DENVER PUBLIC WORKS PRESENTS

A MASTER PLAN FOR MANAGING SOLID WASTE IN THE MILE HIGH CITY - RESEARCH & ANALYSIS

OCTOBER 2010

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NOTE: Appendices are in a separate document entitled
"A MASTER PLAN FOR MANAGING SOLID WASTE IN THE MILE HIGH CITY - APPENDICES"

LIST OF ACRONYMS	
C&D	Construction and Demolition
CCTS	Cherry Creek Transfer Station
CPC	Central Platte Campus
CY	Cubic Yard
DADS	Denver Arapahoe Disposal Site
DIA	Denver International Airport
DSWM	Denver Solid Waste Management
EO	Executive Order
E-Waste	Electronic Waste
FTE	Full Time Equivalents
HHs	Households
HHW	Household Hazardous Wastes
ICI	Institutional, Commercial and Industrial Waste
LEED	Leadership in Energy & Environmental Design
LIP	Large Item Pick-up
MFU	Multi-Family Unit
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NAICS	North American Industry Classification System
PAYT	Pay-As-You-Throw
SFU	Single-Family Unit
SWMP	Denver Solid Waste Master Plan
WCS	Waste Composition Study
USEPA	U.S. Environmental Protection Agency
WMC	Waste Management of Colorado
WMRA	Waste Management Recycle America

PART ONE - BACKGROUND AND BASELINE

Part One of the Denver SWMP sets the foundation for the short- and long-term planning analyses that follow in Parts Two and Three.

Part One includes:

- Section 1.0 – Introduction;
- Section 2.0 – Existing System;
- Section 3.0 – Public Involvement Survey Results;
- Section 4.0 – Service and Policy Survey of Cities Comparable to Denver;
- Section 5.0 – Future Projections; and
- Section 6.0 – System Review and Analysis.

The short-term planning period extends over a 5-year phase in period, and short-term improvement programs are detailed in Part Two of the SWMP. The long-term planning period extends through 2030, and a matrix of long-term improvement programs and proposed schedule are included in Part Three.

1.0 Introduction

This Master Plan was commissioned by DSWM, a section of the Operations Division of the Denver Department of Public Works (Department), within the City and County of Denver. This Master Plan was prepared under a direct contract with the City and County of Denver, procured under a competitive Request for Proposals in 2007. The consultant team, under the auspices of the prime contractor, HDR Engineering, Inc., appreciates the direction and comments received from DSWM.

As used in this report, the term Denver will be used to denote the City and County of Denver (as opposed to the greater Denver Metropolitan Area). Unless otherwise noted, all references to Denver solid waste are meant to indicate solid waste managed by DSWM, not all waste generated in the City and County of Denver. Where available, this report uses 2008 and 2009 year-to-date data and observations and analyses provided by DSWM staff.

COMMUNITY VALUES

The current collection system of Denver is a reflection of community values as defined by available and defined resources over the last thirty years. Denver has been known nationally as a clean city, and the collection program support that reputation with its additional trash collection services established years ago to include LIP and barrel overflow services. In an attempt to gain more efficiency and decrease the number of injuries among its workers, the City invested in the dumpster collection system in the 1980's and the barrel collection system later in the decade. Recognizing the need to recover resources, the City instituted the Denver Recycles program in the early 1990's that evolved into the cost efficient single-stream program in 2005. On the cusp of environmental sustainability, the City is currently piloting an organics collection program.

This evolution of system changes within the collection operations is an ongoing reflection of community values held by Denver residents over the years. Specifically, the desire for a clean City coupled by a high level of customer service led to services that collect unlimited amounts of trash. Recognition of the loss of natural resources and the desire to conserve limited City owned landfill space has led to the investment into a recycling collection program. Collection efficiency through automation emphasized the value of fiscal integrity.

It is hoped that through the SWMP, the future of DSWM will continue to be defined by shared community values of customer service, cost efficiency, personal accountability, safety of the public and employees, environmental sustainability, and the quality of life for residents of Denver reflected in a clean city.

1.1 Background

This Master Plan was developed to provide DSWM and the Department with a road map for implementing processes and procedures to guide Denver's future collection, transfer, and disposal of solid waste, waste diversion, and resource management. This is Denver's first solid waste master plan. Its solid waste management services have developed with input and guidance from the Mayor's office and City Council. The solid waste management services have been defined by four Guiding Principles: good customer service; worker safety; environmental stewardship; and efficiency/cost containment (see Figure 1-1).

Figure 1-1. DSWM Guiding Principles.

1.2 Denver Goals

Part of the intent of this Master Plan is to provide a framework to weigh the relationship between achieving cost efficiency on one hand and fulfilling DSWM's mission to provide good customer service on the other. In the past, good customer service has been defined as balancing the needs of DSWM customers against system efficiency and available resources. The Master Plan will strive to evaluate and improve this balance such that a higher level of environmental and economical sustainability is achieved. All of this deserves public discussion, and a Master Plan is an essential first step in fostering discussion and decision-making.

It is the intent of DSWM to develop a Master Plan that assesses how to more efficiently provide good customer service, achieve cost efficiencies and fulfill its environmental mission.

Greenprint Denver

Greenprint Denver is an action agenda for sustainable development established in 2006 by Mayor John Hickenlooper with the goal of recasting Denver as one of the most sustainable cities in the country. Among its numerous objectives, Greenprint Denver established a specific goal of a 30% reduction of landfill disposal by 2011 using 2004 as a baseline year. The intent of this goal was to increase Denver's level of successful resource conservation. This goal could be achieved through reduction in or reuse of the solid wastes produced by residents, or through increased diversion of waste materials. In spite of an increasing population, the solid waste collected and disposed by DSWM has been decreasing slowly but steadily for several years, perhaps indicating that residents are already reducing or reusing solid wastes. The institution of a recycling collection program has further reduced the disposal of solid wastes. These represent only two out of several possible methods for DSWM to utilize to meet the Greenprint Denver goal.

Table 1-1 compares the Greenprint Denver goal (as a calculated tonnage) with the baseline year (2004); it also shows the actual tons landfilled since 2004. It was clear from the beginning that resources would need to be dedicated to changes to services to achieve this goal by 2011. This Master Plan is DSWM's attempt to lay out resource needs to achieve this goal to allow for community debate and the decision makers support. With resources, DSWM can exceed the Greenprint Goal, just not by the 2011 deadline.

Table 1-1. Greenprint Denver Goals.

YEAR	LANDFILL TONS
2004	254,489
2005	248,596
2006	234,059
2007	231,596
2008	219,675
2009	**221,797**
2011*	**178,100**

*calculated to achieve Greenprint Denver goal

While the primary emphasis of the Greenprint Denver goal is environmental sustainability, it is also expected to have a positive financial impact. DSWM pays a tipping fee for disposal of residential solid waste at the DADS landfill. Denver receives a rebate from the landfill operator, but this is still a net cost item in Denver's budget. In contrast, DSWM does not pay a tipping fee for delivery of single-stream recycling to the material recovery facility (MRF), and Denver receives payments for the materials recycled.

2.0 Existing System

The current system uses money allocated from the general fund to pay for residential solid waste collection and disposal. Sources for the general fund include primarily sales tax from commercial establishments, including money spent by Denver area visitors, and minimal funding from property taxes paid by all residents, including single-family homes and large multi-family units [MFUs]). However,

only single-family unit (SFU) and small MFU residents directly receive solid waste services from DSMW. Large MFUs and commercial establishments must contract directly with private sector haulers to obtain solid waste collection and disposal services.

2.1 Denver's Solid Waste Generators

The Colorado State Demography Office (October 2009) estimated Denver's 2008 population to be 611,509. According to the U.S. Census Bureau, Denver was the 24th largest city in the country in 2007. Denver also boasts the 10th largest central business district in the country, which generates a large portion of the non-residential waste stream in Denver. As a section of the Department of Public Works, DSWM operates under the Public Works Manager's Rules (1993). These rules define DSWM's service area to include all SFUs, and MFUs with seven or fewer units. According to DSWM estimates, there are 144,000 SFUs and 95,200 MFUs in Denver. Of the total MFUs, only 26,000 have seven or fewer units. This translates to 170,000 SFUs and MFUs included as "residential" collection units within DSWM's service area.

The remaining 69,200 large MFUs are served by private sector collection and disposal firms. Denver's 26,000 businesses are also served by private sector collection and disposal firms. There is little city oversight or regulation of private sector haulers. DSWM has no data on solid waste generated by large MFUs (of 8 or more units) or businesses.

DSWM provides household collection service for refuse and recyclables collection within its service area, as well as a number of ancillary collection services. DSWM maintains a comprehensive multi-year database on the collection and disposal or processing of these materials. In 2008, this service area generated 219,675 tons of refuse and diverted 29,560 tons of recyclables, organics and other materials. The resulting 2008 total generation rate (disposed plus diverted tons) was about 8 pounds per household-day or 2 pounds per person-day[1]. The 2008 recycled material rate was 12%[2].

[1] This includes residential waste only. The U.S. Environmental Protection Agency (USEPA) measured a per person generation rate of 4.5 pounds per day in 2008 including all municipal solid waste (residential, commercial, institutional and non-process industrial) in its "Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2008" (November 2009).

[2] This calculation is based on 28,550 tons of recyclables, 210 tons of organics and 800 tons of household hazardous waste, electronic waste, recycled appliances, and organics from DSWM's leafdrop and treecycling program.

2.2 Solid Waste Services

2.2.1 Refuse

Collection

DSWM operates out of four locations: The Platte Campus (NW), Cherry Creek (SW), Roslyn (NE) and Osage (SW) staff and equipment areas (or "camps"). The Platte Campus location includes the recycling, graffiti abatement operations, and administrative staff functions. The transfer station operation, large item pickup and both automated and barrel operations that generally serve the south and southeast areas of the city are based out of the Cherry Creek operations. The Roslyn camp hosts manual, automated and barrel operations that generally serve the north, northeast areas. The Osage camp hosts barrel and manual operations that generally serve the southwest and northwest areas.

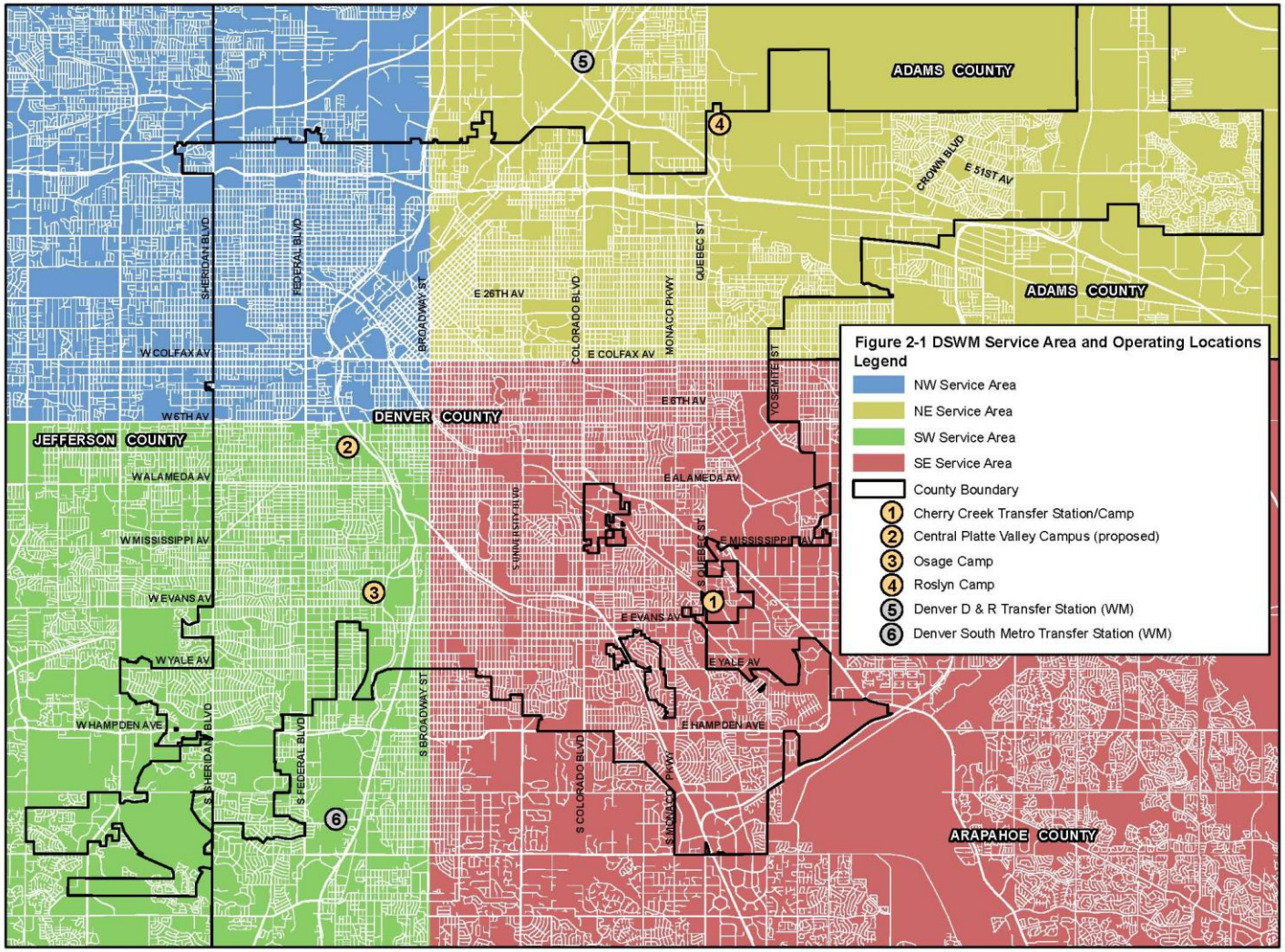
DSWM's overall operations utilize three systems to collect household refuse:

- Manual collection - each household provides its own container (19% of refuse collection in 2008);
- Barrel collection - DSWM provides each household with a standard sized container (31% of refuse collection, including overflow); and
- Dumpster collection - DSWM provides a dumpster to serve multiple households (47% of refuse collection)[3].

DSWM uses these systems to provide weekly service to its service area (see figure 2-1). The refuse service area includes household collection from a mix of alleys (57%) and curbs (43%). Alleys – especially narrow alleys – present space and operating constraints for collection vehicles from low power lines, zero set-backs and unpaved/uneven surfaces.

[3] DSWM's large-item pick-up makes up the other 3% of tons collected.

Figure 2-1. DSWM Service Area and Operating Locations.



Manual Collection

DSWM's manual rear load collection system uses one laborer and one driver to collect refuse from 32-gallon size containers or bags (maximum 50 pounds) provided by residents, which is loaded into 25-cubic yard rear-load collection vehicles by hand. Due to container size restrictions, most households use multiple containers or bags. Denver collects between 500 and 800 homes per day with this system. The smaller vehicle size makes manual collection especially useful in servicing Denver's narrow alley neighborhoods (about 30% of DSWM's manual service area is in these neighborhoods).

Barrel Collection

The fully automated barrel collection system uses one driver to collect refuse from DSWM-provided 95-gallon wheeled carts (or barrels), which is emptied via a 30-cubic yard side-loader with a vehicle-equipped robotic arm. Between 780 and 900 homes are collected each day with this system.

Shared Dumpster Collection

More densely populated areas in the service area are serviced using primarily three-cubic yard dumpsters which are shared by three to four households. Specialized automated 32-cubic yard side loading vehicles are used to empty these containers, and require one driver for operation. All dumpsters are located in alleys, and about 12% of dumpster service is in narrow alley areas that require smaller dumpsters and special operating considerations. DSWM routes range from 175 to 200 dumpsters per day (or about 650 to 700 households).

Ancillary Collection Services

DSWM also maintains a regularly-scheduled LIP system. This system currently allows residents to set out up to five large, bulky items (such as furniture, large brush, etc.) for pick-up every ninth week. In addition, it provides maintenance of the City's right-of-way by keeping the area passable and plays a large role in the cleanup of illegal dumps. The LIP is a manual collection that utilizes varied equipment types including manual rear-load vehicles with up to two workers each.

Collection of barrel overflow refuse is also a manual collection that uses rear-load vehicles and two-worker teams. Up to ten overflow bags or containers (up to 32 gallons) and ten bundles of branches are collected every three weeks using rear-load collection vehicles.

In 2008, LIP and barrel overflow collections accounted for 3% and 8% by weight, respectively, of waste collected by DSWM (the overflow quantity is a subtotal of barrel tons described under Collection above).

Transfer

Once collected, DSWM uses four systems to transport refuse to the landfill. These transfer systems provide DSWM with the ability to consolidate a majority of collected refuse into a single vehicle for final hauling to the landfill. Transfer adds efficiency to the system by maximizing hauling capacity in trailers that are specifically designed for over-the-road transportation, and allowing the specialized collection vehicles to quickly return to collection routes. The four systems include:

- Transfer of waste collected in southeast Denver through the Cherry Creek transfer station, owned by the city and located in DSWM's southeast camp - 46% of refuse collected (by weight) is transferred through this station;
- Transfer of waste collected in northeast Denver through a transfer station in Commerce City owned by Waste Management of Colorado (WMC)[4] – transfers 36% of collected refuse;
- Transfer of waste collected in southwest Denver through another WMC transfer station in Englewood – transfers 12% of collected refuse; and
- A small fraction of waste collected by DSWM is hauled directly to the landfill in DSWM's collection vehicles - 8% of collected refuse is direct hauled.

Disposal

Denver has owned the adjoining Lowry Landfill and DADS since 1964. In 1980, WMC was competitively selected to operate these sites for Denver. Under their contract, WMC has responsibility for day-to-day operation of the landfill, as well as for closure and post-closure care of the landfill, thus relieving Denver of the burden of these costs. In addition, Denver receives the best disposal rate at the landfill, and also receives a portion of the gross disposal revenue from WMC. In 2001, the Mayor's office issued Executive Order (EO) 115, which is intended to optimize the long-term use of DADS, protect Denver's financial interests, minimize potential liability, and protect human health and the environment. Specifically, EO 115 requires the disposal of all City-controlled non-hazardous waste at DADS.

The contract between Denver and WMC extends for the life DADS, which is currently estimated at 30 to 60 years. Under the contract, the fees charged for disposal of Denver-controlled solid waste is negotiated periodically on agreement by both parties. However, Denver's royalties (the percentage of gross disposal revenue due from WMC) are defined in the contract. To date, this arrangement has been a successful public/private partnership, with benefits accruing to both parties.

2.2.2 Recycling

Collection

DSWM implemented voluntary residential recycling in 1991 with a household collection service program utilizing 18-gallon bins, collected every other week. The bins were serviced manually by split body, side load collection vehicles, operated by one driver. This program was subscription-based, requiring each interested household to request service.

Between 2005 and 2007, DSWM modified the program to a single-stream recycling program with 65-gallon carts, serviced by fully-automated 30-cubic yard side-loader vehicles operated by a single driver. Recycling collection is also a mix of alley (43%) and household service collection (57%). Acceptable single-stream recyclables include paper and cardboard, plastic bottles, glass and metal containers fully commingled into one cart.

Processing

[4] WMC is a subsidiary of Waste Management, Inc.

Through a competitive bidding process, DSWM contracted with Waste Management Recycle America (WMRA) whose MRF is currently located at 5395 Franklin Street in north Denver,[5] to process and market collected recyclables. As part of this contract, the city receives revenues for the sale of these materials, which includes both a flat rate revenue based on the weight of recyclable materials delivered to the MRF, and an up market revenue which is paid when the commodity markets are above a benchmark established in the contract.

2.2.3 Organics

DSWM operates seasonal collection programs for fall leaves and Christmas trees. The leaf-drop collection allows Denver residents to drop bagged leaves at several sites throughout the City on three consecutive Sundays in November and at the Cherry Creek Transfer Station during the week, in October and November. As part of its Treecycle program, DSWM provide household collection of undecorated Christmas trees on regular refuse collection days in early January each year. DSWM mulches and grinds these materials, then makes the product available through a free citizen give-away program every spring. In 2008, these programs collected about 650 tons of organics.

Between October 2008 and March 2010, Denver implemented a pilot program to compost yard and food waste as part of a State of Colorado Public Health & Environment grant project. In 2008 and 2009, the project collected about 1,600 tons of material from 3,300 households in neighborhoods throughout Denver. Materials were transferred at Stapleton and processed by A1 Organics' Rattler Ridge facility in Keenesburg.

2.2.4 Other Services

In addition to solid waste services described above, DSWM:

- Collects refuse and recyclables from city-owned buildings and facilities;
- Collects refuse from Parks and Recreation facilities;
- Collects refuse and recyclables from Denver Public Schools[6]; and
- Operates graffiti abatement and Keep America Beautiful programs.

The material quantities for the building and school collections are included in the 2009 tonnages described previously, but not in data before that.

2.2.5 Safety

DSWM provides an aggressive safety program that prioritizes the safe collection of solid waste and recycling services for not only its workers but the general public. Through its operating standards and on-going safety training program, DWSM recognizes exemplary performance by their employees.

The program includes an annual refresher course for staff with an operator's guide that provides instruction on vehicle inspections, defensive driving and crash prevention guidelines, hazard recognition

[5] WMRA is a subsidiary of Waste Management, Inc.
[6] The collection includes DSWM's only front-load vehicles (as well as other types of collection equipment).

and directions on what to do at the scene of an accident, or in case of a fire or spill. In 2008, DSWM's record included:

- 270 total accidents (about 1.6 accidents per vehicle) – only 56 of these were the DSWM driver's fault;
- 223 incidents of property damage (or 47 accidents per 1.7 million miles driven) – only 21 of these were the driver's fault.

DSWM's 2008 safety record was noticeably improved over 2007 (which had 375 accidents). As a result, DSWM received a 2008 Department of Public Works Safety Award.

DSWM's program also includes operator instructions specific to both manual and dumpster collection. This is important as the manual program is associated with significantly more injuries than the other collection systems (in 2008, there were 26 workman's compensation injuries from manual versus a total of 8 injuries from barrel and dumpster collection). The dumpster system includes hazards from maneuvering/tipping large containers and large items awaiting LIP pick-up that block access and hinder collection.

2.3 DSWM Budget, Revenues, Staffing and Equipment

2.3.1 Budget and Revenues

Budget

DSWM's 2009 budget was $24.3 million. Figure 2-2 provides a breakdown of category costs. When taken together, refuse collection and disposal, and LIP and overflow constitute 74% of the total budget. Each category includes all costs that are attributable to these functions, including labor, services, supplies, capital equipment and internal costs. Refuse collection and disposal costs also include late set-out service, transfer station and DADS landfill tip fees, Cherry Creek transfer station operation, dumpster repair, refuse container purchase, and fees to Fleet Management for vehicle maintenance. Of these costs, $15.08 million (62%) was designated for the individual refuse collection system costs, as follows:

- Manual collection – 24% of collection costs or $3.69 million (19% of tons collected)
- Barrel collection – 33% of collection costs or $4.93 million (31% of tons collected)
- Dumpster collection – 43% of collection costs or $6.46 million (47% of tons collected)

Recycling costs include new cart purchase, Graffiti abatement includes paint and gels, and Administration includes workman's compensation reimbursement. The 2010 proposed budget reduces some of these costs, such as reduced LIP and overflow collections. Table 2-1 compares the budgets for 2009 and 2010, and shows the largest cost items in each year's budget.

Figure 2-2. DSWM 2009 Budget ($24.3 million).

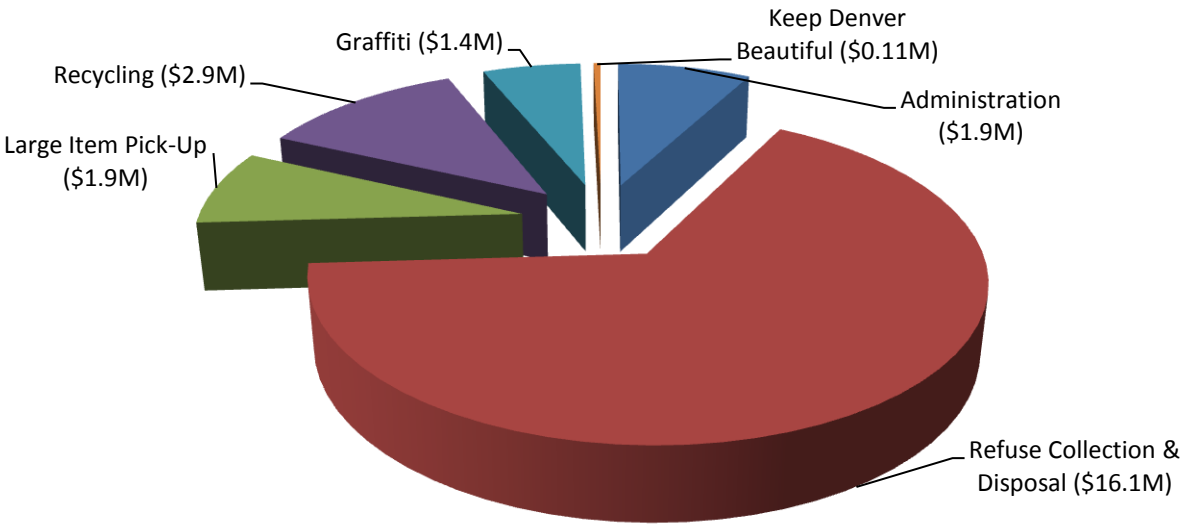


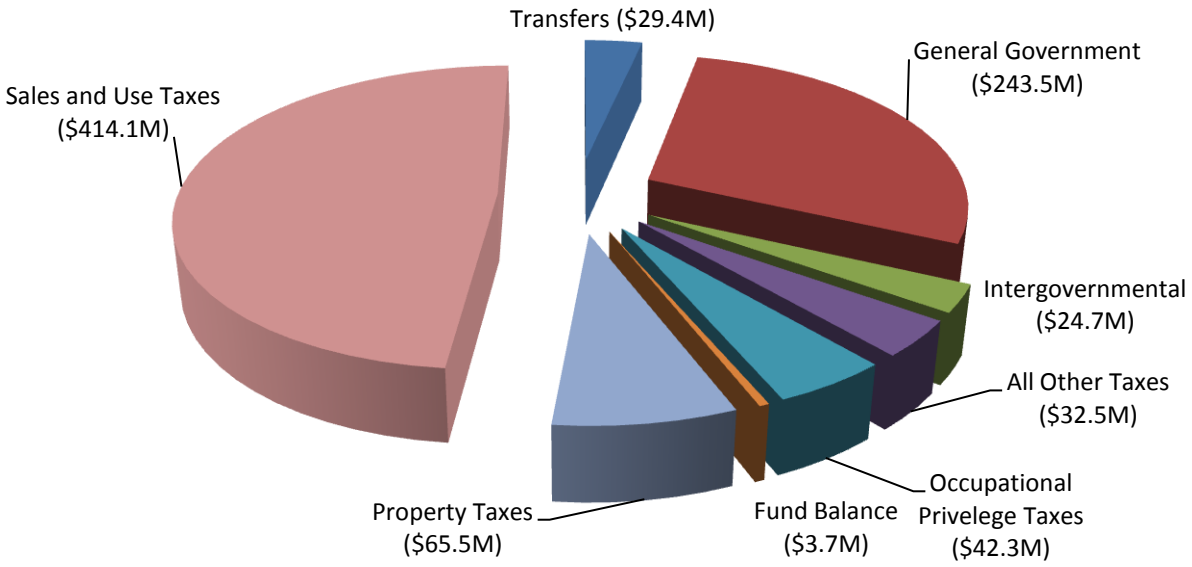
Table 2-1. DSWM Budget 2009 and 2010 (in millions).

ITEM	2009	2010
Wages and Benefits	$11.7	$10.6
Services and Supplies	$5.7	$5.4
• Tip Fees	$3.4	$3.6
• Containers	$1.2	$0.8
• Other	$1.1	$1.1
Internal Billing	$6.8	$6.1
• Office	$0.1	$0.1
• Vehicle Mileage	$5.5	$4.9
• Other Fleet	$0.5	$0.5
• Workmens Comp	$0.8	$0.5
TOTAL	**$24.2**	**$22.1**

Revenues

DSWM is funded through the City's General Fund, which was $855.7 million in 2009. The General Fund revenues are illustrated in Figure 2-3.

Figure 2-3. Denver 2009 General Fund Summary ($855.7 million).



Denver also earns royalties under the city's DADS operating contract with WMC, and revenues from the sale of recyclables under the city's contract with WMRA. Landfill royalties were $5.2 million in 2008 and are managed by the Denver Department of Environmental Health through an enterprise fund. Recyclables revenues were $1.2 million – these revenues are returned to the city's General Fund. Neither revenue stream is directly available to DSWM.

2.3.2 Staffing

In 2008 and 2009, the DSWM budget included 210 full time equivalents (FTEs) for all positions. Due to the economic recession and the need to reduce the budget, the number of FTEs will be reduced to 199 in the 2010 budget. This will result in decreased services, primarily through reduced LIP and overflow collections. Table 2-2 presents the budgetary estimate of DSWM staff for 2010.

Table 2-2. 2010 Budgeted Staffing (shown in FTEs).

		REFUSE COLLECTION AND DISPOSAL							
TITLE	**Admin**	**Dumpster**	**Barrel**	**Manual**	**LIP and Overflow**	**Recycle**	**Transfer**	**Graffiti and KDB**	**Subtotal**
Management	5								5
Clerical	5					2		1	8
Program Manager/Admin/ Coordinator						2		3	5
Inspector	1							1	2
Equipment Operator		30	17	18	11	17	1		94
Operations Supervisor		3	2	3	1	2	1	1	13
Transfer Tractor Operator							6		6
Senior Utility Worker		3		30	14	1	2	7	57
Maintenance Tech		2						7	9
TOTAL	**11**	**38**	**19**	**51**	**26**	**24**	**10**	**20**	**199**

2.3.3 Equipment

DSWM utilizes a fleet of almost 200 vehicles, including collection vehicles, tractors and front-end loaders, plows, dump trucks, pickup trucks and service vehicles. Through an internal service fund arrangement, maintenance of DSWM vehicles is completed by Fleet Maintenance, a sister agency within the Department of Public Works. The service fund is based on mileage charges assessed per vehicle as well as direct charges paid by DSWM. The vehicles undergo routinely scheduled preventive maintenance, and are depreciated based on expected service lifetimes. In normal budget years, vehicles are replaced on their depreciation schedule; however, in the current economic downturn, some vehicles may be retained longer than their service contract dictates. Table 2-3 presents the 2009 fleet by vehicle or service type.

Table 2-3. Vehicle Type or Service.

VEHICLE TYPE	NUMBER
Automated Barrel	21
Manual Rear-loader	47
Automated Recycle	19
Automated Side-loader (Dumpster)	31
Transfer Tractor	7
Transfer Trailer	7
Loader	2
Graffiti Truck	8
Repair/Maintenance	6
Pickup	19
Administrative Vehicles	4
Other [a]	8
TOTAL	**179**

[a] Includes mowers, trailers and other vehicles

2.4 DSWM Service Contracts

Waste Management, Inc.

Denver has established several contractual relationships with private sector companies operating in the solid waste management field. The most significant of these are Denver's contracts with Waste Management, Inc., the largest waste management company in the country. There are two contracts associated with WMC's operation of Denver's DADS landfill in Arapahoe County[7]. These contracts include:

- The operating contract administered by Department of Environmental Health – covers royalties paid to Denver by WMC for every ton of refuse disposed of in DADS (approximately 21% of gate fees received) and joint responsibilities for on-going operation and maintenance of the Lowry Landfill Superfund Site directly adjacent to the landfill; and
- The operating contract administered by the Department of Public Works –a transfer/hauling/disposal contract that defines the pricing structure for transfer of DSWM wastes at the WMC transfer stations, hauling of transferred solid wastes, and tipping fees at DADS landfill[8].

Denver's contract with WMRA for processing and marketing recyclables was described in Section 2.3.1. The contract expires in 2015.

[7] DADS is one of the top ten largest landfills in the country in terms of tons disposed on a daily basis.

[8] This contract, intended to be a five-year agreement, could not be successfully negotiated during renewal discussions in 2009. DSWM and WMC agreed to a one-year contract covering only 2010 and requiring the contract to be renegotiated late in 2010 to cover future year(s).

Finally, both Denver International Airport (DIA) and Denver General Services administer several contracts with WMC. As these departments are not part of the SWMP, however, these contracts are not discussed further.

Other Service Contracts

DSWM has contracts in place to support services for organics, HHW, e-waste, appliances and dead animal collection.

