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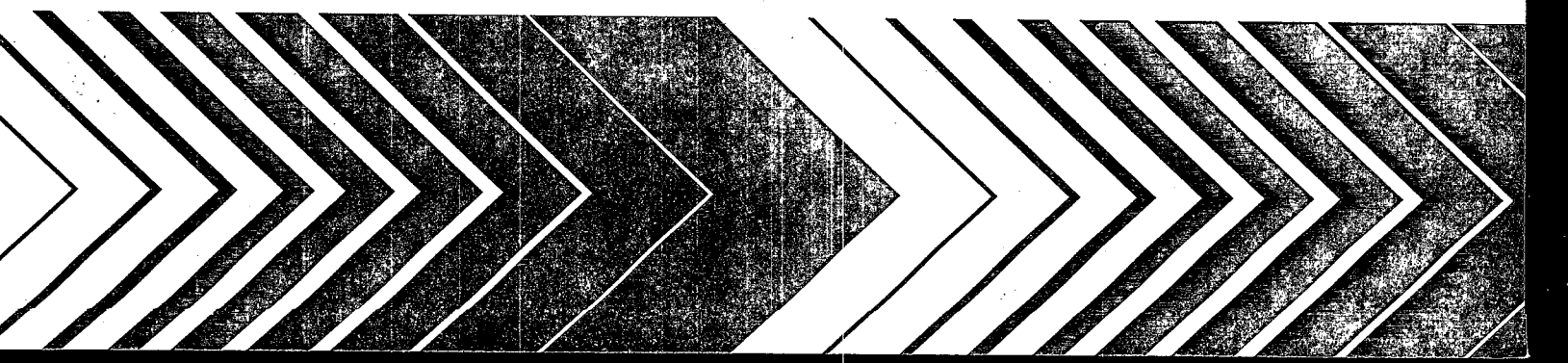
Evaluation of Diversion and Costs for Selected Drop-off Recycling Programs

A MITE Program Evaluation



CONTACT

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EVALUATION OF DIVERSION AND COSTS FOR SELECTED DROP-OFF RECYCLING PROGRAMS A MITE PROGRAM EVALUATION

by

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DISCLAIMER

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Assistance Agreement CR-818238 to the Solid Waste Association of North America (SWANA). It has been subjected to the Agency's peer and administrative reveiw, and it has been approved for publication as an EPA doument Mention of trade names or commerical products does not constitute endorsement or recommendation for use.

Much of the information contained in this document was provided by staff of the case study communities. The information was reviewed by Gershman, Bricknew & Bratton, Inc. (GBB), Burroughs Consulting, and Recycling Concepts for consistency, anomalies, and completeness. Some field verification was also possible during site visits. However, it was not in the scope of the study to independently verify each data point.

FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet these mandates, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

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This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

ABSTRACT

This analysis was undertaken in 1993-94 to examine a sample of drop-off recycling programs in the United States and Canada to determine the quantities of recyclable materials diverted, the cost of diverting those materials, and the impact of a wide range of independent variables on diversion and costs. Case studies were developed for eighteen drop-off systems in twelve programs that included multiple sites, central sites, buy-back facilities, block corner and combination systems. Case study programs were selected to include rural, urban, and suburban communities. Case study data is either calendar or fiscal year 1993, as available. The independent variables included site characteristics, drop-off technology, degree of separation, presence of competing recycling programs, population and number of households served, size of the geographic area served, requirements of state legislation, median income, education levels, and population density.

Because the case study communities were selected to provide information on programs of various types in different regions rather than as a representative sample, findings from the study cannot be considered statistically significant. However, a positive correlation between high diversion rates and high levels of education in the target area was found. Communities with positive site evaluation ratings (convenience, cleanliness, etc.) also showed the highest percent diversion rates. It appears that sites serving relatively small, neighborhood populations (two to four thousand persons) also show higher diversion rates.

Costs did not appear to directly correlate to the amount of materials diverted. In general, the number and types of materials targeted for recovery did not appear to affect total costs. The inclusion of plastics, in particular, did not positively correlate with total costs.

This paper has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication.

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ACKNOWLEDGEMENTS

This project was funded under the U.S. EPA's Municipal Solid Waste Innovative Technology Evaluation (MITE) Program, the American Forest & Paper Association (AFPA), the American Plastics Council (APC), Environmental Products Corp. (ENVIPCO), the National Soft Drink Association (NSDA), the Southeastern Public Service Authority (SPSA), and WMX Technology and Services, Inc. Project management was provided by the Solid Waste Association of North America (SWANA). The EPA Project Officer was Lynnann Hitchens, and SWANA's Project Officer was Charlotte Frola.

The authors wish to express their sincere appreciation to all the municipal solid waste managers in the case study communities who so graciously volunteered their time and expertise to support this project.

GBB, Burroughs Consulting, and Recycling Concepts evaluated the community drop-off programs and prepared this report. Report reviewers included Lynnann Hitchens of the U.S. EPA, Dianne De Roze and Charlotte Frola of SWANA. Peer reviewers included Janet Keller of Rhode Island's Department of Environmental Management and Nancy Nevil of the City of Plano, Texas.

GLOSSARY AND DEFINITIONS OF TERMS

Background Data -- Data that does not figure into the analysis section of the report, but provided for background purposes or to provide additional insight to the local community. It includes:

Demographics

Population -- Total population of community, including the target area.
Total Households -- Total households in entire community.
Area -- Total square miles of community.

Waste Generation

Single Family Waste -- Waste generated by single-family houses, as provided by community. Includes recyclable materials.
Multi-family Waste -- Waste from multi-family buildings, as provided, when available, by community. Includes recyclable materials.
Total Residential Waste -- Total of single family waste and multi-family waste.

Other Residential Recycling Programs

Generally, curbside-collected recyclables programs may or may not serve the target area. Data provided by community includes:

Households served;
Population served;
Annual tons collected; and
Total curbside program costs, net of revenues (collection, processing, administration, education, etc.).

