISH A COMPREHENSIVE, REGIONAL SOLID WASTE MATERIALS MANAGEMENT SYSTEM BY 2025 THAT IS IMPLEMENTED IN AN ECONOMICALLY, ENVIRONMENTALLY AND SOCIALLY SUSTAINABLE MANNER.

Objectives:

A. Upon completion of the Phase 2 Study in 2018, the Coalition has identified and documented specific options for programs and facilities, taking into consideration the balance between economic, environmental and social costs and benefits.

B. The proposed solid waste system addresses future customer service demands in the region over the next 40 years or more, and provides long-term funding to address capital and operating costs.

C. Coalition members are prepared to begin implementing programs and constructing facilities by January 2020.

Goal #2

CREATE A COMPREHENSIVE SOLID WASTE MATERIALS MANAGEMENT PLAN AND IMPLEMENT PROGRAMS AND FACILITIES THAT REFLECT THE NEEDS AND DESIRES OF USERS.

Objectives:

A. The development of programs and facilities shall take a comprehensive, systems-based approach for materials management to conserve resources, manage costs and minimize environmental impacts.

B. The next generation of materials management programs and facilities provides services at competitive rates that are in alignment with the solid waste industry in the US.

C. New programs and facilities result in the increasing application of proven, innovative technologies for reuse, recycling and disposal to substantially reduce the amount of material being landfilled.

D. New programs and facilities are convenient and accessible for citizens, customers, businesses and waste haulers in the Wasteshed.

Goal #3

DEVELOP A SET OF WASTE DIVERSION/REDUCTION GOALS THAT ARE ADOPTED AND IMPLEMENTED BY ALL JURISDICTIONS IN THE WASTESHED.

Objectives:

A. The Coalition establishes consistent definitions and methods for measuring solid waste diversion/reduction within the Wasteshed by the year 2019 that are supported by streamlined and consistent data.

B. Solid waste diversion/reduction measurements will be evaluated on a three-year recurring cycle beginning in 2020 to identify potential program adjustments.

C. Jurisdictions implement policy and regulatory measures to support waste reduction, reuse and recycling efforts, by the year 2024.

Goal #4

DEVELOP A STRONG PUBLIC EDUCATION AND OUTREACH PROGRAM THAT IS CONSISTENT THROUGHOUT THE WASTESHED.

Objectives:

A. Public education and outreach programs convey a clear, consistent message and effectively influence the behavior of citizens regarding the reduction, reuse and recycling of materials that would otherwise be destined for disposal.

B. Public education materials convey shared guidelines for recycling and other information on reuse and reduction within all jurisdictions.

C. Municipal and solid waste representatives meet on a routine basis to coordinate solid waste educational programs and outreach efforts and to resolve any questions about recycling guidelines.

Solid Waste Volumes

Solid Waste Volumes

- **Purpose**
  - Quantify volumes of waste generated in the Wasteshed.
  - Quantify types of waste generated in the Wasteshed.
  - Develop annual per capita waste generation rates (in tons) for:
    - Solid Waste (MSW)
    - Recyclables
    - C & D Waste
    - Yard Waste
  - Assist the Wasteshed to plan for future waste handling and recycling infrastructure due to closure of the Larimer County Landfill.

Detailed Solid Waste Volumes

Solid Waste (In Tons)

	2014	2015	2016
LOVELAND	33,780	32,896	35,105
FORT COLLINS	39,157	50,586	57,198
ESTES PARK	10,267	12,161	14,483
BERTHOUD[1]	301	338	317
RED FEATHER[1]	45	52	51
WELLINGTON[1]	199	188	158
OUT OF COUNTY	10,912	13,691	11,203
SELF-HAUL	22,055	26,026	27,554
OTHER[2]	31,547	23,721	14,213
ALL OTHER SOURCES	62,806	62,560	56,029
SUBTOTAL	**211,069**	**222,219**	**216,311**

1 – Denotes Convenience Center
2 – Includes animal carcasses, tires, non-friable asbestos

Detailed Solid Waste Volumes

C & D (In Tons)

	2014 [1,2]	2015 [2]	2016
LOVELAND	12,631	14,632	14,676
FORT COLLINS	23,130	33,886	38,850
CONSTRUCTION FILL	13,421	17,324	16,301
ALL OTHER SOURCES	105,822	72,331	49,341
SUBTOTAL	**155,004**	**138,173**	**119,168**

[1] - 2014 Includes Flood Disaster Debris
[2] - 2014 & 2015 Include Mall Demolition Debris

Detailed Solid Waste Volumes cont.

Yardwaste (In Tons)

	2014	2015	2016
LARIMER COUNTY LANDFILL	16,053	14,646	15,257
SUBTOTAL	**16,053**	**14,646**	**15,257**

Total Tons Disposed – Larimer County Landfill

	2014	2015	2016
TOTAL DISPOSED – LARIMER COUNTY LANDFILL	**382,126**	**375,038**	**350,736**

Detailed Solid Waste Volumes

Recyclables (In Tons)

	2014	2015	2016
LOVELAND	12,293	11,006	10,786
FORT COLLINS	17,412	15,715	16,189
ESTES PARK	489	941	887
LARIMER CONVENIENCE CENTERS[1]	673	682	791
ALL OTHER SOURCES	8,857	11,244	10,342
SUBTOTAL	**39,724**	**39,588**	**38,995**
TOTAL RECYCLED – LARIMER COUNTY RECYCLING FACILITY	**39,724**	**39,588**	**38,995**

Detailed Solid Waste Volumes

Total Materials to Larimer County Facilities (In Tons)

	2014	2015	2016
TOTAL **DISPOSED** – LARIMER COUNTY LANDFILL	382,126	376,038	350,736
TOTAL **RECYCLYED** – LARIMER COUNTY RECYCLING FACILITY	39,724	39,588	38,995
TOTAL MATERIALS TO LARIMER COUNTY FACILITIES	**421,850**	**414,626**	**389,731**

Waste to Other Facilities

Waste to Other Facilities

Waste to Other Facilities (In Tons)

		2014	2015	2016
SOLID WASTE	Loveland	4,506	4,748	5,605
	Fort Collins	47,859	39,747	35,058
	SUBTOTAL	52,365	44,495	40,663
C & D	Loveland	3,390	3,390	4,243
	Fort Collins	28,270	26,609	23,812
	SUBTOTAL	31,660	29,999	28,055
Total Disposed To Other		**84,025**	**74,494**	**68,718**

Waste to Other Facilities

Waste to Other Facilities (In Tons)

		2014	2015	2016
YARDWASTE	Loveland	18,960	26,374	26,275
	Fort Collins	15,429	16,198	16,601
	SUBTOTAL	34,389	42,572	42,876
RECYCLABLES	Loveland[1]	784	783	969
	Fort Collins[2]	197,556	134,691	98,130
	SUBTOTAL	198,340	135,474	99,099
Total Disposed To Other		**232,729**	**178,046**	**141,975**
TOTAL MATERIALS TO OTHER FACILITIES		**316,754**	**252,540**	**210,693**

1 – includes scrap metal and e-waste
2 – Includes scrap metal, concrete, asphalt, and other recyclables

Wasteshed Tons Managed

Wasteshed Tons Managed

Total Wasteshed Tons Managed

		2014	2015	2016
SOLID WASTE	Larimer County Landfill	211,069	222,219	216,311
	Other Landfills	52,365	44,495	40,663
	SUBTOTAL	**263,434**	**266,714**	**256,974**
C & D	Larimer County Landfill	155,004	138,173	119,168
	Other Facilities	31,660	29,999	28,055
	SUBTOTAL	**186,664**	**168,172**	**147,223**
YARDWASTE	Larimer County Landfill	16,053	14,646	15,257
	Other Facilities - Recycled	34,389	42,572	42,876
	SUBTOTAL	**50,442**	**57,218**	**58,133**
RECYCLABLES	Larimer County Recycling Facility	39,724	39,588	38,995
	Other Facilities	232,729	178,046	141,975
	SUBTOTAL	**272,453**	**217,634**	**180,970**
Total Disposed & Recycled		**772,993**	**709,738**	**643,300**

Per Capita Waste Generation

Per Capita Waste Generation

Annual Per Capita Waste Generation

(In Tons Per Person Per Year)

	2014	2015	2016	3 YEAR AVERAGE	STATE OF WASHINGTON	STATE OF COLORADO
POPULATION	324,657	333,577	339,993	332,742	6,968,170	5,540,000
SOLID WASTE	.81	.80	.76	.79	1.01	1.42
C&D	.56	.51	.43	.50	0.37	N/A
YARD WASTE	.16	.17	.17	.17	N/A	N/A
RECYCLABLES	.84	.65	.53	.67	1.11	.33
Total Annual Per Capita Generation Rate (In Tons)	**2.37**	**2.13**	**1.89**	**2.13**	**2.49**	**1.75**
Total Annual Per Capita Disposal Rate (In Tons)	**1.53**	**1.48**	**1.36**	**1.46**	**1.38**	**1.42**

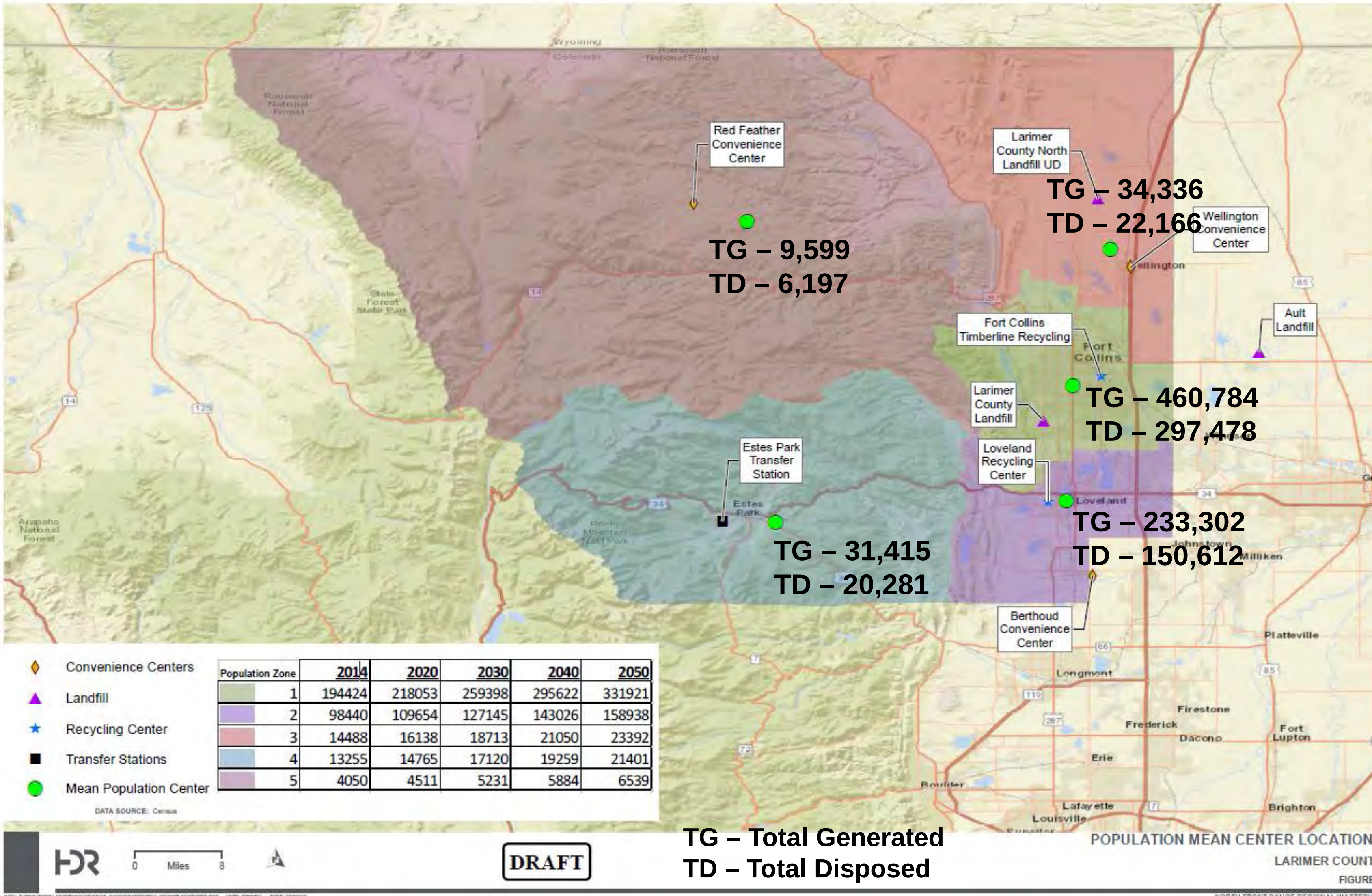
Tabletop Discussion 1

Tabletop Discussion 1

- Have all waste streams been adequately considered based on the information presented?
  - If not, what additional waste streams do you feel are missing?

Population Zones

MAP



Population Zone	2014	2020	2030	2040	2050
1	194424	218053	259398	295622	331921
2	98440	109654	127145	143026	158938
3	14488	16138	18713	21050	23392
4	13255	14765	17120	19259	21401
5	4050	4511	5231	5884	6539

Waste Per Capita 2014

ZONE 1

Solid Waste:	157,483
C&D:	108,877
Yardwaste:	31,108
Recyclables:	163,316
Total generated:	460,784
Total disposed:	297,468

ZONE 2

Solid Waste:	79,736
C&D:	55,126
Yardwaste:	15,750
Recyclables:	82,690
Total generated:	233,302
Total disposed:	150,612

ZONE 3

Solid Waste:	11,735
C&D:	8,113
Yardwaste:	2,318
Recyclables:	12,170
Total generated:	34,336
Total disposed:	22,166

ZONE 4

Solid Waste:	10,737
C&D:	7,423
Yardwaste:	2,121
Recyclables:	11,134
Total generated:	31,415
Total disposed:	20,281

ZONE 5

Solid Waste:	3,281
C&D:	2,268
Yardwaste:	648
Recyclables:	3,402
Total generated:	9,599
Total disposed:	6,197

TOTAL ALL ZONES

Solid Waste:	262,972
C&D:	181,807
Yardwaste:	51,945
Recyclables:	272,712
Total generated:	769,436
Total disposed:	497,724

Estimated Waste Per Capita by 2050

	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	TOTAL ALL ZONES
Solid Waste:	262,218	125,561	18,480	16,907	5,166	428,332
C&D:	165,961	79,469	11,696	10,701	3,270	271,097
Yardwaste:	56,427	27,019	3,977	3,638	1,111	92,172
Recyclables:	222,387	106,488	15,673	14,339	4,381	363,268
Total generated:	706,993	338,537	49,826	45,585	13,928	1,154,869
Total disposed:	484,606	232,049	34,153	31,246	9,547	791,601

Tabletop Discussion 2

Tabletop Discussion 2

- Do the Population Zones presented adequately address future system demands over the next 40 years?
  - Are there any revisions to the Population Zones that need to be considered?