2.5 Legal Requirements

The management and collection of solid waste is subject to legal requirements set forth in state law as well as the Home Rule Charter of the City and County of Denver, Denver municipal ordinances, and regulations adopted by the Department of Public Works. For more detailed information, please see Appendix B.

3.0 Public Involvement Survey Results

The City and County of Denver has conducted several citizen surveys during the last two years to evaluate the public's acceptance of current services and/or desire for additional services. Two of these surveys were focused on overall Denver functions, and two were focused on solid waste programs.

3.1 2008 National Citizen Survey

This survey was developed by a national third-party organization to be consistent with similar surveys conducted for 500 other local governments with populations over 300,000. The survey targeted 3,000 representative households in Denver with questions categorized in a series of topics ranging from public safety to public trust[9]. An environmental sustainability category included four questions about recycling. This survey had a 34% response rate, and findings were statistically weighted to represent the demographic composition of the city. Recycling findings included the following:

1. **Quality of collection services:** 78% of respondents rated refuse collection services good to excellent, 66% rated recycling good to excellent, and 42% rated yard waste collection as good to excellent (these values increased to 83%, 73% and 67%, respectively when all "don't know" responses were excluded).
2. **Frequency of recycling:** 82% of respondents recycled at least once in the 12 months prior to the survey.
3. **Importance of diversion:** 87% identified household recycling and yard waste diversion as very important or essential.
4. **Support of PAYT pricing:** 62% somewhat supported to strongly supported a PAYT pricing mechanism for refuse collection that charges increased fees for those who generate more refuse (that is not recycled).

3.2 2009 Denver Solid Waste Management Public Involvement Survey

DSWM intends for this Master Plan to contain discussion, decision-making and implementation of issues related to community values within Denver. Some of this discussion has already occurred during a public outreach effort in 2009; this effort is described in the Public Involvement Report[10] (the full report is included Appendix C). During this public outreach effort, DSWM sponsored five public meetings and made educational materials available to citizens on the internet. Part of the outcome of the public outreach effort was a public opinion poll available to citizens attending a meeting or accessing the educational materials online.

Based on the polling results, 88 percent of the citizens who responded endorse increased recycling. This is an example of DSWM's commitment to fostering a discussion of community values. It gauges the level of support for increasing recycling collections, and introduces the role that personal responsibility for waste management plays within Denver.

[9] This survey can be found at http://www.denvergov.org/Portals/9/documents/Denver%20DRAFT%202008.pdf
[10] Denver Solid Waste Management Public Involvement Report (HDR Engineering, July 2009).

Issues discussed at public meetings included potential changes to services and the addition of fees. Both the public meetings and on-line surveys were preceded by a short presentation designed to educate respondents about existing services and service issues. The meetings also included break-out sessions with poster-board information and staff discussions. Five public meetings in June, 2009 located throughout Denver were attended by 66 citizens. The on-line survey was taken by an additional 1,163 citizens. The combined meetings/on-line findings included:

1. **Reducing environmental impact:** 70% felt reducing the environmental impact of their personal lives was important, and 73% felt it was important for Denver to reduce the citizens' impact.
2. **Importance of recycling:** 58% of respondents felt that increased recycling/decreased landfilling was the most important solid waste system component for maintaining the health, safety and welfare of neighborhoods.
3. **Priorities in waste services:** 78% felt that – after refuse collection – recyclables collection was the top priority, 37% felt graffiti abatement was the second priority, and 39% felt that LIP collection (10 times per year) was the third priority.
4. **Mandatory Recycling:** 72% felt that recycling should be mandatory for DSWM customers (i.e., all households are provided with recycling containers and encouraged to recycle), and 84% felt that recycling should be mandatory in large residences (greater than 7 units, which DSWM does not currently service).
5. **How to pay for waste services:** 57% felt payment for DSWM services should occur through taxes (as is currently practiced), 25% felt that some services (unspecified) should be paid through direct user fees, and 18% felt that all services should be paid through user fees.
6. **Willingness to pay for services:** 62% indicated a willingness to pay for services (versus reduce services) even given current economic conditions.
7. **Service changes to offset DSWM costs:** When queried in multiple questions about what service changes to make that would off-set DSWM costs, 27% to 31% of respondents indicated that reducing LIP collection to 4 times per year (from 10 times) should be considered in a first- and second-tier rating, and 21% to 30% similarly indicated that adding yard waste diversion should be considered. In a third-tier rating of the same question, both PAYT refuse pricing (19%) and adding drop-sites for recyclables (18%) received public recommendations.

A "Denver Solid Waste Management Public Involvement Report" was developed in July 2009 to summarize this process and findings (provided in Appendix C).

3.3 2009 Denver Citizen Budget Survey

This on-line survey was conducted during the spring/summer of 2009 to obtain citizen input for developing the City and County of Denver's 2010 budget, which was expected to require significant budget cuts[11]. Responses were received from 3,712 participants, and 3,147 were used to assess results. One question gave respondents a list of 11 specific areas for reducing costs or generating revenues and

[11] The results of this survey can be found at http://www.denvergov.org/Portals/0/documents/Citywide_Budget_Survey_results_7-31-09.pdf

asked citizens to select 5 items – two of the programs pertained to new fees for solid waste services. Findings included:

1. **User fees for refuse collection:** 40% of respondents selected a property owner user fee for refuse collection as one of their top five choices – this item was the sixth most frequent selection in this response.
2. **User fees for large-item pickup:** 50% selected a property owner user fee for large LIP collections as one of their top five choices – this item was the second most frequent selection in this response.

3.4 2009 Public Input to Compost Diversion Pilot Project

With the aid of a state grant, both DSWM and DIA conducted a pilot study to collect organics[12] (the main body of the study report is included in Appendix D). DSWM's study included the diversion of yard and food waste (including food-contaminated paper) beginning in October 2008 and continuing through March 2010. A total of 3,300 households participated in the study that included weekly collection from April through November and every-other-week collection from December through March. Two surveys of pilot participants were conducted – one in November 2008 and one in January 2009 – to assess adequacy of the project start-up, participant motivation, participant understanding and logistical success. The response rates for the two surveys were 34% and 23%, respectively.

[12] Increasing Residential & Commercial Organics Waste Diversion in the City & County of Denver Final Report (HDR Engineering, August 2009).

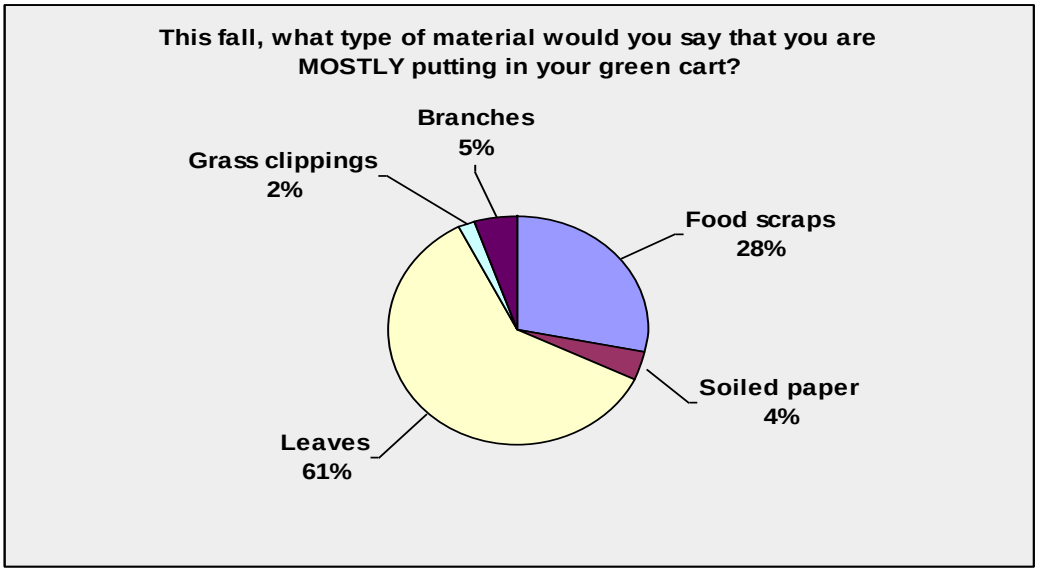
Findings included:

1. **Motivation for participating in the compost pilot study** –39% of respondents wanted to generate less refuse (see Figure 3-1).

Figure 3-1.Reason for Participation in the Pilot.

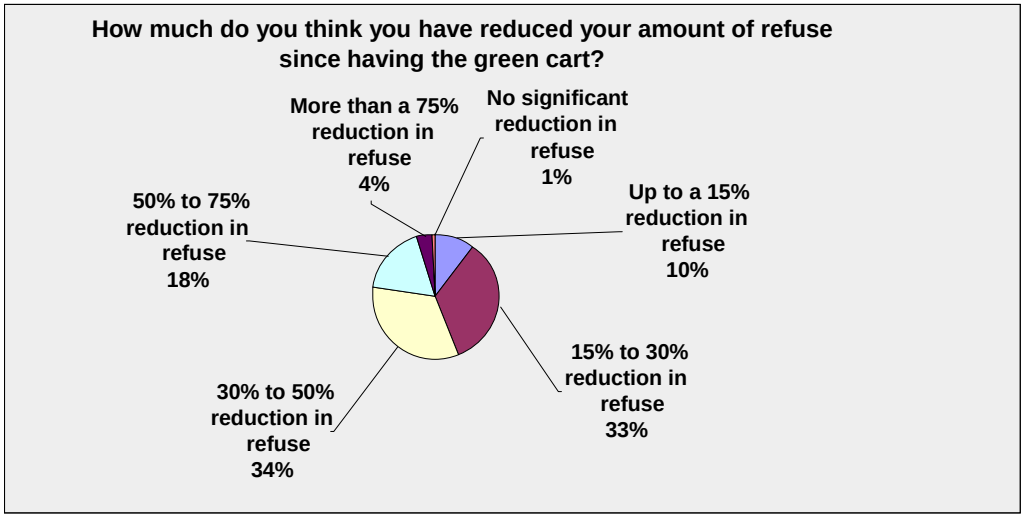
2. **Types of materials diverted** (November 2008 survey) – Respondents indicated that 61% of the material they diverted was leaves, and 28% was food scraps (see Figure 3-2).

Figure 3-2. Residents' Report of Majority of Organics Going into Green Cart.



3. **Perceived reduction in household refuse** (January 2009 survey) –56% of respondents perceived they reduced their household refuse by 30% to greater than 75% (see Figure 3-3).

Figure 3-3. Perceived Reduction of Refuse, by Percent of Respondents.



4. **Satisfaction with collection frequency.** Participants were pleased with the weekly/every-other-week schedule (41% felt that the 65-gallon cart was just barely adequate during weekly collections, while 57% felt every-other-week collection was adequate in the off-season.
5. **Liked the program.** In general, respondents were very enthusiastic about the program, were grateful to Denver for the study, and were willing to problem-solve as needed (e.g., locating carts in crowded alleys and finding creative ways to store food waste between collections).
6. **Considerations for a future program.** Some issues voiced by respondents for future consideration include liquid waste left in alleys from organics carts, squirrel damage, odors during the summer, etc.

4.0 Service and Policy Survey of Cities Comparable to Denver

As an early part of the Master Plan process (2007), DSWM commissioned a policy survey of comparable cities[13] (a full copy of the survey report is included in Appendix E). This survey was intended to determine similarities and dissimilarities in solid waste management policies among these cities, to determine how these policies had been implemented, and to learn from other cities' experiences. This section describes how Denver is similar to and differs from comparable cities.

4.1 Introduction and Methodology

The policy survey focused on five topical areas that pertained to policies and programs which were of greatest interest to DSWM in its evaluation of solid waste and environmental practices. These policy and program areas were:

- User fees;
- Yard waste collection programs;
- Refuse dumpster collection/overages/bulky items/illegal dumping;
- Residential recycling programs; and
- C&D recycling.

The communities were selected on the basis of comparable demographics and services that would have the most relevance in assisting DSWM in evaluating potential policy and program changes from its current system. The ten communities researched are provided in Table 4-1 below:

Table 4-1. Surveyed Communities.

Austin, Texas	Milwaukee, Wisconsin
Charlotte, North Carolina	Salt Lake City, Utah
Chicago, Illinois	Salt Lake County, Utah
Houston, Texas	San Diego, California
Louisville, Kentucky	Thornton, Colorado

These communities were selected to give both national and regional perspectives. All information presented in this section references programs, fees and observations in place in 2007.

4.2 General Findings

Population and Customer Statistics

The survey design focused on providing DSWM with guidance on key policy topics, therefore selected communities included diverse populations. The surveyed communities included:

- Populations ranging from 115,000 to 2,800,000 (Thornton was the smallest community surveyed, and Chicago the largest; Denver's estimated population at the time of the survey was 580,000); and

[13] Denver Strategic Solid Waste Master Plan: Policy Survey of Comparable Cities (HDR Engineering, April 2008).

- Customer bases ranging from 25,000 to 660,000 households (Denver served approximately 165,000 households at the time of the survey).

State Laws and Local Policies for Solid Waste Management

The most notable state laws, in general decreasing order of impact on local governments, include:

- Requirement for local governments to provide residential refuse collection;
- Requirement for 50% waste diversion;
- Bans on disposing of some recyclables, yard waste, white goods (e.g., kitchen appliances), universal/special wastes (e.g., electronics or pesticides) in landfills;
- Mandatory alcoholic beverage container recycling;
- Non-mandatory goal for reduced waste generation; and
- Encouragement for PAYT pricing.

Local ordinances that have a significant impact on community programs also include:

- Prohibition on charging for refuse collection;
- Requirements for citizens to use public solid waste services;
- Mandatory yard waste diversion;
- Mandatory residential and commercial recycling;
- Prohibition of container overages (out of container waste); and
- Structure for franchising or hauler licensing.

Colorado and Denver have none of these requirements or policies. Surveyed cities considered these state and local regulatory drivers important to the establishment of many of their policy-driven programs.

Landfill Tip Fees

Four of the ten communities surveyed paid landfill tip fees in 2007 that ranged between $35 and $55 per ton. Four other communities paid fees ranging from $23 to $26 per ton. Even these lower tip fees were two times the tip fees charged to Thornton and Denver (which paid $10 to $11 per ton respectively) in 2007. It was observed that these tip fees reflected the policy differences between Colorado and other state and local jurisdictions.

General Services

The communities surveyed have a number of common elements:

- All provide for collection of yard waste at some level except Thornton (DSWM has seasonal fall leaf and Treecycle collection);
- Most communities augment recycling household collection service with drop-off sites for additional recyclable materials, or to serve citizens not covered by recycling collection service (DSWM has no drop-sites beyond the seasonal organics collection); and
- Most community drop-sites provide for collection of HHW and special/universal wastes (DSWM has an on-call household service collection program for HHW).

Collection

The communities surveyed have a number of common elements:

- All communities surveyed have semi- or fully-automated refuse collection, and two thirds are fully automated (19% of DSWM's refuse is collected through manual service);
- Half of the communities have 95% of residential collection at the curb, while the other half have significant alley collection (57% of DSWM's collection is in alleys); and
- While several communities have MFU collections in dumpsters, no surveyed community has significant SFU residential collection in dumpsters (47% of DSWM's refuse is collected from dumpsters).

Costs

Table 4-2 summarizes the estimated cost structures for the surveyed communities. These cost structures were estimated based on 2007-8 budgets and estimated population served.

Table 4-2. Costs for Servicing Solid Waste in Ten Cities Surveyed (2007 data).

COMMUNITY	ANNUAL COST PER HOUSEHOLD[a,c]	ANNUAL COST PER TON[b,c]	ANNUAL TONS PER HOUSEHOLD[b,c]
Warmest Climates[d]			
Austin, TX	$150	$140	1.1
Charlotte, NC	$140	$110	1.3
Houston, TX	$160	$85	1.9
Louisville, KY	$240	$130	1.8
San Diego, CA	$180	$110	1.6
Moderate to Cold Climates			
Thornton, CO	$140	$85	1.6 (no yard waste program)
Denver, CO	$140	$90	1.6 (no yard waste program)
Coldest Climates			
Chicago, IL	$250	$110	2.2
Milwaukee, WI	$200	$120	1.7 (yard waste not included)
Salt Lake City,	$140	$80	1.8 (yard waste program starts March)
Salt Lake County, UT	$160	$90	1.9

[a] Excludes non-residential customers
[b] Excludes HHW, special and universal wastes
[c] Rounded to nearest $10 or nearest 0.1 tons; includes refuse, recyclables, and yard waste unless noted otherwise
[d] Climate impacts quantity of yard waste – warmer climates have longer growing seasons

Several observations appear to arise from Table 4-2, including:

- Salt Lake City's and Thornton's (and Denver's) low costs seem related to a lack of yard waste management and low landfill tip fees;
- Austin's and Charlotte's low cost per household reflected a low per-customer tonnage even with yard waste collection included;
- Milwaukee's high unit costs included a significant 'back door' service;

- High unit costs for Chicago, Louisville and Milwaukee included non-core solid waste services such as rodent control, special events, street sweeping, leaf collection, multiple drop-off sites, weed abatement and other (Denver's includes Keep America Beautiful/Graffiti Abatement and leaf collection); and
- Chicago, Houston and Louisville collected recyclables and yard waste which increases unit costs.

4.3 Priority Policy Findings

User Fees

Findings included:

- While six of the surveyed communities were funded through the General Fund, two included some sort of solid waste fee on property tax or another community per unit billing (e.g., property tax or water bill);
- Four communities were operated as enterprise funds and collected user fees from customers (some of these fees were based on a variable rate structure based on the number or size of containers); and
- Some community programs were augmented by other taxes.

Reduction of Overages, Bulky Wastes and Illegal Dumping

DSWM operates under the Public Works Department Manager's Rules, which define collection of overages, bulky wastes (such as LIP) and illegal dumping. The Manager's Rules place reasonable pickup of solid wastes above operational costs, so pickup of these items occurs when reasonable. The majority of surveyed communities had some reasonable standards in 2007, but generally fined or otherwise charged for repeated overages, bulky wastes or illegal dumping. These policies include:

- Eight communities used person-to-person education or warning tags to alert customers of overage or bulky item disposal (some refused to pickup after multiple violations);
- Four of these communities required (or strongly suggested) that the customer purchase additional service through large containers, tags for out-of-container bags, or recycling containers; and
- Two communities (plus Denver) simply collected these materials without fines or charges.

Increased Residential Recycling

DSWM operates a voluntary, subscription-based recycling program for household service collection of paper and containers. Other community programs included:

- Mandatory residential recycling in three communities, although only one of these (San Diego) was heavily enforced;
- Voluntary residential recycling programs in seven communities (plus Denver) - these programs had participation rates varying from approximately 45% to nearly 100% (DSWM's 2009 participation rate was 55%);
- Most recycling programs (including Denver) were single-stream with collection almost evenly split between weekly and every-other-week collections (DSWM collects recyclables every-other-week);

- Two recycling programs relied on private contract collections for all or part of their recycling; and
- Education (in appropriate languages) was critical to maintaining high diversion rates and low contamination (Denver has a bi-lingual education program).

Implementation of Commercial and C&D Recycling

Only one of the ten surveyed cities had formal commercial and C&D recycling policies other than for city-owned buildings.

4.4 Conclusions

The following key conclusions were drawn from the comparison of surveyed cities to DSWM's programs:

- DSWM is unique is relying heavily on dumpster collection of SFU refuse;
- DSWM is unique in its lack of drop-off sites for recyclables;
- Thornton and DSWM are unique in not operating a multi-seasonal yard waste program;
- In 2007, DSWM operated one of three (out of eleven) programs with unlimited overflow refuse (overflow collection was reduced in early 2010); and
- In 2007, DSWM was also one of only three programs with more than quarterly household service collection of bulky wastes (that frequency was reduced to once every nine weeks in 2010).

5.0 Future Projections

5.1 Background

In past years, the typical method for estimating future MSW generation rates was based on population projections: As population estimates increased, MSW would increase. Over the last decade, however, a number of factors have been observed to impact MSW generation in different ways. Specific factors observed in Colorado over the past decade are listed below (this list suggests a decreasing order of significance, although supporting data is not available).

1. **2001 and 2008/2009 Economic Recessions** - During recessions, residents consume less and waste less (construction and manufacturing rates are also reduced during recessions, generating less non-MSW waste).
2. **Weather** – The multi-year drought leads to decreased yard waste generation. As yard waste is nearly 30% of Denver's residential waste stream[14], this reduction can have significant impacts.
3. **Increased Paperless Communication** – As more on-line media is used, less newspaper, office paper and commercial printing waste is generated.
4. **Increased Source Reduction and Reuse** – New and on-going recycling and composting programs gradually raise awareness about the need for conservation and community commitment to the environment. As a result, residents may slowly be adopting buying strategies that generates less waste, as well as reusing some waste materials before discarding them. As these practices are especially important in a recession, they may have an increasing effect in recent years.

The first two factors are likely to cause peaks and valleys in waste generation, while the last two may be associated with long-term declines in waste generation. Taken all together, these factors may account for shifts in solid waste generation over time – shifts that could ultimately revise MSW generation from steady growth to flat or even decreasing growth despite an increasing population.

Nationally, the rate at which MSW is generated has been slowing for several years, and actually decreased in 2007 and 2008 despite an increasing population[15]. Anecdotal and hard data indicate that both landfill and diverted tons have decreased in many states. In Colorado, landfill disposal of both MSW and construction/demolition materials (measured together) has steadily increased most years, but decreased in 2008[16]. As noted in Figure 5-1 below, Denver's residential landfill tons have dropped every year since 2001, despite population growth. Appendix F includes additional details on national and state economic trends, and comparisons to national, state and Denver quantity trends.

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[14] Denver Solid Waste Management Final Report Spring/Fall 2008 Waste Composition Analysis (HDR Engineering, March 2009).
[15] US EPA's 2008 "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2007", EPA-530-F-080-18, November 2008.
[16] Colorado Department of Public Health and Environment Solid Waste Report, www.cdphe.state.co.us/hm/swreport.htm.

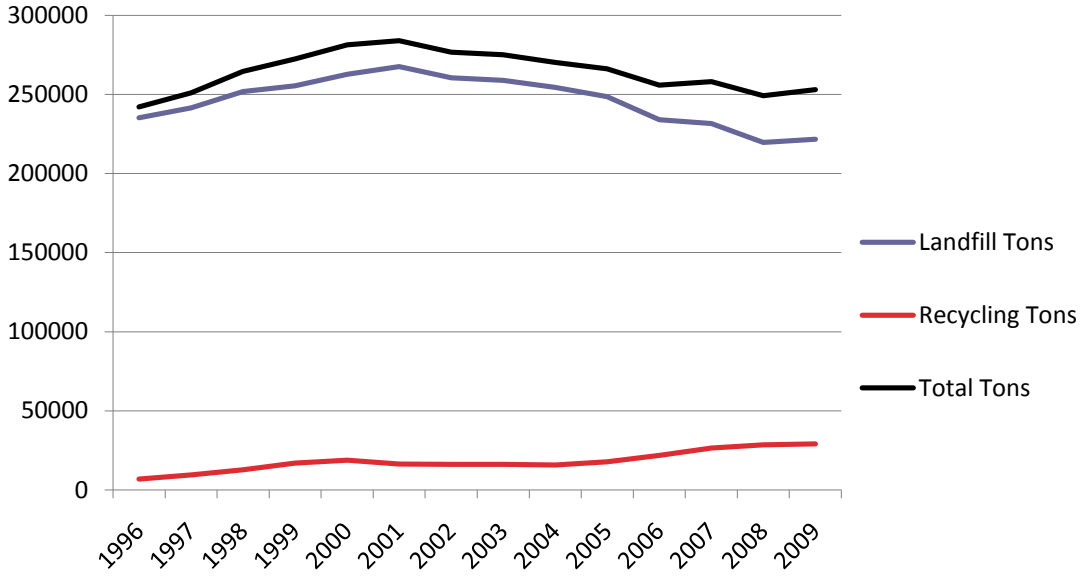
5.2 MSW Materials and Quantity Projections

A key initial task for the Denver solid waste planning effort is an estimation of future diverted and disposed tonnages that DSWM will manage over both the short- and long-term planning periods. These estimations reflect quantities generated within DSWM's service area only – single-family homes and multi-family homes with seven or fewer units. Details of these projections are included in Appendix F.

Basis for Projecting Future Quantities

Future quantity projections for the DSWM service area were based on total MSW generation. In Denver, total MSW includes recycled materials, diverted organics (currently a pilot program), landfilled tons and miscellaneous materials (e.g. electronic waste, HHW, appliances, leaves, Christmas trees, etc.). Figure 5-1 illustrates the historical quantities of these materials managed by DSWM. Linear regression analysis on the resulting total MSW data shows a decrease over time of nearly 400 tons/year[17]. When this annual change is applied to the total MSW tons observed in 2009 (253,100 tons), a projection of approximately 250,800 total MSW tons in 2015 and 245,100 tons in 2030 can be estimated. Appendix F provides additional details on these projections.

Figure 5-1. Denver Solid Waste MSW Tons.



[17] Linear trend line equation for total tons y = -382.26x + 267,185 tons.

Total MSW Tons

Table 5-1 estimates the projected total MSW tons generated in Denver through the short and long-term planning periods. These tons are the basis for all diversion calculations considered in this SWMP. These estimates remain constant over time, while diversion and landfill tons will change depending on future implementation of diversion programs.

Year 2004 data is provided as this is the baseline year used by Greenprint Denver to establish its goal of a 30% reduction in landfill tons managed by DSWM by 2030 (see Section 1.2).

Table 5-1. MSW Quantity Projections (rounded to nearest 100 tons).

	Actual	Projected						
	2004	2011	2012	2013	2014	2015	2030	2011-2030 % Change/Year
Total MSW Tons	270,194	252,300	251,900	251,600	251,200	250,800	245,100	-0.2%

6.0 System Review and Analysis

6.1 Existing Collection System Analysis

6.1.1 Standardizing Refuse Collection

Section 2.0 described DSWM's collection of residential refuse using three separate and unique collection systems. These systems have their own individual requirements to operate – and also represent several opportunities for improving efficiencies through standardization.

Customer Satisfaction DSWM tracks information, work and service requests from customers. Work requests typically include missed and late set-outs. In 2009, 1,835 requests were received concerning the manual system; 5,247 for the barrel system; and 2,962 for the dumpster system. This data indicates that, as DSWM moves to a fully automated barrel system, work requests and associated cost may increase for both refuse and recyclables collection.

Routing Efficiencies

DSMW's manual system services between 510 and 803 homes per day. This rate is based on factors such as the route density, as well as the need to service many narrow alleys and difficult-to-access addresses. Similarly, the barrel system currently collects between 780 and 960 homes per day, based on route density and hours of operation constraints such as alley service. Regardless, automated collection provides the greatest possible efficiency.

Additionally, the three systems have unique routing requirements – for instance, the barrel collection system utilizes right-hand side only path-routing, as does dumpster service. Routing for multiple systems creates more effort and oversight than if the systems were standardized.

Worker Injuries and Staffing Requirements

There are several worker-related reasons to standardize collection:

- Manual collection has greater physical demands and has higher injury rates than automated systems (in 2008, there were 26 workman's compensation injuries for manual workers compared to a total of 8 for barrel and dumpster collection systems);
- Labor costs to maintain three different collection systems (different license requirements and equipment expertise) are higher (Table 2-1 showed that DSWM's 2009 labor costs were nearly equal to all other expenses combined) - this is exacerbated by the inclusion of manual collection, which requires twice as many workers as the automated systems[18]; and
- Three different collection systems each require administrative support to maintain, which requires added coordination and training – customer service representatives must also be trained in each system, and service requests must be directed to specific collection vehicles.

[18] The manual system required 51 workers in 2009, compared to 19 for barrel and 38 for dumpster. Manual system costs were also disproportionally higher than the other systems (requiring 24% of regular refuse collection funding to service only 19% of the tons collected.

Standardizing collection to semi- and fully-automated systems is expected to provide many benefits to DSMW including:

- Reducing staff requirements (although semi-automated collection in narrow alleys would still require a driver and a laborer) and increasing production levels while providing the same levels of service;
- Reducing employee injuries (and subsequent workman's compensation costs) and improving employee working conditions; and
- Generally reducing operating expenses.

Fleet Requirements

Each of the three collection systems requires vehicles that cannot be interchanged. This forces DSWM to maintain three separate fleets of collection vehicles including required spare vehicles (typically spare ratios can range between 15 and 20 percent of the front-line fleet). For each system, maintenance functions are also required to stock separate parts, have trained technicians, and maintain the necessary support equipment such as container delivery vehicles, pickup trucks, and repair vehicles. Additionally, the specialized side-loaders used for dumpster collection are more expensive to maintain (i.e., DSWM paid $3.90 per mile in Fleet Maintenance charges in 2009 for dumpster side-loaders, versus $3.80 per mile for standard side-load vehicles). Standardizing a fleet that focuses on fully automated vehicles (with some semi-automated collection for narrow alley neighborhoods), would notably minimize these requirements.

It is also important to note that rear-load vehicles can be easily adapted for semi-automated operation by adding container tipping devices. This modification would then support providing manual neighborhoods with 95-gallon refuse containers and providing barrel collection service. DSWM could therefore continue to service the narrow alley neighborhoods with the smaller rear-load vehicles.

Container Requirements

Current system inefficiencies include:

- Many manual households generate multiple small bags, which increase collection times and worker injuries;
- Beyond manual collection, DSWM must maintain two container types (barrels and dumpsters);
    - Barrels can be easily moved by hand and transported via a pickup truck whereas dumpsters require specialized equipment to transport;
    - Barrels can generally be repaired in the field - some dumpster repair must be completed at a centralized DSWM dumpster maintenance center with skilled labor;
    - Plastic barrels require simple tools to assemble, require little maintenance, and have a 15-year life expectancy (10-year warranty) whereas metal dumpsters require welding, fabrication, and painting for repair and maintenance, and have a life expectancy of approximately 10 years; and
- Dumpster collection appears to be associated with more illegal dumping than the other systems – this waste likely comes from non-residents and some of Denver's non-residential generators who don't receive the same services Denver residents receive.

Standardizing the refuse system with a focus on fully automated collection would allow the use of 95-gallon plastic containers. The containers would offer reduced collection times and greater worker safety over manual collection, and would require less maintenance than dumpsters.

Waste Generation

DSWM's dumpster system results in the highest collection efficiency of all three systems (a driver can collect more tons in a unit of time). However, this system also collects more refuse per household than the other two systems. In 2008, the average household refuse generation rate was 1.60 tons per year in dumpster homes (compared to 1.24 tons/year for barrel system homes and 0.85 tons/year for manual homes). Based on observations and high generation rates it is believed that residents with large, shared refuse dumpsters do not reduce their waste generation or recycle/compost as much as other residents. In addition, dumpsters can encourage illegal dumping by generators outside the service area, as well as overflows and litter. Since no single household "owns" the dumpster, there is a general lack of ownership and residents don't feel obligated to inform DSWM if they see illegal dumping or "trashing" of the alley. Standardizing collection to exclude dumpster service may alleviate these issues as each resident will have their own container and more direct responsibility for individual waste management.

6.1.2 Ancillary Refuse Collection

One of the hallmarks of Denver Solid Waste Management is its commitment to providing a high level of service to its customers. As described previously, DSWM collects large items and barrel overflows at no direct charge to the resident. While the frequency of these collections adheres to a set schedule, the quantity of items accepted (5 large items every nine weeks, and 10 bags of overflow plus 10 bundles of branches every three weeks) is significant. Similarly, DSWM tries to accommodate late set-outs on the same day of service, as well as addresses most customer complaints and service requests within two to three days of receipt. All of these services are provided at no direct cost to the resident, but do increase DSMW's cost of operation.

Large Item Pickup

Manual LIP is labor and time intensive. Material density and size can hamper collection efficiency as bulky waste does not lend itself to high rates of compaction, forcing collection vehicles to make additional disposal trips compared to a similar number of customers with refuse-only setouts. Requirements to reduce LIP frequency would reduce DSWM operating costs and encourage more diversion. The addition of drop-sites that accept large items from generators is expected to off-set a reduced LIP frequency.

Overflow Collection

This practice delivers a high level of service, but defeats the purpose of automated collection, which is designed to keep operators in their vehicles in order to maximize production and safety. Switching from manual to barrel service does add an element of volume constraint, as the containers have a finite capacity of 95 gallons. Rather than add an additional route system of labor and equipment to accommodate the overflow, outreach can be used to educate residents that recycling and compost collection programs are available to divert a percentage of their waste stream. In cases where large

families and high generators still cannot be accommodated with the 95-gallon refuse container and 65-gallon recycling cart, additional containers can be made available. The operating costs associated with providing and emptying additional barrels at the time of regular collection are lower than the costs associated with a separate system of rear-load collection and the workers required to collect overflow manually.