Commingled Containers -- Glass, metal and plastic bottles and cans mixed together in a single container for collection.

Commercial Solid Waste -- Commercial solid waste means solid waste generated by commercial enterprises engaged in the buying and selling of goods and services that is similar in nature to solid waste generated from residential sources.

Household Solid Waste -- Any solid waste generated by households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

Independent Variables -- Site specific descriptors, as rated by data collectors during site visits to facilities, including:

Site Characteristics -- Includes many factors. Overall site characteristics were determined by rating each of several specific characteristics with the values 1 (highest) through 5 (lowest), and taking a straight average. For communities with multiple sites, the data

collector generalized for all sites together, rather than ranking each site individually.

Cleanliness -- Is the site well maintained and free of windblown litter?

1...free of litter, new containers and equipment

2

3...some litter in view, or containers beginning to show signs of age

4

5...old or dilapidated facility or equipment, or significant litter, or both

Operation and Layout -- Is the site spacious, well organized, and well-lit? Are staff on site to answer questions and assist residents?

1...easy access for both walk-up and drive-through residents, easy to understand instructions, minimal waiting time, helpful staff available

2

3...some phase of operation could be improved, but on the whole, still fairly easy to use

4

5...significant difficulty to park or reach drop-off equipment, confusing signs or lack of instructions, no staff

Safety -- Is the site safe at all times, either because of location or because of on-site staffing?

1...well-lit, staffed, good neighborhood

2

3...either poorly lit or in a in a questionable neighborhood, but no major problems

4

5...poorly lit, no staff on-site, bad neighborhood

Distance from homes -- Is the site relatively close to target area residents? Times are calculated for walking time (urban areas) or driving time (rural/suburban areas)

1...within 1-4 minutes

2...between 5 and 8 minutes

3...between 9 and 12 minutes

4...between 13 and 16

5...over 16 minutes

Convenience -- Is the site next to or near other places that target area residents are likely to visit?

1...In an apartment complex building or parking lot or in the same location as a transfer station or landfill where target area residents self-haul

2...in same parking lot as a supermarket/mall/U.S. Post Office

3...across the street from a supermarket/mall/U.S. Post Office

4...located on the way to/from a destination, but requiring a special stop
5...not located near anything, special trip required

Access periods -- Is the site open 24 hours, or are residents limited in the times they can use the site?

1...open 24 hours, 7 days per week
2...open daytime only, 5 to 7 days per week
3...open daytime 4 to 5 days per week
4...open weekly, but fewer than 4 days per week
5...open every other week, or on some other moving schedule

Materials Collected -- How many materials does the site collect?

1...over 17 materials collected
2...13-16 materials collected
3...9-12 materials
4...5-8 materials
5...1-4 materials

Drop-off Technology -- Details on technologies used by the communities are provided in Chapter IV. In the summary Table II-1, "technology" means the type of containers where target area residents can place their recyclable materials. These include:

-- Roll-off containers with compartments
-- Igloos (with or without compartments)
-- Compacting collection (dumpsters, front-end loader trucks, etc.)

Degree of Separation -- This refers to the ability of the drop-off program to keep materials separate during the collection and transportation phases, to facilitate more efficient and cost-effective processing of the materials. Also rated on a scale of 1 to 5.

1...All materials kept separate
2
3...papers commingled but separate from containers, or containers commingled but separate from paper
4
5...all materials commingled

Competing Recycling Programs -- This is provided as a yes/no answer in the analysis section. A competing recycling program is defined as a residential recycling program (i.e., curbside collection), including some or all of the materials collected by the drop-off program, that provides service to some or all of the drop-off program target population.

Education level -- Percent of population completing high school; percent completing four year college.

Geographic area -- The number of square miles over which the target population is spread. This may not be available in all communities.

Household total -- Where available, the number of households targeted by the drop-off program. This figure may be used to estimate target population.

Legislative Mandate -- This variable illustrates the range of legislative influence through the setting of recycling goals or mandates. State laws affecting recycling were given values of 1 - 5, as follows:

1...*No Legislative Influence* -- No State laws with recycling requirements.

2...*Recycling Goal or Target* -- A State law setting a numerical percent diversion, but for communities to strive to achieve, but no requirement that the diversion be met.

3...*Mandate for Recycling Program Development* -- State law requires that local jurisdictions set up and operate recycling programs without specifying the type of program or a percent diversion such programs must achieve.

4...*Mandate for Curbside Recycling Program* -- State law requires local jurisdictions set up curbside collection for residentially-generated recyclable materials. Does not specify percent diversion to be achieved.

5...*Recycling Mandate* -- State law not only requires local governments to set up and operate recycling programs, but also sets a percent diversion that the program must achieve. These laws often have a deadline for achieving diversion as well as specifying what materials qualify in calculating the percent diversion rate.

Median income -- Latest available figure for dollars per household earned by residents of the community. If available, this figure will apply to the target population, but may use data for broader cross-section of the community if this is the only data available.

Population -- Number of people living in the area targeted by the drop-off program. This will be provided by each participating community. Also referred to as target population.

Population density -- Population divided by the geographic area of the participating community. Once again, this only refers to the drop-off target area boundaries as defined by the participating community. In some cases, it may not be possible to calculate the actual population density.

Industrial Solid Waste -- Solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA. This term includes construction and demolition debris. It does not include mining waste or oil and gas waste.

Institutional Solid Waste -- Solid waste generated by institutional enterprises such as social, charitable, educational, and government services that is similar in nature to that of residential and commercial solid wastes.

Local Government -- Any incorporated or unincorporated jurisdiction including cities, municipalities, towns, townships, boroughs, districts, special purpose districts, authorities, counties or similar local government entities that have been established by state, provincial or local government law for the purposes of serving a designated segment of population within a state or province, or interstate/interprovincial areas.

Medical Waste -- Any solid waste generated in the diagnosis, treatment (e.g., provision of medical services), or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals.