SROI – Infrastructure Options

SROI - Infrastructure Options

- **Infrastructure Options:**
  - Status Quo
  - Central Transfer Station
  - New County Landfill
  - Material Recovery Facility (Clean)
  - Yard Waste Organics Processing Facility
  - C&D Processing Facility
  - Energy from Waste Facility (Direct Combustion)

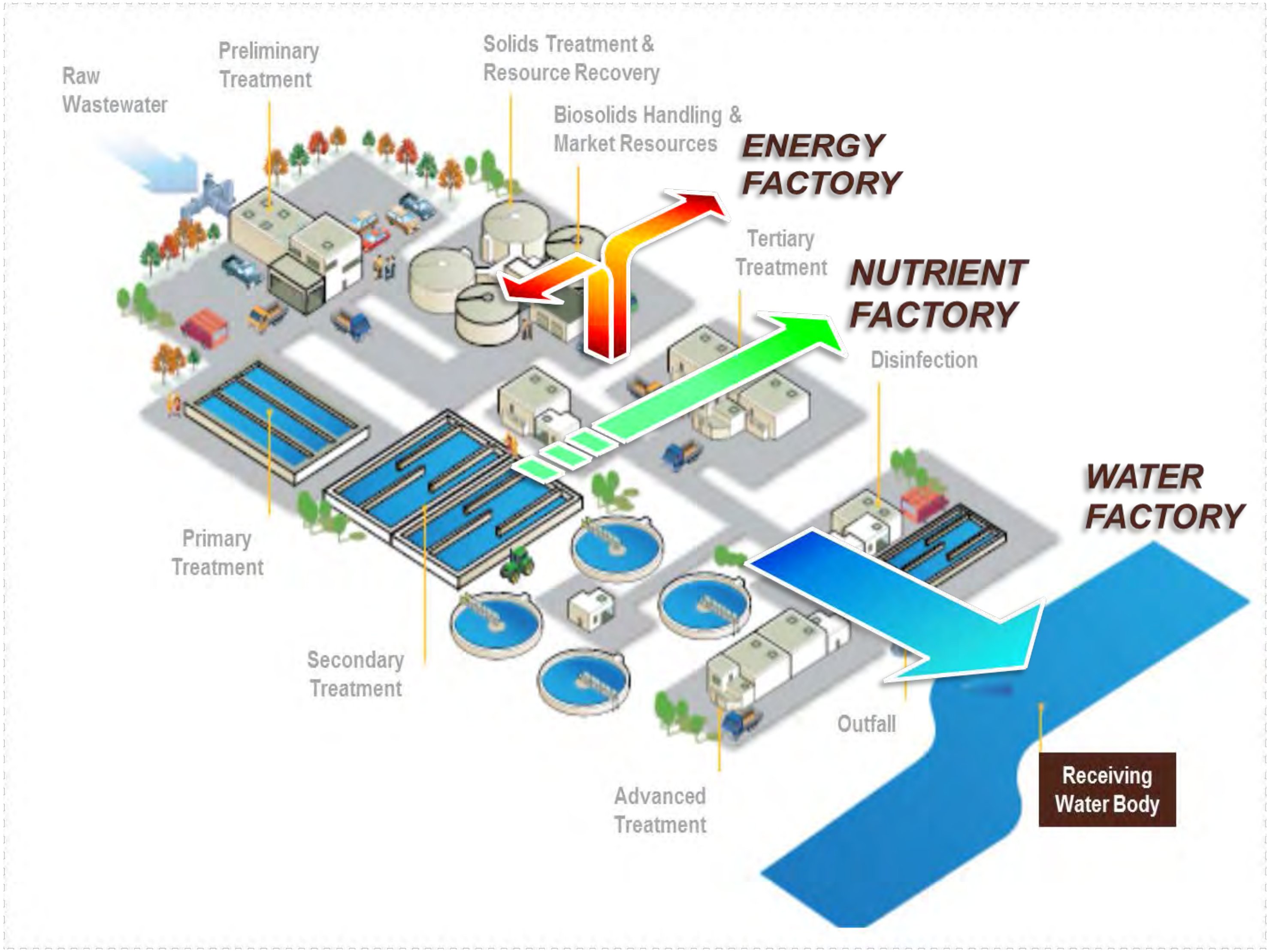
- **4 Additional Emerging Technologies:**
  - Mixed Waste Processing (Dirty MRF)
  - Aerobic Composting Including Food Waste
  - Anaerobic Digestion
  - Refuse Derived Fuel (RDF) Processing

Additional Evaluation

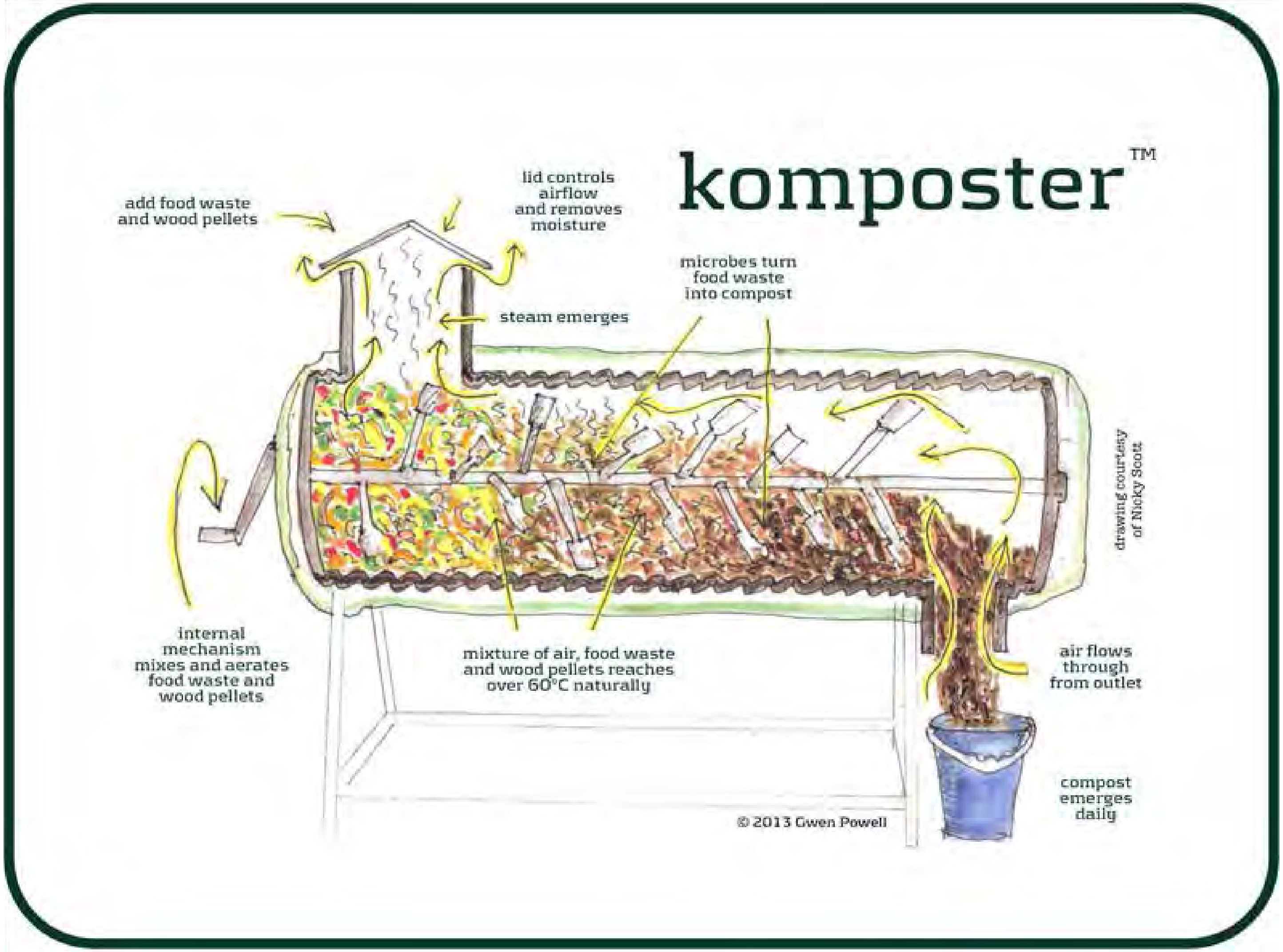
- Anaerobic Digestion at Wastewater Treatment Plants (WWTP)
  - Drake WWTP Project
  - Other WWTP
- Small Scale In-Vessel Aerobic Composting

WWTP Anaerobic Digestor

WWTP Anaerobic Digestor



In-Vessel Aerobic Composter



In-Vessel Aerobic Composter

Stakeholder Feedback – Clicker Questions

Next Steps

Stakeholder Meetings

- **Stakeholder Meeting #4**: Date TBD (Early October)
  - Sustainable Return on Investment
- **Stakeholder Meeting #5**: Date TBD
  - Economic & Market Analysis

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #4:

Sustainable Return on Investment (SROI)

October 25, 2017

Today’s Agenda

I. Welcome and Opening Remarks

II. SROI Update – Central Transfer Station

III. Single Stream Recycling Market Update

IV. Waste Characterization Study

V. Waste Stream Volumes

VI. Infrastructure Options

VII. Potential Costs for Operation

VIII. Stakeholder Feedback

IX. Next Steps

LARIMER COUNTY
COMMITTED TO EXCELLENCE

City of Fort Collins

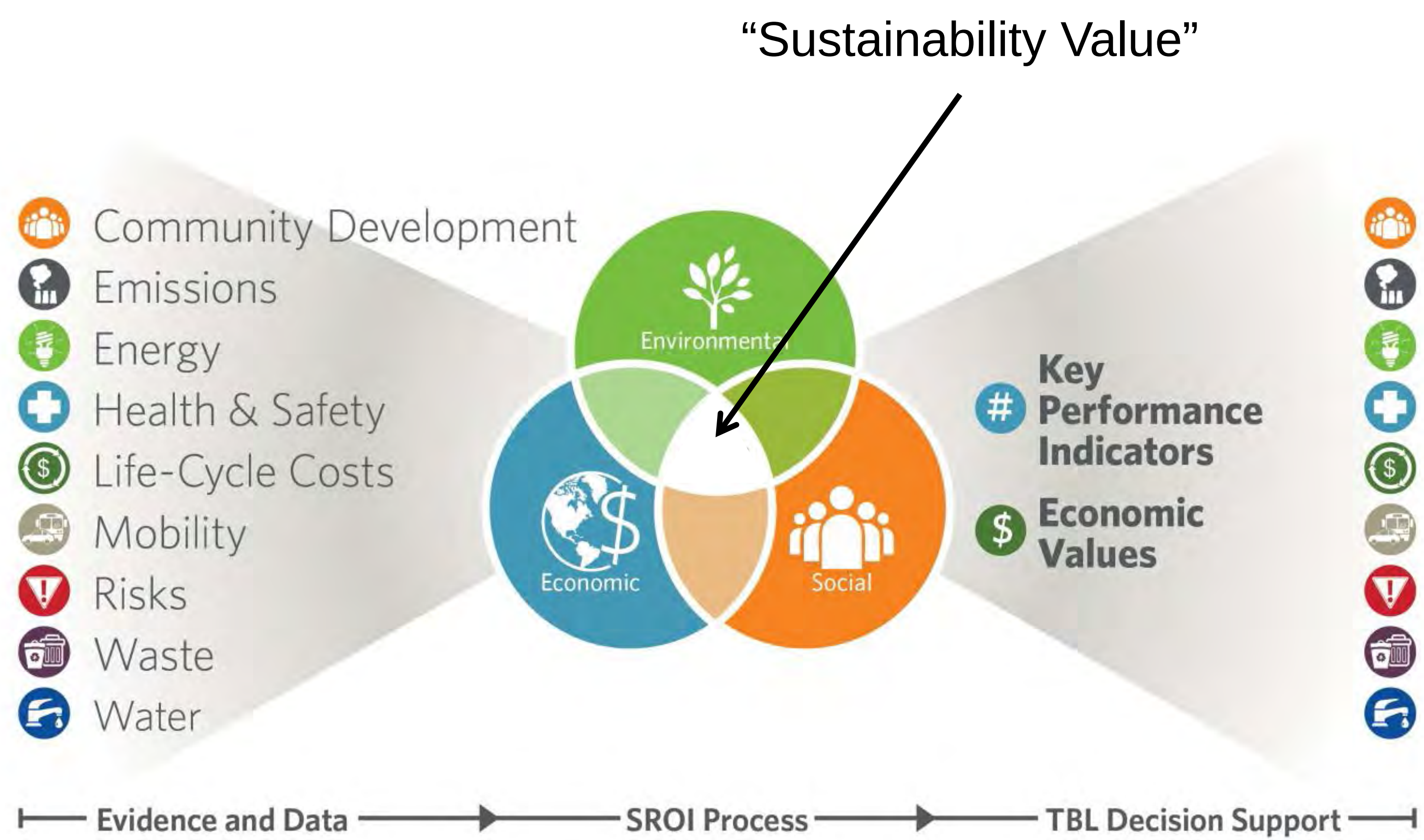
City of Loveland

EP

Sustainable Return on Investment (SROI)

Central Transfer Station

HDR's Sustainability Value Assessment (SVA) Services - *A Better Approach*



SROI Process

Step 1: Identify Impacts

- Collect information about program and key drivers
- Establish framework for estimation
- Identify areas of uncertainty

Step 2: Convene Workshop

- Review "Structure and Logic Diagrams"
- Discuss additional sources of data
- Seek buy-in on methods and output metrics

Step 3: Develop Model

- Create spreadsheet demonstration tool
- Model scenarios
- Analyze model sensitivity

Step 4: Produce Results

- Summarize findings
- Develop documentation on results

SROI – Potential Impacts Categories

Lifecycle Costs	**Environment**	**Social**	**Economic**
Capital	Environmental Impact	Accident Reduction	Tipping Fee Revenue
Operations & Maintenance	Energy Efficiency	Congestion Reduction	Pavement Cost Reduction
			Property Value Impact
			Infrastructure Residual Value

Sustainable Value

SROI Inputs – Central Transfer Station

- **General Assumptions:**
  - 25 Year Analysis
  - 4% Discount Rate
  - Landfill Closure in 2025
- **Waste Tonnage:**
  - 170K (in 2017); 202K (in 2025); 275K (in 2050)
- **Facility Operations:**
  - Landfill Energy Demand – 106k kWh/year
  - Transfer Station Energy Demand – 188k kWh/year
  - 0% Energy Demand Growth
  - $0.10 per kWh
- **Truck Operations:**
  - 55 Trucks per day
  - 489 “Mom & Pop” Customers per day
  - 15 Mile Avg. Haul Distance to Landfill
  - 50 Mile Avg. Haul Distance to Alt. Landfill
  - 12 tons/truck (garbage); 25 tons/truck (transfer)
- **Costs:**
  - $14.3m Capital Costs
  - $1.5m O&M Costs
  - $2.0m Annual Transfer Haul Costs
  - $5.3m Annual Disposal Costs

SROI Inputs (cont.) – Central Transfer Station

- **Pavement Maintenance Impacts:**
  - Marginal Pavement Cost per Mile ($/mile) – FHWA
- **Fuel Costs:**
  - Diesel miles per gallon (mile/gal)
  - Diesel price per gallon ($/gal) – AAA
- **Congestion Impacts:**
  - Marginal Congestion Costs per Mile ($/mile) - FHWA
  - Value of Time ($) – USDOT
- **Property Value:**
  - Avg. square foot by use (sf)
  - Value per square foot ($/sf)
- **Vehicle Emissions:**
  - Vehicle Emissions Rates for Larimer Cty., CO (g/mile) - MOVES
    - SO2, NOX, PM, VOC, CO2
  - Emissions Costs ($/ton) – NHTSA
    - SO2, NOX, PM, VOC, CO2
  - Grams to tons conversion (g/ton)
- **Facility Emissions/Energy:**
  - Emissions Rates for Colorado (tons/kWh) - eGrid
  - Energy Demand (kWh/year)
  - Emissions Costs ($/ton)

SROI Results – Central Transfer Station

Lifecycle Costs	Environment	Social	Economic
Capital Total Impact: $14.3m Present Value: $10.5m	**Environmental Impact** Total Impact: $2.0m Present Value: $1.0m	**Accident Reduction** Total Impact: $64.0m Present Value: $29.0m	**Tipping Fee** Total Impact: $257.9m Present Value: $117.3m
Capital Improvements Total Impact: $3.5m Present Value: $1.4m	**Energy Efficiency** Total Impact: $0 Present Value: $0	**Congestion Reduction** Total Impact: $10.0m Present Value: $4.5m	**Pavement Cost Impact** Total Impact: $0.07m Present Value: $0.05m
O&M Total Impact: $229.9m Present Value: $107.4m			**Property Value Impact** Total Impact: $0 Present Value: $0
			Infrastructure Residual Value Total Impact: $2.5m Present Value: $0.7m