Enforcement

Changes to collection services or service frequency can often be met with resistance – most notably in the form of illegal dumping, at least in the short-term following implementation (as noted previously, illegal dumping is already an issue in neighborhoods with dumpsters) and littered alleys when large items and overflows are stored for long periods between collections. In order to enforce service changes, control illegal dumping, and maintain clean alleys, it is likely that DSWM would need to add enforcement capability (current enforcement staff is less than one FTE). This may take the form of additional personnel or shifting enforcement responsibilities from other city departments with code enforcement capability. Ideally, new policies (such as modifications to the Public Works Manager's Rules for solid waste) could address enforcement, and DSWM's public outreach program could be expanded to address these changes proactively.

6.1.3 Recyclables Collection

DSWM's voluntary, subscription-based recycling program had a participation rate of 55% in 2009. While these subscribers arguably are committed recyclers,[19] service to only half of the DSWM's service area decreases collection efficiency as route density is not maximized. The reasons for this rate may include a relatively new single-stream collection program (not fully implemented until 2007), as well as the lack of a direct financial incentive for Denver residents to recycle.

While a mandatory recycling program is an option, it would likely decrease overall set out rates and weights per household. To achieve the increased participation of a mandate, but still maintain a subscription-based program with high participation, targeted outreach can be employed to increase subscriptions and "fill in" those routes that require improved production. Adding homes to existing routes would increase the workload of each route incrementally, increasing payloads and homes collected per route while keeping overhead costs unchanged.

6.1.4 Other

There are a few miscellaneous operational features that may contribute some level of inefficiencies to DSWM's on-going programs.

Operation of Four Geographical Camps

DSWM utilizes four camps for the operation of its refuse collection and recycling collection systems. Each camp stores, fuels and maintains the equipment for the routes in its quadrant, and serves as a base of operations for those fleets. In addition, each camp serves ancillary functions: Cherry Creek (SE) also

[19] As of October 2009, subscribers had an average set-out rate of 79% and recycled an average 30 pounds per household on their collection days.

includes Denver's transfer station; Osage (SW) includes the dumpster maintenance center; Platte Campus (NW) is DSWM's headquarters and operations center for Recycling, and graffiti abatement, and Roslyn (NE) is the primary operations location for Fleet Maintenance.

This multi-camp operation may create additional operational challenges associated with segregated worker groups and geographically inefficient operation centers (e.g., the dumpster maintenance center at Osage). Potential inefficiencies should be evaluated (possibly in tandem with an assessment of DSWM's refuse transfer operations) to identify potential improvements.

Drop-Site Collections

There are currently no City owned or operated drop-sites for the delivery of refuse and recycling or other materials by residents. Drop-sites can augment existing collection systems,[20] and provide residents with options for managing their waste. Refuse (especially large, bulky items), recyclables, organics (especially yard waste) and other materials can be accepted at drop-sites. Program information kiosks at drop-sites can help educate residents. Depending on the level of participation, drop-sites can be staffed or unstaffed, have controlled access (fences or gates) or be open for use at residents' own risk. Staffed sites are recommended to control litter and contamination, and minimize public risk and maximize education.

Hauler Licensing and Collection Requirements

Currently, DSWM has direct control over the waste it collects and transports. It does not, however, have a mechanism to control the collection, transport, and disposal of other non-residential waste generated in Denver but managed by private haulers (other than state requirements for covered loads and City noise ordinance). Denver also has limited registration requirements for small haulers, and there are no requirements that proscribe the minimum standards a hauler must achieve. As a result, Denver does not have substantive control over impacts to public health, the environment, and human safety associated with private sector collection. Nor does it have control over the services haulers would be required to offer, quantities managed, the safe handling and disposal of waste, vehicle safety inspections, covered loads, or emergency responses.

Many communities have implemented hauler licensing and collection requirements that address these components. Additional policy features often include:

- Designating roads that haulers can use as thoroughfares and through-truck routes to limit noise and improve traffic safety on local roads;
- Creating a mechanism for mandating and/or incentivizing waste diversion activities;
- Requiring reporting the quantity of refuse and recyclables collected, disposed or processed on a regular basis (needed to calculate generation, diversion, and recycling rates to support planning efforts);

[20] Drop sites should not replace door-to-door programs for recyclables or large item collection. Drop site typically generate lower per-capita recycling quantities than door-to-door programs. And some generators of large items do not have the means to haul materials to drop site locations.

- Requiring customer lists and pricing ranges (without violating confidentiality requirements) to assist with consumer affairs issues and hold haulers accountable for providing a minimum level of service to avoid overloads and unsafe conditions; and
- Fees to cover the costs to license and enforce hauler requirements, as well as conduct any necessary inspections.

Waste Composition Study Observations

DSWM conducted a two-season spring/fall residential waste composition study (WCS) in 2008[21] (the main body of the report is included in Appendix G). The purpose of the WCS was to analyze the effectiveness of the existing Denver recycling program and evaluate materials potentially targeted by a future compost collection program. The aggregated spring and fall WCS results were used to develop an estimate of Denver's annual average waste stream. Key observations included:

- The organic material category included the greatest quantity at 57.2% by weight – with food waste at 13.7% and yard waste at 28.7%;
- Dumpster routes generated the greatest amount of organics during the spring season, followed by barrel routes; and
- Single-Stream Paper included mostly cardboard and newspaper by weight.

The primary recommendation from the 2008 WCS was for an evaluation into the feasibility of adding a permanent compost collection program to DSWM's service area. A secondary recommendation was to expand public outreach to increase the diversion of recyclables and launch new diversion programs effectively.

Public Input Observations

Section 3.0 discussed the input from Denver residents on DSWM's current and future services. Residents were generally satisfied with existing services, although a high percentage of respondents from each of the four surveys described previously indicated that household recycling and even yard waste diversion are a high priority. DSWM's own 2009 survey (completed as part of the SWMP research) showed a strong preference for mandatory recycling in all residences (including large MFUs). Survey results also provided input on how residents would be willing to pay for expanded systems (i.e., more recycling, new compost collection and drop-sites), indicating a mixed willingness to pay directly for services and accept reduced services (such as less frequent LIP). These results suggest reasonably strong support for new and expanded diversion programs in Denver in the short-term planning period.

[21] Denver Solid Waste Management Final Report Spring/Fall 2008 Waste Composition Analysis (HDR Engineering, March 2009).

Comparable City Survey Observations

Section 4.0 summarized comparisons of DSWM's programs with ten other U.S. cities. It highlighted Denver's uniqueness in using dumpsters to collect residential refuse and in its frequent LIP and in its generous overflow collections. It also showed that Denver was unique in terms of not yet developing drop-site and yard waste collections. Each of these features (or lack of features) has pros and cons that extend the gap between customer service and cost. Each should be evaluated for opportunities to improve the balance between these two program metrics during the short-term.

Part Two – Short-Term Programs

Part Two of the SWMP evaluates seven short-term program improvements for DSWM's future solid waste management service program. The short-term planning period under consideration extends through Phase 5. The analysis addresses:

- Section 7.0 – Standardized Refuse Collection and Expanded Collection of Diverted Materials;
- Section 8.0 – Reduced LIP and Refuse Overflow Collection;
- Section 9.0 – New Drop-Site Collection;
- Section 10.0 – New Private Hauler Licensing and Collection Policy;
- Section 11.0 – New Restaurant Diversion Policy;
- Section 12.0 – Large MFU Generator Refuse Collection Verification Program; and
- Section 13.0 – Continued HHW Program with Expanded Paint Collection.

In addition, Section 14.0 includes an assessment of the new public education and outreach program components needed to successfully implement the short-term improvement programs. Section 15.0 provides a Short-Term Program Improvements Summary.

The detailed implementation, policy and cost information provided in Part 2 will be used to help DSWM determine a specific strategy for implementing improvements within a 5-phase implementation period.

7.0 Standardized Refuse Collection & Expanded Collection of Diverted Materials

This section evaluates transitioning DSWM's three-component refuse collection to a single system, as well as expanding recyclables collection and adding household collection of organics. Standardizing collection will provide the city with numerous efficiency and cost benefits. Increasing diversion will result in extended DADS landfill life, greater environmental sustainability and quicker achievement of the Greenprint Denver goal.

7.1 Introduction

This program considers three key components regarding automated refuse collection and collection of diverted materials:

1. Automated Refuse Collection:
   - Standardizing all weekly refuse collection to fully automated barrel service, which requires providing new carts to residents and adding new automated collection vehicles and includes an exception for narrow alley neighborhoods (which will receive new carts that will be collected with semi-automated vehicles).
2. Collection of Diverted Materials:
   - Continuing to increase households subscribing to single-stream recycling service, which requires providing containers to new households and adding automated collection vehicles as needed (every-other-week collection); and
   - Adding household service collection of yard waste, food waste and food-soiled paper on a subscription basis, which requires providing new containers to new households and adding new automated collection vehicles (weekly collection from April through November and every-other-week collection from December through March).

Automated Refuse Collection
DSWM's daily refuse collection program represents 67% of its budget. Currently, 19% of refuse managed by DSWM is collected from manual service areas and 47% is collected from dumpster areas (31% is already collected via automated barrel collection and the remaining 3% is LIP). Section 6.1 described the customer service, labor, worker safety and equipment issues that underscore the inefficiencies of maintaining three separate systems – and of manual and dumpster service, in particular. To summarize, developing a standardized, automated system would provide DSWM with:

- Greater collection productivity (households served per day) resulting in larger routes, fewer vehicles and less labor (especially compared to the manual system);
- Reduced staff required to manage illegal dumping, litter and maintain dumpsters;
- Reduced worker injuries (especially from manual system);
- Elimination of specialized side-loaders used in dumpster areas (which cost DSWM $0.17 more per mile in Fleet Maintenance charges than the standard side-load vehicles, and have only a 5- versus a 6-year life);

- Fewer spare vehicles required;
- Ability to convert existing rear-load vehicles currently used for manual collection to semi-automated collection by adding cart tippers or other lift mechanism;
- Increased interchangeability between all collection vehicles – semi-automated rear-loaders can service any barrel area if needed, and all vehicles can be used to service refuse, recycling and compost collection carts;
- Standardized tipping requirements at the city and other transfer stations (i.e., standardized versus three types of vehicles);
- Reduced container maintenance (especially in dumpster areas);
- Consistent service throughout the city, generating fewer customer service requests associated with illegal dumping and cleaner alleys; and
- Consistent educational messages throughout the City.

Collection of Diverted Materials

According to DSWM's waste composition study (Appendix G)[22], 21.3% of residential refuse was single-stream recyclables, and 42.4% was yard and food waste. Continuing to grow the existing subscription program for recyclables collection (currently at a 55% participation level) and adding household service collection for organics will:

- Reduce requirements to collect, transfer and dispose of refuse;
- Increase efficiencies by utilizing fully automated collection;
- Avoid landfill tip fees and generate recyclables revenues;
- Reduce Denver's carbon footprint and reach the Denver Greenprint goal (Section 1.2);
- Follow recommendations in both the 2008 waste composition study and the 2009 report on the pilot compost program,[23] which both strongly recommended the addition of permanent household collection of organics; and
- Respond to citizen survey findings which supported increased recycling and compost programs.

7.2 Implementation

7.2.1 Applicability

Both components of this program would address services provided to DSWM's residential service area (all SFUs and MFUs with seven or fewer units).

Automated Refuse Collection

As of October 2009, 48,461 (28.6 %) homes received refuse service from the manual system, while 65,250 (38.5 %) homes were served by dumpsters. In accordance with this improvement option, a majority of these SFUs and MFUs would be switched to automated service by Phase 5 (a minority percentage of each service area would include narrow alleys, which require semi-automation). Table 7-1

[22] Denver Solid Waste Management Spring/Fall 2008 Waste Composition Analysis (HDR Engineering, March 2009).
[23] Waste Composition Analysis (2009) and the Increasing Residential and Commercial Organics Waste Diversion in the City and County of Denver (Denver Solid Waste Management Division and Denver International Airport, August 2009).

includes an estimate of how many homes would have their service switched each year during the five-phase planning period.

Collection of Diverted Materials

As of October 2009, 95,317 homes were subscribed to recyclables collection. This subscription rate is expected to grow steadily. Denver's composting pilot program is scheduled to continue into 2010, after which time current pilot program participants may continue collection at a rate of $117 per year. Should this program eventually be implemented city-wide, it is expected to grow at a rate similar to the single-stream recycling program since its implementation in 2005 (see Tables 5-1 and 5-3). The service area for this program would include the same SFUs and small MFUs (seven or fewer units) that are currently served by DSWM's refuse and recycling programs. Table 7-3 estimates the growth of a compost collection program in the short-term.

7.2.2 Policy Development

Before implementing the program improvements and additions described in this section, DSWM will need to consider the following activities:

- Final cost-estimating and budget approval;
- Legal review and possible policy change;
- Fleet replacement schedules;
- New vehicle and container procurement;
- Coordination with contractors for tipping additional recyclables and compost;
- Staff re-deployment; and
- Routing modifications.

7.2.3 Phased Implementation

Table 7-1 includes the potential phased implementation established for the purpose of evaluating this option.

Table 7-1. Phased Implementation for Standardizing Refuse Collection and Expanding the Diversion Collection System.

Service Change	Ph 1	Ph 2	Ph 3	Ph 4	Ph 5
Switching Manual & Dumpster Households to Automated Barrel Service (% of households switched) [a]	10%	25%	20%	25%	20%
Expand Existing Recycling Program (% of households added)	20%	20%	20%	20%	20%
Add Organics Collection Program (% of households added)	20%	40%	15%	15%	10%

[a] Applies to both regular and narrow alley neighborhoods

Automated Refuse Collection

For the refuse system conversion, it is expected that DSWM will:

- Modify newer rear-load vehicles (less than about five years old) for semi-automated collection by adding cart tippers or other lift mechanism;
- Utilize phased out rear-load and standard side-load vehicles for spares – replaced side-loaders may be used initially in the new compost program;
- Phase in new 95-gallon carts and side-loaders per fleet replacement schedule;
- Evaluate the ability to trade in dumpster side-loaders for new vehicle purchases (the current limited market may make it difficult to sell these specialized vehicles);
- Remove and recycle/sell metal dumpsters for scrap value;
- Optimize routes (increasing the number of households per route); and
- Re-allocate laborers from collection to other tasks (and reduce positions through attrition).

Table 7-2. Estimated Households Impacted by Refuse Collection System Changes (rounded to nearest 100).[a]

Service Change		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Total Households in DSWM's Service Area Receiving Refuse Collection		175,300	178,000	180,500	182,800	184,400	184,400
Provide Manual and Dumpster Households with Automated Carts for Barrel Service[b]		12,400	30,900	24,700	30,900	24,700	123,700
Convert Manual Households to Barrel Collection							
	Regular (convert to automated)[c]	3,700	9,300	7,400	9,300	7,400	37,200
	Narrow Alleys (convert to semi-automated)[d]	1,500	3,900	3,100	3,900	3,100	15,400
Convert Dumpster Households to Barrel Collection							
	Regular (convert to automated)[e]	6,200	15,600	12,500	15,600	12,500	62,400
	Narrow Alleys (convert to semi-automated)[f]	900	2,200	1,800	2,200	1,800	8,800

[a] Based on five phases to reach total households (Table 7-1) – some summations do not match subtotals due to rounding error
[b] Total households escalated based on CO State Demography Office projections (October 2009); 67.1% of service area receives manual or dumpster service
[c] 28.5% of service area receives manual service; 70.7% of manual customers are regular (no narrow alleys)
[d] 29.3% of manual customers have narrow alleys
[e] 38.6% of service area receives dumpster service; 87.7% of dumpster customers are regular (no narrow alleys)
[f] 12.3% of dumpster customers have narrow alleys

Collection of Diverted Materials

The expanding recycling and new composting collection programs would both require:

- On-going cart purchase – 65 or 95-gallon carts would be used for both the recycling and compost programs (including using the 3,300 compost pilot study carts);
- On-going vehicle purchases (retired side-loaders may provide initial service, especially for compost collection);
- On-going routing evaluation;
- On-going staffing adjustments to accommodate regular growth; and
- On-going marketing/education/ administration/management.

Table 7-3. Estimated Households Impacted by Continued Recycling and New Organics Collection Services (rounded to nearest 100).[a]

Program	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Total Households Receiving Recycling & Compost Collection in DSWM's Service Area[b]	172,900	175,400	178,000	180,300	181,800	181,800
Continued Growth of Existing Household Recycling Collection Program (newly subscribed households only)[c]	4,600	4,600	4,600	4,600	4,600	22,900
New Household Compost Collection Program[d]	20,000	40,000	15,000	15,000	10,000	100,000

[a] Some summations don't match subtotals due to rounding errors
[b] DSWM currently provides recycling to slightly fewer households than refuse (therefore, the total number of households served differs from Table 7-2)
[c] Based on five phases of 2015 total households (Table 7-1); 95,317 homes were subscribed in 2009
[d] Based on five phases of 2015 total households (Table 7-1); no permanent collection prior to Phase 1

The household estimates in Table 7-2 apply the phased implementation established by DSWM for the diversion programs for the purposes of this evaluation (Table 7-1) to 2015 projections made in Tables 5-2 and 5-3.

7.2.4 Implementation Challenges

Replacement of Current Fleet

The phased implementation schedule presented in Tables 7-2 and 7-3 may not be strictly consistent with a routine practice of replacing existing equipment at the end of its life. If this schedule is ultimately implemented, it is likely that DSWM will evaluate the proposed phasing plan to balance routine vehicle replacement with the need to minimize on-going maintenance costs (the specialized dumpster side-loaders are more expensive to maintain). Additionally, the number of households scheduled for conversion may fluctuate to a small degree as new collection route sizes (measured by the total number of homes serviced) are established to maximize new vehicle capacity. It is noted that:

- DSWM replaces its rear-load collection vehicles every eight years;
  - Up to 30 existing units are scheduled for replacement prior to 2011
  - Twelve are scheduled for replacement during the short-term planning period, which are projected to be eliminated as manual routes are converted to automated/semi-automated service
  - Another ten are not currently scheduled for replacement until 2017
- DSWM replaces its dumpster side-load collection vehicles every five years; and
  - Seventeen existing units are scheduled for replacement prior to 2011
  - The remaining 14 units are scheduled for replacement between 2011 and 2015, which are projected to be eliminated as dumpster routes are converted to automated/semi-automated service
- DSWM replaces its standard side-load collection vehicles every six years.

To meet the project phasing of automated collection, DSWM would need to accelerate the replacement schedule of the rear-load collection vehicles with standard side-load vehicles. Dumpster side-load collection vehicles scheduled for replacement prior to 2011 need to be carefully evaluated. If possible, replacement of certain vehicles should be delayed to better match the phased implementation established by DSWM (and used for the purposes of this evaluation). Some of the new rear-loaders scheduled for replacement prior to 2011 could be ordered with the modified attachment in anticipation of semi-automated collection. In this manner, the modified rear-loaders could be operated in manual collection mode until the conversion of those manual routes to automated and semi-automated collection.

Re-Deploying Staff

With the implementation of automated collection systems, the previous collection systems would be eliminated. Where labor categories are suitable (or where employees are willing to obtain additional training and licensing), it is expected that crews from manual and dumpster systems would be re-deployed to automated and semi-automated refuse collection, as well as to recyclables and organics collection. As the collection programs become automated and more efficient, route numbers (and collection staff) totals would decrease. It is expected that DSWM would reduce collection staff as needed through attrition over the short-term planning period.

Facility Capacity

DSWM will need to secure processing capacity to manage the recyclables and organics diverted through this option (as well as other diversion practices described in subsequent sections). It is expected that the capacity needs would be filled using either existing facilities, or new alternatives that provide equivalent capacity and services.

Materials Recovery Facility (MRF) **-** DSWM currently contracts with WMRA for processing and marketing of collected single-stream recyclables at WMRA's MRF in north Denver. WMRA pays DSWM $33 per ton for 95% of the recyclables delivered (this percentage accounts for expected contamination by non-recyclables), as well as an up-market payment when secondary materials markets are strong. WMRA will be completing renovations on the MRF in early 2010, after which the annual capacity of the facility is expected to be 180,000 tons per year (based on two shifts per day). Although it is unknown how much of this capacity WRMA has committed through its own collections or through contracts with generators and haulers other than DSWM, the remaining capacity is expected to accommodate any quantity that DSWM may generate in the short-term.

Composting Facility - Current composting facility options for yard and food waste processing is limited to the A1 Organics' Rattler Ridge facility in Keenesburg (approximately 38 miles from Stapleton, where A1 operates a transfer station). A1 also operates a yard waste processing facility at Stapleton. A1 is currently partnering with DSWM on its pilot compost collection program, utilizing the Stapleton transfer

operation (A1's contract includes preprocessing, transfer, hauling between Stapleton and Keenesburg, and processing).

It is probable that a new compost facility would be developed by WMC at the DADS landfill as early as 2010. It is possible that A1 Organics would be the contract operator of this facility, and that both yard and food waste would be accepted. Capacity, operating constraints and cost information is unavailable at this time. DADS is located about 13 miles from DSWM's Cherry Creek Transfer Station, which may be a potential compost transfer location if and when composting operations are initiated in southeast Denver.

For the purposes of estimating costs in the short-term, it is assumed that DSWM would tip organics at A1 Organics' Stapleton transfer station for a fee of approximately $27 per ton, including both transfer (from Stapleton) and processing costs. It is also assumed that DSWM would earn no revenue from the sale of compost products and would partner with the compost vendor in product distribution.

Customer Opposition to Switching to Automated Collection
Some of the households that currently utilize dumpsters with virtually unlimited refuse collection are expected to be opposed to the conversion to smaller, 95-gallon carts as well as the increased individual responsibility for solid waste management. Ways to mitigate this resistance include:

- Phase implementation over five years;
- Develop a focused public outreach plan that explains that resources are saved by converting to automated collection ;
- Add alternative collection programs (e.g. household collection for organics and drop-site collection);
- Provide education on waste diversion programs; and
- Offer early and on-going notification.

Recyclables and Compost Subscriptions
As noted in Section 6.1, the voluntary nature of DSWM's recycling program yields only partial participation and results in uneven route densities. The same would likely occur with a subscription-based compost program. This issue would ideally be addressed through focused public outreach that targets increased subscription within specific routes (recycling) and generates new subscribers in specific sectors of the city (organics) to continually increase the collection efficiency of these programs.

Organics Collection
Even with a new organics collection program, residents would continue to generate yard waste that will not fit in the 65 or 95-gallon carts (e.g. branches and stumps). These materials would continue to require LIP service. Additional collection of these materials may be provided through drop-sites in the future (see Section 9.0) for those with the ability to transport material to centralized locations. Public education would be an important component of implementing a new city-wide organics program.

7.2.5 Diversion Potential

Recyclables

DSWM's current household recyclables program includes every-other-week collection of single-stream (fully commingled paper, cardboard and container) materials. It is important to evaluate historical program parameters to assist in estimating future recyclable quantities. DSWM's recycling program has grown steadily since its implementation in 1991, and is expected to continue to grow in the future. Table 7-4 includes available performance data for this program to date.

Table 7-4. Historical Denver Recycles Program Data.

YEAR[a]	Year-End Subscribers[b]	Number of Subscribers (% of Eligible HHs)	Average Pounds/Set-Out[c]
2004	80,987	not available	35.6
2005[b]	80,555	not available	34.1
2006	66,298	not available	38.1
2007	76,841	44.5%	39.7
2008	87,227	49.8%	34.4
2009 (through mid-October)	95,317	54.9%	30.0

[a] Phasing in of Denver's single-stream recycling program began mid-2005
[b] Drop-in participation may be due to improved tracking in 2005/2006 with implementation of single-stream program
[c] Average set-out rates ranged from 42.9% in 2004 to 79.2% in 2009
HHS = households

Table 7-5 includes projected recyclables for the short-term planning period, which includes continuation of the existing program. Potential tons diverted by adding recyclables, increasing the collection frequency or adding drop-site collections are not considered.

Table 7-5. Projected Recyclable Program Participation (rounded to nearest 100 tons).

		Future Program Assumptions[a]				
	2010	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**
Subscriber (% of Eligible Households)[b]	55%	57%	59%	61%	63%	65%
Eligible Households[c]	170,277	172,900	175,400	178,000	180,300	181,800
Pounds/Set-Out[d]	31	30	29	29	29	29
Total Tons	**29,600**	**30,000**	**30,400**	**31,900**	**33,400**	**34,700**

[a] Assumptions for increases in subscriber and set-out rates are based on observations from the existing program and knowledge of other U.S. household recycling collection programs
[b] Subscription rate increase corresponds to 20%/20%/20%/20%/20% implementation during short-term
[c] Based on current service area (only 98.6% of Denver's service area is eligible for recycling services) and Colorado State Demography office population projections (October 2009); 2030 households were capped given known property constraints
[d] Future set-out rates assumed to be 78% in short-term and 80% by 2030

Organics

DSWM's current organics collection program is a pilot study begun in 2008 and ending in 2010. Approximately 3,300 homes participated in the diversion of yard waste, food waste and food-contaminated paper. Pilot collection was weekly between April and November, and every-other-week between December and March. Beginning later in 2010, pilot participants will be allowed to purchase on-going organics collection.

For planning purposes, it is assumed that a permanent household organics collection program would be similar to the existing recycling program. It would be subscription-based, have the same operating parameters as the pilot, and would grow similar to the recycling program (see Table 7-4). Table 7-6 includes short- and long-term quantity projections. Quantities do not consider potential future drop-site collection.

Table 7-6. Projected Organic Program Participation (rounded to nearest 100 tons).

			Future Program Assumptions[a]				
		2010	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Subscriber (% of Eligible Households)[b]		2%	11%	33%	41%	50%	55%
Eligible Households[c]		170,277	172,900	175,400	178,000	180,300	181,800
Pounds/ Set-Out[d]	Weekly Collection: (April-Nov)	31	20	20	20	20	20
	Every-Other-Week Collection: (Dec-March)	13	9	9	9	9	9
Total Tons		1,400	2,900	11,200	16,900	24,300	30,900

[a] Assumptions for subscriber and set-out rates based on observations from the pilot program, the existing recycling program, and knowledge of other U.S. household service collection programs

[b] Subscription rate increase corresponds to 20%/40%/15%/15%/10% implementation during short-term

[c] Based on current service area (98.6% of Denver's service area is eligible for recycling services) and Colorado State Demography office population projections (October 2009); 2030 households were capped given known property constraints

[b] The 2009 pilot set-out rates were 61% (weekly) to 65% (every-other-week); future rates assumed to be 40-80% for both weekly and every-other-week collection in short-term and 80% for all collections by 2030

HHS = households

Future Program Diversion Potential

Table 7-7 focuses on those "new" recyclables and organic quantities diverted between Phase 1 and Phase 5 only. It is assumed that 2010 recyclable quantities will be approximately 29,600 tons (29,116 tons were collected in 2009) and organic quantities will be 1,400 (based on the assumption that pilot households will subscribe at same rate as in pilot study). Therefore, Table 7-7 estimates those tons generated above the 2010 thresholds.

Table 7-7. Estimated New Recyclable & Organic Quantities Diverted (rounded to nearest 100 tons).

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Recyclables[a] (generated by newly subscribed households only)	400	800	2,300	3,800	5,100
Organics[b] (generated by newly subscribed households only)	1,500	9,800	15,500	22,900	29,500
Total	**1,900**	**10,600**	**17,800**	**26,700**	**34,600**
Estimated Total Waste Generation from DSWM Service Area[d]	252,300	251,900	251,600	251,200	250,800
Diversion Potential for Tons Added After 2010	**<1%**	**4%**	**7%**	**11%**	**14%**

[a] Based on subscription and set-out assumptions in Table 7-5
[b] Based on subscription and set-out assumptions in Table 7-6
[c] Assumed 2010 diversion of 29,600 tons of recyclables and 1,400 tons of organics
[d] See Table 5-1

7.3 Estimated New Costs

This section summarizes the amortized capital and operating costs for standardizing DSWM's refuse collection program and expanding recyclables/adding organics collection, respectively. These program changes would be phased in five phases. Estimates are based on number of households whose refuse or diversion collection service would be changed and the expected productivity rate (measured by the number of household collections per route).

Automated Refuse Collection

The estimates for standardizing weekly refuse collection (Table 7-8) are based upon the housing calculations presented in Table 7-2 (details are provided in Appendix H) – capital costs are amortized under Annual O&M costs. Phased in over the short-term planning period, these estimates include the following assumptions:

- These costs are considered "new" in Table7-8 as they represent additional service beyond existing collection practices – they are balanced by cost savings in Table 7-11 which reflect a reduction in existing capital and annual expenses;
- Refuse collection productivity rate ranging from 850 to 1,000 households per fully automated route, reflecting increased diversion between Phase 1 and Phase 5 (as refuse tons decrease, productivity rate increases) – steady rate of 750 households per semi-automated route;
- Addition of 25 new automated barrel routes and new standard side-load vehicles by Phase 5 (plus 20% spares of four new standard side-load vehicles);
- Addition of nine new semi-automated routes with modified rear-load vehicles by Phase 5 (plus 20% spares of two more modified rear-load vehicles);

- A total of 25 Equipment Operator Specialists (barrel route drivers), nine Equipment Operators and nine Senior Utility Workers (semi-automated route drivers) and one new Safety Officer[24] (Program Administrator labor category) with 38% benefits;
- Vehicles amortized over 6 years (automated side-loaders) and eight years (modified rear-loaders) at 5% interest rate;
- Other costs include Fleet Maintenance for vehicles[25], annual purchase/delivery of 95-gallon refuse carts, dumpster removal, marketing and education.

Table 7-8. Estimated New Costs Associated with Standardizing Refuse Collection (2010 dollars, rounded to nearest $100).

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Capital Costs						
Automated Vehicles	$720,000	$1,920,000	$1,440,000	$1,680,000	$1,200,000	
Rear Loader Retrofits	$12,000	$12,000	$12,000	$18,000	$12,000	
Total Capital Costs	**$732,000**	**$1,932,000**	**$1,452,000**	**$1,698,000**	**$1,212,000**	
Annual O&M Costs						
Amortized Vehicle Capital (see Total Capital Costs above)	$141,900	$520,200	$803,900	$1,134,900	$1,371,300	
Rear Loader Retrofits	$12,000	$12,000	$12,000	$18,000	$12,000	
Barrel Costs	$676,500	$1,705,000	$1,364,000	$1,705,000	$1,364,000	
Collection Labor	$256,400	$822,800	$1,282,000	$1,794,700	$2,200,500	
Safety Officer	$55,200	$55,200	$55,200	$55,200	$55,200	
Fleet Maintenance	$160,100	$521,000	$800,500	$1,120,600	$1,359,300	
Barrel Delivery	$3,700	$9,300	$7,500	$9,300	$7,500	
Dumpster Removal	$45,600	$91,200	$76,000	$91,200	$76,000	
Total Annual O&M	**$1,351,400**	**$3,736,700**	**$4,401,100**	**$5,928,900**	**$6,445,800**	**$21.9M**

Collection of Diverted Materials

The estimates provided in Tables 7-9 and 7-10 include the continuation of every-other-week, household service collection of single-stream recyclables and the addition of new household organics collection with weekly collection between April and November, and every-other-week collection between December and March. Recyclables would be hauled to WMRA's MRF in north Denver and organics would be taken to A1's Stapleton site in northeast Denver. These estimates are based upon the housing calculations presented in Table 7-3 (details are provided in Appendix H). Phased in over the short-term

[24] The new Safety Officer will be available full-time to implement DSWM's safety program (see Section 2.2.5) for the revised and growing collection programs plus DSWM's LIP/overflow, drop site and HHW programs discussed in Sections 8.0, 9.0 and 13.0, respectively. Allocation of staff is expected to be approximately 60% refuse collection, 10% each for recyclables and organics collection, 8% for LIP/overflow, 8% for drop sites and 4% HHW. The full DSWM cost of safety labor is estimated under Section 7.0 new program costs.