Municipal Solid Waste (MSW) -- Solid waste generated by the general public and from residential, commercial, institutional, and industrial sources consisting of paper, wood, yard wastes, food wastes, plastics, leather, rubber, and other combustible and noncombustible materials such as metal, glass and rock. The term does **not** include:

- -- Any solid waste identified or listed as a hazardous waste under section 3001 of the Solid Waste Disposal Act, created as a result of a response or corrective action taken under sections 104 or 106 of the Comprehensive Environmental Response, Compensation, and Liability Act, or identified as a toxic substance under the Toxic Substance and Control Act;
- -- Medical waste;
- -- Industrial solid waste resulting from manufacturing processes;
- -- Any material diverted from the solid waste stream for the purpose of recycling, reclamation, or reuse;
- -- Any solid waste generated by an industrial facility that is disposed of on-site or by a facility owned by or affiliated with the generator; or
- -- Materials or products returned to the manufacturer or its agent for credit, evaluation, possible reuse, or disposal, or unsold materials returned to the manufacturer or its agent.

Note that materials diverted for recycling, reclamation, etc. are normally NOT considered part of the MSW stream. For the purposes of calculating recycling percent diversion for this study, the total Municipal Solid Waste stream is considered the sum of the amount of MSW generated in the drop-off facility Target Area plus the total amount of materials diverted through the drop-off facility (and other Competing Recycling Programs, if any). The method of calculating diversion is provided under Results Measure: Percent Diversion definition on page 8.

Plastics -- Synthetically produced compounds, usually made from organic materials (e.g., oil, natural gas, wood) by polymerization. The types of plastics addressed in this report include:

HDPE -- High Density Polyethylene, a plastic resin that may be natural (translucent) or colored that is used for milk, water and juice jugs and other containers. Labelled #2 (HDPE).

LDPE -- Low Density Polyethylene, a plastic resin used to make film plastics and some rigid items such as food storage containers. Labelled #4 (LDPE).

PET -- Polyethylene Terephthalate, a plastic resin used for soft drink bottles and other containers. Labelled #1 (PETE).

PP -- Polypropylene, a plastic resin used to make battery cases and some food containers. Labelled #5 (PP).

PS -- Polystyrene, a plastic resin used in food containers, plastic cutlery, etc. Labelled #6 (PS).

PVC -- Polyvinyl Chloride, a plastic resin used to make bottles, blister packs, etc. Labelled #3 (V).

Other Plastic -- Plastics included in this category generally are multiple resins. Expanded polystyrene (foam plastic for containers or packing material) is also included in this category.

Recyclable Materials -- Materials that can be recovered from the municipal solid waste stream for reuse (except where noted in text, all diverted material is from households).

Materials included in this study for evaluation are:

Aluminum -- Aluminum food and beverage cans, may include aluminum foil.

Aseptic packaging and polycoated paperboard -- Juice boxes and paper-based juice and milk cartons.

Blue glass -- Vancouver and Santa Monica collect blue glass containers.

Brown glass -- Brown glass food and beverage containers.

Clear glass -- Clear glass food and beverage containers.

Glass, unspecified -- Mixed clear, green, and brown glass food and beverage containers.

Green glass -- Green glass food and beverage containers.

Magazines -- Magazines and glossy print paper.

Mixed paper -- Chipboard, paperboard, junk mail, colored ledger paper, kraft paper, and other non-contaminated paper stock.

Newsprint -- Newspapers.

Office Paper -- White ledger paper and other high grade white paper, computer paper.

Phone books -- Telephone directories published by local telephone service companies or One Book.

Plastic -- Seven categories of plastics, as follows:
(1) Soda bottles only (PET) (#1)
(2) Milk jugs only (HDPE) (#2)
(3) Soda bottles and milk jugs (PET and HDPE)
(4) All containers (PET and HDPE)
(5) Hard plastic (#1, 2, 5 and some #4, 7)
(6) Soft plastic (#4 and some #7)
(7) Other plastic (#3, 4, 5, 7)

Steel cans -- Steel-based food and beverage containers.

Residential Solid Waste -- Same as Household Solid Waste.

Results Measures: Cost of Diversion -- The cost of diversion is presented as 1993 or FY 1993 dollars spent per ton of materials collected at the drop-off sites. **There are many cost elements of a drop-off program; these elements are shown separately where available. In certain communities (such as where an outside contractor operates the drop-off program), it is possible that only one lump-sum cost will be available.** Specific cost elements, as provided by communities, include:

Administrative Costs -- Administrative costs refer to the expense of additional work required of solid waste division staff to organize, manage, and administer drop-off program operations. Administrative costs would still exist were the drop-off program to terminate, but they would be channelled elsewhere. In some communities, administrative costs may be included in operating costs, and may not be available separately.

Amortization Costs -- The capital investment described below may be paid as a lump sum, or the capital raised can be amortized (paid off) over the operating life of the drop-off program or a specified time period. These amortization costs reflect capital investment

costs on an annual basis, and can be used for comparison purposes. In some communities, amortization costs may be included in operating costs, and may not be available separately. Amortization of land cost is not included.

Capital Investment -- This is the total amount of capital required to implement a drop-off program. Capital investment refers to spending that occurs prior to the start of the program, and is paid as a lump sum over a relatively short time (six months to three years). Investment may be made for land, buildings, containers, trucks, and other large equipment that is necessary to operate a drop-off program. Additionally, marketing and other public education efforts that occurred prior to drop-off program start-up is considered capital investment. Because participating communities started their drop-off programs at different times, and the value of money changes significantly over time, it is difficult to compare capital investment costs.

Education Costs -- These are the costs of preparing, circulating, and evaluating the effect of public education materials that aim to increase awareness and participation of the drop-off program. Education costs include the portion of labor and fringes for any solid waste management staff that spend all or part or their time dealing with drop-off program education. Education costs include the cost of development and distribution of informational materials, and of putting on any other education or recycling awareness program applicable to the drop-off program. Education costs refer only to ongoing annual costs, and would cease entirely were the drop-off program to terminate. In some communities, education costs may be included in operating costs, and may not be available separately.