Total Costs

Total Impact: $247.7m
Present Value: **$119.3m**

Total Benefits

Total Impact: $336.7m
Present Value: **$152.2m**

Total Benefits / Total Costs

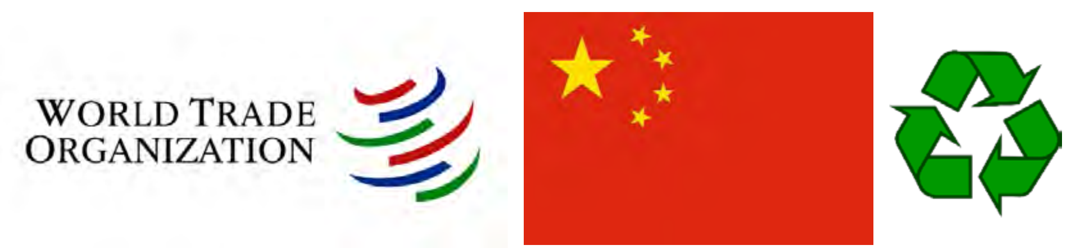
$152.2m / $119.3m = 1.276

Single Stream Recycling Market Update

Single Stream Recycling Market Update

- July 2017, China notified WTO of it's intent to:
  - Prohibit the import of certain solid wastes and scrap into their country
    - including mixed paper and mixed plastics
  - Introduce a new contamination standard applicable to recyclable imports
    - 0.3 percent
  - Beginning on January 1, 2018

- If adopted:
  - Will effectively result in a ban on the importation of virtually all waste and scrap commodities
  - China provides the largest export market for recyclables generated in US
    - 13m tons of paper and 776m tons of plastic
  - Could adversely affect municipal recycling programs through the country



China is the largest export market for recyclables generated in the United States

Industry / Community Recommendations

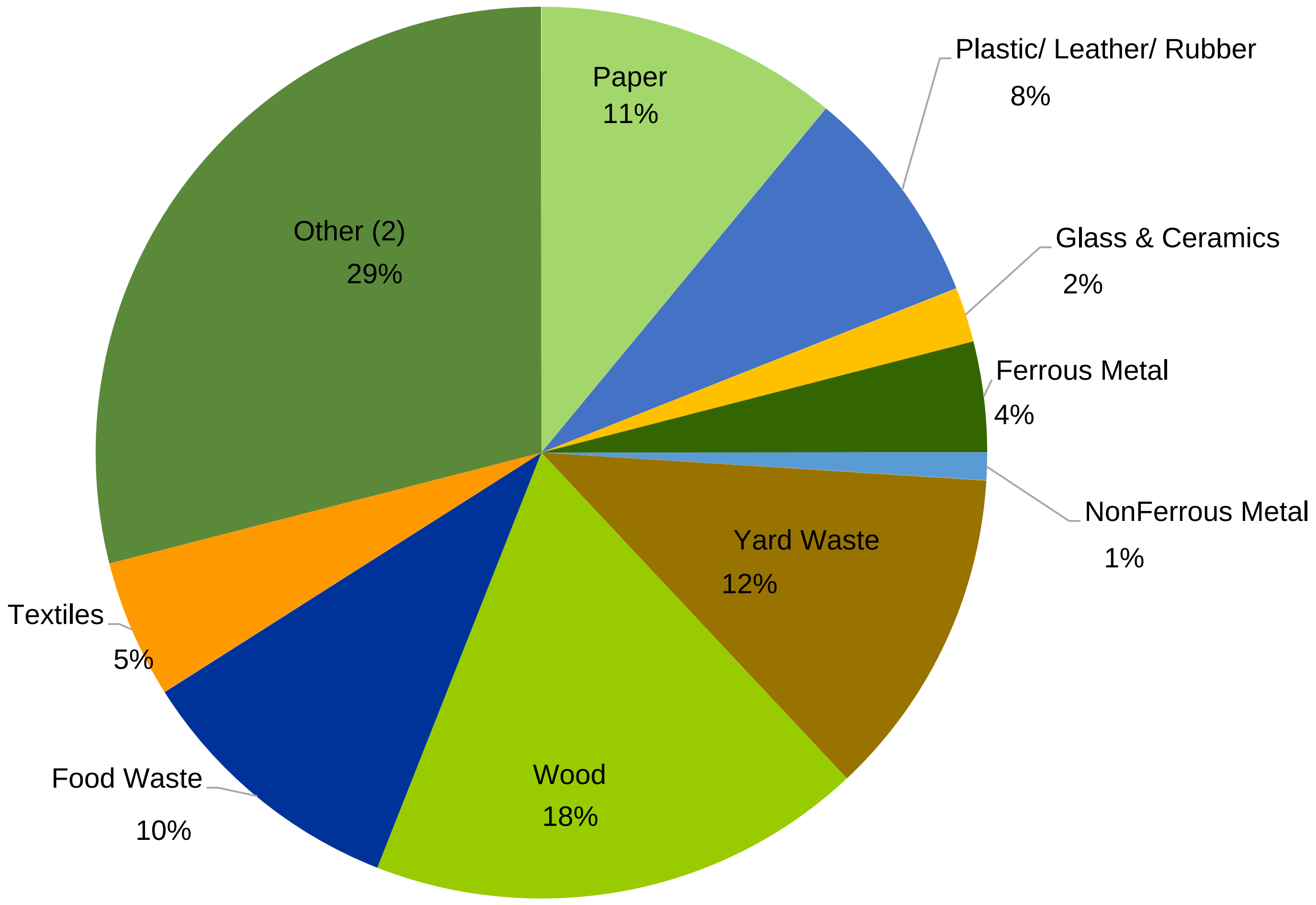
- Strengthen partnerships that focus on cleaning up the recycling steam
- Build and reinforce strong community-MRF relationships
- Stay the course and educate residents
- Focus on the positive and accurate message that recycling is a valued service that is here to stay

Source: The Recycling Partnership

Waste Composition & Characterization Analysis

Larimer Co. 2016 Waste Composition & Characterization Analysis

Percent by Weight, All Wastes Delivered to Landfill (Other = construction and demolition debris and other materials)



Waste Stream Volumes

Detailed Solid Waste Volumes at the Larimer Co Landfill

(In Tons)

	2014	2015	2016
SOLID WASTE	211,069	222,219	216,311
CONSTRUCTION & DEMOLITION DEBRIS	155,004[1,2]	138,173[2]	119,168
YARD WASTE[3]	16,053	14,646	15,257
RESIDENTIAL & COMMERCIAL FOOD WASTE	~25,000	~25,000	~25,000

[1] – 2014 Includes Flood Disaster Debris
[2] – 2014 & 2015 Include Mall Demolition Debris
[3] – Includes only Larimer County landfill

Detailed Solid Waste Volumes

Recyclables (In Tons)

	2014	2015	2016
TOTAL RECYCLED – LARIMER COUNTY RECYCLING FACILITY	39,724	39,588	38,995

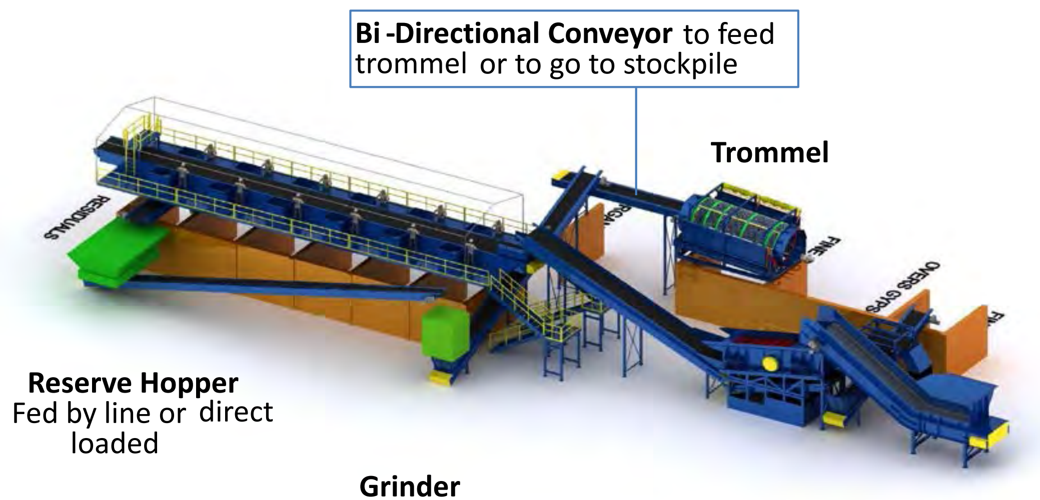
Infrastructure Options

C&D Processing Facility

» Processes materials from mixed loads of C&D debris for reuse, recycling, and/or composting.

» Extract wood, metal, wall board, concrete, fines debris, and other construction related material.

» Recovery of these materials can significantly increase the waste tonnage diverted.



Source Separated Organics

Open Wind-Row

Source Separated Organics

Static Aeration

Commercial Food Waste to WWTP

- Should commercial food waste be the targeted source for the Anaerobic Digestion option?
  - **Anaerobic digestion** is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen to create energy

Projected Operational Costs

Projected Operational Costs

Projected Operational Costs for Infrastructure Options
(Capital and O&M)

	Cost Per Ton
Existing Larimer County Landfill Disposal Costs	$22 / ton
Central Transfer Station	$41 / ton
C&D	$48 / ton - $55 / ton
Yard Waste Open Wind-Row Composting	$36 / ton - $42 / ton
Food Waste Static Aerated Bin Composting	$42 / ton - $46 / ton
Single Stream Recycling	$37 / ton – ↑↓

Residential Cost Per Household Impact

Preliminary Estimates from City of Loveland Solid Waste

» **Current monthly fee:**

- » 17-gallon cart: **$3.00** per mo.
- » 35-gallon cart: **$6.00** per mo.
- » 65-gallon cart: **$12.00** per mo.
- » 95-gallon cart: **$18.00** per mo.

» **Maximum monthly increase:**

- » **$3.35** per mo. (35¢ increase)
- » **$6.70** per mo. (70¢ increase)
- » **$13.40** per mo. ($1.40 increase)
- » **$20.10** per mo. ($2.10 increase)

11.7% Overall Increase

Stakeholder Considerations

Goals & Objectives

1. Establish a comprehensive, regional solid waste **materials management system** by 2025 that is implemented in an economically, environmentally and socially **sustainable** manner.

2. Create a comprehensive solid waste materials management plan and implement **programs and facilities** that reflect the needs and desires of users.

3. Develop a set of **waste diversion/reduction goals** that are adopted and implemented by all jurisdictions in the Wasteshed.

4. Develop a strong **public education** and outreach program that is consistent throughout the Wasteshed.

Process Controls & Ordinances
Examples for Discussion, Not Recommendations

- Flow control
  - Yakima County, Washington
    - All 14 municipalities required to direct MSW to county landfill stations
  - Okaloosa County, Florida
    - Enacted exclusive franchise for residential curb side waste & non-exclusive franchise for commercial collection
  - North Carolina Hauler Licensing Agreements
    - Contract is with county or municipality
    - May be exclusive or non-exclusive
  - San Jose, California
    - 2 Flow Control contracts - one for multi-family waste collection city-wide & second for commercial waste collection city-wide
    - Through agreement, funding became available to construct & operate a MRF
    - Agreement provides that organic waste stream is directed to local anaerobic digestion facility
- C&D recycling ordinances or disposal bans for specific waste materials
  - 16 C&D materials either banned from disposal or required to recycle in various states
  - 5 states currently ban the disposal of wall board
  - Several C&D municipal recycling ordinances in CA, CT, FL NC, & other states
- State food waste bans & city ordinances
  - 5 states (CA, CT, MA, RI, VT)
  - 6 cities (Austin, New York City, Portland, San Francisco, Seattle, Boulder)




Table-top Discussion

These proposed facilities are being considered in response to our final Goals & Objectives and this group's aim to increase diversion rates.

If these facilities are built, what are the best process controls/ordinances to secure the volumes required of these facilities to reprocess C&D, yard waste, and food waste?

Stakeholder Feedback – Clicker Questions

The SROI model is sound
and is inclusive of all potential impacts?

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

To what degree do you support the Coalition implementing process controls/ordinances for the handling of **construction & demolition** waste, in order to increase rates of diversion?

A. Strongly support
B. Support
C. Neutral
D. Do not support
E. Strongly oppose

To what degree do you support the Coalition implementing process controls/ordinances for the handling of **source-separated organics** (yard and food), in order to increase rates of diversion?

A. Strongly support
B. Support
C. Neutral
D. Do not support
E. Strongly oppose

Next Steps

Stakeholder Meetings

- Completion of SROI Process
- **Stakeholder Meeting #5**: Date TBD
  - Economic & Market Analysis

This page intentionally left blank.

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #5:

Infrastructure Option Analyses & Recommendations

January 31, 2018

Today's Agenda

I. Welcome and Opening Remarks

II. Overview of Eleven (11) Infrastructure Options for Consideration

III. Review Sustainable Return on Investment (SROI)

IV. Infrastructure Considerations Research and Analysis

V. TAC Recommendations

VI. Stakeholder Feedback & Recommendation

VII. Next Steps

Review of Infrastructure Options for Consideration

- Status Quo
- Central Transfer Station
- New County Landfill
- Material Recovery Facility (Clean)
- Yard Waste Organics Processing Facility
- C&D Processing Facility
- Energy from Waste Facility (Direct Combustion)
- Mixed Waste Processing (Dirty MRF)
- Aerobic Composting Including Food Waste
- Anaerobic Digestion
- Refuse Derived Fuel (RDF) Processing

Infrastructure Options for Consideration

Central Transfer Station

Energy From Waste Facility – Direct Combustion

Status Quo

NO ACTION IS TAKEN UPON CLOSURE OF LANDFILL

Materials Recovery Facility (Clean)