[25] DSWM's Fleet Maintenance costs include all maintenance costs, fuel, oil, grease, insurance, licensing and taxes.

planning period, and for the purposes of this evaluation, these estimates include the following assumptions:

- These costs are considered "new" in Table 7-9 and 7-10 as they represent growth in the recycling and organics programs beyond existing practices (i.e., only materials diverted from households which subscribe between Phase 1 and Phase 5 are considered);
- Collection productivity rate of 750 subscribing households per route;
- Addition of 2 new automated barrel service routes and vehicles for recyclables collection by Phase 5 (with 20% spares provided by existing vehicles);
- Addition of 27 new automated barrel service routes and vehicles for organics collection by Phase 5 (with 20% spares provided by existing vehicles) to accommodate peak weekly organics collection;
- A total of 29 Equipment Operator Specialists (drivers) by Phase 5 with 38% benefits; to accommodate expanded recycling and peak weekly organics collection
- Vehicles amortized over 6 years at 5% interest rate;
- Other costs include Fleet Maintenance expenses for vehicles and annual purchase/delivery of 65-gallon carts[26]; and
- $27 per ton compost tip fees that include transfer from A1 Organics' Stapleton site (may eventually be negotiation at a different rate).

Table 7-9. Estimated New Costs Associated with Expanding Recyclables Collection (2010 dollars, rounded to nearest $100).

Category[a]	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Capital Costs						
Additional Automated Vehicles	$0	$0	$240,000	$0	$240,000	
Total Capital Costs	**$0**	**$0**	**$240,000**	**$0**	**$240,000**	
Annual O&M Costs						
Amortized Vehicle Capital (see Total Capital Costs above)	$0	$0	$47,300	$47,300	$94,600	
Recycling Cart Costs	$230,000	$230,000	$230,000	$230,000	$230,000	
Collection Labor	$0	$0	$53,500	$53,500	$107,100	
Fleet Maintenance	$0	$0	$56,400	$56,400	$112,700	
Cart Delivery Costs	$4,100	$4,100	$4,100	$4,100	$4,100	
Total Annual O&M	**$234,100**	**$234,100**	**$391,300**	**$391,300**	**$548,500**	**$1.8M**

[a] Some existing recycling routes have capacity to absorb additional households without adding routes – however, depending upon location of new households, new routes may be required earlier than estimated

[26] The 3,300 carts used in the organics pilot project are expected to be used in 2011.

Table 7-10. Estimated New Costs Associated with New Organics Collection (2010 dollars, rounded to nearest $100).[a]

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Capital Costs						
Automated Vehicles	$1,440,000	$2,400,000	$960,000	$960,000	$720,000	
Total Capital Costs	**$1,440,000**	**$2,400,000**	**$960,000**	**$960,000**	**$720,000**	
Annual O&M Costs						
Amortized Vehicle Capital (see Total Capital Costs above)	$283,700	$756,500	$945,600	$1,134,700	$1,276,600	
Organic Cart Costs	$835,000	$2,000,000	$750,000	$750,000	$500,000	
Collection Labor	$267,600	$713,700	$892,100	$1,070,500	$1,213,200	
Fleet Maintenance	$282,900	$754,400	$943,000	$1,131,600	$1,282,200	
Cart Delivery Costs	$2,300	$4,500	$1,700	$1,700	$1,100	
Total Annual O&M	**$1,671,500**	**$4,229,100**	**$3,532,400**	**$4,088,500**	**$4,273,100**	**$17.8M**
Tipping Fees						
Total Annual Compost Facility Tip Fees[a]	**$40,500**	**$264,600**	**$418,500**	**$618,300**	**$796,500**	
Total Tipping Fees	**$40,500**	**$264,600**	**$418,500**	**$618,300**	**$796,500**	**$2.1M**

[a] Households added to program between Phase 1 and Phase 5 are 20,000; 40,000; 15,000; 15,000; 10,000
[b] Assumes compost tip fee at A1's Stapleton site would be $27 per ton

Costs excluded from these estimates include:

- Implementation activities described in Section 7.2.2 – these may be challenging to complete given current staffing conditions;
- Costs for narrow alley collection of recyclables and organics[27];
- DSWM staff time needed for public education and outreach (addressed in Section 14.0);
- Salvage value (revenue) from sale of used dumpster; and
- Staff training to transition existing rear-loader equipment operators (drivers) to automated vehicle operators.

7.4 Estimated Reduced Costs, Avoided Costs & Potential Revenues

Reduced Costs

Reduced costs associated with standardizing refuse collection are expected to include the removal of manual rear-loaders and specialized side-loader collection vehicles from service between Phase 1 and Phase 5, as well as eliminating dumpster maintenance and selling surplus dumpsters for salvage. Table 7-11 estimates these savings, as well as the net cost reductions when compared to future costs estimated in Table 7-8 (details are provided in Appendix H). The reduced cost estimate assumes that:

[27] It is assumed that these materials will be collected at the curb instead of the alley if needed.

- 18 manual routes and vehicles would be converted to automated/semi-automated service by Phase 5;
- 24 dumpster routes and vehicles would be converted to automated/semi-automated service by Phase 5; and
- Approximately 19,200 dumpsters would be removed from service by Phase 5.

Table 7-11. Estimated Cost Reductions Associated with Standardizing Refuse Collection (2010 dollars, rounded to nearest $100).

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Amortized Vehicle Capital	$153,800	$548,300	$833,600	$1,199,100	$1,484,400	
Collection Labor	$352,200	$1,152,400	$1,707,600	$2,507,800	$3,062,800	
Fleet Maintenance	$200,300	$633,400	$956,300	$1,389,400	$1,712,300	
Dumpster Maintenance	$45,600	$136,800	$212,800	$304,000	$380,000	
Dumpster Resales	$144,000	$288,000	$240,000	$288,000	$240,000	
Total Annual Cost Reductions	**$895,900**	**$2,758,900**	**$3,950,300**	**$5,688,300**	**$6,879,500**	**$20.2M**
Net Refuse Collection Conversion Costs[a]	**$455,500**	**$977,800**	**$450,800**	**$240,600**	**($433,700)**	**$1.7M**

[a] Based on comparison of Total Annual Cost Reductions to Total Annual O&M Costs in Table 7-5

Avoided Costs

Avoided costs are expected to include the savings DSWM would realize by not tipping recyclable and organics tons as refuse at the DADS landfill. Over-arching any savings or reduced revenues is the impact on the life of the DADS landfill, which will be extended with every ton of diverted material.

In 2010, the aggregated DADS tip fee for DSWM is $16 per ton[28]. This represents a negotiated price between DSWM and WMC (this pricing has increased about 4% per year between 2005 and 2009). Avoided costs are calculated on the increase in recyclable and organic tons estimated in Table 7-7. The estimates in Table 7-12 include only those tons likely generated after 2010.

[28] Considers that 7.6% of 2009 tons were hauled directly to DADS in compactor vehicles; 46.4% were hauled to DADS in DSWM transfer trailers; 35.5% were transferred through WMC's Commerce City facility; 10.6% were transferred through WMC's Englewood facility.

Table 7-12. Estimated Costs Avoided by Expanding Collection of Diverted Materials Beyond 2010 Levels (2010 dollars, rounded to nearest $100).[a]

Material	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Diverted Quantity (tons)[b]	1,900	10,600	17,800	26,700	34,600	
Estimated Tip Fee[c]	$16	$16	$16	$16	$16	
Avoided Costs	**$30,400**	**$169,600**	**$284,800**	**$427,200**	**$553,600**	**$1.5M**

[a] These avoided cost estimates are in addition to the avoided cost savings generated by existing recyclable tons (the 28,600 tons in 2010 would save DSWM about $457,600)
[b] Based on Table 7-7 tons
[c] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

Potential Revenues

In addition to avoided costs, DSWM would earn revenues associated with an increase in the tons recycled. Revenues earned through Denver's contract with WMRA (which expires in 2015) can include two payments:

- Base payment of $33 per ton for 95% of tons delivered to WMRA's north Denver facility (the 95% accounts for contamination); and
- Up-market payment of 50% of the difference between the annual market value of recyclables and the established contract threshold (this payment is only available during "high markets"[29]).

Potential revenues are calculated based on the increase in recyclable tons generated as a result of this option (see Table 7-4). Potential estimated revenues are provided in Table 7-13 and detailed in Appendix I (note that pricing for all materials except amber glass are projected to increase annually, based on historic pricing).

[29] The contract establishes a base market value of $80.70/ton based on a recyclables composition (by weight) of 34% newspaper (ONP8), 34% newspaper (ONP7), 10% cardboard (OCC), 2% aluminum and 20% amber glass. Price indices include Yellow Sheet (Chicago) for paper and Mill Trade Journal (Midwest) for containers. In 2008, the annual market value of DSWM recyclables was $105 and over $343,000 in up-market revenue was earned; in 2009, the annual market value was less than $80.70 and no up-market revenue was earned.

Table 7-13. Estimated Recyclables Revenues Generated by Expanding Collection of Diverted Materials Beyond 2010 Levels (2010 dollars, rounded to nearest $100).[a]

Material	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Recyclable Quantity (tons)[b]	400	800	2,300	3,800	5,100	
Base Payment[c]	$12,500	$25,100	$72,100	$119,100	$159,900	
Up-Market Payment[d]	$700	$1,400	$4,100	$6,800	$9,100	
Total Revenues	**$13,200**	**$26,500**	**$76,200**	**$125,900**	**$169,000**	**$0.4M**

[a] These recyclable revenues estimates are in addition to the revenues generated by existing recyclable tons (the 28,600 tons in 2010 are expected to earn DSWM about $896,600 in base payment and $51,200 in up-market revenue)
[b] Based on differential recyclables tons in Table 7-7
[c] Based on $33/ton paid by WMRA on 95% of tons delivered by DSWM
[d] Based on payment made by WMRA on 50% differential between base market value ($80.70/ton) and annual average market value projected for 2010 (about $84/ton)

8.0 Reduced Large Item Pick-up and Refuse Overflow Collection

This section evaluates reducing DSWM's existing large item pick-up and barrel overflow collections to increase individual responsibility for waste, increase diversion and reduce operational costs.

8.1 Introduction

DSWM's regular LIP program includes collection of large, bulky items once every nine weeks beginning January 2010 (prior to this date, LIP collection was every five weeks. This service represents 8% of the section's budget and 3% of collected tons (collected with rear-loaders, and two-worker crews). While LIP composition data is not available, observations indicate that this material includes primarily cardboard; furniture, mattresses and other bulky consumer items; and large yard waste[30]. This is a valuable service to residents who cannot place large items in refuse or recycling containers, and/or do not have the ability to transport these materials to recycling, reuse or disposal facilities.

DSWM collects overflow refuse from neighborhoods who receive automated barrel service. Overflow is typically household waste that does not fit in residents' refuse containers. This material represented 6% of the 2009 budget and 8% of total refuse collected in 2009 (collected with rear-loaders and two-worker crews). It was noted in Section 6.1 that it is more expensive for DSWM to manually collect overflow than it would be to collect multiple automated carts from the same household. Until January 2010 (when collection was reduced to once every three weeks), DSWM collected overflow refuse weekly.

The ownership of these materials (especially LIP) can be difficult to determine. When waste generated by non-Denver residents and businesses is placed in Denver neighborhoods (usually alleys) as LIP or overflow, it is illegal dumping. DSWM currently has limited enforcement capability, therefore these materials must be handled as city refuse at additional cost. When stockpiled, these materials can also lead to litter, public health concerns, and unsightly and unsafe alleyways, requiring further DSWM resources for clean-up. Additionally, many customer service issues are related to LIP and refuse overflow (there were 161 large branch and special collection requests in 2009, and 623 illegal dumping and spilled trash complaints).

This improvement option would reduce LIP collections to once every quarter and eventually phase out overflow collections.

[30] DSWM operates a separate service for appliance collection through its contract with Unwanted Appliances. Both Freon-containing (refrigerators, freezers, air conditioners) and other appliances are collected weekly from residents in DSWM's service area by appointment. The Freon gas is recovered and the appliances are recycled.

8.2 Implementation

8.2.1 Applicability

Both components of this improvement option address services provided to DSWM's residential service area (SFUs and MFUs with seven or fewer units). Enforcement actions may ultimately impact non-Denver residents and non-residential generators in the case of illegal dumping.

8.2.2 Policy Development

In order to reduce the collection frequencies of these materials through phase 5, the city would need to adjust its budget and resources, consider any legal requirements, evaluate vehicle and staff e-deployment, and revise routing prior to implementation.

Other activities require notifying residents (typically through its website and the WasteWise newsletter). As part of this implementation, DSWM may be phasing in other programs that may reduce the perceived burden associated with this change – those programs may include a new organics collection program and one or more drop-sites for the collection of large items, recyclables and organics.

It may be helpful for DSWM to be able to obtain support for reduced collections through other municipal examples. As noted in Section 4.0, 70% of the surveyed communities collect large items once per quarter or less often. Other Colorado communities charge for refuse overflow collection through various refuse policies and contract hauler requirements[31].

For this option to be successful, DSWM would need to have a penalty system (and the staff to implement it) for addressing illegal dumping, as well as litter and unsafe conditions associated with LIP and overflow refuse placed on curbs and in alleys. The penalty system needs to be significant enough to discourage violations, and staffing must be suitable to investigate and enforce a majority of violations. Staffing for enforcement would work with other city code enforcement entities for consistent messaging, standard protocols, and access to existing legal processes. DSWM would also need to consider whether LIP and overflow placement must be limited to the day of collection (which would minimize litter and scavenging, but may be a hardship for large, bulky items that cannot easily be stored).

8.2.3 Phased Implementation

For evaluation purposes, DSWM is proposing a phased implementation of this improvement option:

- LIP – current collection reduced to once per quarter in Phase 3, maintained for the rest of the planning period; and
- Overflow – collections reduced to once every quarter in Phase 2, and eliminated in Phase 5.

In order to estimate quantities generated (and in the absence of waste composition data for LIP or overflow waste streams), the assumed composition of each material has been determined as follows:

[31] For example, Aspen, Boulder and Fort Collins require that generators be charged for all refuse, and Oak Creek limits the number of free overflows to three 32-gallon bags per collection day.

- LIP composition was based on general observation – assumed to include 25% recyclables (primarily cardboard), 40% organics (primarily yard waste) and 35% refuse;
- Overflow composition was based on Denver's 2008 waste composition study results[32] – assumed to include 21.3% recyclables, 42.4% organics and 36.3% refuse; and
- When overflow collection is eliminated in Phase 5, all materials are assumed diverted as recyclables or organics.

LIP management was also considered in tandem with potential new drop-site collection sites DSWM is also considering as a short-term improvement option (Section 9.0), in that some LIP items may be diverted through the new drop-sites rather than left as refuse at curbs and in alleys. Table 8-1 estimates LIP and overflow quantities over the short-term planning period based on DSWM's phasing and composition assumptions.

Table 8-1. Estimated Quantities Managed by LIP & Overflow Collections (rounded to the nearest 100 tons).

Program		Phase 1	Phase	Phase	Phase 4	Phase 5
LIP[a]						
	LIP Drop-Site	0	300	300	500	500
	Recyclables	400	400	500	500	600
	Organics	100	400	600	900	1,200
	Refuse	4,800	4,200	3,900	3,400	3,100
Overflow[b]						
	Recyclables	1,200	1,300	1,500	1,600	1,800
	Organics	500	1,600	2,200	2,900	3,500
	Refuse	12,000	10,800	10,100	9,200	8,500
Refuse Managed as Litter[c]		2,400	2,100	2,000	1,800	1,600
Remaining Refuse		14,300	12,800	12,000	10,900	10,000

[a] Assumed composition
- Resident diversion to new DSWM drop-sites (see Table 9-2)
- 25% recyclables; diverted 30% to 50% between Phase 1 and 2030
- 40% organics; diverted 20% to 60% between Phase 1 and 2030

[b] Assumed composition same as Denver residential waste stream (DSWM's Spring/Fall 2008 Waste Composition Analysis, March 2009)
- 21.3% recyclables; diverted 40% to 60% between Phase 1 and 2030
- 42.4% organics; diverted 40% to 60% between Phase 1 and 2030

[c] Assumed 25% of LIP refuse and 10% of overflow refuse would remain as litter in alleys (requiring manual collection); some may be managed through automated barrel collection; remainder would be managed manually as overflow (until Phase 5) and LIP

[32] Waste Composition Analysis (2009).

8.2.4 Implementation Challenges

The primary challenge will likely be customer opposition to a perceived decrease in service. Methods to mitigate this include:

- Phased implementation over five years, with associated grace periods;
- Focused public outreach that explains that resources saved by reduced collection frequency would be used to maintain current program costs and/or for new services;
- Addition of alternative collection programs (e.g. household compost collection program and drop-sites);
- Education on waste diversion programs;
- Early and on-going notification; and
- Consistent enforcement.

8.2.5 Diversion Potential

Table 8-2 includes an estimate of recyclables and organics currently in DSWM's LIP and overflow that may be diverted through the household collection programs only – i.e., continued growth in recycling household subscriptions and the addition of a new household organics subscription program in the short-term planning period. Other diversion activities, such as those described in subsequent sections, would provide additional diversion. This estimated diversion potential would be in addition to the diversion accomplished by DSWM's existing household recycling and pilot organics collection programs.

Table 8-2. Estimated Recyclable & Organics Quantities Diverted (rounded to nearest 100 tons).

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Recyclables[a]	1,600	1,700	2,000	2,200	2,400
Organics[a]	500	1,900	2,800	3,700	4,700
Total	**2,100**	**3,600**	**4,800**	**5,900**	**7,100**
Estimated Total Waste Generation from DSWM Service Area[b]	252,300	251,900	251,600	251,200	250,800
Diversion Potential	**<1%**	**1%**	**2%**	**2%**	**3%**

[a] Based on Table 8-1 estimates for both the LIP and overflow collection programs
[b] See Table 5-1

8.3 Estimated Re-Allocated Costs

This section summarizes the annual operating costs for an option that reduces LIP and overflow collections, which would be phased in beginning inPhase 2 (overflow) and Phase 3 (LIP). Table 8-3 includes a cost estimate for LIP collection reductions, based on tons of materials managed through LIP and overflow collections (see Table 8-1) and DSWM's 2010 budget line items for these programs (details are provided in Appendix J). Assumptions for this estimate include:

- Costs are not "new" but instead represent a re-allocation of existing budget line items to reflect a change in how these materials may be managed in the future;
- Existing rear-loaders and 2-person crews would be used; and
- Other annual costs including Fleet Maintenance costs for vehicles and DADS landfill tip fees.

The reductions in LIP collection frequencies and implementation of collection changes described in Section 8.0 are anticipated to decrease the LIP program costs by approximately $395,200 between Phase 1 and Phase 5.

Table 8-3. Estimated Re-Allocated Program Costs Associated with Reduced LIP Collections (2010 Dollars, rounded to nearest $100).

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Annual O&M Costs						
Fixed Charges[a]	$145,200	$145,200	$145,200	$145,200	$145,200	
Variable Labor & Fleet Maintenance[b]	$1,104,000	$1,104,000	$736,000	$736,000	$736,000	
Waste Disposal[c]	$76,800	$67,200	$62,400	$54,400	$49,600	
Total Annual Costs - General LIP[d]	**$1,326,000**	**$1,316,400**	**$943,600**	**$935,600**	**$930,800**	**$5.5M**

[a] Fixed charges include services, rental, fixed vehicle maintenance and labor (operations supervisor and on-call utility worker)
[b] Variable charges include route labor and vehicle maintenance
[c] Based on $16/ton tip fee; waste disposal costs in 2010 are expected to be about $76,800 (based on estimated 4,800 tons)
[d] LIP and LIP Night routes remain the same and are not included in this total

Table 8-4 includes a cost estimate for re-allocated DSWM resources associated with reduced refuse overflow collection, based on tons of materials managed through LIP and overflow collections (see Table 8-1) and DSWM's 2010 budget line items for these programs (details are provided in Appendix J). Assumptions for this estimate include:

- Costs are not "new" but instead represent a re-allocation of existing budget line items to reflect a change in how these materials may be managed in the future;
- Existing rear-loaders and staff (Equipment Operators, Senior Utility Workers, and On-Call Utility Worker) would be used with staff reductions corresponding to reduced overflow collection frequency; and
- Other annual costs including Fleet Maintenance costs for vehicles and DADS landfill tip fees.

Table 8-4. Estimated Re-Allocated Program Costs Associated with Reduced Overflow Collections (2010 dollars, rounded to nearest $100).

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Annual O&M Costs						
Collection Labor[a]	$567,200	$377,100	$377,100	$377,100	$0	
Fleet Maintenance[b]	$157,700	$114,200	$114,200	$114,200	$0	
Waste Disposal[c]	$192,000	$172,800	$161,600	$147,200	$0	
Total Annual Costs – Overflow	**$916,900**	**$664,100**	**$652,900**	**$638,500**	**$0**	**$2.9M**

[a] Collection labor includes 2-worker crew per route
[b] Fleet maintenance costs assume 64 miles/route-day and rear-loader mileage rate
[c] Based on $16/ton tip fee; waste disposal costs in 2010 are expected to be about $190,400 (based on estimated 11,900 tons)

Table 8-5 includes a cost estimate for re-allocating DSWM resources associated with litter collection expected as LIP and overflow collections are reduced. These estimates are based on Table 8-1 quantities (details are provided in Appendix J). Assumptions for this estimate include:

- With exception of new enforcement labor, costs associated with litter management are not "new" but instead represent a re-allocation of existing budget line items to reflect a change in how these materials may be managed in the future;
- Existing rear-loaders and staff (Equipment Operator and Senior Utility Worker) would be used;
- Other annual costs including Fleet Maintenance costs for vehicles and DADS landfill tip fees; and
- DSWM staff for enforcing illegal dumping and litter management associated with this option.

Table 8-5 Estimated Re-Allocated Program Costs Associated with Litter Collections (2010 dollars, rounded to nearest $100).

Category	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Annual O&M Costs						
Enforcement Labor[a]	$31,200	$37,400	$37,400	$31,200	$18,700	
Collection Labor[b]	$191,600	$191,600	$191,600	$191,600	$191,600	
Fleet Maintenance[c]	$88,400	$88,400	$88,400	$88,400	$88,400	
Waste Disposal[d]	$38,400	$33,600	$32,000	$28,800	$25,600	
Total Annual Costs – Litter	**$349,600**	**$351,000**	**$349,400**	**$340,000**	**$324,300**	**$1.7M**

[a] Enforcement labor includes partial time of Assoc City Insp
[b] Collection labor includes 2-worker crew per route, 2 routes rotated throughout city
[c] Fleet maintenance costs assume 2 routes, 55 miles/route-day and rear-loader mileage rate
[d] Based on $16/ton tip fee; waste disposal costs in 2010 are expected to be about $38,400 (based on estimated 2,400 tons)

Costs excluded from these analyses includes the miscellaneous activities described at the beginning of Section 8.2.3 (these may be challenging to complete given current staffing conditions) and the incremental costs for the collection of recyclables and organics that may be diverted from LIP or overflow collections. It is expected that these materials would be handled by the routine household collections, which were described and estimated in Section 7.0. The cost estimates in Section 7.3 assumed productivity rates (subscribing households served per route) that would accommodate increased quantities such as those generated from the reduced collections discussed in this section.

8.4 Estimated Avoided Costs & Potential Revenues

Avoided Costs

Avoided costs are expected to include the savings DSWM would realize by not tipping recyclable and organic tons, diverted from existing LIP and overflow collections, as refuse at the DADS landfill. The avoided costs estimated in Table 8-6 are in addition to any cost savings associated with household collection programs.

Table 8-6. Estimated Costs Avoided by Reducing LIP & Overflow Collections (2010 dollars, rounded to nearest $100).

Material	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Diverted Quantity (tons)	2,100	3,700	4,700	5,900	15,600	
Estimated Tip Fee [a]	$16	$16	$16	$16	$16	
Avoided Costs	**$33,600**	**$59,200**	**$75,200**	**$94,400**	**$249,600**	**$0.5M**

[a] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

Potential Revenues

In addition to avoided costs, DSWM would earn revenues associated with increased diversion of recyclables from existing LIP and overflow collections. Revenues earned through Denver's contract with WMRA can include both a base and up-market payment (see Section 7.4 and Appendix I). The potential revenues estimated in Table 8-7 are in addition to revenues generated from the expanded household recycling collection program.

Table 8-7. Estimated Recyclables Revenues Generated (2010 dollars, rounded to nearest $100).

Material	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Recyclables Quantity (tons)	1,600	1,700	2,000	2,200	5,200	
Base Payment[a]	$50,200	$53,300	$62,700	$69,000	$163,000	
Up-Market Payment[b]	$2,900	$3,000	$3,600	$3,900	$9,300	
Total Revenues	**$53,100**	**$56,300**	**$66,300**	**$72,900**	**$172,300**	**$0.4M**

[a] Based on $33/ton paid by WMRA on 95% of tons delivered by DSMW in current contract

[b] Based on payment made by WMRA on 50% differential between base market value ($80.70/ton) and projected annual average market value for 2010 (about $84/ton)

9.0 New Drop-Site Collection

This section evaluates the addition of two drop-sites for the collection of recyclables, organics and large items in the short-term planning period. A new drop-site collection program is included in DSWM's short-term plan because it will increase the opportunity for residents to divert waste materials (especially those who have not subscribed to household collection programs or may have sporadic high quantities to manage). It will also provide an additional site for residents' use in disposing of large items that may be more convenient than their scheduled collection (LIP service will be reduced to quarterly during the long-term).

9.1 Introduction

This program would include the phased development of two new customer drop-sites for the collection of diverted recyclables and organics, as well as large item (or bulky) refuse materials[33]. The drop-sites would provide a collection option for residents in DSWM's service area. They would be especially beneficial for those who don't subscribe to DSWM's household collection service, or who find that the collection frequencies provided are not adequate.

While the exact location of these sites would be determined at a later date, it is expected that they would be established in areas with easy access and that each would serve approximately half of the service area. Possible locations include in the:

- Southeast – possibly at the CCTS; and
- Southwest – possibly in the CPC at approximately West 2nd and Tejon Street.

It is expected that these sites would be staffed by DSWM employees. Staffing the drop-sites would help control littering, dumping of unacceptable materials, maintain safety, and manage liabilities associated with scavenging and other prohibited behavior.

Materials that customers would be allowed to drop at these sites include:

- The single-stream recyclables currently collected by DSWM in its household collection program;
- Food waste, food-contaminated paper and yard waste potentially collected in a future household collection program (described Section 7.0); and
- Large, bulky materials currently collected in DSWM's LIP program (Section 8.0 discussed the LIP collection program).

The materials would be accepted in "household quantities", or quantities that fit in a passenger car or pick-up truck. Drop-site operators may refuse large loads of materials. Regular refuse, HHW, other hazardous waste or e-waste would not be accepted at these drop-sites (Section 13.0 addresses management of HHW and e-waste).

[33] Waste Management of Colorado (WMC) does operate a recyclables drop site at the DADS Landfill for single-stream materials. As DSWM collected residential refuse and recyclables, it is not expected that the DADS site is used significantly by Denver residents.

9.2 Implementation

9.2.1 Applicability

This option would provide new drop-off collection service of selected materials for residential customers currently served by DSWM (i.e., all SFUs and MFUs with seven or fewer units). No other generators would be allowed access to these sites. It is expected that operating staff would require proof of residency.

In order to estimate a potential service area for each drop-site, the number of households served by DSWM in each area of the city was considered. Table 9-1 identifies the service area for each quadrant. This data was used to assume that 29% of Denver's residential population would likely use the proposed CCTS site, and 13% would use the proposed CPC site.

Table 9-1. Estimated Service Area for Proposed Drop-Sites.

Area	Service Area Households (2009)	% of Total Service Area (2009)
Northeast	60,431	36%
Northwest	38,232	23%
Southwest (proposed CPC location)	22,328	13%
Southeast (proposed CCTS location)	48,574	29%

9.2.2 Policy Development

As with most program changes, DSWM will need to consider the following steps prior to developing new drop- sites:

- Confirmation of final, acceptable site locations;
- Final cost-estimating and budget approval;
- Legal review and possible policy change;
- Site development and equipment procurement;
- Coordination with contractors for tipping additional recyclables, compost and large items;
- Staff assignment/hires for drop-site operation; and
- Routing adjustments to service the drop-site.

9.2.3 Phased Implementation

For evaluation purposes it is anticipated the first drop-site would be developed in Phase 2, and the second in Phase 4. The sites would consist primarily of roll-off containers provided with stairs and platforms for customer access, and therefore would be flexible and easily expanded. DSWM may modify the size and orientation of these sites over time, as customer needs change and grow.

9.2.4 Implementation Challenges

Challenges to implementing this new service are not expected to be significant beyond DSWM's pre-planning and coordination activities (see Section 9.2.2). New drop-site collection is not associated with a reduction in service for residents and increases their overall convenience – as a result, this new program should be readily accepted.

9.2.5 Diversion Potential

There is no Denver drop-site data available and it is difficult to estimate the quantities of recyclables, organics and large items that would be generated at future sites. Table 9-2 includes quantity estimates based on generation rates observed in other cities over the last several years - many with differing service areas and ancillary collection programs - and are approximate guidelines only. The potential diversion would be in addition to the diversion achieved through DSWM's household collection programs. For estimating purposes, it was assumed that the CCTS drop-site would be developed first, followed by the CPC site.

Table 9-2. Estimated Drop-Site Quantities Diverted During the Short-Term Planning Period (rounded to nearest 100 tons).

	Location (% of service area)	Population Served[a]	Recyclables[b]	Organics[c]	Large Items[d]	Total Materials	Estimated Total Waste Generation[e]	Diversion Potential
One Drop-Site								
Phase 2	CCTS (29%)	**134,000**	**1,700**	**1,100**	**300**	**3,100**	**251,900**	**1%**
Phase 3	CCTS (29%)	**136,000**	**1,700**	**1,100**	**300**	**3,100**	**251,600**	**1%**
Two Drop-Sites								
Phase 4	CCTS (29%)	137,700	1,700	1,100	300	3,100		
	CPC (13%)	61,700	800	500	200	1,500		
	Phase 4 Total	**199,400**	**2,500**	**1,600**	**500**	**4,600**	**251,200**	**2%**
Phase 5	CCTS (29%)	138,900	1,700	1,100	300	3,100		
	CPC (13%)	62,300	800	500	200	1,500		
	Phase 5 Total	**201,200**	**2,500**	**1,600**	**500**	**4,600**	**250,800**	**2%**

[a] Based on Table 9-1 and Colorado State Demography Office estimates (October 2009); adjusted by 71% (fraction of Denver residences that are SFUs or MFUs with 7 or fewer units in 2009)
[b] Assumed 25 pounds/person-year based on available data from Colorado & US drop-site programs
[c] Assumed 16 pounds/person-year (Charleston County, SC ratio of 1.5 tons of recyclables to 1 ton yard waste)
[d] Assumed 5% of population at 100 pounds/year of large items (equivalent of 5 pounds/person-year)
[e] Total waste generated in DSWM's service area (see Table 5-1)

9.3 Estimated New Costs

Table 9-3 summarizes the estimated capital and operating costs for this drop-site option, including one new drop-site in Phase 2 and a second in Phase 4. Details are provided in Appendix K. Assumptions for these estimates include:

- The costs in Table 9-2 are considered "new" , as they represent additional service beyond existing collection practices and all associated costs are in addition to existing DSWM budgeted resources;
- On-half acre of land for each site is already owned by Denver – and is relatively flat and cleared;
- Sites would be open to DSWM service area customers 40 hours per week with actual days and times to be determined by DSWM (and would be secured after hours);
- Full-time staffing for each site with 38% benefits (labor category – Senior Utility Worker) to verify residency and household-load sizes, oversee site operations, and manage materials collected ;
- Site development including concrete slab on grade, steel rails and access platforms for roll-offs – remaining surface cover consisting of crushed rock/gravel and development of a small building (eight feet by eight feet with basic utilities) at each site for worker protection, sanitation, and record-keeping;
- Mobile equipment would include three 40-cubic yard roll-offs per site, plus two roll-off spares and a roll-off truck shared between the sites; and
- Site improvement capital costs amortized over 20 years and equipment costs over 10 years at 5% interest rate.

The cost estimate, based on Phase 5 quantities in Table 9-1, includes up to 22 pulls per week from both sites (approximately 13 for recyclables hauled to WMRA's MRF, six for organics hauled to A1 Organic's Stapleton site, and three for large items hauled to DADS landfill).

Table 9-3. Estimated New Drop-Site Program Costs (2010 dollars, rounded to nearest $100).