Operating and Maintenance Costs (O&M) -- The costs associated with daily operation, maintenance, and service for the drop-off program. O&M costs include labor and fringes for drop-off program staff, and any portion of labor and fringes for solid waste management staff who spend part of their time dealing with drop-off program operations. O&M costs include materials and supplies, insurance, and contractual costs for services provided at the drop-off center(s). Finally, operating costs include transportation costs for hauling the drop-off materials to the first processor, and also the tip fees paid or revenues received from the delivery of the recyclable material. All operating costs would cease were the drop-off program to terminate.

Overhead Costs -- Overhead costs are defined for purposes of this study as the costs of education and administration. Because these costs vary widely from one jurisdiction to the next, they were deleted from operations and maintenance (O&M) costs in order to more fairly assess O&M costs associated with different drop-off technologies. Additionally, by separating Overhead Costs, it is possible to evaluate whether such expenditures affect the success of individual programs.

Program Development and Marketing -- If available, the length of time in months or years

spent educating the public, distributing informational materials, and improving public awareness of recycling prior to program start-up. If the capital investment for these activities is available, it will be listed.

Total Costs -- The sum of operating and maintenance costs, education costs, administrative costs, and amortization costs. Due to their somewhat speculative nature, avoided costs are **not** factored into total costs. The limited availability of data and the lack of a uniform method for calculating avoided costs prevent their use in quantitative analysis. Total costs will summarize the readily quantifiable total annual spending that occurs to support the drop-off program. Total drop-off program cost divided by the total tons of material collected at the drop-off site(s) will yield the cost of diversion result measure.

Results Measures: Percent Diversion -- Drop-off program diversion is defined as the amount of materials that the drop-off program has collected that otherwise would have been a part of the waste stream of the drop-off target area. All diversion calculations in the study apply only to the target population (as specified by the participating community) of the drop-off program. Diversion is estimated using two different measures, percent diversion and per capita diversion.

Participating communities provided the total quantity of materials (individually and in total) collected at the drop-off sites. Participating communities also provided the estimated waste generation for the drop-off program area. Given this information (all quantities in tons), drop-off program percent diversion is calculated as a percent of the total waste stream that has been collected by the drop-off program, or

$$Percent\ Diversion = \left(\frac{Total\ Drop\text{-}off\ Quantity}{Total\ Residential\ MSW,\ Drop\text{-}off\ Target\ Area} \right) x\ 100$$

If total waste generation data provided by the community did not include the drop-off materials, then drop-off quantities were added back into the denominator (i.e., the denominator includes the numerator) before making percentage calculations. Ideally, drop-off quantities would be provided net of residue after processing. Realistically, gross drop-off quantities were used in all calculations, because limited data was available on the amount of residue from processed drop-off materials.

In addition to the percent diverted from the total waste stream, per capita diversion for each material collected (and for all materials combined) were calculated. The formula for this result measure is

$$Per\ Capita\ Diversion,\ Material_M = \frac{2{,}000\ x\ (Tons\ of\ Material_M)}{Drop\text{-}off\ Program\ Area\ Population}$$

Once again, the population in the denominator must be an estimate of the population served by

the drop-off target area, and not the population of the entire community.

Solid Waste -- Any garbage; refuse; sludge from a wastewater treatment, water supply treatment, or air pollution control facility; and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations; and from community activities. Does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permits; or material as defined by the Atomic Energy Act of 1954, as amended.

Target Area -- The geographic area served by the drop-off facility, as defined by the community; details provided in Chapter IV.

Total Residential Municipal Solid Waste -- All MSW from single-family and multi-family households, including yard waste and recyclable materials. Amounts were provided by communities.

LIST OF ACRONYMS

CY	Calendar year, January through December.
FY	Fiscal year. Usually October through September; sometimes July through June.
HDPE	High Density Polyethylene
LDPE	Low Density Polyethylene
MRF	Materials Recovery Facility, also called an IPF or Intermediate Processing Facility. A facility designed to accept, separate, process/upgrade, and market recyclable materials.
MSW	Municipal Solid Waste (see Glossary)
MSWM	Municipal Solid Waste Management
O&M	Operations and maintenance
PET	Polyethylene Terephthalate
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act of 1976, as amended (40 U.S. Code of Federal Regulations, Part 260, ff.).
SWDA	Solid Waste Disposal Act -- 40 U.S. Code of Federal Regulations, Part 260, ff., as amended by RCRA.

I. INTRODUCTION AND PURPOSE

Drop-off recycling programs have been integral to recycling recovery efforts for decades. However, with the advent of curbside recycling programs and increasing demands from constituents, many solid waste program managers across the country are re-evaluating the role of drop-off programs for residential recyclable materials in their municipal solid waste management (MSWM) systems.

This analysis was undertaken to examine a sample of drop-off recycling programs in the United States and Canada to determine:

- The quantities of recyclable materials diverted;
- The cost of diverting those materials; and
- The impact of a wide range of variables on diversion and costs.

The case study information contained in this report is intended to provide meaningful data to MSW program managers about the potential role of drop-off recycling in their residential MSWM systems. All data was collected in 1993-94, and costs are reported in Calendar or Fiscal Year 1993 numbers, as available.

The sections of this report that follow address the data collection and analysis protocols used, the findings, and conclusions/observations.

II. APPROACH TO THE PROJECT

A. SELECTION OF THE CASE STUDY SITES

The Project Team worked with peer advisors, project sponsors, SWANA Staff, and EPA Staff to identify a list of candidate sites that met the following key criteria:

- Diversion from the drop-off program was reported to be approximately four percent or better, although study research showed some case study communities' drop-off programs diverted less than four percent;
- The drop-off program had been in place for at least one year;
- Data were maintained on quantities of materials collected and costs of drop-off program management;
- The community was willing to participate in the Study; and
- Diversity was sought in geographic representation, demographic considerations, technologies employed, and legislative conditions.