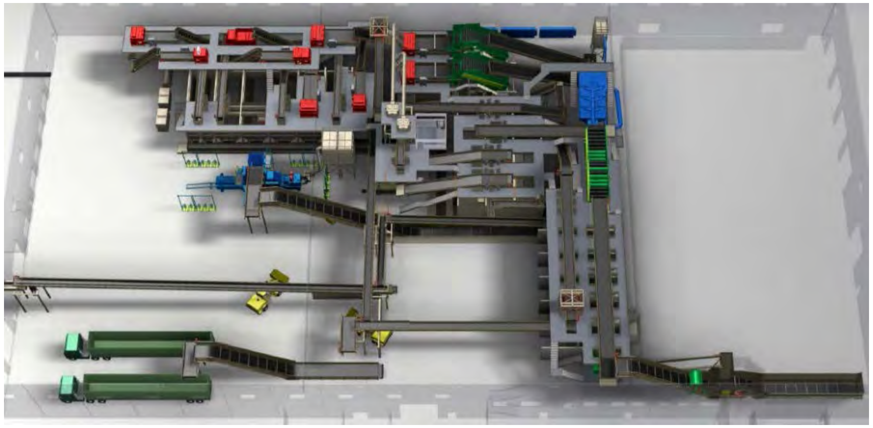
Yard Waste Organics Processing Facility

New County Landfill

Construction & Demolition (C&D)Processing Facility

Additional Emerging Technologies

Mixed Waste Processing – Dirty MRF



Anaerobic Digestion

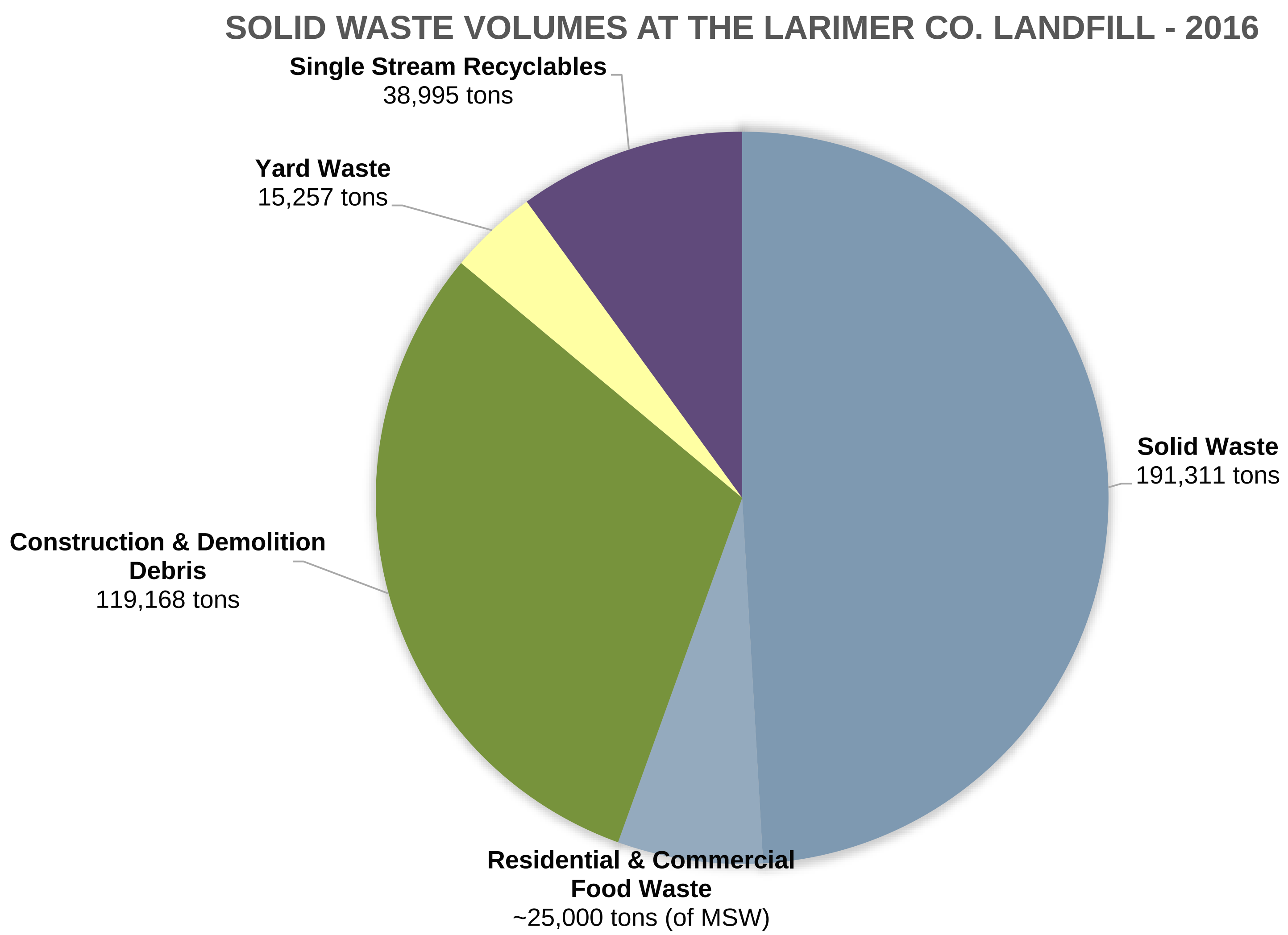
Aerobic Composting Including Food Waste

Refuse Derived Fuel (RDF) Processing

Goals Intended to Guide Evaluation and Decision Making Process

1. Establish regional materials **management system**
2. Implement **programs and facilities**
3. Develop waste diversion/reduction **goals** for all jurisdictions
4. Conduct strong, consistent **public education** and outreach

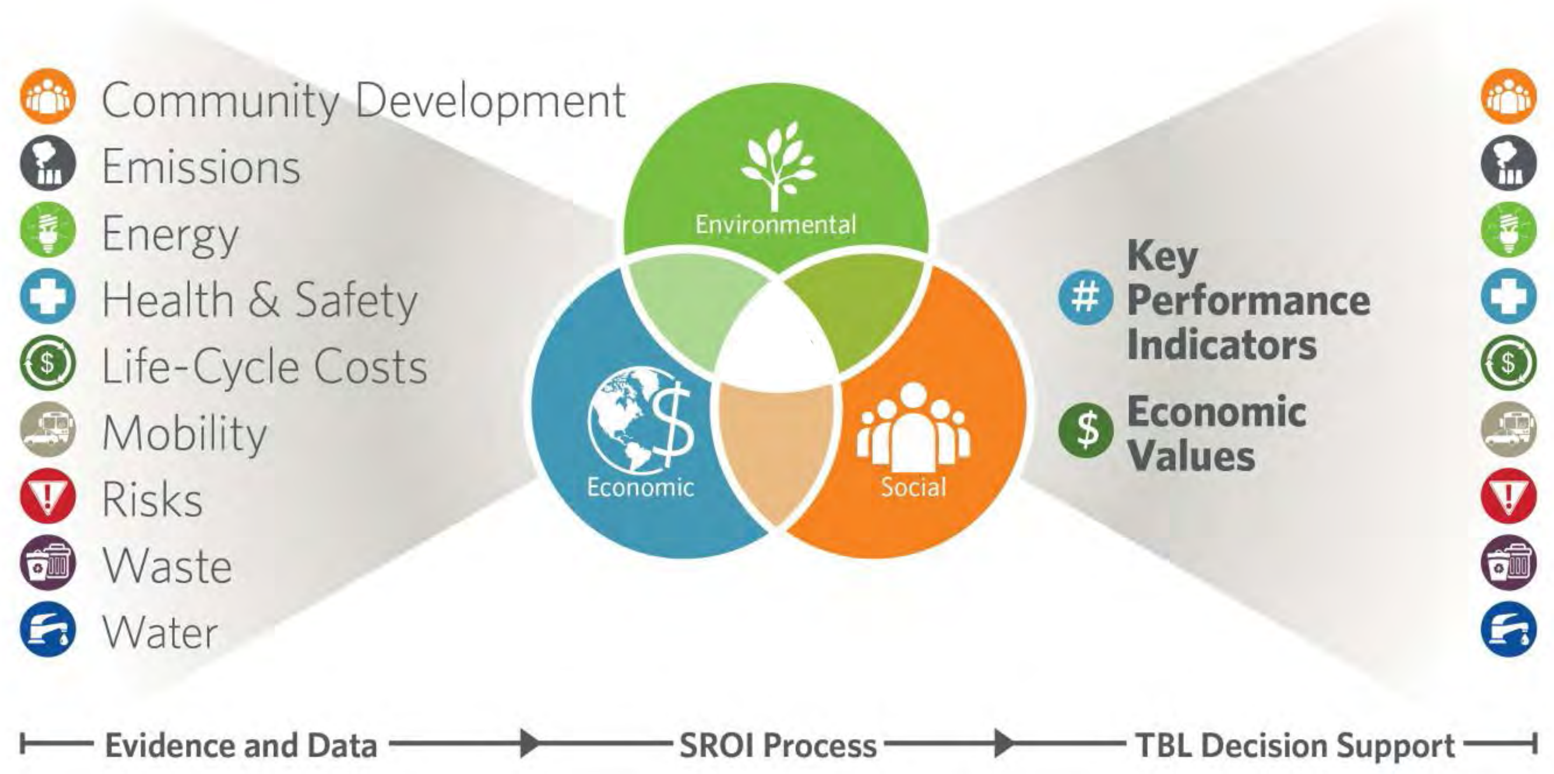
Review of Solid Waste Volumes at the Larimer Co Landfill



Review Sustainable Return on Investment (SROI) Results Process

HDR's Sustainability Value Assessment (SVA) Services - *A Better Approach*

"Sustainability Value"



Physical Impacts

Physical Impacts

$ Economic/Financial

__ **gallons of fuel** saved annually

___ **% change** in annual operating costs

___ **% change** in annual maintenance costs

___ **of additional people** employed (full-time equivalent)

Environmental

___ **fewer cars** on road, in a car equivalent reduction in GHG

___ **% change** in stormwater pollutant concentrations

___ **acres** of infill land development

___ **induced riders** who divert from autos

Community

___ **fewer people at risk** of air pollutant – related illnesses

___ **% change** in personal vehicle operating costs

__ **numbers** of properties with potential value growth

__ **fewer** traffic accidents

SROI – Potential Impacts Categories

Lifecycle Costs	**Environment**	**Social**	**Economic**
Capital	Environmental Impact	Accident Reduction	Tipping Fee Revenue
Operations & Maintenance	Energy Efficiency	Congestion Reduction	Pavement Cost Reduction
			Property Value Impact
			Infrastructure Residual Value

Sustainable Value

Infrastructure Considerations

& TAC Recommendations

Infrastructure Considerations - Base Information

	Cost per ton*	Benefit Cost Ratio	Capital Costs	Waste Volume Managed (%)
Central Transfer Station	$43 / Ton	1.11	$14.3M	100%
New County Landfill **(Accepting Transferred Materials Primarily)**	$25 / Ton	2.13	$11.7M (1st Phase)	100%
Yard Waste Open Windrow Composting	$31 / Ton - $35 / Ton	5.89	$10.6M	13%
Construction & Demolition (C&D) Processing	$35 / Ton	2.05	$13.7M	31%*
Food Waste Static Aerated Bin Composting	$36 / Ton - $43 / Ton	3.94	$10.6M	13%
Anaerobic Digestion (AD) / Preprocessing - WWTP	$77 / Ton - $82 / Ton	8.48	$11.9M	6%
Mixed Waste Processing – Dirty Material Recovery Facility (MRF)	$57 / Ton - $61 / Ton	0.75	$47.2M	56%*
Waste to Energy – Direct Combustion	$110 / Ton	0.47	$313.8M	56%
Refuse Derived Fuel (RDF) Processing	$126 / Ton	0.42	$322.9M	56%*
Clean MRF	($6) / Ton – ($12) / Ton	2.25	$23.7M	10%

* Cost per ton does not include general administrative costs
** Residual disposal required

ESTIMATED Residential Cost Per Household Impact (Example)

- **Current monthly fee:**
  - 17-gallon cart: **$3.25** per mo.
  - 35-gallon cart: **$6.50** per mo.
  - 65-gallon cart: **$13.00** per mo.
  - 95-gallon cart: **$19.50** per mo.

- **Maximum monthly increase:**
  - **$3.65** per mo. (40¢ increase)
  - **$7.25** per mo. (75¢ increase)
  - **$14.50** per mo. ($1.50 increase)
  - **$21.80** per mo. ($2.30 increase)

11.7% Overall Increase

Infrastructure Considerations - Capital Investment

	Cost per ton*	Benefit Cost Ratio	Capital Costs	Waste Volume Managed (%)
Central Transfer Station	$31 / Ton	1.11	$14.3M	100%
New County Landfill (Accepting Transferred Materials Primarily)	$17 / Ton	2.13	$11.7M (1st Phase)	100%
Yard Waste Open Wind-Row Composting	$27 / Ton - $28 / Ton	5.89	$10.6M	13%
Construction & Demolition (C&D) Processing	$30 / Ton	2.05	$13.7M	31%**
Food Waste Static Aerated Bin Composting	$33 / Ton - $38 / Ton	3.94	$10.6M	13%

* Cost per ton does not include general administrative costs

** Residual disposal required

ESTIMATED Residential Cost Per Household Impact (Example)

- **Current monthly fee:**
  - 17-gallon cart: **$3.25** per mo.
  - 35-gallon cart: **$6.50** per mo.
  - 65-gallon cart: **$13.00** per mo.
  - 95-gallon cart: **$19.50** per mo.

- **Maximum monthly increase:**
  - **$3.45** per mo. (20¢ increase)
  - **$6.90** per mo. (40¢ increase)
  - **$13.80** per mo. (80¢ increase)
  - **$20.10** per mo. ($1.20 increase)

6.2% Overall Increase

Tier Recommendations

TIER RECOMMENDATIONS	SROI CRITERIA BENEFIT / COST RATIO	POTENTIAL SCHEDULE[2]			
		Local Siting Approval	Permitting/Design	Construction	In Service
Tier 1[1]					
Central Transfer Station	1.11	2018	2020	2021	2022
New County Landfill	2.13	2018	2020	2022	2023
Yard Waste Open Windrow Composting	5.89	2018	2018	2020	2020
Construction & Demolition (C&D) Waste Processing	2.05	2019	2019	2022	2022
Food Waste Composting – Static Aerated Bin	3.94	2019	2021	2023	2024
Tier 2					
Clean Material Recovery Facility (MRF) /Upgrade	2.25	Assessed Annually Moving Forward			
Anaerobic Digestion (AD) /Pre-Processing - WWTP	8.48				
Tier 3					
Waste to Energy (Direct Combustion)	0.47	2019 (Additional investigation)	2024	2026	2028
Refuse Derived Fuel (RDF) Processing	0.42	2019 (Additional investigation)	2024	2026	2028
Mixed Waste Processing - Dirty MRF	0.75	2019 (Additional investigation)	2022	2024	2025

1 – County Transfer Stations will remain in operation at Estes Park, Wellington, Berthoud, and Red Feather

2 – **Criteria includes:** Local Government Approval Including Zoning, Site Plans, Building Permits, and Special Use Permits; Preliminary Assessment; Engineering Design; CDPHE Permitting; Facility Construction; and Process Controls/Regulatory Requirements.

Tier 2 Work Plan

- Clean Material Recovery Facility
  - Researching contiguous markets for potential partnerships to gain much needed volume
  - Potential markets include Greeley, Wyoming, & Western Nebraska

2019 - 2030

- Anaerobic Digestion (AD) / Pre-Process WWTP
  - Hartland AD Facility, Anaerobic Digesters at Wastewater Treatment Plants
  - Collection, equipment capacities, and operational efficiencies of such facilities are key factors to be assessed regularly

Table-Top Discussion

When considering the criteria for each infrastructure option, how important are the benefit-cost ratios (social, economic, and environmental benefits) to you in assessing an infrastructure option versus cost, schedule, etc.?

Comprehensive Solid Waste System

New County Landfill

Yard Waste Organics Processing Facility

Construction & Demolition (C&D)Processing Facility

LARIMER COUNTY

City of Fort Collins

City of Loveland

EP

Central Transfer Station

Existing MRF Transfer

Aerobic Composting Including Food Waste

Stakeholder Engagement Highlights

MAY 2017	JUNE 2017	AUGUST 2017	OCTOBER 2017	JANUARY 2018
30 comments were provided, in addition to discussion, to **guide the confirmation** of the North Front Range Regional Wasteshed **final Goals & Objectives**	86% of stakeholders agreed that the **Coalition identified all appropriate infrastructure options** for review	95% of stakeholders agreed the **solid waste volume data** presented was detailed enough to **support the next phase** of the project	91% of stakeholders agreed they would **support the implementation of process controls/ordinances** for the handling of **construction & demolition waste** in order to increase rates of diversion 78% of stakeholders would **support process controls/ordinances for yard and food waste organics**	**Goal: Gain consensus to move forward with top five (5) infrastructure options as new solid waste facilities for our Wasteshed**

Table-Top Discussion

Do you support the TAC recommendation to proceed with Tier 1 options, and continue to investigate Tier 2 Options in the future, understanding that regulatory mechanisms may be needed and will be discussed at the final Stakeholder meeting?

Stakeholder Feedback

Stakeholder Feedback – Clicker Question

To what degree do you agree that the Coalition has worked to find the balance of reasonable infrastructure options that will serve the waste management needs of the Wasteshed while enhancing and improving diversion of waste?