Category	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 2-Phase 5
Capital Costs					
Drop-Site Improvements	$87,400	$0	$87,400	$0	
Mobile Equipment	$167,200	$0	$17,600	$0	
Total Capital Costs	**$254,600**	**$0**	**$105,000**	**$0**	
Annual O&M Costs					
Amortized Capital (Drop-Site Improvements above)[a]	$7,000	$7,000	$14,000	$14,000	
Amortized Equipment (see Mobile Equipment above)[b]	$21,700	$21,700	$24,000	$24,000	
Labor[c]	$46,800	$46,800	$93,600	$93,600	
Site Maintenance and Utilities	$5,100	$5,100	$10,200	$10,200	
Haul Costs[d]	$81,700	$81,700	$116,000	$116,000	
Total Annual O&M	**$162,300**	**$162,300**	**$257,800**	**$257,800**	**$0.8M**
Total Annual Compost Facility Tip Fees[e]	**$29,700**	**$29,700**	**$43,200**	**$43,200**	**$0.1M**
Total Annual Landfill Disposal Tip Fees[f]	**$4,800**	**$4,800**	**$8,000**	**$8,000**	**<$0.1M**

[a] Amortized over 20 years at 5% interest rate
[b] Amortized over 10 years at 5% interest rate
[c] Based on Senior Utility Worker (2009 step #5 base salary, escalated 3% to 2010$ plus 38% benefits)
[d] Based on number of roll-off loads, distances to facilities, Equipment Operator and fleet maintenance costs
[e] Based on Table 9-1 quantities and $27/ton assumed tip fee for A1 Organics
[f] Based on Table 9-1 quantities and $16/ton tip fee at DADS landfill for large items

Expenses not included in this estimate include DSWM staff time needed for public education and outreach, which would precede the Phase 2 start date (addressed in Section 14.0).

9.4 Estimated Avoided Costs and Potential Revenues

Avoided Costs

Avoided costs are expected to include the savings DSWM would realize by not disposing the recyclable and organic tons diverted through the drop-sites. Avoided costs estimated in Table 9-4 are in addition to any cost savings associated with household collection service for diverted materials.

Table 9-4. Estimated Costs Avoided by Adding Drop-Site Collections (2010 dollars, rounded to nearest $100).

Material	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 2-Phase 5
Diverted Quantity (tons)	2,800	2,800	4,100	4,100	
Estimated Tip Fee[a]	$16	$16	$16	$16	
Avoided Costs	**$44,800**	**$44,800**	**$65,600**	**$65,600**	**$0.2M**

[a] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

Potential Revenues

In addition to avoided costs, DSWM would earn revenues associated with recyclable tons diverted through these drop-sites. Revenues earned through Denver's contract with WMRA can include both a base and up-market payment (see Section 7.4 and Appendix I). Potential revenues estimated in Table 9-5 are in addition to revenues generated from the household recyclables collection service.

Table 9-5. Estimated Recyclables Revenues Generated (2010 dollars, rounded to nearest $100).

Material	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 2-Phase
Recyclable Quantity (tons)	1,700	1,700	2,500	2,500	
Base Payment[a]	$53,300	$53,300	$78,400	$78,400	
Up-Market Payment[b]	$3,000	$3,000	$4,500	$4,500	
Total Revenues	**$56,300**	**$56,300**	**$82,900**	**$82,900**	**$0.3M**

[a] Based on $33/ton paid by WMRA on 95% of tons delivered by DSMW in current contract

[b] Based on payment made by WMRA on 50% differential between base market value ($80.70/ton) and projected annual average market value (about $84/ton)

10.0 New Private Hauler Licensing and Collection Program

This section evaluates a new program requiring private hauler licensing, as well as refuse hauler collection of recyclables and compostable organics from their customers. This program will provide DSWM with critical data needed for future program evaluation and development, will increase community awareness about sustainable waste management, and will increase diversion throughout the city.

10.1 Introduction

This program considers two components:

1. A licensing and data reporting requirement for private sector haulers.
2. A hauler requirement to provide collection services for any recyclables and compostable organics generated by their customers.

Hauler Licensing

As described in Section 6.1.4, Denver currently requires small haulers[34] to register (14 are currently registered). It is estimated that as many as 100 haulers may operate in Denver[35]. There are no operating, reporting or permit/license requirements in the existing policy. The goals – and benefits – of this component would be:

- The development of an accurate data base of all haulers – to facilitate communication and implement consistent standards for all solid waste service providers;
- To verify that minimum hauler operating and safety standards are being met;
- To document the quantities of refuse and diverted materials generated by commercial, institutional and industrial[36] (ICI) generators including large MFUs with more than seven units;
- To increase protection for businesses and reduce the risk of fraud and misrepresentation; and
- To track commercial activities within the city.

Recyclables & Organics Collection Requirement

The new hauler policy would also include a requirement for all refuse haulers to provide collection services on a subscription basis for any recyclables and compostable organics that their customers separate for diversion (with the exception of eligible full-service restaurants in Section 11.0, ICI customers would divert materials on a voluntary basis). The goals – and benefits – of this policy component would be to:

[34] These are defined in Chapter 48 of the Revised Municipal Code as refuse haulers that do not have a compactor or roll-off container.

[35] The 2009-2010 Denver Metro Yellowbook lists 82 refuse removal companies, as well as several refuse equipment, container and disposal companies.

[36] According to the U.S. EPA, commercial sources include office buildings, retail and wholesale establishments and restaurants); institutional sources include schools, libraries, hospitals and prisons; and industrial sources include packaging and administrative waste but excludes process waste. Denver considers large MFUs (8 or more units) to be commercial generators.

- Facilitate diversion practices for large MFU and ICI customers;
- Provide an understanding of the commercial waste stream for future master plan implementation;
- Increase quantities diverted;
- Minimize the number of haulers serving any one customer; and
- Enhance public health and safety.

10.2 Implementation

10.2.1 Applicability

Both private sector solid waste haulers and their ICI customers would be impacted by this policy. Table 10-1 identifies the specific ICI generators in Denver, as identified by the North American Industry Classification System (NAICS) in 2007[37].

Table 10-1. 2007 Denver Commercial, Institutional & Industrial Generators.

Generator Source	Break Down of Generators	Individual Data
Large Multi-Family (with 8 or more units)[a]		
	8-50 units	24,306 units
	51-150 units	21,834 units
	151-300 units	23,995 units
	301-959 units	24,839 units
Other ICI[b,c]	22,094 business establishments	399,872 employees

[a] This data represents units within 1,642 MFU complexes (note that most large MFUs are clustered in the northeast quadrant of the city)
[b] Source = 2007 Business Patterns (NAICS)
[c] Category includes government operations in city-owned buildings

10.2.2 Phased Implementation

For evaluation purposes both components of this improvement are expected to be implemented in Phase 3. This timing would allow DSWM and representative haulers (or trade groups) to negotiate on specific policy language and implementation issues, and for both parties to promote collection service changes to non-residential customers. In Phase 3, the two-part policy would become effective. At the same time, DSWM would add both enforcement and data tracking capability for full implementation.

10.2.3 Policy Development

Hauler Licensing

A new hauler licensing policy can include a wide array of components. Table 10-2 includes a summary of example policies from Colorado and beyond.

[37] The commercial/institutional generators included city-owned buildings in 2007 (through the present). Despite their listing as an ICI generator, these buildings were serviced directly by DSWM. By 2009, DSWM service to the Denver Public School system (also an ICI generator) was also provided.

Table 10-2. Hauler Licensing Policies.

	License Fee	License Application Requirements	Other
Aspen, CO	No	• Verify paid occupational tax	General business license/occupation tax return (additional county licensing requirements)
Boulder, CO	$25 per registration	• Required for each location in city • One-time license only (annual filing required) • Hauler trash tax required under separate ordinance	General sales & use tax return/business license
Fort Collins, CO	$100/ Vehicle	• Vehicle descriptions • US DOT • Hours of operations • Service areas, rate systems & customer notifications • Reports for previous year & 3-year records retention • Insurance coverage ($500,000 bodily injury & property damage/occurrence of in aggregate)	License/recycling ordinance combined; city identification stickers; designates county landfill; limits hours of operation; city may audit at any time
Norwalk, CT	$500 + $750/ vehicle	• Service areas • Vehicle descriptions	Also require permits for roll-off containers; city inspections
Pasco County, FL	$2,500 + $200/ vehicle	• Service areas, services, accounts, container sizes, collection frequency & rates • Vehicle descriptions • Landfill used • Financial statements • Prior experience & environmental actions • Insurance coverage (ties to state requirements)	County has right to inspect vehicles without notice
Wake County, NC	$100 per registration	• Service areas/routes, services & rates • Number of employees • Vehicle descriptions • Landfill used • Financial statements • Prior experience • Insurance coverage (general liability)	Waste to be dumped from vehicles daily; vehicle signage requirements
Westport, CT	$500/ vehicle > 30 cy, $100/ roll-off truck	• Service areas • Prove city vehicle inspections	No out of town waste accepted; no overnight waste storage; city vehicle decals; roll-off containers $250 each; city inspections

Given the large number of haulers operating in Denver, it is recommended that licensing be required for each hauling company, without licensing/permitting individual vehicles or containers (which could be added in the future). A new hauler licensing policy for Denver would ideally be negotiated to include the following:

1. **General**
    - One-year term with an annual renewal (all the Table 10-3 examples specify 1-year terms except Boulder);
    - Mandatory operating hours; and
    - A licensing fee to off-set administrative and auditing costs.
2. **Customers, services and rates**
    - Description of customers in terms of number of each type (may be generally broken into MFU, commercial, institution and industrial accounts or detailed by NAICS code);
    - Description of services provided (by customer type);
    - Description of general service area (ideally highlighted on a map of the city); and
    - Range of rates (by customer type).
3. **Collection vehicles**
    - Description of all vehicles used to collect, transport or manage solid waste – this can include vehicle identification number, make, color, year, Colorado license plate number, cubic yard capacity and tare weight;
    - Proof that all vehicles have been registered with the Colorado Department of Revenue, Division of Motor Vehicles, and inspected by the Colorado Department of Transportation;
    - Acknowledgement that all vehicles shall be appropriately identified and signed with the company's name, telephone number, and vehicle identification number; and
    - Acknowledgement that DSWM may inspect the company's vehicles at any time.
4. **Miscellaneous application requirements**
    - Identify landfill, recyclables and compost processing facilities where materials would be managed;
    - Proof that each facility is appropriately permitted; and
    - Verify liability and workers compensation insurance (can specify city requirement or tie to state statute).
5. **Reporting requirements**
    - Annual reporting (during renewal period) of customers by type and quantities of refuse, recyclables and organics collected in tons from each customer type[38];
    - Annual estimate in tons of solid waste collected in Denver for any loads containing both in- and out-of-city waste; and
    - Notification as needed of changes in services provided, rates, vehicles, facilities used or insurance coverage throughout the permit period.

DSWM would also need to develop an enforcement mechanism for lack of compliance. Failure to comply with any of these requirements could be a condition of annual licensing. The ability for the city to audit hauler operations at any time should also be a component of the ordinance.

[38] Eventually, this requirement could be expanded to include reporting of set-out rates, diversion rates, tons tipped at each processing or disposal facility and historical data trends.

Recyclables and Organics Collection Requirement

Like the hauler licensing component, the recyclables and organics collection requirement can include a variety of components. Table 10-3 includes a summary of example policies. It should be noted that the three Colorado examples are hauler ordinances that apply to all generators (only the MFU and commercial requirements are summarized in this table). The non-Colorado examples each include a generator mandate to divert materials, as well as other requirements.

Table 10-3. Hauler Collection Requirement Examples for MFU and Commercial Generators.

	Required Collection	Fre-quency	Containers	Reporting	Hauler Auditing	Other
Aspen, CO	Recyclables from MFUs, commercial	As needed to prevent overflow	No hauler requirement to provide	Annual tons/yards of all materials	Maintain records for 3 years, audited at any time	No banned yard waste; break down cardboard; contamination notice
Boulder, CO	Recyclables from MFUs		Hauler provides to MFUs at no charge; min ½ refuse volume	Annual tons of all materials	Audited at any time	Must use county MRF unless customer specifies other; distribute city brochures
Fort Collins, CO	Recyclables from MFUs, commercial (space waiver)	Twice per month	Hauler provides 2 plastic carts at no charge	Quarterly tons of all materials	Maintain records for 3 years, audited at any time	Cannot reduce cost if no recycling; use "qualified" MRF; recycling vehicle signage; e-waste ban
San Francisco, CA (generator policy)	Recyclables, organics from MFUs, commercial (space waiver)	As needed for anticipated generation	Generator provides; signage/color requirements	Annual tons all materials	Inspections at any time	Generator must separate materials
Sarasota, FL (generator policy)	Recyclables from MFUs, commercial; yard waste commercial	As needed for 4-day generation; min 2X/ week collection	Generator provides (some leasing from city); generator maintains	Monthly quantity recyclables		Generator must have recycling plan, separate materials
Sarasota County, FL (generator policy)	Recyclables, yard waste from MFUs, commercial	As needed for 1-week generation	Generator provides, maintains	Annual tons all materials, franchise requirements	Inspections at any time	Generator must separate materials
Seattle, WA (generator policy)	Recyclables, organics from MFUs (space waiver), commercial	As needed for waste generated	Generator provides, maintains			Generator must separate materials; EPS, disposable plastic food ware use ban

A new policy that requires private hauler collection for diverted materials from Denver's large MFU and ICI waste generators would ideally be negotiated to include the following:

1. **Acceptable materials**
    - This should include a specific list of those recyclables and organics that are accepted at all the local MRFs and compost facilities;
    - Acknowledge that the list is subject to change; and
    - Encourage the diversion of additional materials.
2. **Containers and collection frequency** - This item does not need to specify whether the generator or hauler provides and maintains containers, but can state that collection frequency is adequate to prevent overflows from the containers utilized.
3. **Contamination notices** – This item would require haulers to notify customers of contaminated recycling or compost containers as part of a hauler education effort.
4. **Reporting** – Reporting would be covered under the hauler licensing component.
5. **Inspections and enforcement**
    - Inspections should include the ability for the city to verify that recyclables and organics are being diverted and managed at permitted recycling and compost facilities; and
    - Enforcement may eventually include revoking a non-compliant hauler's license and a fine (during the short-term planning period, however, it is likely that haulers would be given warnings only).

As space constraints are one of the biggest obstacles to MFU and commercial diversion, it would be beneficial in the future for the city to also consider a new policy requiring new construction to include adequate room for the storage and collection of recyclables and organics[39]. This could include interior and/or exterior storage areas.

10.2.4 Staff Requirements for Licensing, Enforcement and Data Tracking

These staff requirements for DSWM would begin in Phase 3 when both components of this policy are expected to be implemented. Specific activities and estimated labor requirements are summarized in Table 10-4. It is expected that the implementation of this option would largely be accomplished through electronic media. As shown, it is estimated that less than one FTE would be required annually. This estimate does not consider the DSWM staff time needed to develop, negotiate and obtain approval for final policy language (which would precede the Phase 3 start date).

[39] Good examples are available from Broomfield, CO; Fort Collins, CO; San Francisco, CA; and Sarasota County, FL.

Table 10-4. Estimated City Staffing Requirements for Hauler Policy Implementation during Short-Term Planning Period.

Staff Requirement	Assumption	Hours in Phase 3	Hours in Phase 4	Hours in Phase 5
Assist in Evaluating License Applications & Develop Database of Licensed Haulers[a]	100 applications per year	300 hours	250 hours	200 hours
Spot Vehicle Inspections	100 inspections per year	150 hours	150 hours	150 hours
Spot Recyclable/Organic Load Inspections	50 inspections per year	75 hours	75 hours	75 hours
Respond to MFU/ICI Customers without Diversion Service[b]	300 complaints in Phase 3; 30 per year thereafter	600 hours	60 hours	60 hours
Investigate Non-Compliance & Evaluating Need for License Revocation/Fines	15 investigations per year	60 hours	45 hours	30 hours
Review Annual Reports & Compile Quantity Data	100 reports per year	300 hours	250 hours	200 hours
TOTAL		**1,485 hours (0.7 FTE)**	**830 hours (0.4 FTE)**	**715 hours (0.3 FTE)**

[a] Based on estimate of approximately 100 private sector haulers in 2010
[b] Based on 1,642 MFU complexes and 22,094 ICI generators in 2007

10.2.5 Implementation Challenges

Hauler Licensing

This policy component may create some hardship for haulers, who would be required to obtain a license, provide service and vehicle information, and submit quantity data. Most haulers who work in communities other than Denver, however, would be familiar with these requirements, as similar policies are commonly enforced in other Colorado and U.S. cities[40]. Those issues likely to cause the most difficulty for haulers include:

1. **Customer information:** Some haulers may feel this (and subsequent) information is proprietary, and should be handled confidentially by the city. Collecting it, however, would provide significant benefit to DSWM by identifying the types of ICI customers in the city. This data would allow DSWM and haulers to better serve these customers in the future in terms of both policy changes (e.g., waste diversion) and facilitate service consistency across the sector.
2. **Service areas and rates:** These are required in general terms only (i.e., the overall service area must be generally defined but not every customer location specifically identified – and the low and high end of rates provided, not the exact rate structure). This data would help DSWM to verify full coverage of the MFU and ICI sectors, that competitive and reasonable pricing is used, and that competition is readily available to customers throughout the marketplace.

[40] Colorado examples include Aspen, Boulder and Fort Collins, CO.

3. **Reporting changes in collection vehicles:** While possibly onerous for companies with large fleets, this information would be important to DSWM in verifying that only registered and inspected vehicles are being used within the city.

One of the positive aspects for hauler licensing that should be stressed is that this policy would identify solid waste collection standards in Denver for the first time. It would also establish hauling as a privilege for compliant companies.

Recyclables & Organics Collection Requirements

Waste diversion will cause generators and haulers to re-evaluate and revise waste management practices in some cases. This may pertain to recyclables/organic containers (either generator or hauler may provide and will need to consider type and size of container, as well as who will be responsible for maintenance), verifying adequate container storage space, providing employee training (generators), and revised routing (haulers).

Because DSWM does not have access to waste generation information from ICI generators, quantities of waste that will potentially be diverted as a result of this option cannot be easily estimated. It is noted that without financial or other incentives to increase MFU and ICI generators to divert more materials, this option only provides collection services of recyclables and organics (most likely at additional cost) on a subscription basis and may not increase current diversion levels appreciably. This option is an important first step however, to start increasing waste diversion beyond the residential sector[41]. Recyclable and organic material types and quantities can vary greatly depending on the generator. For example, big box stores typically generate mostly cardboard, while restaurants/bars generate high quantities of container glass and food waste.

The collection of recyclables (especially if they are commingled into a single-stream) may not be a hardship in most instances. This would be especially true at any generator location that can accommodate automated carts. Carts can be serviced by most vehicles so that any size hauler can relatively easily add recyclables collection. Rear-loaders can be modified with a lift attachment and front-loaders can similarly be outfitted with front forks or a container. It is expected that many haulers operating in Denver already provide some level of recycling services.

Collection of organics may present additional challenges. Key issues for generators and haulers are expected to include:

1. **Containers -** The high moisture content in food waste is corrosive and would decrease the life of metal containers (and vehicles). It may also make this material too heavy for bags for some generators. Plastic containers can be a reasonable alternative, although plastic is not suitable for hot waste, which may be generated in some food waste streams). From a collection standpoint, plastic carts can be an ideal solution, depending upon space constraints. Plastic dumpsters are also available in sizes ranging from two to eight cubic yards.

[41] Next steps may include bundled or differential rates that incentivize diversion, diversion mandates (such as that discussed in Section 11.0) and educating generators about the financial and other benefits of diversion.

2. **Container maintenance -** In some instances, containers may be provided by the generator and in some, they may be provided by the hauler (however, containers provided by generators risk compatibility with haulers' equipment). Regardless, there would have to be a clear understanding of which party is responsible for keeping the containers clean and minimizing odors and vermin.
3. **Collection frequency -** Collection of organics may be required more frequently in the summer than in winter, requiring different schedules depending on the time of year.
4. **Compost facility -** One of the biggest challenges for small haulers may be the identification of a compost facility. At this time, the only state-permitted compost facility that accepts food waste within reasonable distance from Denver is A1 Organics (Platteville and Keenesburg)[42]. Other facilities accept yard/green waste (e.g., A1's Stapleton facility).

Even though private haulers would have expenses to implement recyclables and organic collection services (e.g. vehicles, drivers, carts, etc. and the MRF or compost facility tip fee), it is anticipated that fees charged for refuse, recyclables and/or organics collection would generate the revenues needed to cover the incremental cost increases. Direct marketing of collected recyclables or partnership/contract with a local MRF can also generate revenues.

10.2.6 Diversion Potential

There are no data available on ICI waste generation or composition in Denver. Table 10-5 estimates the total solid waste, recyclables and food waste for the non-residential generators impacted by this option. These estimates are based on generation rates observed in other cities over the last several years and are approximate guidelines only[43]. One hundred percent diversion of these materials is not likely, however. Table 10-6 evaluates a more probable diversion by the ICI sectors of 25% during the short-term planning period[44]. This range is arbitrary and is likely to vary widely depending on the generator type[45]. Verification of these numbers would be attained as the hauler reporting component of this policy becomes effective.

[42] Waste Management of Colorado and A1 Organics may be partnering on a new yard/food waste compost facility at the DADS Landfill as early as 2010.

[43] An evaluation of the Table 10-5 estimated quantities - coupled with the 257,680 tons managed by DSWM in 2007 (refuse and recyclables) – indicate that 45% of the total waste generated in Denver was from residential sources (including large MFUs) and 55% was from commercial/institutional/industrial sources. This break down is generally consistent with USEPA findings which observe a 55-65% to 35-45% ratio for residential to non-residential waste generation (USEPA's "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008", November 2008). Other state data (e.g., Minnesota Pollution Control Agency's Statewide MSW Composition Study, 2000 and Eagle/Garfield/Pitkin County Waste Composition Study, 2009) showed ratios of residential tons ranging from 37% to over 50%.

[44] Based on national municipal solid waste diversion rate of 33.2% (USEPA's "Facts and Figures for 2008", November 2008 and CA Integrated Waste Management Board's "Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups", June 2006).

[45] Big box and grocery stores may divert over 60% of their total wastes, while office buildings may divert less than 10% (CA Integrated Waste Management Board's 2006 Study).

Table 10-5. 2007 Estimated Denver Non-Residential Waste Quantities (rounded to nearest 100 tons).

Generator	Total Solid Waste	Total Recyclables	Total Food/Yard Waste
Large Multi-Family (7 or fewer units)	95,000[a]	28,500[b]	18,100[b]
Other ICI	439,900[c]	92,400[d]	127,600[d]
TOTAL NON RESIDENTIAL	**534,900**	**120,900**	**145,700**

[a] Using Table 10-1 findings and an un-weighted average 1.0 tons/unit-year (based on data available from US cities and the CA Integrated Waste Management Board's 1999 Statewide Waste Characterization Study)
[b] Based on adjusting DSWM's "Spring/Fall 2008 Waste Composition Analysis", March 2009 to allocate yard waste to other materials categories for MFU composition (i.e., 30% recyclables and 19% food/yard waste organics)
[c] Using Table 10-1 findings and an un-weighted average 1.1 tons/employee-year (based on data available from CA
[d] Based on 2009 Eagle/Pitkin/Garfield Counties ICI waste composition results and 2008 CA Integrated Waste Management Board's 2008 Statewide Waste Characterization (i.e., 21% recyclables and 29% food/yard waste)

The diversion potential of this policy cannot be clearly estimated as ICI waste quantities hauled by the private sector are unknown. Table 10-6 estimates can be used to approximate potential diversion within the ICI service area. These quantities are not managed or tracked by DSWM at this time, but may become accessible once this policy is implemented

Table 10-6. Estimated Non-Residential Waste Quantities Diverted During the Short-Term Planning Period[a, b] (rounded to nearest 100 tons).

Generator	2007 Generation Base Year		Phase 3		Phase 4		Phase 5	
	R	O	R	O	R	O	R	O
Large Multi-Family (w 8 or more units)[a]	7,100	4,500	7,300	4,600	7,300	4,700	7,400	4,700
Other ICI[a]	23,100	31,900	23,700	32,700	23,800	32,800	23,800	32,900
TOTAL	**66,600**		**68,300**		**68,600**		**68,800**	
Estimated Total Waste Generated from ICI Service Area[b]	**534,900**		**547,900**		**550,100**		**552,300**	
Diversion Potential			**12%**		**12%**		**12%**	

[a] Based on assumed 25% diversion of recyclables and food/yard waste tons estimated in Table 10-5; annual growth rate based on 0.4% observed for Denver's residential waste stream (see Table 5-4)
[b] See Table 10-5; annual growth rate based on 0.4% (see Table 5-4)
R = recyclables, O = organics

10.3 Estimated New Costs

Table 10-7 summarizes the annual operating costs estimated for DSWM's implementation of this hauler licensing and collection option, which for evaluation purposes would be implemented between Phase 3 and Phase 5. These costs would be "new" as they represent expenses for activities not currently practiced by DSWM.

Table 10-7. Estimated New Hauler Licensing & Collection Program Costs (2010 dollars, rounded to $100).

Category		Phase 3	Phase 4	Phase 5	Total Phase 3-Phase 5
Data Tracking Labor[a]					
	Hours	600	500	400	
	Staffing (FTE)	0.3	0.2	0.2	
	Labor Category - Sup of Admin1[b]	$66,700	$66,700	$66,700	
Enforcement[a]					
	Hours	885	330	315	
	Staffing (FTE)	0.4	0.2	0.2	
	Labor Category - Assoc City Insp[b]	$62,400	$62,400	$62,400	
Labor Costs		**$45,800**	**$25,900**	**$22,300**	
Miscellaneous Costs (software, training, mileage, printing, & mailing)		$3,000	$1,000	$1,000	
Total Program Costs		**$48,800**	**$26,900**	**$23,300**	**$0.1M**

[a] Based on Table 10-4 hours
[b] Labor costs based on DSWM 2009 labor rates step #5, escalated 3% to 2010 plus 38% benefits

Costs excluded from this estimate and difficult to project include:

- DSWM and city legal staff time needed to work with private haulers to develop and enact the policy;
- Hauler cost for gathering and consolidating required data (haulers familiar with licensing requirements in other communities may already have the data in a useable reporting format), as well as any licensing fees established by the city; and
- Cost to generators for new recycling service from private haulers (these costs can be highly variable and a function of the program and materials).

10.4 Estimated Avoided Costs and Potential Revenues

The estimates in this section are guidelines only - they apply to private haulers and not DSWM. As specific tip fees paid, and savings/revenues earned by haulers are not available, DSWM estimates have been used. These may not be representative for haulers (i.e., fees may be lower and saving/revenues may be higher than haulers actually realize).

Avoided Costs

Avoided costs reflect the potential savings private haulers (not DSWM) may realize by not disposing recyclable and organics tons that are diverted as a result of this option. The avoided costs estimated in Table 10-8 are based on landfill tip fees that DSWM is paying in 2010.

Table 10-8. Potential Costs Avoided by Haulers with New Private Hauler Policy (2010 dollars, rounded to nearest $100).

Material	Phase 3	Phase 4	Phase 5
Diverted Quantity (tons)	68,300	68,600	68,800
Estimated Tip Fee[a]	$16	$16	$16
Avoided Costs	**$1,092,800**	**$1,097,600**	**$1,100,800**

[a] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

Potential Revenues

In addition to avoided costs, private haulers (not DSWM) may earn revenues associated with the sale of increased recyclable tons. Potential revenues summarized in Table 10-9 are calculated on the recyclable tons estimated in Table 10-6 and are based on the base payment ($33/ton) that DSWM currently earns under its contract with WMRA.

Table 10-9. Potential Recyclables Revenues Generated by Haulers (2010 dollars, rounded to nearest $100).

Material	Phase 3	Phase 4	Phase 5
Recyclable Quantity (tons)	**31,000**	**31,100**	**31,200**
Total Revenues[a]	**$971,900**	**$975,000**	**$978,100**

[a] Based on base payment revenues currently earned by DSWM under its contract with WMRA

11.0 New Restaurant Diversion Program

This section evaluates a new program requiring restaurants to divert food waste. This program will increase diversion beyond DSWM's service area, extend the life of the DADS landfill and increase community awareness throughout the city.

11.1 Introduction

This program would require large Denver restaurants to divert food waste. Food waste can be 25% or more of a community's commercial waste stream. Restaurants - one of the larger waste generators in the ICI sectors - produce a high level of food waste (as much as 50% of its total). By targeting these generators, a significant portion of food waste organics can be diverted from Denver's municipal solid waste stream.

Restaurants in Denver are currently served by private sector haulers, who would be required to collect all customer recyclable and organics materials (including food waste) under the new private hauler policy described in Section 10.0, and managed at a permitted composting facility.

11.2 Implementation

11.2.1 Applicability

This option is expected to apply to full-service restaurants only[46]. Restaurants with less than 10 employees (generating less than about 30 tons/year of waste) would be exempt from this policy. According to NAICS, there were 662 full-service restaurants in Denver, and 398 of these have 10 or more employees. Table 11-1 lists the impacted restaurants and their estimated food waste generation. The waste quantities are based on generation in other parts of the U.S. and are approximate guidelines only.

[46] Full-service restaurants (NAICS code 7221) are defined as those establishments that primarily provide food services to customers who are served while seating (i.e., have waiter/waitress service).

Table 11-1. 2007 Denver Restaurant Food Waste Quantities (rounded to nearest 100 tons).

NUMBER OF EMPLOYEES[a] (median value)	NUMBER OF RESTAURANTS	ANNUAL TOTAL REFUSE GENERATION[b]	FOOD WASTE GENERATION[c]
1-4 (2.5)	163	N/A	N/A
5-9 (7)	101	N/A	N/A
10-19 (14.5)	128	5,800	2,900
20-49 (34.5)	180	19,300	9,700
50-99 (74.5)	75	17,300	8,700
100-249 (174.5)	15	8,100	4,100
Total for Restaurants with > 10 Employees	**398**	**50,500**	**25,400**

[a] Source = 2007 Business Patterns (NAICS)

[b] Assumed 3.1 tons/employee-year (based on Santa Barbara County Public Works Department "Guide to Solid Waste and Recycling Plans, 1995 and CA Integrated Waste Management Board "Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups", 2006)

[c] Assumed 50% food waste composition (based on Resource Recycling "Commercial Food Waste from Restaurants and Grocery Stores", 1993 and CA Integrated Waste Management Board's 2006 Study)

11.2.2 Phased Implementation

For evaluation purposes it is expected that this improvement would be implemented in Phase 4. This sequencing would allow DSWM four years to negotiate policy language with restaurant and hauler trade groups or representatives, and for restaurants to prepare for the required change in solid waste management.

11.2.3 Policy Development

Unlike the hauler policies discussed in Section 10.0, this option would be a generator policy, focused on requirements for full-service restaurants operating in Denver. San Francisco, California (Table 11-2) has a policy requiring food vendors (including restaurants) to separate both recyclables and organics (including food waste, excluding fats, oils and grease; contaminated paper; and plant trimmings). The policy further requires vendors to provide enough color-coded and signed containers and storage space to make separation convenient, and to train staff, customers, janitors and any contractors. A space waiver is available, but options for container sharing and drop-site collection are to be evaluated. Enforcement includes inspections paid for by the generator.

Table 11-2. Generator Requirement for Refuse Collection Examples.

	Applicability	Requirements	Enforcement	Other
San Francisco, CA	Food vendor separation of recyclables, organics excluding fats, oils, grease	Provide containers/location to make source separation convenient; sign/color containers to identify materials; train staff/customers/janitors/contractors	City may inspect at any time; inspection fee imposed by city	Space waiver available (options include sharing containers or drop-site collection)

A new food waste separation policy for Denver full-service restaurants would ideally include:

1. **Acceptable materials** – Acceptable materials should include those food waste and contaminated paper materials accepted at local composting facilities (this list may be subject to change).
2. **Designated containers**
   - Separated organics should be contained separately from refuse and recyclables;
   - Require that generators provide adequate containers and storage space to contain waste generated between collections without overflows, nuisance conditions or health hazards; and
   - Verify through spot inspections.
3. **Verification of organics collection service**
   - Copy of a refuse collection service agreement between the generator and hauler, a copy of a recent invoice for service, or similar documentation that identifies the generator location(s), number and size of containers, and frequency of collection; and
   - Submitted directly to DSWM annually.
4. **Staff training** – This should cover both new employees and refresher training (records should be maintained for DSWM review at any time).
5. **Enforcement** – Enforcement could ultimately include fines.

11.2.4 Staff Requirements for Enforcement and Data Tracking

These staff requirements for DSWM would begin in Phase 4 when both components of this option are expected to be implemented. Specific activities and estimated labor requirements are summarized in Table 11-3. It is expected that an electronic tracking system would be established. It is estimated that less than one FTE would be required annually. This estimate does not consider the DSWM staff time needed to develop, negotiate and obtain approval for final policy language (which would precede the Phase 4 start date).

Table 11-3. Estimated City Staffing Requirements for Organics Diversion by Restaurants during Short-Term Planning Period.