A preliminary list of nearly 40 case study sites was developed, and these communities were contacted to assess interest and availability of data. Based on the limitations of the project schedule and scope, it was determined that approximately ten case study sites would be targeted.

The communities selected for inclusion in this study are listed below in alphabetical order by state or territory. Information on the characteristics of each community are provided in Chapter IV, Case Studies. Because of the geographic proximity of some sites, a total of twelve communities/programs were examined, which resulted in data about 18 drop-off recycling systems. The communities display a variety of drop-off approaches, including:

- Multiple sites (e.g., Central Virginia, Southeast Colorado)
- Central sites (Vancouver, Burnaby)
- Buy-back (Tampa)
- "Block Corner" (Philadelphia sites)
- Combinations of the above.

The reason there are more drop-off systems than communities included in this study is the presence of six multiple-site programs. The communities also display different site configurations and accept varied materials. The case study sites are:

- Burnaby, British Columbia

- Vancouver, British Columbia (Main and Mini Depots)
- Santa Monica, California
- Southeastern Colorado
- Largo, Florida
- Tampa, Florida (Drop-off and Buyback)
- Southern Maine (Falmouth, Freeport)
- Blue Ash, Ohio
- Philadelphia, Pennsylvania (Queen Village, Cedar Park)
- West Greenwich, Rhode Island
- Central Virginia Waste Management Authority (Chesterfield County, City of Petersburg, Henrico County)
- Norfolk, Virginia (Southeastern Public Service Authority)

Figure II-1 presents a map showing the location of the case study sites.

B. DATA COLLECTION

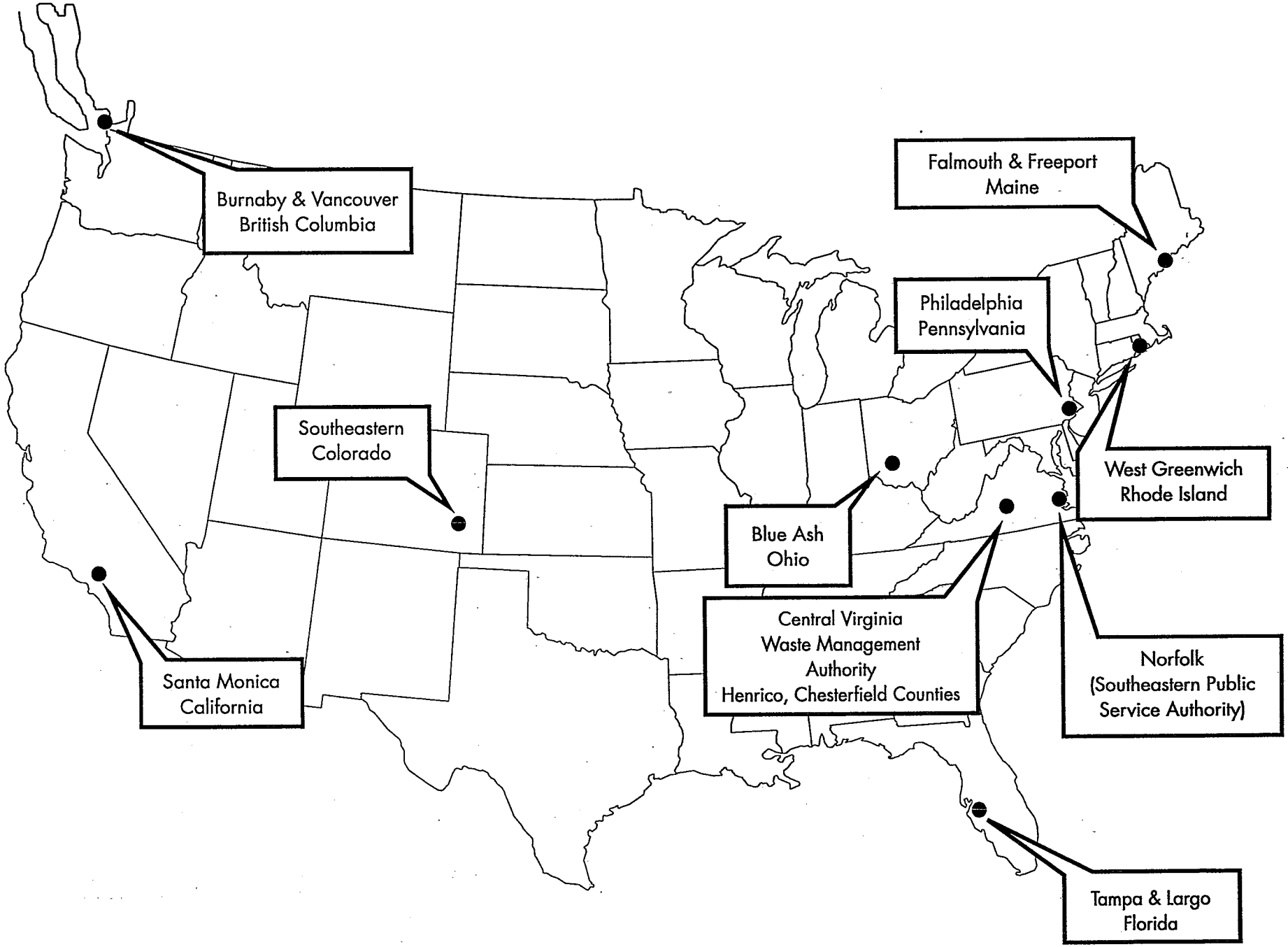
Prior to initiating the case study visits, the Project Team developed a list of independent variables that could impact two results measures: diversion of materials and program costs. The independent variables considered were:

Demographic Considerations
- Population and Density
- Median Annual Household Income
- Percent of Population with High School Diploma
- Percent of Population with four Years of College

Program Characteristics
- Number of Sites
- Number of Materials Collected
- Number of Separations Required
- Staffing Levels
- Technology Used
- Public Education and Program Administration