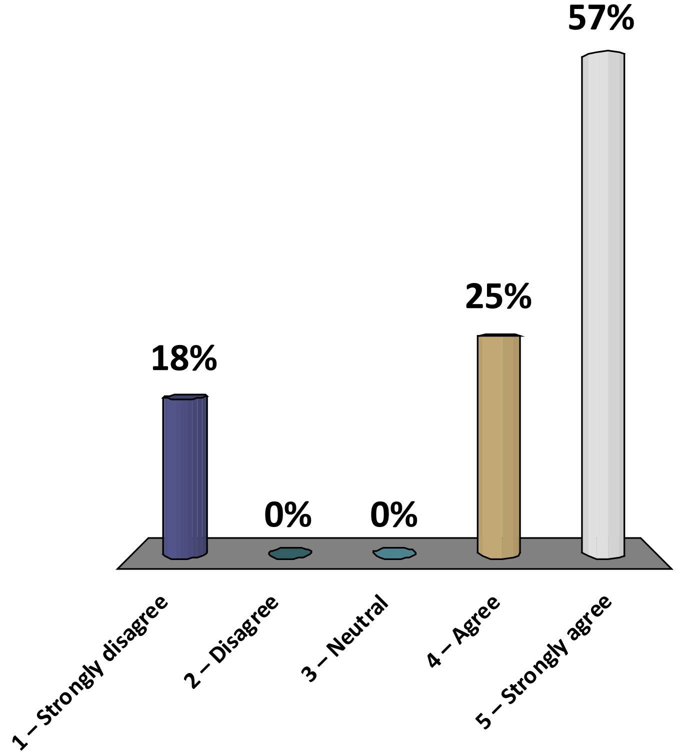
A. 1 – Strongly disagree

B. 2 – Disagree

C. 3 – Neutral

D. 4 – Agree

E. 5 – Strongly agree



Enter Question Text

To what degree do you support the infrastructure options identified as Tier 1 Recommendations?

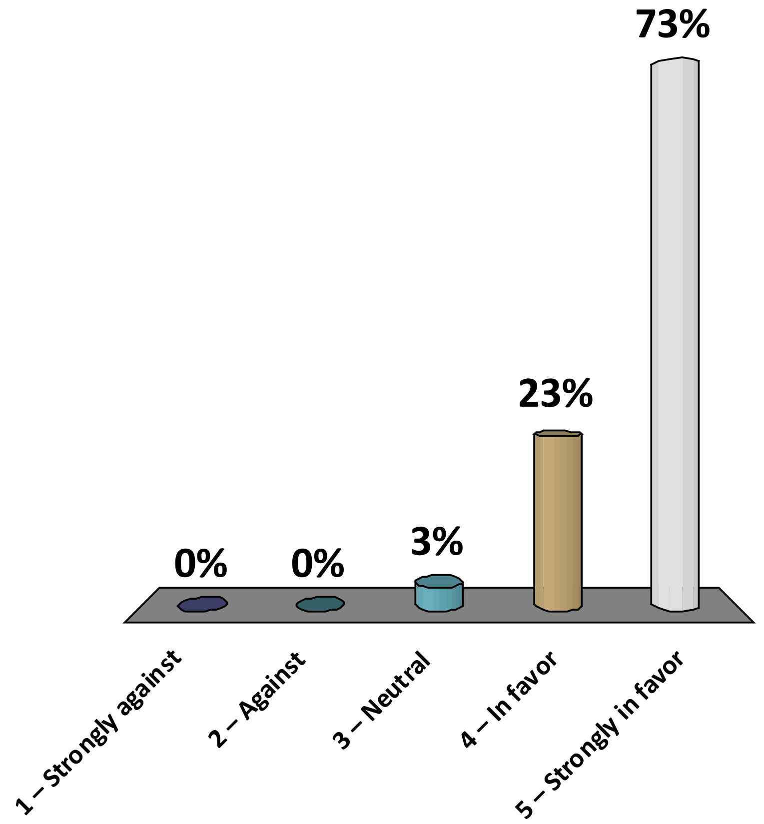
A. 1 – Strongly against

B. 2 – Against

C. 3 – Neutral

D. 4 – In favor

E. 5 – Strongly in favor



Next Steps

Stakeholder Meetings

- **Stakeholder Meeting #6**: Date TBD
  - Recommended Governmental Options for Each of the Final Infrastructure/ Solid Waste Facilities
  - Blended Infrastructure Options - SROI Results

This page intentionally left blank.

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #6:

Blended Options Analysis & Solid Waste Process Controls

March 21, 2018

Today's Agenda

I. Welcome and Opening Remarks

II. Tier 1 Infrastructure Options

III. Infrastructure Analysis Overview

IV. Blended Options and SROI Analysis

V. Recommended Solid Waste Process Controls

VI. Stakeholder Feedback & Recommendation

VII. Next Steps

LARIMER COUNTY

City of Fort Collins

City of Loveland

Tier 1 Infrastructure Options

Selected by TAC/PAC

New County Landfill

Yard Waste Organics Processing Facility

Construction & Demolition (C&D)Processing Facility

LARIMER COUNTY
City of Fort Collins
City of Loveland
EP

Existing MRF Transfer

Central Transfer Station

Aerobic Composting Including Food Waste

Tier 2 Work Plan

- » Clean Material Recovery Facility
  - » Researching contiguous markets for potential partnerships to gain much needed volume
  - » Potential markets include Greeley, Wyoming, & Western Nebraska

- » Anaerobic Digestion (AD) / Pre-Process WWTP
  - » Heartland AD Facility, Anaerobic Digesters at Wastewater Treatment Plants
  - » Collection, equipment capacities, and operational efficiencies of such facilities are key factors to be assessed regularly

2019 - 2030

Materials Recovery Facility (Clean)

Anaerobic Digestion at WWTP

Infrastructure Analysis Overview

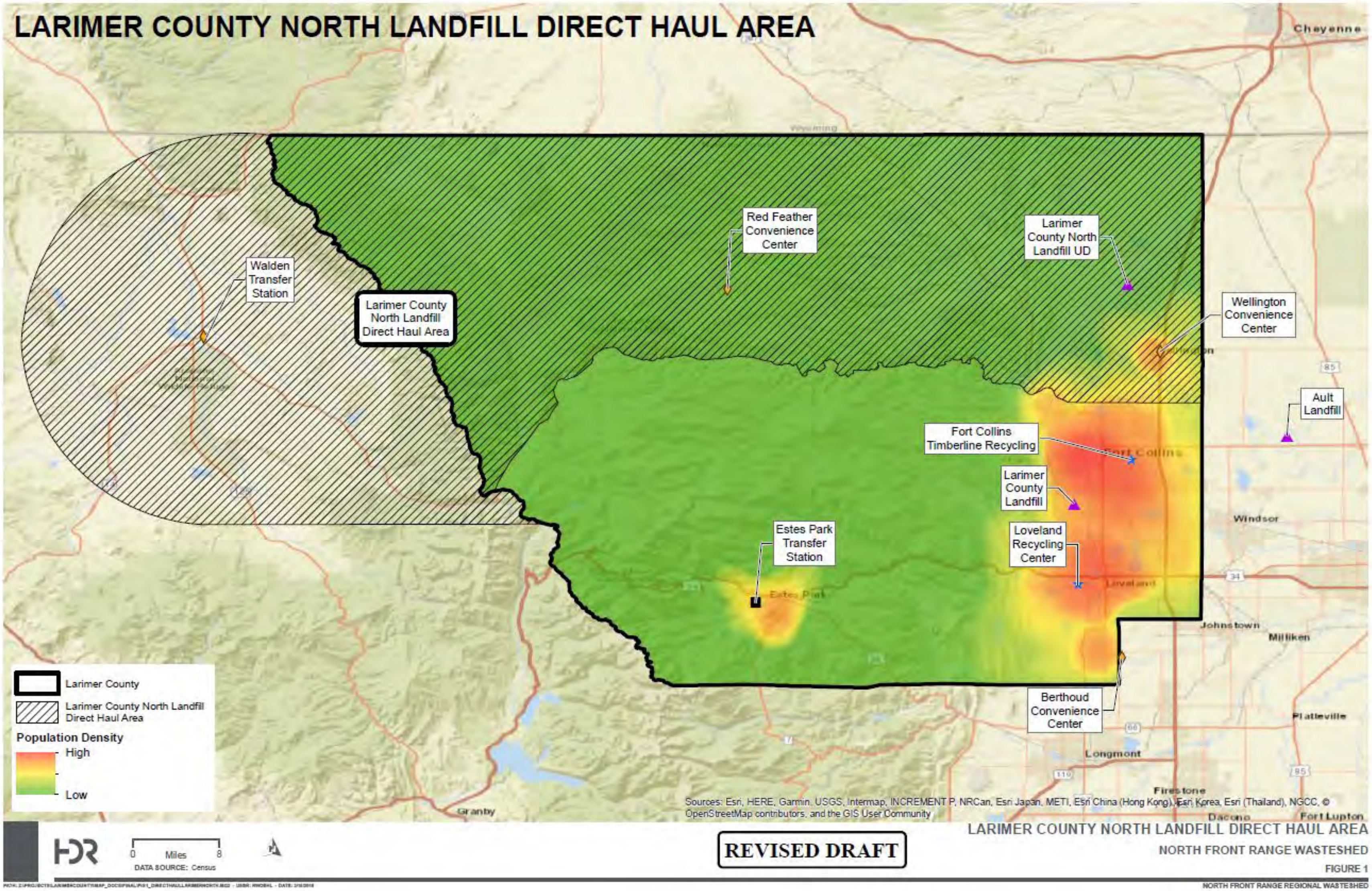
Infrastructure Considerations - Base Information

~$22/Ton
current fee

	Benefit Cost Ratio	Waste Volume Managed (%)	Cost per ton*	Capital Costs
Central Transfer Station	1.11	100%	$43 / Ton	$14.3M
New County Landfill (Transferred Materials/Direct Haul Zone)	2.13	100%	$25 / Ton	$11.7M (1st Phase)
Yard Waste Open Windrow Composting	5.89	13%	$31 / Ton - $35 / Ton	$10.6M
Construction & Demolition (C&D) Processing	2.05	31%*	$35 / Ton	$13.7M
Food Waste Static Aerated Bin Composting	3.94	13%	$36 / Ton - $43 / Ton	$10.6M

* Cost per ton does not include general administrative costs
** Residual disposal required

Direct Haul Map



TAC Tier 1 Recommendation - Capital Investment

	Capital Costs	Cost per ton*	Benefit Cost Ratio	Waste Volume Managed (%)
Central Transfer Station	$14.3M	$31 / Ton	1.11	100%
New Public Landfill *(Transferred Materials/Direct Haul Zone) *	$11.7M (1st Phase)	$17 / Ton	2.13	100%
Construction & Demolition (C&D) Processing	$13.7M	$30 / Ton	2.05	31%**
Yard Waste Open Wind-Row Composting	$10.6M	$27 / Ton - $28 / Ton	5.89	13%
Food Waste Static Aerated Bin Composting	$10.6M	$33 / Ton - $38 / Ton	3.94	13%

$22/Ton current tip fee
Bundled projects will lower CTS fee

* Cost per ton does not include general administrative costs
** Residual disposal required

Blended Options and SROI Analysis

Blended Scenario #1

No Solid Waste Process Control Assumptions Adopted

Estimated Costs

	Capital Costs (2017 $)	Tons Captured (2025)	Tipping Fee (2017 $)
New County Landfill	$11.7M (1st Phase) $11.7M (Equity) $0.0M Finance	276,100	$19.89 / Ton
Central Transfer Station	$15.8M $15.8M (Equity) $0.0M Finance	238,000	$41.39 / Ton

Blended Scenario #2

Solid Waste Process Control Assumptions Adopted

Estimated Costs

	Capital Costs (2017 $)	Tons Captured (2025)	Tipping Fee (2017 $)
New County Landfill	$11.7M (1st Phase) $11.7M (Equity) $0.0M Finance	344,800	$14.09 / Ton
Central Transfer Station	$15.8M $15.8M (Equity) $0.0M Finance	321,600	$29.29 / Ton
Construction & Demolition (C&D) Processing	$13.7M $13.7M (Equity) $0.0M Finance	150,000	$37.17 / Ton
Yard Waste & Food Waste Composting	$11.8M $0.0M (Equity) $11.8M Finance	72,200	$37.92 / Ton

Blended Scenario #3

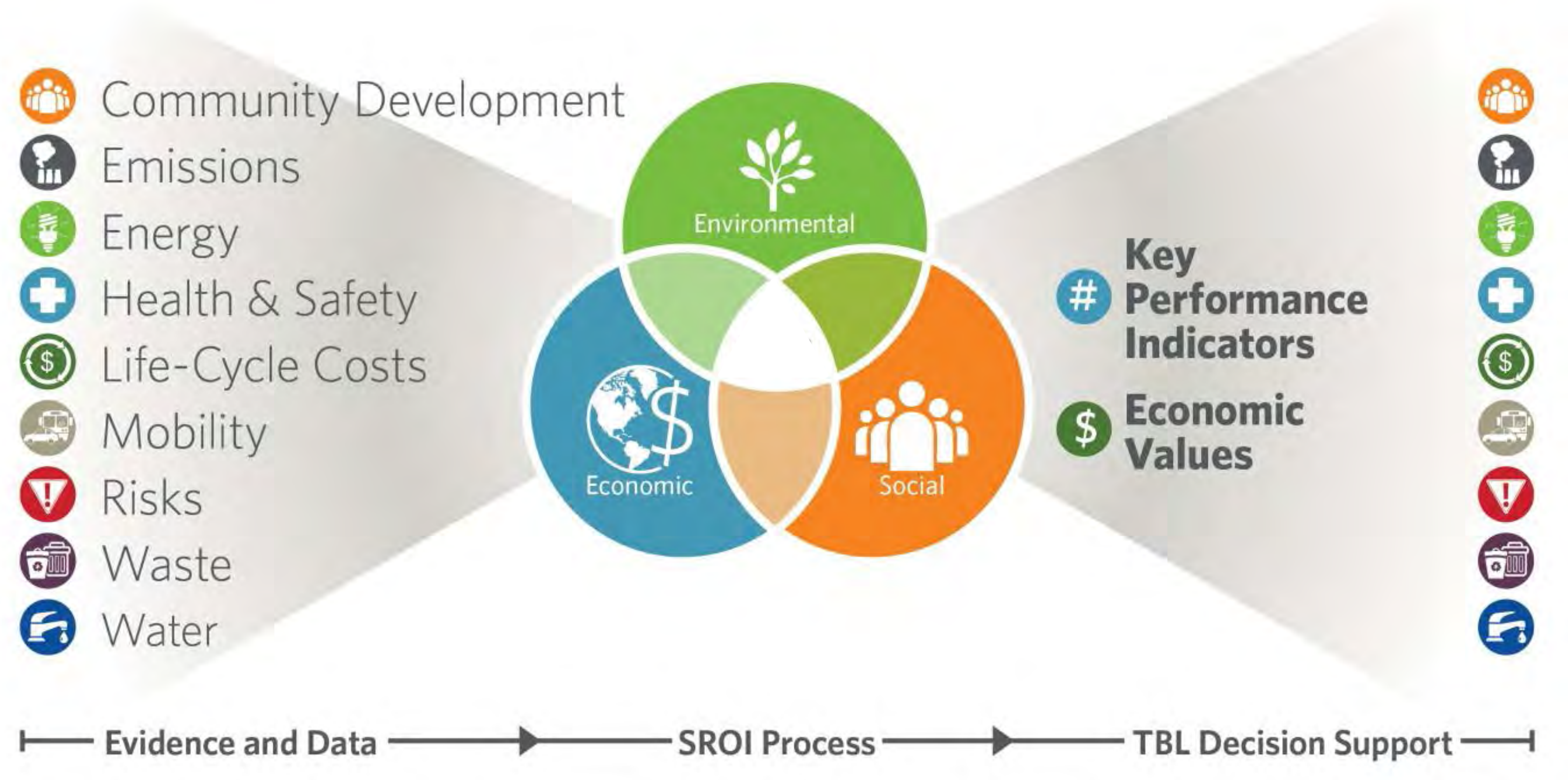
Solid Waste Process Control Assumptions Adopted