Staff Requirement	Basis	Hours in Phase 4	Hours in Phase 5
Verify Collection Service Annually	398 restaurants in 2007	120 hours	100 hours
Spot Container/Training Inspections	80 per year	120 hours	120 hours
Investigate Non-Compliance & Evaluate Enforcement	40 investigations per year	160 hours	120 hours
TOTAL		**400 hours (0.2 FTE)**	**340 hours (0.2 FTE)**

11.2.5 Implementation Challenges

Challenges to commercial diversion of organics were addressed in Section 10.2.5. Key issues for generators and haulers are expected to include:

1. **Containers -** The high moisture content in food waste is corrosive and would decrease the life of metal containers (and vehicles). It may also make this material too heavy for bags for some generators. Plastic containers can be a reasonable alternative, although plastic is not suitable for hot waste, which may be generated in some food waste streams). From a collection standpoint, plastic carts can be an ideal solution, depending upon space constraints. Plastic dumpsters are also available in sizes ranging from two to eight cubic yards.
2. **Container maintenance -** In some instances, containers may be provided by the generator and in some, they may be provided by the hauler (however, containers provided by generators risk compatibility with haulers' equipment). Regardless, there would have to be a clear understanding of which party is responsible for keeping the containers clean and minimizing odors and vermin.
3. **Collection frequency -** Collection of organics may be required more frequently in the summer than in winter, requiring different schedules depending on the time of year.
4. **Compost facility -** One of the biggest challenges for small haulers may be the identification of a compost facility. At this time, the only state-permitted compost facility that accepts food waste within reasonable distance from Denver is A1 Organics (Platteville and Keenesburg)[47]. Other facilities accept yard/green waste (e.g., A1's Stapleton facility).

11.2.6 Diversion Potential

Table 11-1 estimated the total food waste generated by eligible restaurants. One hundred percent diversion of these materials is not likely – even with a mandatory diversion requirement. Table 11-4 evaluates a more probable 60% diversion of food waste generated during the short-term planning period[48]. This diversion estimate is likely to vary depending on how much time passes between policy

[47] Waste Management of Colorado and A1 Organics may be partnering on a new yard/food waste compost facility at the DADS Landfill as early as 2010.

[48] Based on 23.5% food waste diversion rate for full-service restaurants for areas with no diversion mandate (California Integrated Waste Management Board's "Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups", June 2006).

implementation and the success of Denver's enforcement program. Verification of these numbers would be attained as the reporting component of the hauler licensing policy becomes effective.

The diversion potential of this option cannot be clearly estimated as exsiting ICI waste quantities hauled by the private sector are unknown. Table 10-5 estimates can be used to approximate diversion within the ICI service area. These quantities are not managed or tracked by DSWM at this time, but may become accessible once this policy and the hauler licensing policy are implemented.

Table 11-4. Estimated Restaurant Food Waste Quantities Diverted During the Short-Term Planning Period (rounded to nearest 100 tons).

Generator	2007 Generation Base Year	Phase 4	Phase 5
Food Waste Organics[a]	15,200	15,700	15,700
Estimated Total Waste Generation from ICI Service Area[b]	534,900	550,100	552,300
Diversion Potential		**3%**	**3%**

[a] Based on assumed 60% of food waste tons estimated in Table 11-1; annual growth rate based on 0.4% observed for Denver's residential waste stream (see Table 5-4)
[b] See Table 10-5; annual growth rate based on 0.4% (see Table 5-4)

11.3 Estimated New Costs

Table 11-5 summarizes the estimated annual operating costs for this restaurant diversion option, which would be implemented in Phase 4. These costs would be "new" as they represent expenses for activities not currently practiced by DSWM.

Table 11-5. Estimated New Restaurant Policy Program Costs (2010 dollars, rounded to $100).

Category		Phase 4	Phase 5	Total Phase 4-Phase 5
Data Tracking Labor[a]				
	Hours	120	100	
	Staffing (FTE)	0.1	0.05	
	Labor Category - Sup of Admin1[b]	$66,700	$66,700	
Enforcement Labor[a]				
	Hours	280	240	
	Staffing (FTE)	0.1	0.1	
	Labor Category - Assoc City Insp[b]	$62,400	$62,400	
Labor Costs		**$12,200**	**$10,400**	
Miscellaneous Costs (software, training, mileage, printing, & mailing)		$3,000	$1,000	
Total Program Costs		**$15,200**	**$11,400**	**<$0.1M**

[a] Based on Table 11-3 hours
[b] Labor costs based on DSWM 2009 labor rates step #5, escalated 3% to 2010 plus 38% benefits

Costs excluded from this estimate and difficult to project include:

- DSWM and city legal staff time to work with full-service restaurants and private haulers to develop and enact the policy; and
- Cost to restaurants for collection of diverted food waste where this new service is not fully offset by reduced refuse collection (if composting facility tip fees are higher than landfill tip fees, additional small to modest incremental costs may be incurred by generators).

11.4 Estimated Avoided Costs

The estimates in this section are guidelines only - they apply to private haulers and not DSWM. As specific savings/revenues earned by haulers are not available, DSWM estimates have been used. These may not be representative for haulers (i.e., savings/revenues may be higher than haulers actually realize).

Avoided Costs

Avoided costs reflect the potential savings private haulers (not DSMW) may realize by not tipping organic tons as refuse. However, these organic materials would have a tip fee at a permitted compost facility, reducing the impact of any avoided costs and effectively shifting costs from one aspect of system management to another (compost facility tip fees may even be higher than landfill tip fees). The avoided costs estimated in Table 11-6 are based on the organic tons estimated in Table 11-4 and are based on landfill tip fees that DSWM is currently paying in 2010.

Table 11-6. Potential Costs Avoided by Hauler with New Restaurant Policy During the Short-Term Planning Period (2010 dollars, rounded to nearest $100).

Material	Phase 4	Phase 5
Quantity (tons)	15,700	15,700
Estimated Tip Fee[a]	$16	$16
Avoided Costs	**$251,200**	**$251,200**

[a] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

12.0 Large MFU Generator Refuse Collection Verification Program

This section evaluates a new program requiring large MFUs to verify refuse collection service. This program will reduce abuse of DSWM service by generators outside its service area and will increase community awareness about sustainable waste management throughout the city.

12.1 Introduction

It is likely that some larger MFU generators (more than seven units) occasionally use residential dumpsters for disposing of their refuse. In this case, DSWM is burdened with the need to collect and manage the material, as well as control litter and maintain alleyways. To minimize this practice, this option would require large MFU generators to provide proof that they have obtained the services of a private hauler for managing refuse.

12.2 Implementation

12.2.1 Applicability

This option would apply to all MFUs with more than seven units. As noted in Table 10-1, there were 1,642 MFU complexes in this size range in 2007 (including just fewer than 95,000 total units). Specifically, the property owner or management company would be responsible for compliance.

12.2.2 Phased Implementation

For evaluation purposes, this option is expected to be implemented towards the end of the short-term planning period, in Phase 5. This timing would allow both the hauler (Section 10.0) and restaurant (Section 11.0) programs to be fully implemented. It would also allow DSWM adequate time to coordinate verification and enforcement with sister city agencies.

12.2.3 Policy Development

Table 12-1 includes two examples of municipal policies that require generators to obtain solid waste collection service from a private sector hauler. Neither of these examples requires verification that such service has been obtained.

Table 12-1. Generator Requirement for Refuse Collection Examples .

	Applicability	Requirement	Other
San Francisco, CA	MFU, commercial business or property owner	Must subscribe to and pay for solid waste collection service; location must be accessible to hauler; must provide containers/adequate space as determined by city	Rates set by city; $100 fine plus additional penalties
Sarasota County, FL	MFU, commercial business or property owner	Must contract for solid waste collection services under county's franchise agreement; must provide/maintain containers needed for weekly generation	Rates set by county

A new policy requiring all large MFU generators in Denver to provide proof that they have obtained refuse collection service is expected to include:

1. **Proof of service**
   - Copy of a refuse collection service agreement between the generator and hauler, a copy of a recent invoice for service, or similar documentation that identifies the generator location(s), number and size of refuse containers, and frequency of collection.
2. **Containers and storage space**
   - Require that generators verify adequate containers and storage space to contain waste generated between collections without overflows, nuisance conditions or health hazards; and
   - Verify through spot inspections.
3. **Enforcement** – Enforcement could ultimately include fines and/or property liens.

12.2.4 Staff Requirements for Enforcement

These staff requirements for DSWM would begin in Phase 5 when this policy is expected to be implemented. Specific activities and estimated labor requirements are summarized in Table 12-2. It is expected that an electronic verification process would be established. Table 12-2 estimates that a total of 0.4 FTE would be required annually. The DSWM verification/enforcement position could be combined with the other staff requirements described in Section 10.0 and 11.0. This estimate does not consider the DSWM staff time needed to develop, negotiate and obtain approval for final policy language (which would precede the Phase 5 start date) or develop mechanisms for both verification and enforcement.

Table 12-2. Estimated City Staffing Requirements for MFU Service Verification during Short-Term Planning Period.

Staff Requirement	Basis	Hours in Phase 5
Verify Quarterly Submittal of Acceptable Documentation	1,642 MFU complexes in 2007	410 hours (0.2 FTE)
Spot Container Inspections	160 per year	240 hours
Investigate Non-Compliance & Evaluating Need for Enforcement	16 investigations per year	100 hours
TOTAL		**750 hours (0.4 FTE)**

12.2.5 Implementation Challenges

This policy would require property owners or managers of large MFUs in Denver to provide proof of refuse collection service. As most MFUs are expected to have this service in place currently, the only requirement would be submitting documentation. While seemingly onerous at first, this requirement is expected to become routine by the end of the short-term planning period. Additionally, an enforcement mechanism would need to be implemented in those instances when acceptable documentation is not received (Table 12-2 estimates these staffing requirements).

12.3 Estimated New Costs

Table 12-3 summarizes the annual operating costs for the MFU verification option, which would be implemented in Phase 5. These costs would be "new" as they represent expenses for activities not currently practiced by DSWM.

Table 12-3. Estimated New MFU Verification Program Costs (2010 dollars, rounded to $100).

Category		Phase 5
Data Tracking Labor[a]		
	Hours	410
	Staffing (FTE)	0.2
	Labor Category - Sup of Admin1[b]	$66,700
Enforcement Labor[a]		
	Hours	340
	Staffing (FTE)	0.2
	Labor Category - Assoc City Insp[b]	$62,400
Labor Costs		**$23,300**
Miscellaneous Costs (mileage/inspections, printing & mailing)		**$1,500**
Total Program Costs		**$24,800**

[a] Based on Table 12-2 hours
[b] Labor costs based on DSWM 2009 labor rates step #5, escalated 3% to 2010 plus 38% benefits

Costs excluded from this estimate and difficult to project include:

- DSWM and city legal staff time to work with large MFU owners and property managers to develop and enact the policy; and
- Cost to MFUs for policy compliance.

13.0 Continue the HHW Program with Expanded Paint Collection

This section evaluates continuation of DSWM's HHW program. This program manages a small, but toxic component of the waste stream. It provides sound management of household quantities of hazardous waste and reduced liability at the DADS landfill.

13.1 Introduction

HHW is generally a small part of the municipal solid waste stream, but can include highly toxic and hazardous materials. Collection and recycling/disposal of HHW is important both to help residents safely manage these materials and to keep them from being disposed of in the landfill, storm water and sewer systems, or dumped illegally. It is DSWM's intention to maintain private contractor-provided HHW services during the short-term planning period. It is assumed for this option that latex paint drop-off at retailer locations would become a permanent part of this program.

HHW Program

DSWM currently contracts with Curbside, Inc. (Curbside) for the provision of household collection service and drop-off HHW services to residents once each year. The drop-site and processing facility is located in Denver.

Household collection is partially subsidized by DSWM and requires a co-payment from residents– a maximum of 125 pounds per resident is accepted during the annual collection (plus a maximum of five automotive batteries and five fluorescent bulbs). Eligible materials include both recyclables and non-recyclables. Use of the drop-off site is on an appointment basis, and is also subsidized. Additional collection fees can be charged for excessive quantities, special collection needs and materials not specified in DSWM's contract (such as electronic waste).

A new contract component added in 2010 is a pilot program for the collection of used latex paint at retail locations. A limited number of qualified retailers will participate, filling Gaylord boxes on pallets with used latex paint – no blending or bulking will be done at the retail locations. Curbside will collect full boxes on an on-call basis, and recycle the collected paint. DSWM will pay the full cost of this pilot, which include $50 set-up at each retailer and $350 per collection from each retail location.

Electronic Waste Program

DSWM has also provided a residential e-waste collection option since 2003. E-waste continues to grow as a significant portion of the waste stream (typically 1% to 2% - a fraction that was non-existent a dozen years ago). Special e-waste management is important as cathode ray tubes (such as those included in televisions and computer monitors) are a significant safety concern for manually collected refuse or when set out for large item pick-up. They can pose ergonomic challenges or cut/abrasion risks if broken.

Denver's e-waste service has been provided through funding from corporate sponsorships[49] and grants. The service has included some exceptional collection events (including annual events in 2008 and 2009), but the event frequency has been sporadic and residents have inconsistent e-waste management options[50]. In 2009, Denver obtained a small grant to develop an e-waste recycling coupon program, which enabled residents to bring unwanted electronic equipment to Metech Recycling at no charge. These funds are nearly exhausted at this time. Quantities diverted through these programs has varied, but has ranged from 35 tons per year in years without a collection event, to nearly 250 tons annually during those years with collection events and the e-coupon program.

13.2 Implementation

13.2.1 Applicability

The household collection service for HHW is available to DSWM's current service area (all SFUs and MFUs with seven or fewer units), while the drop-off collection is available to all city residents (including the large MFUs with more than seven units). Each resident may use one or the other service a maximum of once per year.

13.2.2 Phased Implementation

The existing HHW program is expected to continue through the short-term planning period and will include permanent retail drop-off collection of latex paint. Future contracts may be negotiated with Curbside or other private sector contractors.

13.2.3 Diversion Potential

Table 13-1 includes an estimate of future HHW quantities. An estimated 3% annual growth rate has been assumed for HHW materials, including latex paint (this material has been a majority of the material collected by Curbside historically). Expanding the future program to include retail drop-off is not expected to change the total HHW tons appreciably, but rather partially shift paint collection from household collection service to retail locations. Note that if DSWM maintains an e-waste program, an additional 200 tons could be diverted annually.

[49] Corporate partners have included Metech Recycling, Dell, Comcast, LG Electronics, Waste Management, 9News and Best Buy.

[50] DSWM maintains a list of private vendors in Denver that accept e-waste for recycling (for a fee), however, staff is aware that these vendors vary in their range of service, fees, convenience levels for residents, and caliber of recycling.

Table 13-1. Estimated Household Hazardous Waste Quantities Diverted During the Short-Term Planning Period[a] (rounded to nearest 5 tons).

	2008 (actual)	2009 (actual)	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Quantity (tons)	103	84	115	115	120	125	125
Estimated Total Waste Generated by DSWM's Service Area[b]	249,195	253,096	252,300	251,900	251,600	251,200	250,800
Diversion Potential	**<1%**	**<1%**	**< 1%**	**< 1%**	**< 1%**	**< 1%**	**< 1%**

[a] Assumed 3% quantity increase per year, based on 2008 tons (in 2009, the contract was suspended during fourth quarter) – growth is assumed in all years (may be hidden by rounding)
[b] See Table 5-1

13.3 Estimated Costs

HHW program costs are covered by Denver's Wastewater Management Division. As the manager of this program, DSWM has utilized - and exceeded - the HHW budget since 2006 (see Table 13-2). The 2009 quantities are low because curbside services were reduced during the fourth quarter to minimize budget overruns.

Table 13-2. Historical HHW Quantities & Program Costs.

Generator	2003	2004	2005	2006	2007	2008	2009
Quantity (tons)	64	84	92	97	104	103	84
Budget	$212,000	$212,000	$212,000	$212,000	$212,000	$212,000	$212,000
Actual Cost	$136,304	$184,056	$202,643	$220,358	$258,056	$265,525	$218,562
Cost/Ton	$2,129	$2,191	$2,202	$2,271	$2,481	$2,578	$2,602

A unit cost of $2,600 per ton (2010 dollars) was used for the short-term planning period, based on an expectation by DSWM that the inclusion of retail collection of latex paint (the largest component of most HHW programs) would reduce the cost of household collection service and drop-off collection, therefore controlling HHW program costs in the future[51]. Estimated future costs for maintaining this program are included in Table 13-3 – these are not considered "new" costs as they represent continuation of an existing program already addressed as a DSWM budget line item.

This estimate considers increasing costs based on potentially increasing quantities collected. However, DSWM and the Wastewater Management Division may continue to cap quantities managed in order to cap expenditures. These costs include basic public education completed by DSWM staff through 2008 – any expanded outreach efforts are not included in Table 13-3 (see Section 14.0).

[51] As much as 75% of paint collected may eventually come from retailer versus door-to-door or drop-off collection (December 2009 phone conversation with Chad Centola, Deschutes County, OR).

As noted in Section 13.1, DSWM should consider funding for the continuation of its e-waste program. Table 13-3 includes the cost of supporting two one-day collection events each year during the short-term planning period. It is possible that the new DSWM drop-sites (Section 9.0) could also be expanded in the future to accommodate on-going e-waste collection.

Table 13-3. Estimated HHW and E-Waste Program Costs for Short-Term Planning Period (2010 dollars).

Material	2008 (actual)	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
HHW Quantity (tons)[a]	84	115	115	120	125	125	
HHW Cost Projection[b]	$218,562	$299,000	$299,000	$312,000	$325,000	$325,000	$1.6M
E-Waste Cost Projection[c]		$200,000	$200,000	$200,000	$200,000	$200,000	$1.0M
Total Costs		$499,000	$499,00	$512,000	$525,000	$525,000	$2.6M

[a] Assumed 3% quantity increase per year
[b] Based on $2,600 per ton
[c] Cost estimate provided by DSWM

13.4 Avoided Costs

Avoided costs are expected to include the potential savings DSWM would realize by not tipping HHW tons as refuse at the DADS landfill. Avoided costs are based on landfill tip fees that DSWM is currently paying in 2010. Avoided tons and associated cost savings are estimated in Table 13-4. Other, less quantifiable cost benefits associated with managing HHW as described in this section include the increased public safety and reduced environmental liability for Denver. Note that if DSWM maintains an e-waste program, as much as 250 additional tons (and associated cost savings) could be diverted annually.

Table 13-4. Estimated HHW Avoided Costs for Short-Term Planning Period (2010 dollars).

Material	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Quantity (tons)	115	115	120	125	125	
Estimated Tip Fee[a]	$16	$16	$16	$16	$16	
Avoided Costs	**$1,800**	**$1,800**	**$1,900**	**$2,000**	**$2,000**	**<$0.1M**

[a] Based on $16/ton pro-rated DADS landfill tip fee for DSWM waste in 2010

14.0 Public Education and Outreach to Support Short-Term Programs

This section evaluates a new program providing targeted public education and outreach for DSWM's new short-term planning programs. The success of these programs will be largely based on increasing the awareness and sense of individual responsibility for Denver's residents.

14.1 Introduction

Public education about services, service changes, rules, regulations, guidelines, and desired behavior is a critical component of DSWM's services. Without adequate education and the resulting compliance from those impacted, the cost to provide services would undoubtedly increase. Public education is essential to ensure success in each option.

A variety of educational efforts would support each option. Since almost all service change programs are taking a phased approach, education programs would be designed in phases. And, because education and outreach methods are constantly evolving with new technologies and changing media, this section provides a recommended approach based on current knowledge.

Implementation of education initiatives would be led by DSWM staff, and when necessary, outside assistance would be sought from other professionals, such as graphic artists and advertising professionals. The timing for education programs varies depending on the service being implemented and the message goals. As a general rule of thumb, education planning and work should begin at least six months prior to service launch.

14.2 Implementation

14.2.1 Program Coordination

Some of the public education program costs are expected to be absorbed by current staffing; however, the expansion of educational activities drives the need for one new FTE, a program coordinator. Overall education costs include the one new Program Coordinator and some general web and graphic support. The Program Coordinator would be added in Phase 1 and on board through Phase 5 to aid in carrying the additional education load. This person's duties would include:

- Crafting messages;
- Preparing copy, photographs, layout, etc.;
- Managing the educational process, including securing advertising and free promotional avenues;
- Working with graphic designers as needed;
- Managing web-delivered information;
- Being available for public meetings; and
- Answering questions from effected constituencies as new programs launch.

14.2.2 Standardizing Refuse Collection and Expanding Collection of Diverted Materials

Education for this option must address three key components over the short-term planning period:

- The move of refuse collection to automated/semi-automated service, including providing new carts to residents;
- Increasing household subscriptions for single-stream recycling service and getting containers to new households; and
- Adding household organics collection service on a subscription basis and getting new containers to new households.

Implementation of these changes is discussed in detail in Section 7.2. Education related to the first set of changes – move to automated/semi-automated service between Phase 1 and Phase 5 – is expected to consist of the following:

- Direct mail one-page brochure;
- Flyers;
- Posters; and
- Audit tags.

Education for increasing the number of voluntary subscribers to single-stream recycling would include the following outreach methods:

- Direct mail one-page brochure;
- Flyers, posters, and audit tags;
- Local print advertising; and
- Radio advertising.

And, education to support the addition of subscription residential organics collection would include:

- Electronic announcements;
- Direct mail one-page brochure;
- Flyers, posters, and audit tags;
- Local print advertising;
- Radio advertising;
- Television/cable advertising; and
- Truck signs.

14.2.3 Reduced Large Item Pick-up and Refuse Overflow Collection

Education for this option must address two key components over the short-term planning period:

- The reduction of DSWM's LIP service from once every nine weeks to once per quarter; and
- The reduction of refuse overflow collection in barrel service areas from once every three weeks to once per quarter and ultimately elimination of service.

Implementing these programs (see Section 8.2) would represent a large shift in behavior for the targeted populations, necessitating a strong education effort. Education related to reduced LIP service is expected to include:

- Electronic announcements;
- A direct-mail multiple-page brochure explaining changes in LIP service, and alternatives residents can use to manage unwanted items;
- Communications via DSWM's WasteWise newsletter[52]; and
- Online services including calendars for LIP would be continuously available[53].

Education related to reduced over time collection would include:

- A direct-mail one-page brochure explaining changes; and
- Flyers, posters, and audit tags.

14.2.4 New Customer Drop-Site Collection

This option would include the phased development of two new customer drop-sites for the collection of diverted recyclables and organics, as well as large item (or bulky) refuse materials (see Section 9.2). The drop-off sites would provide a collection option for residents in DSWM's service area and would be brought online in Phase 2 and Phase 4.

Education for this option must address the need to make residents aware of the location, services, hours, and items received at the drop-off sites. It is expected to cover the entire city and to include:

- Electronic announcements;
- Print advertising (local);
- Radio advertising; and
- Television/cable advertising.

14.2.5 New Private Hauler Licensing and Collection Policy

This option (described in Section 10.2) does not apply to DSWM's residents, and therefore does not require residential public education. The planning option includes the following key features:

- Licensing for all private sector haulers;
- Reporting requirements for haulers;
- Requirement for haulers to collect recyclables and compost generated by their ICI customers; and
- Inspections and enforcement.

The preferred outreach method would most likely include direct mail to private sector haulers, which would be a minimal effort for DSMW, even if multiple mailings are required.

[52] See http://denvergov.org/Portals/522/documents/Waste%20Wise%20Denver%202009.pdf for 2009 letter .
[53] See http://denvergov.org/Portals/522/documents/LIP_calendar_2009.pdf as an example.

14.2.6 New Restaurant Diversion Policy

This option would require Denver full-service restaurants to divert food waste. The private sector haulers serving the targeted restaurants would be required to collect the food waste and deliver it to a permitted compost facility (see Section 11.2).

The preferred outreach method would most likely include direct mail to full-service restaurants. As the number of targeted restaurants is expected to be about 400, this represents a minimal effort for DSWM, even if multiple mailings are required. Additionally, DSWM will add dedicated education staff to work directly with restaurants on the benefits and logistics of diverting food waste. This is expected to require 0.5 FTE during the short-term implementation years of Phase 4 and Phase 5 (Prog Coor labor category).

A very low cost option DSWM may consider in the future is annual recognition/awards to restaurants with the highest diversion rates. Published recognition awards the generator and raises public awareness.

14.2.7 Large MFU Generator Refuse Collection Verification Policy

As this option targets large MFUs (more than 7 units) outside of DSWM's service area, it would not require public education (see Section 12.2). It would include developing a policy for generators to provide proof of storage capacity and collection services. This policy would coordinate with the hauler requirement policy to collect recyclables and compost from ICI generators (see Section 10.2). This policy would not be expected to be implemented until the end of the planning period, in Phase 5.

The preferred outreach method would most likely include direct mail to the large MFU facilities' owners or property managers. This would be a minimal effort for DSWM.

14.2.8 Continued Household Hazardous Waste Program with Expanded Paint Collection

This option would continue to provide Denver's residents with the existing level of household collection service and recycling/disposal of HHW. As well, latex paint drop-off at Denver retailer locations would become a permanent part of this program. These services would be available to Denver residents citywide (see Section 13.2). Education related to promoting the HHW collection service is expected to include:

- Electronic announcements;
- Print advertising (local); and
- Radio advertising.

14.3 Estimated New Costs

Education costs vary depending on the number of people who need to be reached, how often, and through what mechanism. Table 14-1 summarizes estimated "new" public education and outreach costs, and details are provided in Appendix L. This summary includes all the direct costs presented above for each option. The following across-the-board, general costs are allocated to each option:

- Professional design services;
- Updating Denver's websites including more interactive features and up-to-date information; and
- A new Program Coordinator (labor rate is based on DSWM's 2009 rates for Step #5, escalated 3% to 2010$ with 38% benefits).

Table 14-1 Estimated New Costs for Public Education and Outreach (2010 dollars, rounded to nearest $100).

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total Phase 1-Phase 5
Standardize Collection (Section 14.2.2)	$57,700	$58,800	$50,700	$54,800	$47,400	
Continue Recycling Growth and Add Organics Collection (Section 14.2.2)	$101,500	$118,700	$55,600	$55,600	$42,600	
Reduce LIP and Overflow Collections (Section 14.2.3)	$0	$53,300	$85,800	$0	$52,500	
New Drop-Sites (Section 14.2.4)	$0	$34,600	$18,600	$33,600	$17,800	
Continued HHW with Retail Paint Collection (Section 14.2.8)	$27,900	$23,100	$22,100	$22,100	$21,300	
Total Costs	**$187,100**	**$288,500**	**$261,900**	**$228,500**	**$243,100**	**$1.2M**

15.0 Short-Term Program Improvements Summary

15.1 Observations

Sections 7.0 through 14.0 evaluated various program improvements DSWM intends to implement over the next several years. These programs have been detailed in terms of implementation, diversion potential, estimated costs and projected savings and/or revenues.

Table15-1 summarizes the benefits and challenges, as well as potential landfill diversion, for each program. Additional detail for each program can be found in the corresponding Part Two section. For evaluation purposes, these programs have been assumed to be phased in a 5-phase period.

The following observations are made from this table:

- **Ability to Meet Greenprint Denver Goal –** Programs 1 through 4, 8 and 9 in Table 15-1 pertain directly to DSWM's service area. If all six of these programs are implemented, it is estimated that 45,900 tons of recyclables and organics material would be diverted in Phase 5 – this quantity would be in addition to recyclables and organics diverted prior to 2011 (estimated to be about 29,600 and 1,400 tons, respectively). In other words, 76,900 total tons would likely be diverted annually at the end of the short-term planning period.

  Based on projected total MSW of 250,800 tons in Phase 5 (see Table 5-1), this diversion tonnage would reduce landfilling to only 173,900 tons in Phase 5. This would represent a 32% decrease in landfill tons since 2004 (see Section 1.2) and would allow DSWM to meet the Greenprint Denver goal of reducing landfill tons by 30% (to a maximum of 178,100 tons) by the end of the short-term planning period.

- **Ability to Maximize Landfill Diversion -** Programs 5 through 7 in Table 15-1 pertain to policies developed to influence waste management practices outside of DSWM's service area. Two of these programs – hauler licensing and mandatory restaurant diversion of food waste – are estimated to divert large quantities of recyclables and organics from landfill disposal (84,500 tons). Combined with the diversion projected for DSWM-only programs, the diversion potential of these new short-term program improvements could total more than 161,000 tons in Phase 5.

While the Greenprint Denver goal does n**o**t address a reduction in landfill tons managed by haulers other than DSWM, the city's ability to practice environmental and economic sustainability through waste diversion is greatly expanded when <u>all</u> short-term programs are considered. Additionally, the city's ability to raise community awareness and increase overall responsibility for sustainable waste management is greatly enhanced with new programs that impact generators beyond DSWM's current service area. In other words, a concerted, city-wide effort is required to meet the goal.

It should be noted that the success of any of the short-term programs will be due in large part to DSWM's ability to make appropriate policy changes, receive adequate financial and labor resource allocations, obtain public support, build/maintain partnerships with the private sector and implement a comprehensive outreach program (see Section 14.0).

PROGRAM NUMBER	PROGRAM	REFERENCE SECTION	BENEFITS	CHALLENGES	LANDFILL DIVERSION[a] (upon completion of Phase 5)
1	**Standardize Refuse Collection Phase 1-Phase 5 (service changed for 123,700 hhs)**	Section 7.0	Increase efficiency Greater worker safety More consistent service Vehicle interchangeability	Accelerate vehicle replacement Re-deploy workers Remove dumpsters	N/A
2	**Grow Recycling & Add Organics Collection Phase 1-5 (up to 53,900 new hhs serviced)**	Section 7.0	Greater landfill diversion Respond to public input	Ongoing outreach Partial participation	34,600 tons 14% diversion in addition to 29,600 tons in 2010[c]
3	**Reduce LIP (1/qtr) & Overflow (eliminate) Collections Phase 1-5**	Section 8.0	Increase efficiency Greater landfill diversion	Need enforcement	7,100 tons 3% diversion
4	**Add Drop-Sites Phase 2-Phase 5 (2 locations)**	Section 9.0	New service Locate w/ existing city function	Refuse not accepted Limited hours Residential use only	4,600 tons 2% diversion
5	**Implement New Hauler License Phase 3-5 (up 95,000 MFUs & 22,100 businesses)**	Section 10.0	Minimum standards New service for commercial Greater landfill diversion Obtain quantity data Make hauling a privilege	Need city ordinance Need enforcement Organics collection	68,800 tons outside of DSWM service area
6	**Mandate Restaurant Food Waste Diversion Phase 4-5 (up to 400 restaurants)**	Section 11.0	Greater landfill diversion	Need city ordinance Need enforcement Organics collection	15,700 tons outside of DSWM service area
7	**Require Large MFU Service Phase 5 (95,000 units)**	Section 12.0	Less abuse of city service	Need city ordinance Need enforcement Coordinate w Denver Water	N/A
8	**Continue HHW w Retail Paint Collection Phase 1-5**	Section 13.0	• Sound HHW management • Drop service to all residential • Expanded paint collection	Coordinate w retailers	125 tons < 1% diversion
9	**Public Education & Outreach Phase 1- 5**	Section 14.0	• Ongoing targeted service • New staff		N/A
Short-Term Improvement Programs Total (rounded to nearest 1,000 tons)				**45,900 tons DSWM service area (76,900 tons w existing recycling tons)**	

[a]Estimated Phase 5 total waste generation in DSWM service area – 250,800 tons; [b]All costs and revenues estimated in 2010$; [c]2010 estimations: 29,600 tons recyclables, 1,400 tons organics

Part Three - Long-Term Programs

Part Three of the Denver SWMP evaluates four long-term programs for DSWM's future solid waste management service program. The long-term planning period under consideration extends through 2030. The option analysis addresses:

- Section 16.0 –Additional Drop-Site Collections;
- Section 17.0 – Incentives for Waste Diversion;
- Section 18.0 – Refuse Transfer Station System Improvements; and
- Section 19.0 – Construction and Demolition Diversion.

Section 20.0 includes a summary of long-term programs. The detailed implementation, policy and cost information provided in this Part Three will be used to help DSWM determine a specific strategy for improvements between Phase 5 and 2030.

16.0 Additional Drop-Site Collection

This section evaluates the addition of a third drop-site for the collection of recyclables, organics and large items in the long-term planning period. An additional drop-site is included in DSWM's long-term plan because it will improve coverage of the city and increase the opportunity for residents to divert waste materials (especially those who have not subscribed to household recycling and organics collection programs or who have sporadic high quantities to manage). It will also provide an additional site for residents' use in disposing of large items that may be more convenient than their scheduled collection (large item pick-up service will be quarterly during the long-term).