Site Characteristics
- Operation and Layout
- Distance from Households
- Convenience
- Access Periods
- Cleanliness/Appearance
- Safety/Lighting

Figure II-1 Map of Case Study Sites



Other Variables

Legislative Conditions
Competing Recycling Programs

In addition to the Independent Variables listed above, Table II-1 also provides data lines for the average capacity per site and the average number of users per site. The average number of users per site is calculated by dividing the Target Area population by the number of sites operated by the drop-off program. This information is intended to help the reader understand the relative scale of the sites. The Vancouver Mini Depots, the Santa Monica sites, and the Southeast Colorado drop-offs have small cubic yard (cy^3) capacities. All three have a relatively small number of daily visitors per site, either because of a small average number of users per site (Santa Monica), vast distances (Southeast Colorado), or competition from a larger drop-off facility (Vancouver Main Depot).

Case study communities were then contacted by telephone and letter prior to the site visits to expedite the data collection process. Site visits included interviews with staff, tours of drop-off sites, and review of operational records, budget data and reports. Follow-up included phone calls with program managers, budget personnel, processors/markets, and other appropriate contacts.

The Glossary provided at the front of this document presents a list of definitions used during the data collection and analysis process.

C. SUMMARY OF COLLECTED DATA

Tables II-1 and II-2 show a summary of the program characteristics, demographics, and other independent variables considered as part of the study. Please refer to the Glossary for definitions of terms used in report tables. Note that individual table columns may not add due to rounding.

Table II-3 summarizes diversion data from the case study sites. The quantity of materials recovered from the drop-off programs was evaluated as a percentage of the total residential MSW generated by the target population. Diversion rates ranged from 0.36 percent in Tampa, Florida to 15.61 percent in Santa Monica, California. Table II-4 presents per capita diversion (in pounds per person per year) for each of the case study communities.

Costs of diversion from the case study systems are shown in Table III-5. Total costs have been broken down into operating and maintenance costs, education and administrative costs, and annualized capital costs (where applicable and available). In some cases, communities were not able to assign costs for overhead (education and administration) or to separate out annualized capital costs. These spaces are left blank in the table. Where "$0" is entered on the table (Philadelphia sites), there is no expenditure made by the community for that line item. Total cost lines (in bold) are available for all communities.

Section III of this report provides a discussion of the analysis of the study data and its findings. Section IV of this report presents detailed descriptions of each of the case study programs.

Table II-1. Independent Variables: Program Characterics

PARTICIPATING COMMUNITY	Burnaby, B. Columbia	Vancouver, B. Columbia		Santa Monica, California	Southeast, Colorado	Largo, Florida	Tampa, Florida		Blue Ash, Ohio
Program Type	Drop-off	Main Depot	Mini Depots	Drop-off	Drop-off	Drop-off	Drop-off	Buy-back	Drop-off
Number of Sites	1	1	6	104	53	9	20	1	6
Average Capacity/site (yd^3)	60	114	12	6	3.9	42.9	34.3	Unlimited	44.7
Staffed/Not-staffed	Staffed	Staffed	Not	Not	Not	Not	Not	Staffed	Not
Technology	Compact	Multiple	Compact	Compact	Igloo	Igloo	Multiple	Central	Compact
Number of Materials Collected	11	6	6	6	5	4	4	4	8
Average Users per Site	158858	244770	40795	836	2108	4267	11486	229712	2272
Avg. Collection Qty.(ton/site)	697	1584	46	31	25	227	164	1680	117
Site Eval. Rating(Scale 1-5)[1]									
Cleanliness	3.00	1.00	3.00	4.00	1.00	2.13	2.50	3.00	1.00
Operations & Layout	3.00	1.00	3.00	3.00	2.00	2.25	3.00	3.00	2.50
Safety	1.00	1.00	2.00	3.00	2.00	3.00	2.72	3.00	3.17
Distance from Households	3.00	4.00	2.00	1.00	4.50	3.00	2.89	3.00	2.50
Convenience	5.00	4.00	3.00	3.00	1.00	2.25	3.00	3.00	2.50
Access Periods	2.00	2.00	1.50	2.00	1.00	2.25	2.94	2.00	1.67
Materials Collected	3.00	3.00	4.00	4.00	4.00	2.00	3.00	4.00	3.17
Total Score	20.00	16.00	18.50	20.00	15.50	16.88	20.06	21.00	16.50
Average Rating	2.86	2.29	2.64	2.86	2.21	2.41	2.87	3.00	2.36
Separation of Materials									
Collection Compartments	11	6.00	3.00	4.00	4.00	4.00	4.00	4.00	5.00
Collection Sep. Factor[2]	1.00	1.00	2.00	1.50	1.25	1.00	1.00	1.00	1.60
Paper Collection(Mtl/Seprt)	Separate	Separate	Separate	Separate	Separate	Separate	Separate	Separate	Separate
Container Collection	Separate	Mixed	Mixed	Mixed	Separate	Separate	Separate	Separate	Separate
Separation Rating(scale 1-5)[1]	1.00	3.00	3.00	1.00	1.00	2.00	4.00	1.00	3.00

[1] See Glossary for discussion of rating scale. 1 = highest, 5 = least

[2] Calculated as the total number of materials collected divided by the number of compartments used to collect them.