Estimated Costs

	Capital Costs (2017 $)	Tons Captured (2025)	Tipping Fee (2017 $)
New County Landfill	$11.7M (1st Phase) $11.7M (Equity) $0.0M Finance	344,800	$14.79 / Ton
Central Transfer Station	$15.8M $15.8M (Equity) $0.0M Finance	321,600	$30.79 / Ton
Construction & Demolition (C&D) Processing	$13.7M $13.7M (Equity) $0.0M Finance	150,000	$34.32 / Ton
Yard Waste & Food Waste Composting	$11.8M $0.0M (Equity) $11.8M Finance	72,200	$37.92 / Ton
WWTP Pre-Processing	$3.1M $0.0M (Equity) $3.1M Finance	14,000	$83.65 / Ton

HDR's Sustainability Value Assessment (SVA) Services - *A Better Approach*

"Sustainability Value"



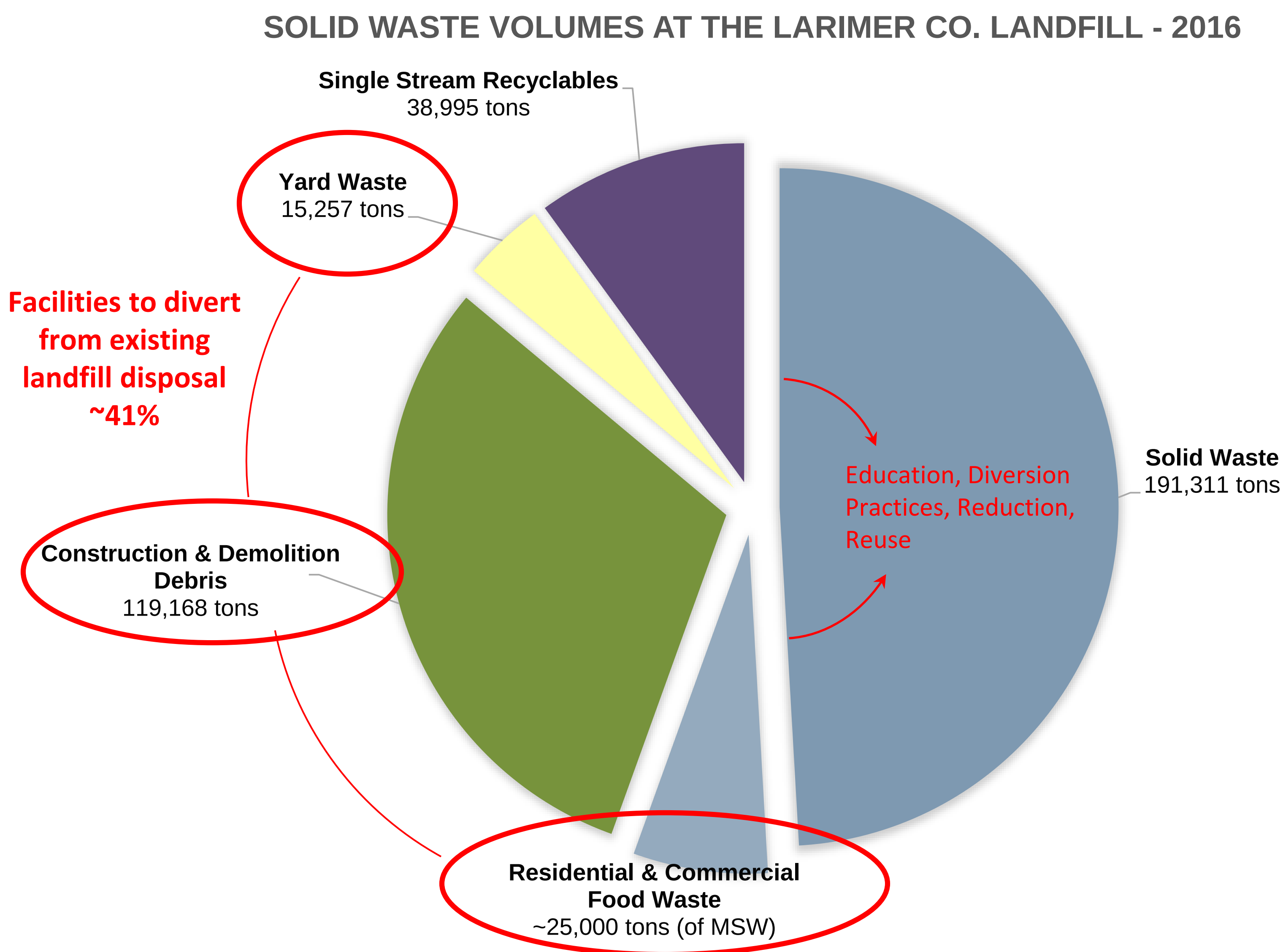
SROI Blended Results

	Infrastructure Options Included	Benefit-Cost Ratio	Total Cost of Package	Total Diversion Percentage
Scenario #1	Transfer Station Landfill	> 1.00	27.5M	0%
Scenario #2	Transfer Station Landfill C&D Processing Yard & Food Waste	> 1.00	53M	38%
Scenario #3	Transfer Station Landfill C&D Processing Yard & Food Waste WWTP Pre-Processing	< 1.00	56.1M	41%

Recommended Solid Waste Process Controls To Meet Coalition Goals

1. Establish regional materials **management system**
2. Implement **programs and facilities**
3. Develop waste diversion/reduction **goals** for all jurisdictions
4. Conduct strong, consistent **public education** and outreach

Solid Waste Volumes at the Larimer Co Landfill



Recommended Solid Waste Process Controls

Intergovernmental Agreement (IGA)

Municipal Solid Waste (MSW)

- Hauler Licensing - Uniform Requirements
- PAYT
- Centralized data collection
- Education Programs

Construction & Demolition (C&D)

- Process Controls
- Flow Control (Limited term)
- Centralized data collection
- Education Programs

Yard Waste

- Hauler Licensing
- Yard Waste Ban
- Centralized data collection
- Education Programs

Food Waste

- Hauler Licensing / Process Control Requirements
- Centralized data collection
- Education Programs

Recyclables

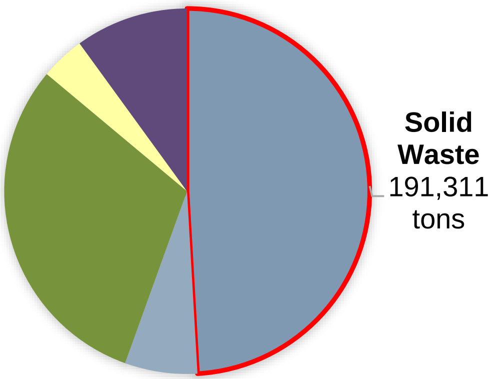
- Hauler Licensing
- Flow control
- Centralized data collection
- Education Programs

Intergovernmental Agreement (IGA)

- Establish a consolidated hauler license program throughout Larimer County
- Establish consistent solid waste process controls through ordinances
- Centralize all data collection and reporting requirements
- Establish an Advisory Board
- Document performance requirements for County to deliver facilities and infrastructure
- Document performance requirements for municipalities to adopt controls and licensing requirements

Municipal Solid Waste (MSW)

- Hauler Licensing - Uniform Requirements
  - Pay As You Throw (PAYT) –
    - Volume-based pricing for waste collection service (17-gallon cart, 35-gallon cart, 65-gallon cart, 95-gallon cart); options for bear resistant containers
    - Potential Bundling of recycling and trash collection for multi-family unit (MFU) customers ; Potential Bundling of recycling, trash and yard waste for single family residential customers.
  - All MSW shall be transported to a permitted landfill facility, which must have an active landfill gas collection system
  - Centralized data collection and recording requirements, superseding municipal reporting but with access to disaggregated data by municipalities
  - Requirements to implement education programs
  - Mapped limits for direct haul allowed to new landfill



Construction & Demolition (C&D) Processing Facility

- Regulatory requirement to manage mixed C&D material separately from landfill waste, and transport to processing facility.
- Prohibits the disposal of mixed C&D waste and requires the recycling of metal, wood, cardboard, drywall and aggregate from construction and demolition sites with the following conditions:
  - Applies to all residential and commercial new buildings, and demolition; applies to additions and remodels over 1,000 square feet
  - Construction Waste Management Plan required for demolition projects that will yield over 1,000 tons of C&D debris and must be submitted to Larimer County for review and approval
  - Projects yielding over 1,000 tons of C&D debris may be processed on site and processed materials may be distributed to markets outside of Larimer County

Construction & Demolition (C&D) Processing Facility

(Continued)

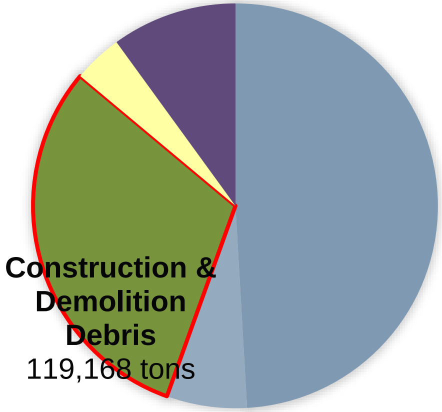
- Prohibits the disposal of mixed C&D waste and requires the recycling of metal, wood, cardboard, drywall and aggregate from construction and demolition sites with the following conditions:
  - Documentation and reporting required for any material not sent to Larimer County Regional C&D Processing Facility
  - Provides jobsite convenience of commingled collection of concrete and masonry, wood, metals, cardboard, and dry wall
  - Exceptions allowed for asbestos, lead paint and other regulated hazardous materials
  - Clean segregated loads of concrete and deconstructed road/highway base material can be processed at the Hoffman Mill Facility or a private crushing site

Construction & Demolition (C&D) Processing Facility

(Continued)

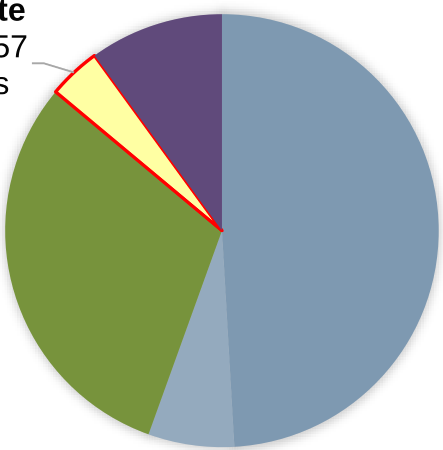
- Flow Control Requirements:
  - All mixed C&D debris generated and collected within Larimer County will be delivered to Larimer County Regional C&D Processing Facility (Limited term of 10 Years)
- Centralized data collection and reporting requirements
- Requirements to implement education programs

- Justification for flow control requirement
  - Initial investment needs minimum volume per year to recover capital costs
  - High volume of C&D allows us to mature end markets
  - Relatively new C&D diversion process needs to be established in this region

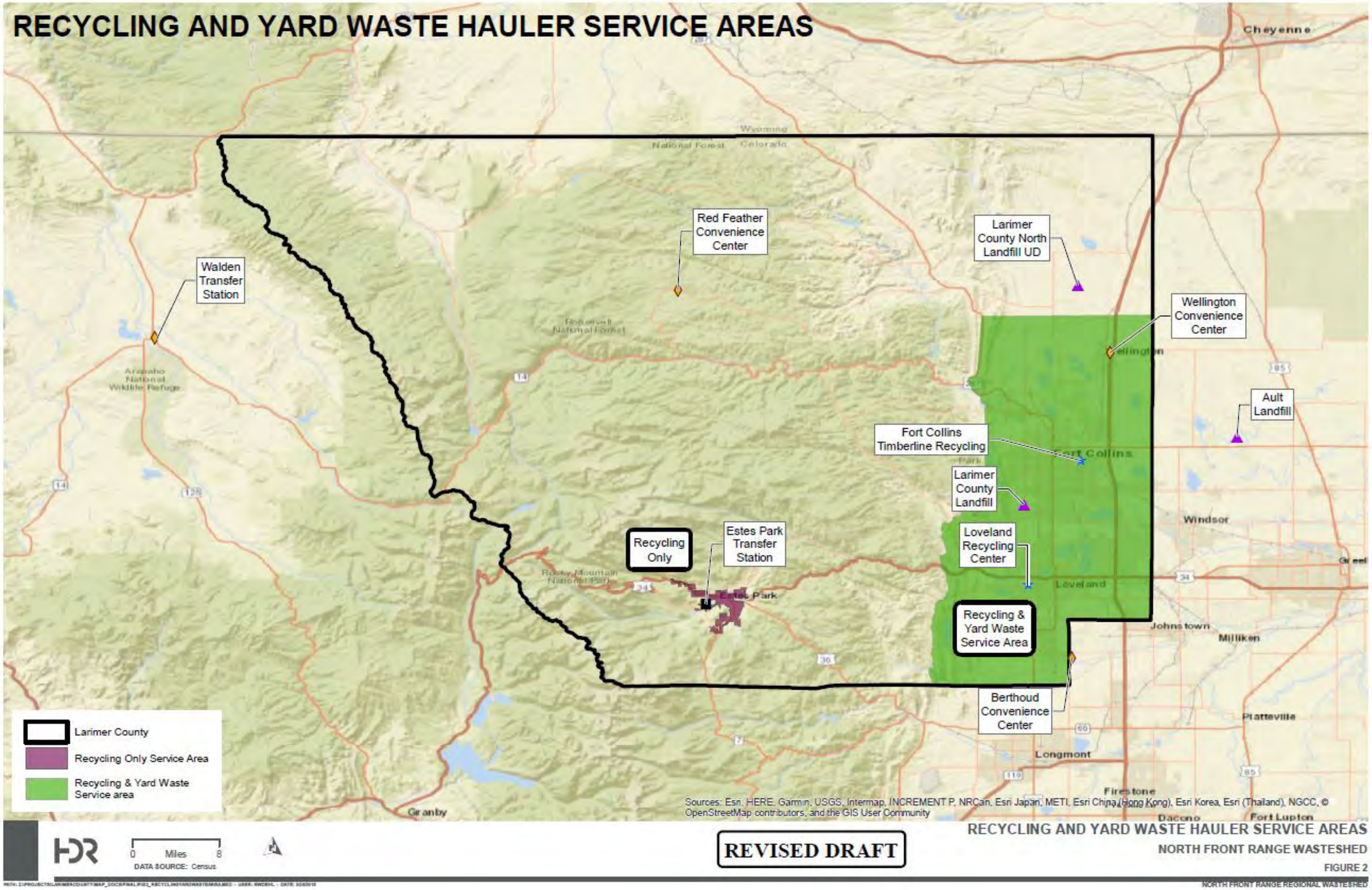


Yard Waste (YW)

- Hauler Licensing Requirements:
  - Waste ban within specified zones, depicted on a map
  - Requires haulers to provide yard waste collection to customers within designated service area ; yard waste may be bundled with trash and recycling for single family residential customers.
  - Commercial landscaping businesses are required to be licensed
  - Centralized data collection and reporting requirements
  - Requirements to implement education programs
- Yard Waste Ban prohibits disposal of yard waste in MSW landfills, including trash collection carts
- Public sector commitment to provide selected facilities to receive yard waste (both public and private)
- Commitment by County and municipalities to use a certain portion of generated material as soil amendments on land use projects