16.1 Introduction

This program option would include an additional drop-site to further serve DSWM's service area and complement the two customer drop-off sites evaluated in Section 9.0[54]. All three DSWM sites would be operated to collect diverted recyclables and organics, as well as large item (or bulky) refuse materials. Materials that customers will be allowed to drop at these sites include:

- The single-stream recyclables currently collected by DSWM in its household collection program;
- Food waste, food-contaminated paper and yard waste organics potentially collected in a future household collection program (described in Section 7.0); and
- Large, bulky materials currently collected in DSWM's large item pick-up program (the LIP collection program is discussed in Section 8.0).

All drop-sites would serve residents in DSWM's service area. As noted in Section 9.0, it is expected that these sites will be staffed by DSWM employees to control littering, dumping of unacceptable materials, maintain safety, and manage liabilities associated with scavenging and other prohibited behavior. The materials will be accepted in "household quantities", or quantities that fit in a passenger car or pick-up truck. Drop-site operators may refuse large loads of materials. Regular refuse, HHW, other hazardous waste or e-waste will not be accepted at these drop-off sites (Section 13.0 addresses management of HHW).

While the exact locations of the short-term sites addressed in Section 9.0 have not been confirmed, it is expected that they would be established in the:

- Southeast area of Denver – possibly at the CCTS; and
- Southwest area – possibly in the CPC, approximately West 2nd and Tejon Street.

[54] Waste Management of Colorado (WMC) also operates a drop site at the DADS Landfill that accepts single-stream recyclables at no cost from residents. The site also accepts appliances, tires and asphalt shingles for a fee from residents and some commercial customers. It is not expected that the DADS site is used significantly by Denver residents.

16.2 Implementation

16.2.1 Applicability

Figure 2-1 (Part One) illustrated the four general service areas of the city[55], as well as the location of the proposed drop-sites evaluated in Section 9.0. As shown, the southeast area of the city would be served by the CCTS drop-site on the eastern city limit. The southwest area would be served by the CPC drop-site near the north/south border of the western areas of the city (this site may be able to serve residents in both the northwest and southwest areas). Table 16-1 identifies the numbers of households served by DSWM in each area. These households include all SFUs and MFUs with seven or fewer units.

Table 16-1. Households by Areas of the City (2009)

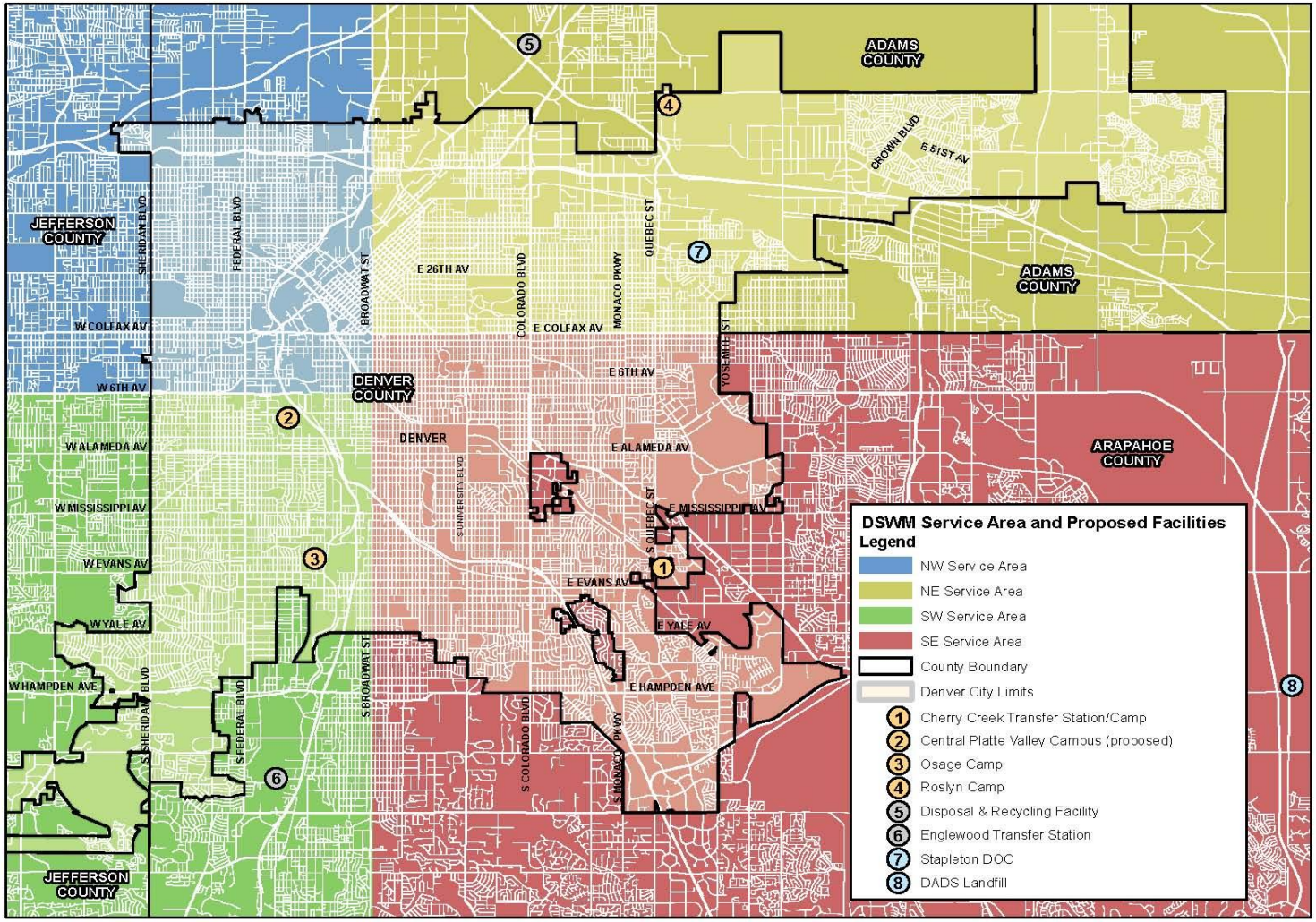
Area	Households[a]	Percent of Total Households[b]
Northeast	60,431	36%
Northwest	38,232	23%
Southwest (proposed CPC drop-site)	22,328	13%
Southeast (proposed CCTS drop-site)	48,574	29%

[a] Excludes night or special district LIP generators
[b] Totals may not equal 100% due to rounding

The northeast service area, which has the largest number of households (36%), would be the most logical location for an additional public or private long-term drop-site[56]. For estimating purposes, it is assumed that a new northeast drop-site would be located relatively central in the northeast area near Stapleton (see Figure 16-1).

[55] These areas generally match the quadrants or "camps" DSWM uses for ongoing operations.
[56] Additionally, the greatest concentration of large MFUs (more than seven units) are located in the northeast - while these are not currently in DSWM's service area, future operations may allow the city to serve large MFU residents.

Figure 16-1.DSWM Service Area and Proposed Facilities.



16.2.2 Policy Development

DSWM can develop the additional drop-site any time during the long-term planning period. Since 2010 costs were used for estimations, the exact period of implementation and operation is not critical to this evaluation. For long-term evaluation purposes, it is noted that DSWM will need to accomplish the following before adding a third drop-site:

- Final cost-estimating and budget approval;
- Legal review and possible policy change;
- Site acquisition, development and equipment procurement;
- Coordination with contractors for tipping additional recyclables, organics and large items;
- Staff assignment/hires for drop-site operation; and
- Routing adjustments to service the drop-site.

16.2.3 Diversion Potential

As discussed in Section 9.0, drop-site data is not available for Denver and estimates must be based on generation rates observed in other cities over the last several years. These estimates, shown in Table 16-2, are approximate guidelines only. The waste managed (and diverted) from a third drop-site would be in addition to waste managed at the two drop-sites proposed for the short-term planning period (Section 9.0) and which are provided in Table 16.2 for comparative purposes. These quantities would also be in addition to any materials managed through DSWM's household collection programs.

Table 16-2. Estimated Drop-Site Quantities Diverted Annually by 2030 (rounded to nearest 100 tons)

Location (% of service area)	Population Served[a]	Recyc-lables[b]	Organics[c]	Large Items[d]	Total Materials	Estimated Total Waste Generation[e]	Diversion Potential[f]
CCTS (29%)	153,100	1,900	1,200	400	3,500		
CPC (13%)	68,700	900	500	200	1,600		
New Northeast Drop-Site (36%)	190,100	2,400	1,500	500	4,400		
Total	**411,900**	**5,200**	**3,200**	**1,100**	**9,500**	**245,100**	**3%**

[a] Based on Table 9-1 and Colorado State Demography Office estimates (October 2009); adjusted by 71% (fraction of Denver residences that are SFUs or MFUs with 7 or fewer units in 2009)
[b] Assumed 25 pounds/person-year based on available data from Colorado & U.S. drop-site programs
[c] Assumed 16 pounds/person-year (Charleston County, SC ratio of 1.5 tons of recyclables to 1 ton yard waste)
[d] Assumed 5% of population at 100 pounds/year of large items (equivalent of 5 pounds/person-year)
[e] Total waste generated in DSWM's service area (see Table 5-4)
[f] Considers recyclables and organics only

16.3 Estimated New Costs

The additional drop-site will consist primarily of roll-off containers provided with stairs and platforms for customer access, and they will be flexible and easily expanded. DSWM may modify the size and orientation of these sites over time, as customer needs change and grow. Table 16-3 summarizes the capital and operating costs for the third drop-site. As costs are provided in 2010 dollars, they are the same as those developed for the short-term drop-sites in Section 9.0. Cost estimate details are provided in Appendix M. Assumptions for this estimate include:

- One-half acre of suitable land for each site is already owned by Denver – and is relatively flat and cleared;
- Site will be open to the DSWM service area 40 hours per week with actual days and times to be determined by DSWM (and will be secured after hours);
- Full-time staffing for the site with 38% benefits (labor category – Senior Utility Worker) to verify residency and household-load sizes, oversee site operations and manage materials collected;
- Site development including concrete slab on grade, steel rails and access platforms for roll-offs – other surface crushed rock/gravel and small building (eight feet by eight feet with basic utilities) at each site for worker protection and record-keeping;
- Mobile equipment will include three 40-cubic yard roll-offs (plus two spares) and a roll-off truck for the additional site; and
- Site improvement capital costs amortized over 20 years and equipment costs over 10 years at 5% interest rate.

This estimate, based on 2030 quantities in Table 16-2, includes up to 21 pulls per week from the new northeast site (approximately 13 for recyclables hauled to Waste Management Recycle America's [WMRA] material recovery facility [MRF], 5 for organics hauled to A1 Organics' Stapleton site and 3 for large items hauled to DADS Landfill). The haul costs in Table 16-3 are based on year 2030 quantity projections; initial haul costs will depend upon the timing of development of the northeast drop-site during the long-term planning period and number of pulls per week.

Table 16-3. Estimated Long-Term Drop-Site Program Costs (2010 dollars, rounded to nearest $100)

Category		Northeast Drop-Site Costs	CCTS & CPC Drop-Sites Costs
Capital Costs			
	Drop-Site Improvements	$87,400	See Table 9-2
	Mobile Equipment	$167,200	See Table 9-2
Total Capital Costs		**$254,600**	**--**
Annual O&M Costs			
	Amortized Capital (see Drop-Site Improvement costs above)[a]	$7,000	$14,000
	Amortized Equipment (see Mobile Equipment Costs above)[b]	$21,700	$24,000
	Labor[c]	$46,800	$93,600
	Site Maintenance and Utilities	$5,100	$10,200
	Haul Costs[d]	$75,600	$128,400
Total Annual O&M		**$156,200**	**$270,200**
Total Annual Compost Facility Tip Fees[e]		**$40,500**	**$45,900**
Total Annual Landfill Disposal Tip Fees[f]		**$8,000**	**$9,600**

[a] Amortized over 20 years at 5% interest rate
[b] Amortized over 10 years at 5% interest rate
[c] Based on Senior Utility Worker (2009 step #5 base salary, escalated 3% to 2010$ plus 38% benefits)
[d] Based on number of roll-off loads, distances to facilities, Equipment Operator and fleet maintenance costs for 2030 tons (therefore annual O&M costs for CCTS and CPC drop-sites differ slightly from Table 9-3)
[e] Based on Table 16-2 quantities and $27/ton assumed tip fee for A1 Organics
[f] Based on Table 16-2 quantities and $16/ton tip fee at DADS Landfill for large items

Expenses not included in this estimate are as follows:

- The implementation costs identified in Section 16.2.2; and
- DSWM staff time needed for public education and outreach, which are assumed to be addressed through resources previously evaluated in Section 14.0.

16.4 Estimated Avoided Costs and Potential Revenues

Avoided Costs

Avoided costs are expected to include the savings DSWM would realize by not tipping the recyclable and organics tons diverted through the drop-sites as refuse at the DADS Landfill. In 2010, the aggregated DADS tip fee for DSWM is $16 per ton[57]. Avoided costs estimated in Table 16-4 are in addition to any cost savings associated with household collection programs for diverted materials.

[57] Considers that 7.6% of 2009 tons were hauled directly to DADS in compactor vehicles; 46.4% were hauled to DADS in DSWM transfer trailers; 35.5% were transferred through Waste Management's Commerce City facility; 10.6% were transferred through Waste Management's South Metro Transfer Station.

Table 16-4. Estimated Costs Avoided by Long-Term Drop-Site Collections (2010 dollars, rounded to the nearest $100)

Material		2030[a]
Diverted Quantity (tons)		
	CCTS	3,100
	CPC	1,400
	New Northeast Drop-Site	3,900
Estimated Tip Fee[b]		$16
Avoided Costs		**$134,400**

[a] Considers recyclables and organics only (see Table 16-2)
[b] Based on $16/ton pro-rated DADS Landfill tip fee for DSWM waste in 2010

Potential Revenues

In addition to avoided costs, DSWM would earn revenues associated with recyclable tons diverted through these drop-sites. Revenues earned through Denver's contract with WMRA can include both a base and up-market payment (see Section 7.5 and Appendix I). Potential revenues estimated in Table 16-5 are in addition to revenues generated from the household recyclables collection. This table also assumes a continued (and unknown) contractual relationship between DSWM and WMRA through 2030.

Table 16-5. Estimated Recyclables Revenues Generated (2010 dollars, rounded to the nearest $100)

Material	2030
Recyclable Quantity (tons)	5,200
Base Payment [a]	$163,000
Up-Market Payment [b]	$9,300
Total Revenues	**$172,300**

[a] Based on $33/ton paid by WMRA on 95% of tons delivered by DSMW in current contract
[b] Based on payment made by WMRA on 50% differential between base market value ($80.70/ton) and projected annual average market value (about $84/ton)

17.0 Waste Diversion Incentives

This section evaluates the possible implementation of one or more incentives to encourage Denver residents to divert more recyclables and organics. As discussed previously, increased diversion would benefit DSWM and the city by decreasing reliance on landfill disposal, reducing money spent on landfill tip fees, generating recyclables revenues and supporting GreenPrint Denver goals.

17.1 Introduction

It is human nature to opt for the "easy way" to do something and research has shown this to be true when it comes to managing waste. Current operational policy is based upon convenience for the resident with no consequences for less preferred behavior. Some residents find it easier to simply throw everything into one container and set it out once a week for pick up. Research shows that given no outside incentives other than personal values, most people do not think about their disposal options such as source reduction, re-use and recycling. It is a recognized that waste diversion requires a greater commitment associated with individual behavior such as handling sloppy, messy garbage components, extra storage, multiple containers and different collection schedules. This commitment requires greater individual responsibility.

Many communities across the U.S. have found that incentives can successfully encourage residents to make this extra effort to divert waste. Incentives can be "carrots", which reward generators for preferred behavior, or "sticks" which mandate certain behavior with enforcement and penalties. As a possible long-term option, incentives are briefly evaluated for DSWM in this section.

17.1.1 Individual Responsibility

While "carrots" and "sticks" have a role in most MSW systems (and have been proven successful for other utilities), at the core of successful programs is a basic level of commitment by waste generators to key community values associated with:

- Environmental stewardship – or the acknowledgement that waste diversion has benefits to all parties in the short- and long-term and should be a priority;
- Cleanliness – of alleyways, streets, parks, drop-sites and other areas where waste is collected; and
- Safety – that may be compromised by inappropriately disposing of unacceptable materials or contaminating waste streams.

These values can be challenging to install - and maintain - and typically require clear and transparent city leadership and on-going public outreach. Ideally, these values would lead to waste generators who:

- Take ownership in their generation of refuse, overflows, large items and other wastes (appliances, HHW, e-waste, etc.) by observing waste management requirements and guidelines;
- Communicate this responsibility with other generators who abuse individual or community collections[58]; and

[58] This communication may extend to reporting violations (increasingly easy with the use of cell phones).

- Take advantage of opportunities to maximize diversion including on-going, seasonal and special event diversion programs.

Denver has worked to create these values in its service area over several years and has likely achieved as much success as it can with public goodwill and commitment. Challenges to further progress include:

- Diversion programs that are complimentary to refuse management, subscription based and voluntary;
- Lack of policies encouraging waste diversion outside the residential sector;
- Cost of services is embedded in general fund taxes and cost is not recognized by most residents;
- Costs do not reflect actual levels of service;
- No other "carrot" or "stick" incentives;
- Minimal levels of enforcement; and
- Reduced outreach efforts due to budget constraints.

Denver has the ability to reverse the messages these factors communicated to its residents and other waste generators. This effort can be initiated by implementing the short- and long-term program improvements evaluated in the SWMP and subsequently tackling the challenging issues of incentives, appropriate user fees and prioritizing sound waste management practices for its citizenry.

17.1.2 Incentive Options

In order to establish desired community values, Denver needs to consider incentives such as those described below.

Variable Refuse Rates

Often referred to as pay-as-you-throw (PAYT), variable rates refer to a fee structure for refuse collection that charges generators based on how much waste they create. This structure is similar to the Denver Water utility through which users pay only for the volume of water consumed. PAYT incentivizes waste diversion by giving residents the opportunity to limit their cost of service collection by minimizing refuse generation. PAYT provides equitable service fees to users. PAYT can be implemented in all types of collection scenarios, including public or privately operated programs. There are a number of mechanisms for implementing PAYT including pre-paid stickers, bags, multiple containers (same size), varying size containers and weight-based systems.

Incentives are further increased when PAYT requirements include collection for recycling and organics composting. These diversion options can be offered at no additional cost and sometimes applied within a rate structure as a cost reduction strategy to the consumer.

Program implementation throughout the US has proven the benefits of PAYT:

- Single most effective method to increase diversion[59];
- One of the most effective reducers of greenhouse gas emissions[60];
- Fast, easy and inexpensive to implement[61]; and
- Significant public acceptance of PAYT programs[62].

Denver Water has implemented a similar incentive program over recent years as the Front Range has struggled with drought conditions. This utility tied a portion of customer rates to actual consumption and very successfully incentivized water conservation throughout its customer base.

Customer Loyalty/Rewards Program

Other incentive options include points-based rewards programs. These can be based on partnering with local municipalities and/or haulers to reward residential generators for diversion activities. Key features of example programs vary depending upon specific partnerships but generally include:

- Rewarding residents with points for recyclables diverted (points are redeemable for free products at local retailers);
- Adding equipment to collection trucks to track participation; and
- Developing a mechanism for implementation (public or private service).

Material Bans

Material bans are another way to encourage recycling by prohibiting the disposal of selected materials. Bans can be imposed on landfills, transfer stations, haulers, municipalities and/or generators. Many U.S. municipalities and states implement material bans. Colorado currently bans motor vehicle waste (personal automobile tires, waste oil and used car batteries). Corrugated cardboard is the most common recyclable banned nationally, but all traditional recyclables (containers and fiber), yard waste and white goods are targeted in many programs[63].

Material bans applied to the DADS Landfill and DSWM's CCTS would have a negative impact on any royalty fees paid to Denver and as such would need to be thoroughly evaluated before implementation.

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[59] PAYT has been observed to decrease MSW tons 6% through source reduction; 5% to 6% from additional recycling; and 4% to 5% from yard waste diversion ("Pay As You Throw (PAYT) in the US: 2006 Update and Analysis, Skumatz Economic Research Associates, December 2006).

[60] Reducing one metric ton of carbon dioxide equivalent (MTCE) through PAYT can be accomplished at one-ninth the cost of reduction through residential weatherization; every $1 spent on PAYT achieves the same carbon reductions as $2 on curbside recycling, $3 on retrofitting commercial light bulbs, $9 on weatherizing homes, $21 on wind energy and $54 on solar ("What Steps Should Colorado Take to Improve Diversion? If I Ruled Colorado!", Skumatz CAFR News Article, Winter 2010).

[61] Speed and ease vary with municipal, contract or open system implementation (sociopolitical support and obstacles are difficult to predict). Program costs (beyond implementation) are borne by users not city.

62 San Francisco's PAYT program not only doubled the city's diversion rate, but also achieved a 90% customer satisfaction rating (Pay-As-You-Throw, Spring 2009 Bulletin).

[63] Some programs also ban the disposal of batteries, construction/demolition waste, laser toner cartridges, tires and other materials.

Material bans would also be difficult for Waste Management's transfer stations, which serve communities in addition to Denver, and which may not implement similar bans.

A possible scenario for Denver would be a collection ban that is placed on generators and enforced by both DSWM collection crews and private haulers[64]. This would require additional costs in enforcement for both the public and private service providers. To implement a ban in Denver, an evaluation would be needed of materials that would make a significant impact on diversion[65], of materials that DSWM could collect (both household service and drop-site) and that would be accepted at WMRA's MRF or permitted composting facility. Challenges would include gaining public and hauler acceptance and enforcement. More feasible may be Denver's future support of a statewide disposal ban(s) that would be implemented consistently across Colorado.

17.2 Implementation of PAYT Program

17.2.1 Applicability

If considered favorably during DSWM's long-term planning process, a new PAYT program would be implemented in the current SFU and MFU service area.

17.2.2 Policy Development

For Denver to consider PAYT for its solid waste service area, the following steps would likely be required:

- Develop a billing function within DSWM – this may include the development of a utility similar to Denver Water under which revenues from one or more sources would be necessary to cover utility costs (the solid waste utility could be stand-alone or potentially combined with another Denver utility);
- Identify an enforcement mechanism and costs[66];
- Evaluate the cost in lost royalty payments of diverted materials from the DADS Landfill;
- Evaluate the impact to recyclables and organics collection routes and plan for additional routes as needed;
- Assess regular user fees for refuse service – part of the benefit of PAYT is realized when generators receive their bill and are reminded of the opportunity to reduce costs;
- Establish variable refuse rates for single- and multi-family units served with costs for second, third, etc. containers set at 80% to 100% of the initial container;
- Standardized refuse collection – to eliminate multi-household dumpster and provide consistent containers for all residents;
- Evaluate the additional constraints associated with MFUs (such as multi-household container use and less convenient recycling) – as well as incentive or rebate programs necessary to encourage MFU participation;

[64] For example, the City of Fort Collins has a collection ban on electronic wastes that is largely enforced by the private haulers operating in the city.

[65] DSWM's Waste Composition Analysis (March 2009) observed that yard waste (28.7% by weight), single-stream paper (15.0%) and food waste (13.7%) are materials present in the greatest quantity.

[66] Denver could develop a solid waste utility or merge with an existing utility (penalties could include the termination of service). Alternative actions could include a lien on the property.

- Utilize existing inventory of 96-gallon refuse carts – but consider adding smaller carts in the future to give residents more options for reduction (a less likely option may be the possibility of collecting refuse every-other-week for some residents); and
- Promote the new system.

The assessment of user fees will undoubtedly be the most difficult and time-consuming step for Denver. Obviously, passing new fees will be difficult hard on the heels of a recession, and it is possible that such a step would drive Denver's political leaders to require a direct referendum vote by Denver citizens PAYT has been implemented in the Colorado municipalities of Aspen, Boulder, Fort Collins, Lafayette and Loveland in recent years. Increases in residential waste diversion have been realized ranging from 28% (Lafayette) to over 55% (Loveland) and city-wide waste diversion of 14% (Aspen) to 27% (Fort Collins) – these rates are the result of PAYT pricing, as well as other program improvements.

In a continuing effort to reduce waste generation, Denver can include the commercial waste streams by requiring PAYT pricing on generators outside of its service area such as large MFUs and institutional/commercial/industrial generators. Regulations could be adopted and implemented as part of the hauler licensing program evaluated in Section 10.0. The city would establish a rate structure (not the rates) that haulers would be required to use in serving their customers. Experience with PAYT in other Colorado and US programs show that, as long as the requirements are consistent for all haulers, implementation is successful.

17.2.3 Diversion Potential

A range of estimated diversion rates resulting from the implementation of PAYT pricing is included in Table 17-1. As quantities diverted as a result of PAYT will vary depending on what other program (pre-existing) improvements may have been previously implemented, the multiple short-term improvement options described in Part Two have been paired with PAYT in the table below. The results shown in Table 17-1 are in addition to the diversion results generated by other short-term programs potentially implemented as early as Phase 5.

As the impact of PAYT pricing is expressed as a percentage of additional tons diverted, its magnitude is more pronounced where less diversion is occurring. Regardless of what programs are implemented prior to (or with) PAYT, its potential diversion impacts are significant, and second only to the household recycling and organics collection programs described in Section 7.0. This makes PAYT one of the most important tools DSMW has for reaching the Denver Greenprint goal in the short-term and extending waste diversion practices in the long-term. Although PAYT has been evaluated in this SWMP document as a long-term planning option, Denver should consider implementing PAYT at the same time as the new household organics and drop-site collection programs. This will increase the success of the new programs and may also ease the establishment of new fees by tying them to the addition of new services.

Table 17-1. Estimated Diversion Associated with PAYT Pricing for 2030 (rounded to nearest 100 tons)

Range of Potentially Pre-Existing Diversion Programs	Tons Diverted by Pre-Existing Program	Resulting Landfill Tons[a]	Additional Tons Diverted by PAYT Pricing[g]				
			Source Reduction Tons	Recyclable Tons	Organic Tons	Total Tons Diverted by PAYT[a]	Diversion Rate from PAYT Only[b]
Continuation/Growth of Existing Household Recycling Program Only[b]	17,800 tons recyclables	197,700	11,900	11,900	9,900	33,700	14%
Existing Household Recycling Plus New Household Organics Collection (Section 7.0 programs)[c] (hhs after 2010)	76,000 tons recyclables + organics	138,100	8,300	8,300	6,900	23,500	10%
Household Recycling/ Organics Plus Reduced LIP/Overflow Collections (Section 8.0 programs added)[d]	87,100 tons recyclables + organics from curbside, LIP/OF reductions	127,000	7,600	7,600	6,400	21,600	9%
Household Recycling/ Organics, Reduced LIP/Overflow & New Drop-Site Collection (Section 9.0 program added)[e]	91,600 tons recyclables + organics from curbside, LIP/OF reductions, drop-sites	122,500	7,400	7,400	6,100	20,900	9%
Household Recycling/ Organics, Reduced LIP/Overflow, New Drop-Site Collection & HHW (Section 13.0 program added)[f]	91,800 tons recyclables + organics from curbside, LIP/OF reductions, drop-sites + HHW	122,300	7,400	7,400	6,100	20,900	9%

[a] Total projection of MSW generation in 2030 is 245,100 tons (see Table 5-1) - landfill estimates consider that 29,600 tons of recyclables and 1,400 tons of organics were diverted in 2010
[b] Based on Table 7-7 recyclables quantity (plus 29,600 ton estimated for 2010), escalated to 2030 (190,000 households, 80% subscription, 30 pounds/set-out, 80% set-out rate) or 17,800 tons recyclables
[c] Adds Table 7-7 organics quantity escalated to 2030 (190,000 households, 68% subscription, 13-30 pounds/set-out (every-other and weekly collection), 80% set-out rate) or 58,200 tons organics
[d] Adds Table 8-1 recyclables/organics quantities escalated to 2030 (based on 50-60% diversion of LIP items and 100% of overflow items) or 3,700 tons recyclables and 7,400 tons organics
[e] Adds Table 16-2 recyclables/organics quantities for CCTS and CPC (short-term sites) or 2,800 tons recyclables and 1,700 tons organics
[f] Adds Table 13-1 HHW quantities, escalated to 2030 (3% annual increase from 2008 quantities) or 195 tons HHW (assumes all diverted from disposal)
[g] Assumed a total of 17% reduction in landfill tons per Skumatz 2006 (6% from source reduction, 6% from recycling, 4.5% from organics diversion)

17.3 Estimated New Costs

DSWM could implement PAYT any time during the long-term planning period (because 2010$ costs were used for estimations, the exact period of operation is not critical to this evaluation). DSWM staff requirements for implementing PAYT for SFUs are estimated in Table 17.2. These costs do not include:

- DSWM and other city labor required to evaluate utility and billing options and rates (legal and Mayor's office staff);
- DSWM staff time to educate City Council, Mayor's office and public about pros and cons of PAYT program during the pre-implementation planning and approval stages;
- Development of regulatory language;
- Support of a referendum vote if needed;
- Additional collection routes for recyclables and organics, and potential re-routing of refuse collection routes due to increased efficiencies; or
- Implementation of PAYT beyond the DSWM service area (i.e., PAYT requirement for large MFU and ICI generators and their haulers).

Table 17-2. Estimated City Staffing for Variable Rate Implementation (2010 dollars, rounded to nearest $100)

Category		Initial Annual Cost[a]
Public Education[a]		
	Hours	1,040
	Staffing (FTE)	0.5
Labor Category – Prog Coor[c]		$66,700
Enforcement		
	Hours	1,560
	Staffing (FTE)	0.75
	Labor Category - Assoc City Insp[c]	$62,400
Labor Costs		**$80,200**
Miscellaneous Costs (software, printing, & mailing)		**$3,000**
Total Program Costs[b]		**$83,200**

[a] Long-term planning costs reflect initial implementation (expected to decrease as program matures)
[b] These costs would be in addition to Section 14.0 cost estimates
[c] Based on 2009 step #5 base salary, escalated 3% to 2010$ plus 38% benefits

17.4 Estimated Avoided Costs and Potential Revenues

Avoided Costs

Avoided costs reflect the potential savings DSWM would realize by not tipping recyclable and organics tons, diverted as a result of this option, as refuse. The avoided costs estimated in Table 17-3 are based on the aggregated landfill tip fees that DSWM is paying in 2010.

Table 17-3. Estimated Costs Avoided by Implementing Variable Rates (2010 dollars, rounded to nearest $100)

Material	2030
Diverted Quantity (tons)	20,900 - 33,700
Estimated Tip Fee [a]	$16
Avoided Costs	**$334,400 - $539,200**

[a] Based on $16/ton pro-rated DADS Landfill tip fee for DSWM waste in 2010

Potential Revenues

The most notable revenue stream associated with PAYT will be user fees. In addition, DSWM would also earn revenues associated with the generation of increased recyclable tons. Potential revenues summarized in Table 17-4 are based on the base and up-market payments that DSWM currently earns under its contract with WMRA (see Section 7.5 and Appendix I). Potential revenues estimated below are in addition to revenues generated from other diversion programs. This recyclables revenue estimation assumes a continued long-term contractual relationship between these parties.

Table 17-4. Estimated Recyclables Revenues Generated by Implementing Variable Rates (2010 dollars, rounded to nearest $100)

	2030
Recyclables Quantity (tons)	7,400 - 11,900
Base Payment[a]	$232,000 - $373,100
Up-Market Payment[b]	$13,200 - $ 21,300
Total Revenues	**$245,200 - $394,400**

[a] Based on $33/ton paid by WMRA on 95% of tons delivered by DSMW in current contract
[b] Based on payment made by WMRA on 50% differential between base market value ($80.70/ton) and projected annual average market value (about $84/ton)

18.0 Transfer Station Improvements

This section evaluates DSWM's existing refuse transfer station system in terms of optimizing for future management. In 2009, 93% of DSWM's refuse passed through one of three transfer stations prior to being hauled to the DADS Landfill (see Table 18-1). The location (Figure 2-1), efficiency and cost of these transfer stations have a significant impact on DSWM's resource allocations to all of its programs. Future transfer options are expected to include capital improvements to DSWM's CCTS, enhanced use of vendor transfer stations, and possibly a new DSWM station located in the northeast area of the city (see Figure 16-1).