Table II-1 (cont). Independent Variables: Program Characterics

PARTICIPATING COMMUNITY	Southern Maine		Philadelphia, Pennsylvania		Rhode Island	Central Virginia			SPSA Norfolk
Study Area	Falmouth	Freeport	Queen Village	Cedar Park	West Greenwich	Chester-field	Petersburg	Henrico	
Program Type	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off
Number of Sites	2	3	24	23	1	35	6	15	7
Average Capacity/site (cy^3)	36.0	65.0	Unlimited	Unlimited	54.0	41.5	34.0	33.7	68.6
Staffed/Unstaffed	Both	Both	Staffed	Staffed	Staffed	Unstaffed	Unstaffed	Unstaffed	Both
Technology	Roll-off	Roll-off	Compact	Compact	Roll-off	Roll-off	Roll-off	Roll-off	Roll-off
Number of Materials Collected	7	8	3	3	6	7	7	9	9
Average Users per Site	3,805	2,348	393	585	2,749	6,431	6,400	15,333	37,318
Avg. Collection Qty.(ton/site)	169	107	10	9	156	88	60	227	140
Site Eval. Rating(Scale 1-5)[1]									
Cleanliness	1.00	1.00	3.00	3.00	1.00	3.00	3.00	3.00	2.50
Operations & Layout	1.00	1.00	2.00	2.00	2.00	4.00	4.00	4.00	3.00
Safety	1.50	1.67	1.00	1.00	1.00	2.00	2.00	2.00	2.00
Dis. from Households	2.00	2.00	1.00	1.00	5.00	3.00	3.00	3.00	3.00
Convenience	3.00	2.67	1.00	2.00	1.00	2.50	3.00	2.50	3.00
Access Periods	2.00	1.67	1.00	1.00	4.00	1.00	1.00	1.00	1.00
Materials Collected	3.50	3.33	4.00	4.00	2.00	4.00	4.00	3.00	3.00
Total Score ,	14.00	13.34	13.00	14.00	16.00	19.50	20.00	18.50	17.50
Average Rating	2.00	1.91	1.86	2.00	2.29	2.79	2.86	2.64	2.50
Separation of Materials									
Collection Compartments	4.00	4.00	2.00	2.00	2.00	8.00	7.00	8.00	6.14
Collection Sep. Factor[2]	1.75	2.00	1.50	1.50	3.00	0.88	1.00	1.13	1.47
Paper Collection(Mtl/Seprt)	Separate	Separate	Separate	Separate	Separate	Separate	Separate	Separate	Separate
Container Collection(M/S)	Separate	Separate	Separate	Separate	Mixed	Separate	Separate	Separate	Separate
Separation Rating(scale 1-5)[1]	2.00	1.67	1.00	1.00	3.00	1.00	1.00	1.00	1.00

[1] See Glossary for discussion of rating scale. 1 = highest, 5 = least

[2] Calculated as the total number of materials collected divided by the number of compartments used to collect them.

Table II-2. Independent Variables: General

PARTICIPATING COMMUNITY	Burnaby, B. Columbia	Vancouver, B. Columbia		Santa Monica, California	Southeast, Colorado	Largo, Florida	Tampa, Florida		Blue Ash, Ohio
Program Type	Drop-off	Main Depot	Mini Depots	Drop-off	Drop-off	Drop-off	Drop-off	Buy-back	Drop-off
Demographics, Target Area									
Population	158,858	244,770	244,770	86,905	111,727	38,400	229,712	229,712	13,629
Households	62,000	101,000	101,000	35,000	41,309	22,100	100,485	100,485	5,220
Single Family						NA			3,900
Multi-family						NA			1,320
Area, Square Miles	40.0	43.7	43.7	8.3	36,200.0	14.3	150	150	7.7
Population Density	3,971	5,601	5,601	10,470	3	2,685	1,531	1531	1,770
Income/Education, Target Area									
Median Annual HH Income	$24,697	$24,934	$24,934	$35,997	$29,600	$24,296	$35,997	$35,997	$46,339
Percent w/HS Diploma[1]	NA	23.1%	23.1%	87.5%	75.7%	77.1%	70.6%	70.6%	84.2%
Percent w/College Degree[1]	NA	16.3%	16.3%	43.4%	7.0%	13.8%	18.7%	18.7%	40.0%
Drop-off Program Factors									
Legislative Mandate (1-5)[2]	3	3	3	2	1	5	5	5	3
Competing Recycling? (Y/N)	Y	N	N	Y	N	Y	Y	Y	Y

[1] For population over 25 years of age, except Philadelphia, which is population over 18.
[2] See Glossary for definition. 1 = no legislation, 5 = mandated program and diversion rate.

Table II-2 (cont). Independent Variables: Program Characterics

PARTICIPATING COMMUNITY	Southern Maine		Philadelphia, Pennsylvania		Rhode Island	Central Virginia			SPSA Norfolk
Study Area	Falmouth	Freeport	Queen Village	Cedar Park	West Greenwich	Chester-field	Petersburg	Henrico	
Program Type	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off
Demographics, Target Area									
Population	7,610	7,043	9,443	13,461	2,749	225,100	38,400	230,000	261,229
Households	3,076	2,666	3,984	5,679	961	75,264	16,196	94,103	54,990
Single Family	2,601	2,159			961	65,029	10,926	57,820	26,633
Multi-family	475	507			0	10,235	5,270	36,283	28,357
Area, Square miles	29.6	34.7	0.5	0.5	51.2	446	23	245	65.7
Population Density	257	203	18,886	26,922	54	505	1,670	939	3,976
Income/Education, Target Area									
Median Annual HH Income	$44,863	$37,150	$34,464	$26,409	$41,250	$43,604	$21,309	$35,604	$23,563
Percent w/HS Diploma[1]	87.5%	86.0%	64.3%	64.3%	81.0%	84.2%	62.2%	81.3%	72.7%
Percent w/College Degree[1]	44.0%	32.0%	41.0%	31.0%	21.0%	29.2%	13.5%	19.0%	16.8%
Drop-off Program Factors									
Legislative Mandate (1-5)[2]	2	2	4	4	5	2	2	2	2
Competing Recycling? (Y/N)	N	N	N	N	N	Y	N	N	Y

[1] See Glossary for discussion of rating scale. 1 = highest, 5 = least

[2] Calculated as the total number of materials collected divided by the number of compartments used to collect them.