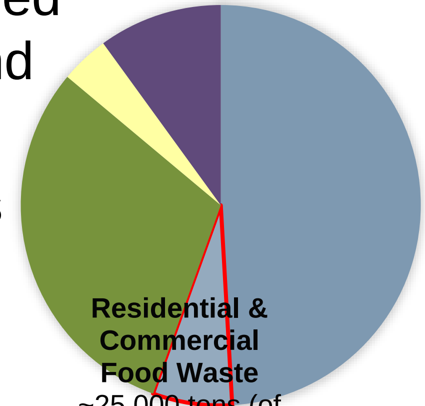


Hauler Service Areas



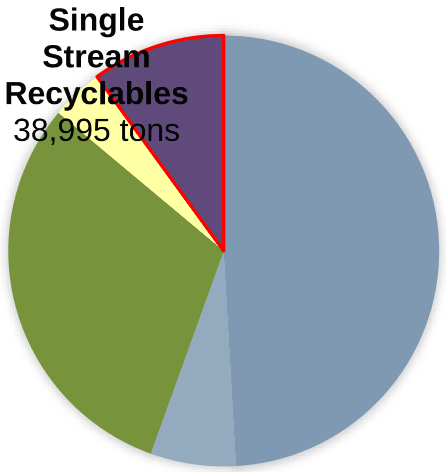
Food Waste

- Hauler Licensing/Process Control Requirements:
  - County-wide adoption of Fort Collins Code; Section 12-23 – Requires grocers to send food scraps to a permitted facility that processes food waste; bans landfill disposal; applies to grocers that generate more than 96 gallons of food scraps per week; surplus edible food may be donated - commences by a specified date
  - Food scraps to include both Pre-Consumer (food scraps generated from meal preparation and grocery stores) and Post-Consumer (food scraps generated from plate scrapings, uneaten food that has already been prepared or served) will be considered for future landfill diversion; restaurants, institutional and residential – commences by specified dates
  - Centralized data collection and reporting requirements
  - Requirements to implement education programs



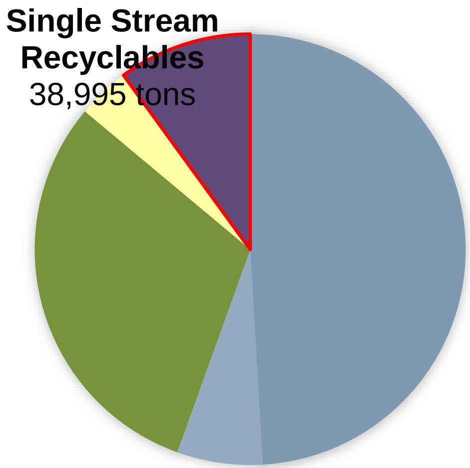
Recycling Services

- Hauler Licensing
  - Requirement to provide unlimited single stream recycling within designated zones
  - Minimum frequency of service – every other week
  - Specifies minimum requirements for roll carts
  - Requires haulers to provide single stream recycling to customers as a potential bundled service within designated service area
- Centralized data collection and reporting requirements
- Requirements to implement education programs
- Flow Control
  - All single stream recyclables generated and collected within Larimer County shall be delivered to Larimer County Facilities



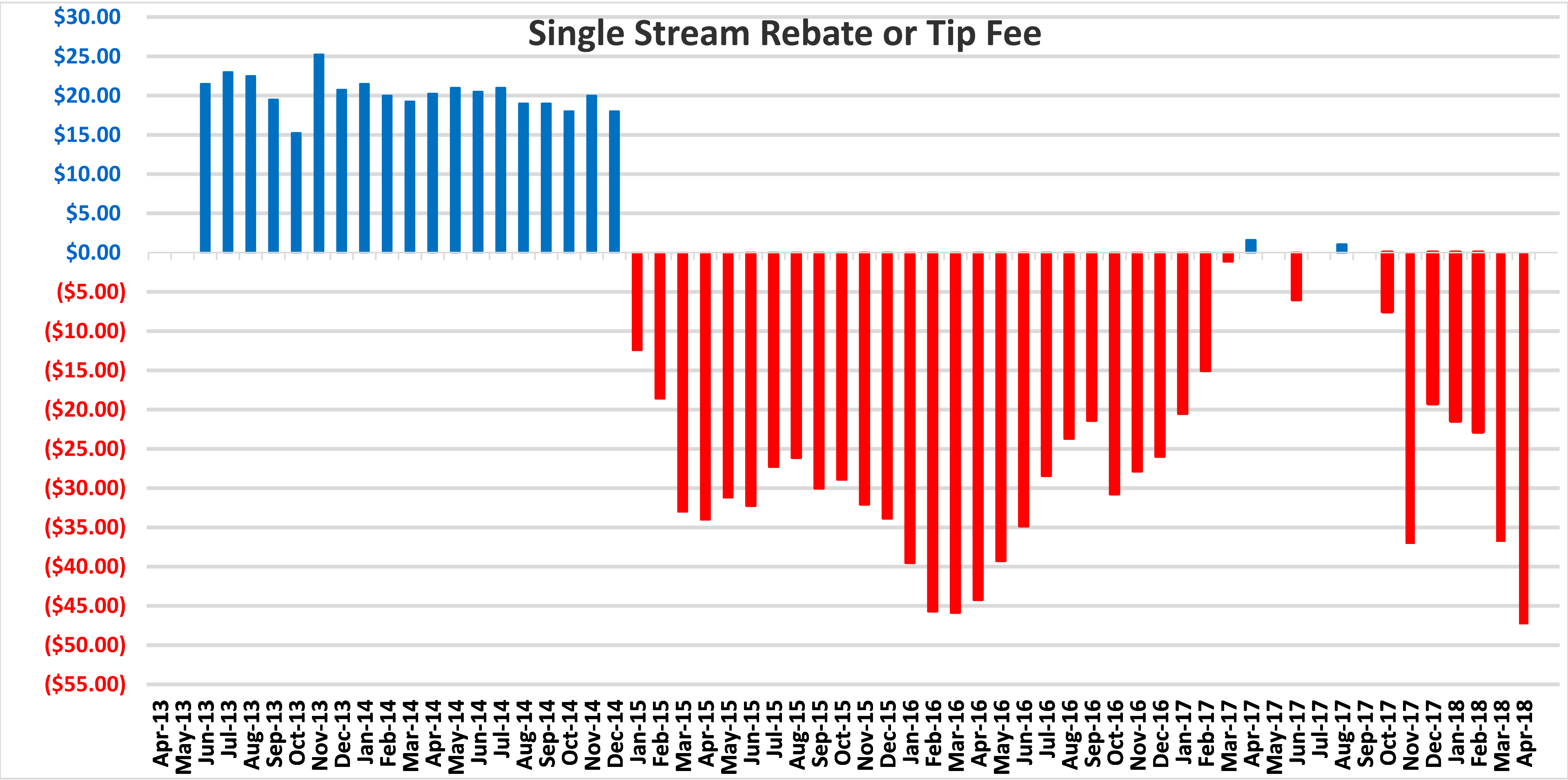
Recycling Services

- Justification for flow control of single stream recycling
  - Securing additional volume will attract more competition for Private/Public Relationships lowering long term processing fees
  - Higher annual volume will allow for much needed MRF upgrade providing new equipment to meet/exceed new contamination threshold
  - Better controls with local haulers to clean up incoming loads that do not meet contamination standards



*Loveland municipal fee is equivalent to bundling

Single Stream Commodity Trends



Stakeholder Feedback

Table-Top Discussion

Do you believe that an Interlocal Government Agreement (IGA) is the best mechanism for implementing solid waste process controls in Larimer County?

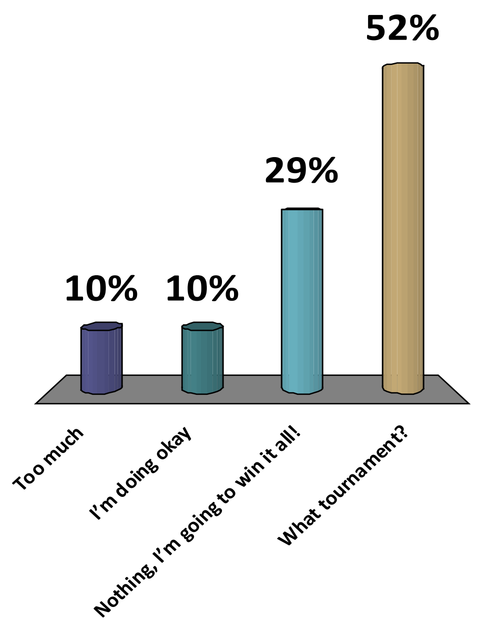
Table-Top Discussion

Do you have any other suggestions for effective solid waste process controls in Larimer County?

Clicker Question

How much have you lost in the 2018 NCAA Tournament?

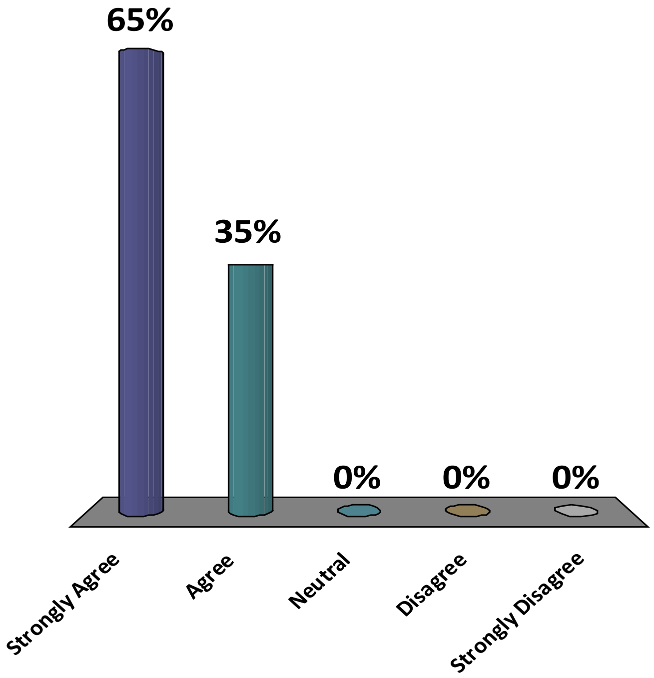
A. Too much
B. I’m doing okay
C. Nothing, I’m going to win it all!
D. What tournament?



Clicker Question

I support the recommended solid waste process controls presented for capturing the necessary volume of **Construction & Demolition (C&D)** debris generated in Larimer County?

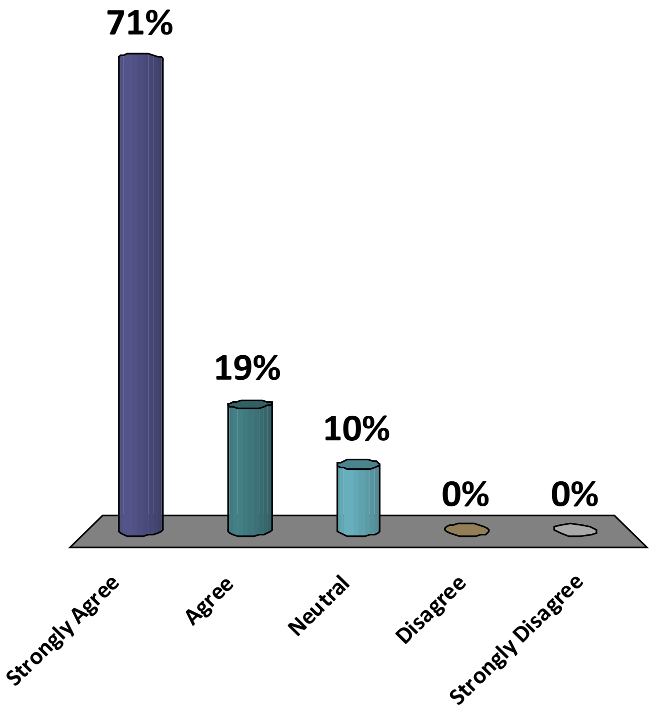
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree



Clicker Question

I support the recommended limited-term flow control requirements for mixed **Construction & Demolition (C&D)** debris generated in Larimer County?

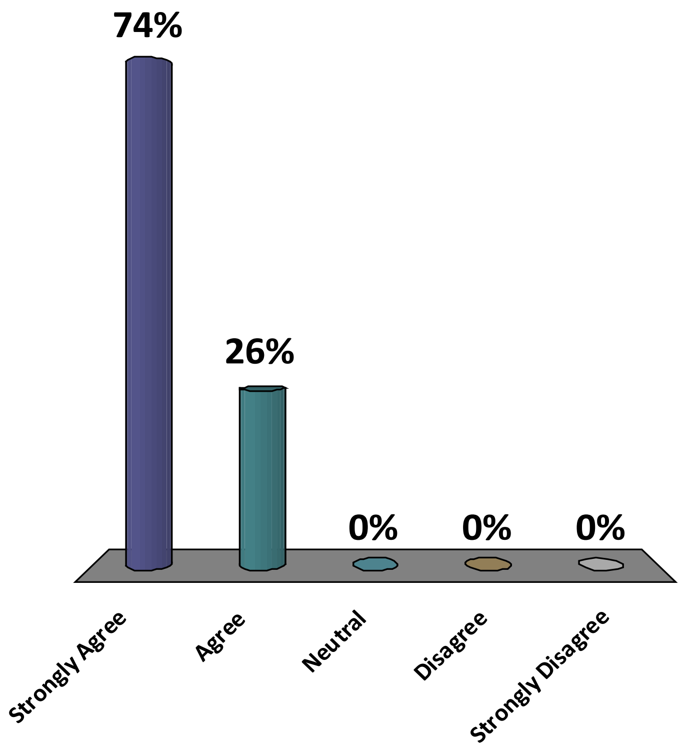
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree



Clicker Question

I support the solid waste process controls presented for capturing necessary volume of **Yard Waste** generated in Larimer County?

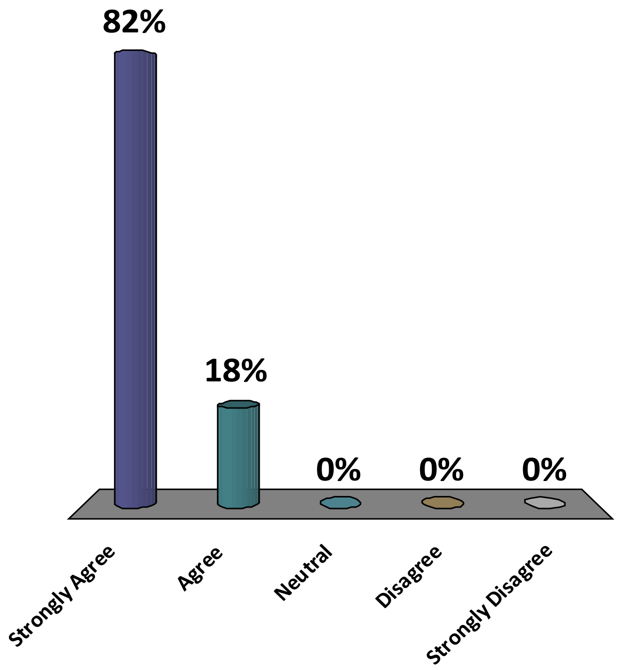
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree



Clicker Question

I support the recommended flow control requirements for all **single-stream recycling** generated in Larimer County?