Table 18-1. DSWM Transfer Haul in 2009

Facilities	Area	Percentage of Total Denver Tons Transferred (2009)[a]
Direct Haul		8%
CCTS	Southeast	46%
WM D&R TS	Northeast	36%
WM South Metro TS	Southwest	11%

[a] Based on 2009 quantities through September - totals may not equal 100% due to rounding

18.1 Introduction

As stated in Section 2.2.1, transfer of refuse from collection vehicles to over-the-road tractor/trailer combinations results in several efficiencies. DSWM uses three transfer stations for refuse:

- DSWM's Cherry Creek Transfer Station (CCTS);
- WMC's Disposal and Recycling (D&R) transfer stations in Commerce City; and
- WMC's South Metro Transfer Station (SMTS) in Englewood.

CCTS Observations

CCTS is located in southeast Denver and was used to transfer 46% of the total refuse collected by DSWM in 2009. Constructed in the 1950s, this is the oldest of the transfer facilities currently used by DSWM, and requires the most urgent updating of the three. The facility consists of a trailer top load, dump-and-load system in a three-sided building. Tipping of refuse occurs on a raised platform enclosed with a combination of solid wall and chain link fencing to reduce blowing of litter. The platform is located approximately 18 feet above a transfer trailer loading roadway. Front-end loaders push refuse into a hopper that fills a transfer trailer located in a tunnel directly below. The CCTS is currently operating close to capacity[67], which may cause DSWM to increase use of the two WMC transfer stations.

[67] The facility has operated at approximately 101,000 tons per year for the last five years.

In 2009, DSWM hired an outside consultant to propose design and operational changes for the CCTS and associated City operations at the site[68]. These improvements are discussed in Section 18.2.2.

D&R Observations

D&R is located in Commerce City (3 miles north of DSWM's northeast service area) and was used to transfer 36% of the refuse collected by DSWM in 2009. This is the second oldest of the facilities used by DSWM (dating to the early 1970s). It consists of high capacity buildings that enclose a top load system. WMC has made numerous improvements to D&R over the last several years to improve safety and efficiency. D&R is located on a 10-plus acre parcel that potentially could be expanded in the future to increase throughput capacity for DSWM and other users. As shown in Table 18-2, D&R is not currently operating at its design capacity.

Table 18-2. D&R Transfer Station[a].

Year	Loads	Tons/Year
2006	32,168	688,981
2007	27,073	660,368
2008	23,803	592,549
2009	20,292	503,702
Facility Capacity		**990,000**

[a] Based on data provided by WMC

SMTS Observations

SMTS is an enclosed transfer station located in Englewood (adjacent to DSWM's southwest service area) and was used to transfer 11% of the refuse collected by DSWM in 2009. Also owned by WMC, it is the newest of the transfer stations in the DSWM system. Like D&R, SMTS is not yet operating at its full capacity (see Table 18-3).

Table 18-3. SMTS Transfer Station[a].

Year	Loads	Tons
2006	20,081	430,295
2007	17,719	432,762
2008	16,313	406,120
2009	15,111	370,845
Facility Capacity		**660,000**

[a] Based on data provided by WMC

[68] "City and County of Denver Cherry Creek Transfer Station Site Master Plan," DR Architecture, LLC, March 2009.

18.2 Implementation

18.2.1 Applicability

Table 18-4 identifies the DSWM refuse tons collected in each of the service areas and the projected quantities for the long-term planning period. The projections are based on total MSW estimates (see Table 5-1) and expected recycling tons diverted through continued growth of the existing household collection program. Tons diverted through the collection of organics or through other programs evaluated in this SWMP were not considered in this estimate, as their implementation is unknown at this time. Should additional tons be diverted through new/expanded DSWM programs, the quantities generated in these service areas would be reduced.

Table 18-4. Projected Tons Managed by Area (rounded to nearest 100 tons).

Area	Service Area Refuse Tons (2008)[a]	Percentage of Total Service Area Refuse Tons (2008)[a]	Service Area Refuse Tons (Phase 5)[b]	Service Area Refuse Tons (2030)[b]
Northeast	72,400	34%	71,200	65,100
Northwest	50,800	24%	49,900	45,700
Southwest	30,900	14%	30,400	27,800
Southeast	59,300	28%	58,400	53,400
Total[c]	213,400	100%	209,900	192,100

[a] Includes barrel overflow tons but excludes LIP tons
[b] Based on projected MSW tons (Table 5-1) minus projected recyclable tons (Table 7-5)
[c] Totals may not match due to rounding

18.2.2 Improvement Options

This SWMP considers four options available to assist DSWM in increasing its transfer station capacity during the 20-year planning period:

- Improving the CCTS to allow this station to handle additional refuse resulting in future growth of the southeast service area;
- Further improving/expanding the CCTS to reduce use of other, privately-owned transfer stations;
- Adding a new Denver-owned transfer station in northeast Denver; and
- Improving future service agreements with private transfer stations.

The following paragraphs describe each of these options.

Proposed Improvements to CCTS

The CCTS is co-located with Denver Street Maintenance and Fleet Maintenance facilities on a 12.5-acre site in southeast Denver. DSWM's design consultant has recommended facility improvements to better integrate the separate site uses, upgrade Street and Fleet Maintenance facilities and enhance solid waste transfer station features. Specific improvements include a recyclables drop-site, a new/expanded

refuse tipping area and improvements to the existing tipping area to allow tipping and transferring of non-refuse materials (possibly recyclables and organics). The consultant's estimated cost for these improvements (in 2009 dollars) was $850,000. Based on a review of the executive summary of the DR Master Plan[69], the following observations can be made:

- The capacity for transferring refuse may increase by approximately 25%;
- The new recyclables drop-site is consistent with DSWM's short-term planning (see Section 9.0), although it is not clear whether the drop-site area would be separate from transfer operations or would tip materials on the existing tipping floor ;
- New capacity for transferring diverted materials has been added although the feasibility and sustainability of transferring trailer loads of recyclables from the southeast service area to the WMRA MRF has not been verified (the recyclables collected at a future CCTS drop-site – as estimated in Section 9.0 - are expected to be collected in 40-cubic yard roll-offs and hauled directly to the MRF);
- Site modifications should be based on differential grades for loading trailers; and
- The capital cost estimate may not be adequate for a new transfer building (reported to be approximately 4,800 square feet) and overall site modifications.

During the next few years, DSWM will need to closely evaluate the suggested CCTS improvements in terms of functionality relative to its overall collection and transfer system, adequacy in providing needed system capacity and detailed costs.

Further Improvements/Expansion to CCTS

While not addressed in DSWM's transfer station consultant's study, Denver could also consider further expansion of CCTS to increase its capacity. These improvements might include additional transfer floor capacity that would decrease tonnage transferred to other transfer facilities. This expansion would allow a decrease in the use of private facilities.

The costs associated with this option have not been detailed in the SWMP. In the 2020 to 2030 timeframe, DSWM should analyze feasibility of this option, including consideration of the following factors:

- Feasibility of expanding the CCTS footprint - this might require rearrangement of space used by other city operations or moving these operations to other locations, either of which may not be feasible;
- Capital costs (including amortization if the capital expenses are covered by bonds) and operating costs for additional transfer operations; and
- Avoided costs associated with reduced/eliminated use of private transfer stations including differential refuse haul costs for more distant transfer stations.

[69] Detailed drawings and full planning details of the DR Master Plan were not available for review.

New DSWM Transfer Station Capacity

Northeast Denver is the largest refuse generating area in Denver, and this will likely increase as the Stapleton redevelopment progresses.

For the purpose of the SWMP, this part and Section 18.3 will focus on a new DSWM transfer station alternative. For this alternative, it has been assumed that a new City-owned transfer station will be developed in the northeast Denver area. Section 18.3 includes an estimate of capital and operating costs. As estimated, this new transfer station would require a significant capital investment (estimated to be approximately $3.2 million in capital improvements alone in 2010 dollars).

The transfer station was sized assuming all refuse collected in the northwest service area and one-half of the refuse collected in the northeast service area would be managed at this facility. This equates to an average throughput of 330 tons per day (5 days per week) with peaks up to 560 tons per day[70]. It is expected that by the time a new northeast transfer station is constructed, it - coupled with the existing CCTS – could meet 100% of the refuse transfer needs of all of DSWM's service area:

- At a minimum, the new transfer station design is 85,500 tons per year and the existing CCTS capacity is 101,000 tons per year (which total 186,500 tons per year);
- CCTS's current capacity would be expanded with future improvements to this facility;
- It is probable that DSWM will implement additional diversion programs during the short- and long-term planning period (e.g., organics collection, new drop-sites, diversion incentives, etc.) – each new program will reduce the projected quantity of refuse requiring transfer and landfilling; and
- Some percentage of the refuse generated may continue to be direct-hauled to the landfill (currently 8%).

As a result, it is likely that a majority of the 192,100 refuse tons estimated in Table 18-4 for 2030 could be managed exclusively through DSMW's two transfer stations (and direct haul). This may notably reduce DSWM's need for private transfer facilities.

Improving Future Service Agreements with Private Transfer Stations

DSWM currently uses WMC's D&R Transfer Station in Commerce City to manage 36% of its solid wastes. As indicated previously, this percentage of waste is expected to increase as growth in the northeast quadrant continues. DSWM operates its hauling to D&R under a 5-year contract with WMC. The contract (which also covers waste hauled to the SMTS) defines general terms and conditions; however, tipping and hauling fees are negotiated annually between DSWM and WMC. In addition, the WMC landfill contract requires WMC to offer "most favorable" tipping fees to DSWM vehicles, but this term is not directly incorporated into the transfer and hauling contract. It is recommended that future negotiations with WMC consider the inclusion and definition of "most favorable" rates (together with a right to audit financial records) in the transfer station tipping and hauling contract with WMC.

[70] These capacities are based on projected Phase 5 quantities (Table 18-4), which are the highest expected in the long-term planning period.

Two other privately-owned transfer stations exist within less than two miles of D&R. All three of these transfer stations may be alternatives for DSWM's current transfer system in the northeast and may conceivably be used in the future. An open bidding process could be conducted to solicit services and costs from qualified transfer stations. This process could be repeated periodically to ensure that DSWM receives the best terms, conditions and pricing to protect the interests of Denver and its citizens.

18.3 Cost Estimate for New DSWM Transfer Station

Table 18-5 summarizes the estimated capital costs for a new DSWM transfer station. Costs will vary based on site conditions, final transfer station sizing and functions. A contingency of 25% is included to reflect the preliminary nature of this analysis. Table 18-6 summarizes the estimated operating costs. Details of sizing assumptions and costs are provided in Appendix N. Primary assumptions for these estimates include:

- The costs in Tables 18-5 and 18-6 are considered “new” as they represent additional service beyond the existing system and all associated costs are in addition to existing DSWM budgeted resources;
- Four acres of suitable land will be already owned by Denver that is relatively flat and cleared (i.e., land purchase cost is not included);
- Site development will include site work and utilities, one truck scale with automated card reader, roadways, concrete maneuvering area (6,400 square feet), transfer station building and tipping floor, trailer load-out scales and small office building (900 square feet);
- Design throughput is 330 (average) and 560 (peak) tons per day (2015 quantities);
- Transfer station will be an enclosed building approximately 8,800 square feet with a lower level drive through tunnel for transfer tractor-trailers;
- Mobile equipment will include one large loader (no on-site spare);
- Hauling costs based on 2030 quantities;
- Facility operations will accommodate collection vehicles 5 days per week, 8 hours per day;
- Four full-time staff will supervise, operate equipment and manage the site; another four full-time staff will transfer the waste to the landfill with one additional driver on rotation; and
- Site improvement capital costs amortized over 20 years and equipment costs over 10 years at 5% interest rate.

Table 18-5. Estimated New Transfer Station Capital Costs (2010 dollars, rounded to nearest $100).

Category		Northeast Transfer Station
Capital Construction Cost		
	Site Work and Utilities	$780,300
	Concrete & Foundations	$338,900
	Transfer Station Building	$764,600
	Truck Scale & Automated Reader	$101,300
	Office Building	$150,900
Subtotal Capital Cost		**$2,136,000**
	General Contractor Fees	$107,000
	Design/Engineering (8%)	$179,000
	Permitting (3%)	$67,000
	Construction Management/Observation (8%)	$179,000
	Contingency (25%)	$561,000
Total Capital Cost		**$3,229,000**
Mobile Equipment		
	Front Loader	$350,000
	Contingency (10%)	$35,000
Total Mobile Equipment		**$385,000**

Table 18-6. Estimated New Transfer Station Operating Costs (2010 dollars, rounded to nearest $100).

Category		Northeast Transfer Station
Annual O&M		
	Amortized Capital [a]	$259,000
	Amortized Equipment [b]	$50,000
	Labor [c]	$270,000
	Insurance [d]	$16,000
	Site Maintenance and Utilities	$70,400
	Mobile Equipment Maintenance	$44,300
	Haul Costs [e]	$721,200
Total Annual O&M		**$1,430,900**

[a] Amortized over 20 years at 5% interest rate
[b] Amortized over 10 years at 5% interest rate
[c] Excludes the four semi-tractor trailer operators which is contained in the haul costs
[d] Insurance (general, liability, fire, etc.) estimated at 1% of buildings and equipment capital
[e] Based on 78,300 tons per year, 20-ton payloads, distance to DADS Landfill, Semi-Tractor Trailer Operator and fleet maintenance costs

Expenses not included in this estimate include:

- The transfer station improvement costs to the existing CCTS;
- The alternative analysis described in Section 18.2.2; and
- Land purchase and approvals.

19.0 Construction and Demolition Debris Diversion Program

This section evaluates the opportunities for Denver to encourage diversion of C&D debris. In many Colorado landfills, C&D tons can equal MSW tons[71]. Although not all C&D components are readily recyclable in Colorado markets, over 50% of this waste stream (by weight) could potentially be diverted. While C&D diversion would largely occur outside of DSWM's service area, it would extend local area landfill life, reduce greenhouse gases, create jobs, support city-wide environmental community values, and increase awareness of sound waste management practices by generators in all sectors.

19.1 Introduction

C&D debris can be generated by new construction, renovation and demolition such as building, roofing, transportation or land clearing projects. Small amounts of C&D are generated by Denver residents and are managed in DSWM's residential waste stream[72]. The majority of C&D in Denver is generated by builders, roofers, roadway/bridge contractors and landscapers.

Several Colorado haulers and landfills actively manage C&D wastes by diverting clean wood, metals, concrete/asphalt, green waste, tires and cardboard. Some landfills encourage diversion with lower fees for separated C&D waste[73]. The DADS Landfill accepts C&D for disposal but does not provide differential rates for sorted loads[74]. Currently, Denver has no specific policy supporting diversion of C&D waste generated from projects in Denver. Any diversion activities that occur are accomplished by contractors or haulers that realize net profits from sorting out valuable materials.

Challenges and Opportunities

Challenges associated with diverting C&D include a number of issues:

- On-site space to separate and store segregated materials;
- Cost of hauling multiple segregated loads to landfills/users/recyclers;
- Landfill tip fee reductions inadequate to incentivize diversion of small quantities;
- Lack of markets for some high-quantity materials (e.g., treated wood and drywall); and
- Lack of processing infrastructure in Colorado.

There are, however, a number of factors that may work to increase C&D diversion in Colorado in the future:

[71] This relationship applies especially to rural areas with high levels of construction/renovation in normal economic conditions. During economic downturns (such as the current recession), C&D wastes tend to decrease more notably than MSW waste (see Appendix F).

[72] DSWM's Waste Composition Analysis (March 2009) observed that only 3.7% of the residential waste sampled was C&D materials.

[73] Examples include Eagle County, Mesa County and Pitkin County Landfills. Some landfills (e.g., Pitkin County) also use ground C&D waste as alternative daily cover.

[74] At the DADS Diversion Center (operated by WMC), appliances and asphalt shingles are accepted from residents and select commercial customers for a fee. This service is not available to all C&D generators.

- More construction and renovations to LEED[75] standards;
- More government policies that incentivize or require diversion;
- Incentives based on new/expanded metrics such as greenhouse gas emission reductions;
- Increasing landfill tip fees and hauling costs;
- Material disposal bans; and
- Market development for additional materials.

Local Programs and Recyclers

Examples of green building codes in Colorado that include waste diversion components include:

- City of Aspen/Pitkin County Efficient Building Code – requires compliance with minimum requirements for resource conservation, indoor air quality and reuse/recycling as condition of occupancy permit (points based);
- City of Boulder Green Points – requires resource conservation and reuse/recycling for new residential construction as a condition of occupancy permit (points based – see Table 19-1);
- Boulder County Build Smart – establishes minimum requirements for new residential construction and prohibits demolition of residential buildings (requires deconstruction to salvage materials for reuse or recycling); and
- Eagle County Eco-Build – requires compliance with recycling, use of salvaged/reclaimed/renewable and U.S. Forest Service-certified materials (points based).

Currently in Colorado there are existing markets for cardboard, metals, concrete, asphalt, clean wood and most land-clearing debris. There are also emerging local markets for asphalt shingles (recent CDOT and Boulder County demonstration project) and insulation (through reuse sites). Future market development may include drywall (proprietary project development in north central Colorado) and carpet/padding (currently being hauled to Utah for use as fuel in cement kilns and recycled in the southeastern U.S.).

As there are currently no dedicated C&D processing facilities in Colorado, C&D diversion in the Denver area is generally limited to what can be accomplished:

- At the construction/deconstruction site;
- At landfills that separate a limited number of materials (e.g., scrap metal and clean wood);
- By asphalt/concrete/aggregate processors (e.g., Recycled Materials Company and Oxford Recycling);
- By composters of land-clearing debris and clean wood (e.g., A1 Organics); and
- Organizations able to sell used building materials for reuse (e.g., Architectural Salvage and ReSource) or directly reuse in their own projects (e.g., Habitat for Humanity).

[75] Leadership in Energy and Environmental Design program administered by the US Green Building Council, which certifies green projects, based on compliance with resource conservation criteria.

19.2 Implementation

19.2.1 Applicability

DSWM has no data on the quantity or composition of C&D materials in the overall Denver waste stream. The estimations provided in this section are approximate guidelines only. Based on USEPA findings for building construction alone, Americans generate an average of 2.8 pounds of C&D waste per person per day[76]. Using state population projections[77], it is estimated that 344,700 and 380,100 tons of building C&D waste could be generated in Denver in 2015 and 2030, respectively. These quantities are approximately 1.5 times higher than the total MSW expected to be managed by DSWM for the same time frames (see Table 5-1). The total C&D waste stream (including roofing, transportation and landscaping debris) may be higher.

19.2.2 Policy Development

Table 19-1 includes several examples of C&D diversion policy implemented throughout the U.S. These policies have supported successful diversion programs to date. Measured diversion rates for mixed C&D have ranged from 35% (Orange County, NC) to 85% (Chicago, IL). Even Portland, OR's program - without enforcement – observed a 67% diversion rate. Also of note is the San Jose, CA program which funneled $5.5M of un-refunded deposits into its solid waste program administration, other waste diversion activities and C&D processing infrastructure in 2007.

While a new Denver C&D diversion program could take many forms, initial policy should be considered dynamic, such that it can be modified over time to accommodate evolving C&D processing capability in the Front Range. Key policy components would include:

1. **Tie to building permit**
   - Applicability levels (i.e., type, size and/or cost of project) would need to be established – initial policy may target only residential construction/demolition and may set a relatively high threshold to capture large construction and most demolition projects;
   - Compliance would ideally be required as a pre-requisite for Certificate of Occupancy from Denver's Development Services Department;
   - May require submittal of a waste diversion plan, completion of a checklist and/or verification of compliance (can be self-verified or completed by third-party); and
   - Consider incentives for cooperative builders such as "fast track" permitting.

2. **Impose deposit requirements –** Refundable deposits can also be required to create an additional incentive. Unclaimed deposits would off-set administrative costs; however, deposits can also inhibit building starts (especially in a down economy).
   - Deposit amounts would need to be established - these may vary between types and size of project and residential versus commercial (or may be flat for small projects like roofing); and

[76] USEPA's "Characterization of Building-Related Construction and Demolition Debris in the United States," EPA-530-R-98-010, June 1998.
[77] Colorado Division of Local Government State Demography Office (October 2009).

- Establish a method for using unclaimed deposits - ideally these would be dedicated to administering the C&D diversion program, general waste diversion activities or possibly grants or low-interest loans to support new C&D processing equipment and facilities.

3. **Specify minimum diversion levels**
   - May differentiate between mixed C&D and inert materials, or may identify specific materials with existing markets – initially the policy should only target those materials that generators can reasonably sort on site (which can be expanded as processing infrastructure becomes more available); and
   - Establish minimum recycling levels (percent by weight) and methodology for measuring and reporting.
4. **Method for verifying results** – can include completed checklist and submittal of weight tickets from user or recycler for diverted materials.

Additional pre-implementation requirements by DSWM would include:

- Work with Denver builders, roofers, contractors and demolition companies to establish reasonable project thresholds, recycling levels and measurement methodology;
- Legal review and policy development;
- Coordination with Development Services;
- DSWM staffing for implementation; and
- On-going work towards new recycled material markets.

Table 19-1. Example C&D Diversion Policies

	Diversion Requirement	Deposit Requirement	Residential Threshold	Commercial Threshold	Deconstruction /Recycling Plan Requirement
Alameda County, CA (condition of occupancy permit)	C&D = 50% Concrete/ asphalt = 100%	3% of project value (min $10,000)	C >$50,000 D >$25,000 Any > 1,000 SF		Yes
Boulder, CO (Green Points program)	C = 50% including wood, metal, cardboard, concrete	No	Mandates deconstruction of residences (may require up to 65% diversion)	Does not apply to commercial C&D	Yes
Chicago, IL	C&D = 50% by weight, also site cleanliness standards	No – city can fine based on SF (notarized affidavits required to certify compliance)	New construction and structures with substantial rehabilitation	C – any requiring certificate of occupancy D >$10,000	
Lee County, FL	C&D = 50%	From $100 (roofing, residential alterations) to $5,000 (commercial demolition >10,000 SF)	Must use processing facilities capable of diverting >50%		Yes
Long Beach, CA (condition of occupancy permit)	C&D = 60% with max 20% inerts	3% of project value (min $1,500, max $50,000)	C >$75,000 D >$50,000		Yes

	Diversion Requirement	Deposit Requirement	Residential Threshold	Commercial Threshold	Deconstruction /Recycling Plan Requirement
Orange County, NC (recycling permit required)	Bans disposal of metal, wood, cardboard	No – 2X tip fees for loads with banned materials, $400 for any cardboard, also criminal/civil penalties	Must use certified processing facilities		
Portland, OR	Must recycle concrete/asphalt, land debris, wood, cardboard, metal	None – City can fine up to $500/violation (not currently enforced)	All projects >$50,000	Yes	
San Diego, CA (unclaimed funds to General Fund)	C&D = 50% (expected to increase to 75%)	$0.20 to $0.70/SF (fees can range from $200 up to $40,000)	C >500 SF D >286 SF Alterations > 500 SF	C >1000 SF D >1000 SF	Yes
San Jose, CA	C&D = 50% Inert = 90%	$1.10-1.16/SF; unclaimed funds used for diversion	C >$115,000 D >$2,000	C >$135,000 D >$5,000	Yes

C = new construction D = renovation and/or demolition
Min = minimum Max = Maximum
SF = square foot

Table 19-2 estimates the labor requirements for DSWM's implementation of this proposed program. This estimate does not consider the pre-implementation requirements identified above.

Table 19-2. Estimated City Staffing Requirements for C&D Division Program Implementation[a,b]

Staff Requirement	Assumption	Hours in 2030
Verify Compliance	0.5 hour/project	4,500 hours
Spot Project Inspections	10% of projects, 1 hour/inspection	900 hours
Manage Unclaimed Deposits		40 hours
Compile Annual Data		60 hours
TOTAL		**5,500 hours (2.6 FTE)**

[a] Based on assumed 18,000 building permits (from 21,000 permits in 2005 and 9,000 in 2008 per www.builderonline.com/local-markets/the-healthiest-housing-markets-for-2009.aspx?; assumed 10,000 building permits in 2010, escalated 3% annually)

[b] Assumed 50% of permits would exceed established policy threshold (or about 9,000 projects)

19.2.3 Diversion Potential

Table 19-3 tabulates C&D composition data and diversion potentials for the ten C&D materials that are typically present in the greatest quantity by weight (these materials comprise about 95% of the C&D stream). A diversion range of 10% to 50% was selected to bracket potential diversion success with a new Denver C&D diversion policy. This range is provided for reference only. This diversion is also expected to occur outside of the DSWM service area.

As noted, a significant amount of diversion could result if a new diversion policy is implemented. While the diversion tons would be accomplished by contractors and haulers outside of DSWM's residential service base, it would notably contribute to overall waste diversion occurring within the city limits.

Table 19-3. Top Ten C&D Materials and 2030 Diversion Potential for Denver (rounded to nearest 100 tons)

Material	Percent by Weight[a]	Low Diversion (10%)[b]	High Diversion (50%)[b]
Clean Wood	19%	7,200	36,100
Concrete and Asphalt	12%	4,600	22,800
Aggregates	12%	4,600	22,800
Other Wood (treated)	11%	4,200	20,900
Drywall	10%	3,800	19,000
Metals	8%	3,000	15,200
Asphalt Shingles	8%	3,000	15,200
Corrugated Cardboard	7%	2,700	13,300
Other Roofing	5%	1,900	9,500
Carpet and Carpet Pad	3%	1,100	5,700
Total	95%	36,100	180,500

[a] Based on a review of local and national C&D databases (Gracestone, Inc., "Boulder County Zero Waste Effort: Construction and Demolition Waste Diversion Baseline Information & Gap Analysis", January 2009)
[b] Based on 2030 estimate of 380,100 tons of building C&D waste

19.3 Estimated New Costs

DSWM can implement a C&D diversion policy any time during the long-term planning period (because 2010 costs were used for estimations, the exact period of operation is not critical to this evaluation). DSWM staff requirements for implementing this policy were estimated in Table 19-2. These costs do not include:

- DSWM and Development Services labor required to establish program details and policy language;
- Denver legal review; and
- DSWM staff time to educate City Council, Mayor's office, contractors, haulers and public during the pre-implementation planning and approval stages.

Table 19-4. Estimated City Staffing for C&D Diversion Implementation (2010 dollars, rounded to the nearest $100)

Category		Initial Annual Cost[a]
Tracking & Verification[a]		
	Hours	4,600
	Staffing (FTE)	2.2
	Labor Category – Prog Coor[b]	$66,700
Enforcement		
	Hours	900
	Staffing (FTE)	0.4
	Labor Category - Assoc City Insp[b]	$62,400
Labor Costs		**$174,500**
Miscellaneous Costs (software, printing, & mailing)		**$3,000**
Total Program Costs		**$177,500**

[a] Long-term planning costs reflect initial implementation (expected to decrease as program matures)
[b] Based on 2009 step #5 base salary, escalated 3% to 2010$ plus 38% benefits

20.0 Long-Term Program Improvements Summary

20.1 Observations

Sections 16.0 through 19.0 evaluated program improvements that DSWM may consider during the long-term planning period (i.e., between 2015 and 2030). These improvements include both expansion of short-term improvements (expected to be implemented by Phase 5) and new programs. Table 20-1 summarizes the benefits and challenges, as well as estimated landfill diversion levels, for each long-term option. For evaluation purposes, these options have been evaluated based on 2030 projected quantities.

Table 20-1. Long-Term Program Improvement Options (rounded to 100 tons)

Program Number (cont'd from Table 15-1)	Program	Reference Section	Benefits	Challenges	Landfill Diversion (in yr 2030)
10	Additional Northeast Drop-Site	Section 16.0	Expanded service for recyclables, organics, large items	May require new site development, refuse not accepted, limited hours, residential use only	3,900 tons 2% diversion in addition to 4,500 tons diverted by CCTS/CPC sites
11	PAYT Pricing	Section 17.0	Equitable for all users, individual control of fees charges, increased diversion, ability to expand beyond DSWM service area	Need to standardize refuse collection, establish DSWM billing function, implement residential fees	20,900-33,700 tons 9-14% diversion depending on implementation of other diversion programs
12	Additional Northeast Transfer Station	Section 18.0	Improved service in growing eastern service area, potential to improve control/, cost of DSWM transfer	Requires new site development, capitally intensive construction/ operation	NA
13	C&D Diversion Program	Section 19.0	Increased diversion of C&D debris (currently not targeted)	Need to implement policy outside of DSWM service areas, city administration requirements	36,100-180,500 tons outside of DSWM service area
	Long-Term Improvement Program Options (rounded to nearest 1,000 tons)				24,800-37,600 tons DSWM service area depending on other diversion programs

Table 20-2 evaluates the potential combined waste diversion impacts of both short- and long-term improvement options.

Table 20-2. Potential Diversion from Short- & Long-Term Program Improvement Options[a] (rounded to 100 tons)

Program Number	Program	Reference Section	Landfill Diversion (in yr 2030)
1	Standardize Refuse Collection	Section 7.0	No direct diversion
2	Grow Recycling/ Add Organics Collection	Section 7.0	76,000 tons - 44% diversion in addition to 29,600 recyclable/1,400 organic tons already diverted in 2010
3	Reduce LIP/Eliminate Overflow Collection	Section 8.0	11,100 tons - 5% diversion
4	Add CCTS/CPC Drop-Sites	Section 9.0	4,500 tons - 2% diversion
5	Implement New Hauler Licensing	Section 10.0	73,000 tons outside of DSWM service area
6	Mandate Restaurant Food Waste Diversion	Section 11.0	16,700 tons outside of DSWM service area
7	Require Large MFU Service	Section 12.0	No direct diversion
8	Continue HHW w/ Paint Collection	Section 13.0	195 tons - <1% diversion
9	Public Education & Outreach	Section 14.0	No direct diversion
10	Additional Northeast Drop-Site	Section 16.0	3,900 tons – 2% diversion
11	PAYT Pricing	Section 17.0	20,900-33,700 tons – 9 to 14% diversion (20,900 tons if all short-term programs implemented)
12	Additional Northeast Transfer Station	Section 18.0	No direct diversion
13	C&D Diversion Program	Section 19.0	36,100-180,500 tons outside of DSWM service area
Short- and Long-Term Program Improvements			**116,600 tons DSWM service area** **(147,600 tons with existing recycling/organics tons)**

[a] Based on escalating 2015 estimates to 2030 (see Table 17-1) and comparison to projection of total MSW generation in 2030 (245,100 tons)

Including tons diverted prior to 2011, continued growth of short-term programs alone (programs 1-4 and 8) will divert approximately 123,000 total tons, which will achieve about 50% diversion by 2030 (based on projected total MSW tons of 245,100 for the end of the long-term planning period). With the addition of long-term improvement, nearly 148,000 tons of the MSW generated in DSWM's service area could potentially be diverted (which equates to a diversion rate of over 60%). If Denver is successful in implementing diversion policies outside DSWM's service area, as much as 418,000 tons could be diverted in Denver.

Obviously, these estimates are based on a number of assumptions, including continued decreasing MSW generation rates, successful implementation of DSWM programs and broad acceptance of Denver-wide diversion policies. Actual success may vary from the projections developed in this SWMP. It is expected, however, that these programs will be implemented early enough in the 20-year planning period that they will have matured and be operating effectively by 2030.

20.2 Recommendations

Based on the findings of this SWMP document, the following recommendations apply to implementation of Part Two and Part Three options:

1. Establish a long-term (2030) waste diversion goal - that supports the intent of the original Greenprint Denver goal. Depending on Denver's projected ability to implement Part Three programs, this goal should be a minimum of 50%.

2. As a priority, implement the Part Two short-term program improvements according to the phasing schedule noted in Section 7.0 through 9.0, 13.0 and 14.0.

1. Evaluate Denver's ability to implement PAYT refuse pricing during the short-term planning period - this component will improve the participation and efficiency of the household recycling and organics collection programs. Additionally, despite the challenges to implementation, new fees may be more easily accepted by residents if combined with other program changes (especially those that provide new, additional services such as organics and drop-site collection).

2. Work to implement the short-term improvements identified in Sections 10.0 through 12.0 - to extend waste diversion as a management priority throughout Denver. Due to the social-political influence and constraints of many stakeholders, these policies may take longer to implement than described in this SWMP.

3. Revisit and review the SWMP in 2015 or 2016 - and revise it to refine the direction and strategy for the remaining planning period. Revisions are likely to include adjusted quantity, staff and cost estimates; new or modified goals; and improvements to accommodate new or changed program opportunities and challenges.

4. Implement the remaining Part Three improvements as early in the long-term planning period as possible - so they will be matured by the end of the period.

5. During the long-term planning period, continue to evaluate the need for a new DSWM transfer station – such evaluation should consider any capacity improvements to the existing CCTS and service agreements with private transfer stations.