A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree



Next Steps

Next Steps

- Public information meetings throughout Larimer County
  - **Dates TBD**
- Review policy recommendations with elected officials

North Front Range Regional Wasteshed Planning Study – Phase 2

Stakeholder Meeting #7:

Evaluation of Disposal Sites

September 19, 2018

Today's Agenda

I. Welcome and Opening Remarks

II. Review of Solid Waste Infrastructure Master Plan

   a. Recommended Facilities; Costs; Proposed Timeline

   b. Proposed Process Controls and Estimated Tipping Fees

   c. Summary of Public Meetings

III. Evaluation of Disposal Sites

   a. SROI Results

   b. Public vs. Private Advantages and Disadvantages

   c. Risk Assessment Matrix

IV. Stakeholder Feedback

LARIMER COUNTY

City of Fort Collins

City of Loveland

EP

Review of Solid Waste Infrastructure Master Plan

Recommended Infrastructure Options

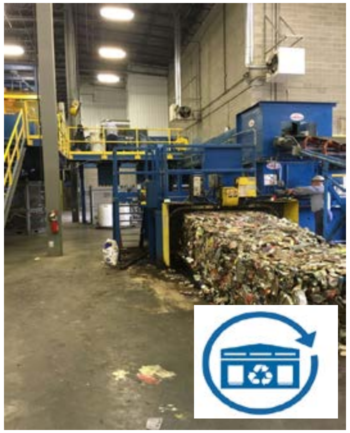
New County Landfill

Yard Waste Organics Processing Facility

Construction & Demolition (C&D)Processing Facility

LARIMER COUNTY
City of Fort Collins
City of Loveland

Existing MRF Transfer



Central Transfer Station

Aerobic Composting Including Food Waste

Costs of Recommended Facilities

Public Landfill	**$11.7M** (Equity – 1st Phase)
Central Transfer Station	**$15.8M** (Equity)
Yard Waste & Food Waste Composting Facilities	**$11.8M** (Finance)
Construction & Demolition Debris Processing Facility	**$13.7M** (Equity)
Total:	**~$53M**

Facility Development Timeline

	2019	2020	2021	2022	2023	2024
Central Transfer Station (Jan 2019 – Jan 2023)						
New County Landfill (Jan 2019 – Jan 2024)						
Yard Waste Composting **Open Windrow** (Jan 2020 – Jan 2023)						
Construction and Demolition Waste Processing (Jan 2020 – Jan 2023)						
Food Waste Composting **Static Aerated Bin** (Oct 2023 – Feb 2025)						

Implementation: Policy & Process Controls

Recommendation	Implementation Responsibility	Implementation Year	
		2018	2019
Policy and Process Controls			
Draft policy language will be developed through a collaborative process by the TAC for process controls, waste bans, and hauler licensing that will yield specific results associated with waste diversion, reductions, and recycling while achieving consistency among the Coalition members. Once drafted, the policies/codes should be vetted through each of the Coalition's government entities for comments.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Q4	-
An Intergovernmental Agreement for Solid Waste handling will be drafted by the Coalition members and adopted by each of the Coalition's government entities.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	-	Q1

Main Policy Controls

Flow Control
Construction & Demolition Debris

- Mixed loads
- 10-year term
- Jobsite convenience
- Market development

Flow Control
Mixed Recyclables

- “Single-stream” recyclables
- Residential and commercial
- Assured volumes attract investment

Waste Ban
Yard Trimmings

- Wood, branches, leaves, etc.
- Readily recyclable at multiple sites
- Generate finished compost

Estimated Fee Per Ton

Facility	Fee per ton
Current Landfill	$22
Transfer Station: Trash	$29
Compost: Yard	$38
Compost: Food	$38
Construction Debris	$37

Public Informational Meetings

» Four public meetings held around Larimer County for members of the public to:

  » Learn more about the future of solid waste in the region

  » Provide feedback on the draft regional master plan concepts for waste recovery and disposal

» 11 informational boards set up in an open-house format, and included an overview presentation

» More than 100 participants attended and provided valuable feedback via in-person comments and comment forms

nfrwasteshedpublicmeeting.com

Evaluation of Disposal Sites

Public Landfill or Private Long Term Contract

Sustainable Return on Investment (SROI)

Private Contracted Fee Per Ton:	**$10**	**$12**	**$14**	**$16**	**$18**	**$20**
Private Landfill - Miles from Central Transfer Station	**Benefit-Cost Ratio (BCR)**					
26 Miles	3.31	2.76	2.37	2.07	1.84	1.66
43 Miles	1.87	1.56	1.34	1.17	1.04	0.94
63 Miles	0.18	0.15	0.13	0.11	0.10	0.09
Public Owned Landfill 25 Miles from Central Transfer Station			2.41			

Public Landfill Advantages/Disadvantages

- Control and stability for waste disposal
- Ability to direct waste to new or evolving resource recovery options
- Increased service quality and flexibility
- Tip fees set by local government / competitive rates
- Control over haul timing / impacts
- Facility inspection and performance are maintained at local level
- Ease of future change to other disposal options
- Early mitigation of existing landfill

- Competitive market could reduce volumes resulting in higher tip fee
- Capital costs for construction & equipment
- Closure / post-closure financial assurance
- Long-term environmental liability
- Political process can slow responses to regulatory changes with financial impacts
- Takes time to investigate, permit, design, and construct
- Potential land value impacts
- Increased traffic to new landfill
- No current guarantees property is suitable for landfill use

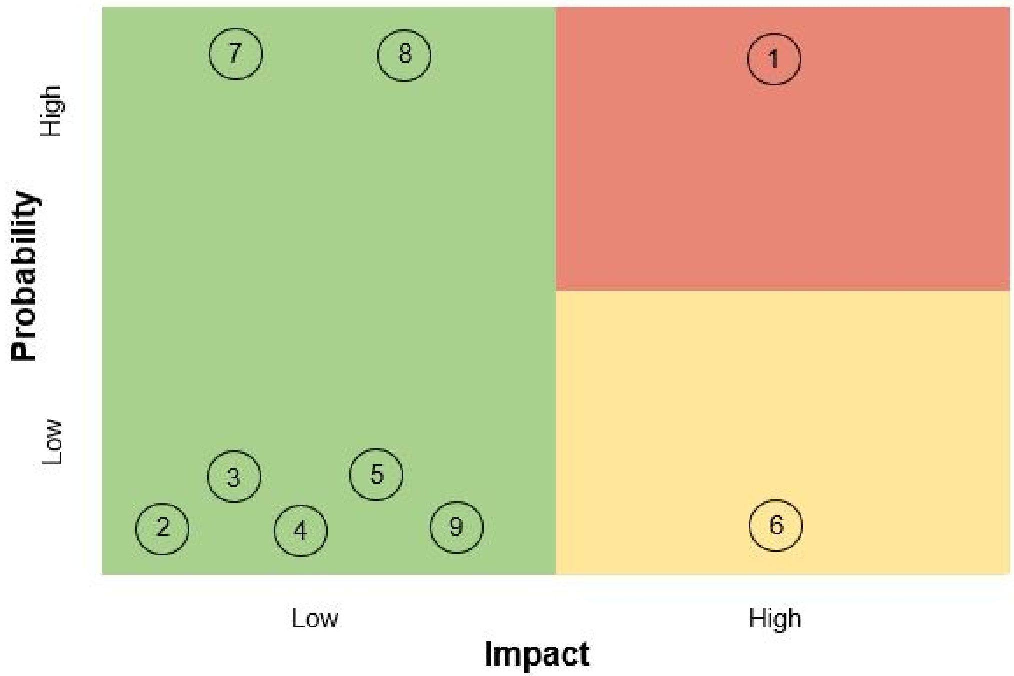
Private Landfill Advantages/Disadvantages

- No capital costs for construction
- No Operations & Management costs
- No closure/post-closure financial assurance
- Potential cost savings measure as tip fees can be negotiated
- Choice of providers through competition
- Environmental liability is partially mitigated
- National waste mgmt. expertise and resources
- Quick response to changes in technology/regulation
- Mitigates landfill closings due to wind
- No permitting, inspections, & engineering design

- Loss of control and stability
- Potentially discourages resource recovery
- Loss of flexibility and accountability
- Contract disputes if terms are not clear
- Volume or type of waste increases or decreases over time impacting pricing
- Site doesn't operate as designed & permitted resulting in redirection of waste
- Lengthy time requirement necessary if decide to develop public landfill after commitment to private landfill
- No control over transfer haul timing
- Landfill design/operation likely to maximize potential profit for operator which may conflict with Wasteshed social and environmental goals

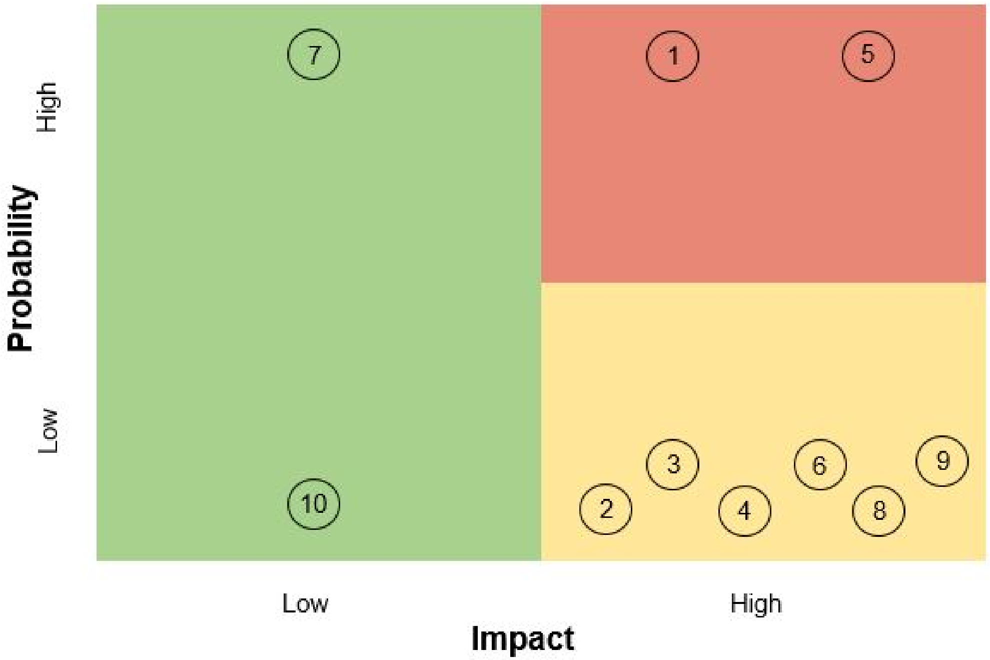
Public Landfill Risk Assessment

1. Competition lowers tipping fees
2. Capital costs exceed budget
3. Closure/post closure funding
4. Long-term environmental liability
5. Political process can result in slow responses to changes
6. Permitting, inspections and design process can be timely
7. Service disruption can occur
8. Traffic impacts due to commercial trucks
9. Potential impacts to property value, road serviceability, and community growth near landfill



Private Landfill Risk Assessment

1. Loss of control and stability (put or pay)
2. Redirection of waste with greater haul distance
3. Limits resource recovery opportunities
4. Reduced flexibility and accountability
5. Varying volumes of waste could impact pricing
6. Possible contractual disputes if terms not clear
7. Additional staffing to enforce contract terms
8. Changes in regulatory requirements trigger increased fees for disposal
9. Loss of control over transfer haul time
10. Time required to permit public landfill once commitment to private landfill



Stakeholder Feedback

Table-Top Discussion

Do you think there are additional advantages or disadvantages to a public or privately owned disposal site that have not already been considered?

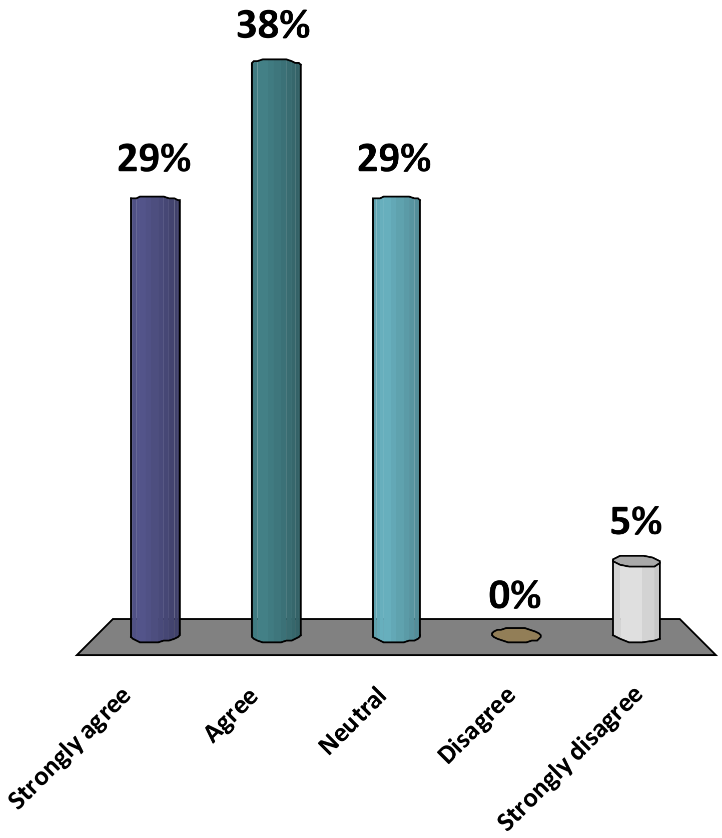
Table-Top Discussion

Do you feel the TAC has appropriately assigned the probability and impact values in the risk assessment matrix?

Clicker Question

The private disposal site has been thoroughly evaluated in a similar manner to the other infrastructure options.

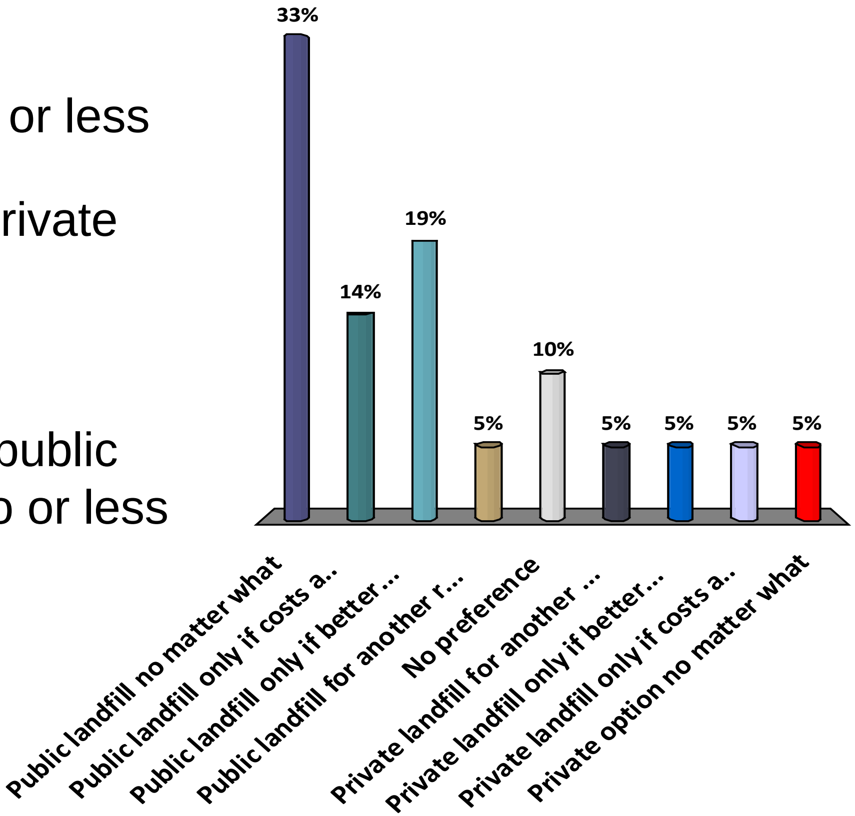
A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree



Clicker Question

I prefer the following for the Wasteshed:

A. Public landfill no matter what
B. Public landfill only if costs are equal to or less than private landfill
C. Public landfill only if better BCR than private
D. Public landfill for another reason
E. No preference
F. Private landfill for another reason
G. Private landfill only if better BCR than public
H. Private landfill only if costs are equal to or less than public landfill
I. Private option no matter what



Thank you!