Table II-3. Results Measure: Diversion in Tons Per Year and as a Percent of Residential MSW

PARTICIPATING COMMUNITY	Burnaby, B. Columbia	Vancouver, B. Columbia		Santa Monica, California	Southeast, Colorado	Largo, Florida
Program Type	Drop-off	Main Depot	Mini Depots	Drop-off	Drop-off	Drop-off
Residential Waste Disposal, incl. Recyclables (TPY):						
Drop-off Target Area only	48,288	75,672	75,672	20,584	39,870	25,840
Area-wide	48,288	202,400	202,400	29,730	39,870	49,760
Materials Collected (TPY)						
Paper:						
Newprint	184.26	418.0	123.0	2665.2	902	1734
Office Paper	23.75					
Magazines	44.81					
Phone Books						
Mixed Paper	271.25	862.6	79.0			
Total Paper	524.1	1280.6	202.0	2665.2	902.0	1734.0
Glass:						
Clear Glass	41.84	115.0	26.9		287.0	
Green Glass	41.84	125.4	29.4			
Brown Glass	10.51	20.9	4.9		61.0	
Glass, Unspecified				398.7		265.2
Total Glass	94.2	261.3	61.2	398.7	348	265.2
Plastic:						
Soda Bottles only (PET)						
Milk Jugs only (HDPE)						
Soda Bottles & Milk Jugs						20.4
All PET & HDPE Containers		41.8	9.8	70.7		
Plastic, Hard (1,2,5, some 4.7)	25.8					
Plastic, Soft (LDPE, some 7)	28.5					
Other Plastic (PVC/LDPE/PP)				1.5		
Total Plastic	54.4	41.8	9.8	72.2	0	20.4
Metal:						
Aluminum	4.68			6.6	14.8	20.4
Steel Cans	19.89			71.5	59.2	
Total Metal	24.6	0	0	78.1	74	20.4
Recovered Material Composition (% of Total Recd. Materials)						
Paper, %	75.2%	80.9%	74.0%	82.9%	68.1%	85.0%
Newspaper Only %	26.4%	26.4%	45.1%	82.9%	68.1%	85.0%
Glass, %	13.5%	16.5%	22.4%	12.4%	26.3%	13.0%
Plastic, %	7.8%	2.6%	3.6%	2.2%	0.0%	1.0%
Metal, %	3.5%	0.0%	0.0%	2.4%	5.6%	1.0%
Total Materials Collected (TPY)	697.2	1583.7	273.0	3214.2	1324.0	2040.0
Percent Diversion, Target Area	1.44%	2.09%	0.36%	15.61%	3.32%	7.89%
Percent Diversion, Total Waste	1.44%	0.78%	0.13%	10.81%	3.32%	4.10%

Table II-3 (cont). Results Measure: Diversion in Tons Per Year and as a Percent of Residential MSW

PARTICIPATING COMMUNITY	Tampa, Florida		Southern Maine		Blue Ash, Ohio	Rhode Island
Study Area			Falmouth	Freeport		West Greenwich
Program Type	Drop-off	Buy-back	Drop-off	Drop-off	Drop-off	Drop-off
Residential Waste Disposal, incl. Recyclables (TPY):						
Drop-off Target Area only	137,596	NA	2,494	2,601	6,496	1,604
Area-wide	171,139	171,139	2,494	2,601	6,496	1,604
Materials Collected (TPY)						
Paper:						
Newprint	2528.7		269.0	89.0	430.5	109.0
Office Paper				30.0		
Magazines			21.0	7.0		
Phone Books			3.0	1.0		
Mixed Paper			4.0	108.0		
Total Paper	2528.7	NA	297.0	235.0	430.5	109.0
Glass:						
Clear Glass					73.9	15.0
Green Glass					30.6	9.0
Brown Glass					23.5	5.0
Glass, Unspecified	471.3		4.0	37.0		
Total Glass	471.3	NA	4.0	37.0	128.0	29.0
Plastic:						
Soda Bottles only (PET)					27.9	
Milk Jugs only (HDPE)			11.0	27.0	36.5	
Soda Bottles & Milk Jugs						7.0
All PET & HDPE Containers	258.5					
Plastic, Hard (1,2,5, some 4.7)						
Plastic, Soft (LDPE, some 7)						
Other Plastic (PVC/LDPE/PP)						
Total Plastic	258.5	NA	11.0	27.0	64.4	7.0
Metal:						
Aluminum	14.2				28.9	
Steel Cans			26.0	21.0	49.2	11.0
Total Metal	14.2	NA	26.0	21.0	78.2	11.0
Recovered Material Composition (% of Total Recd. Materials)						
Paper, %	77.3%	NA	87.9%	73.4%	61.4%	69.9%
Newspaper Only %	77.3%	NA	79.6%	27.8%	61.4%	69.9%
Glass, %	14.4%	NA	1.2%	11.6%	18.3%	18.6%
Plastic, %	7.9%	NA	3.3%	8.4%	9.2%	4.5%
Metal, %	0.4%	NA	7.7%	6.6%	11.1%	7.1%
Total Materials Collected (TPY)	3272.7	1680.0	338.0	320.0	701.0	156.0
Percent Diversion, Target Area	2.38%	NA	13.55%	12.30%	10.79%	9.73%
Percent Diversion, Total Waste	1.91%	0.98%	13.55%	12.30%	10.79%	9.73%

Table II-3 (cont). Results Measure: Diversion in Tons Per Year and as a Percent of Residential MSW

PARTICIPATING COMMUNITY	Philadelphia, Pennsylvania		Central Virginia			SPSA Norfolk
Study Area	Queen Village	Cedar Park	Chesterfield	Petersburg	Henrico	
Program Type	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off
Residential Waste Disposal, incl. Recyclables (TPY):						
Drop-off Target Area only	7,250	10,336	83,881	19,077	147,602	79,091
Area-wide	7,250	10,336	83,893	19,077	152,250	111,058
Materials Collected (TPY)						
Paper:						
Newprint	160.0	149.5	2524.3	231.6	2,471.9	809.7
Office Paper						34.3
Magazines					41.0	
Phone Books					41.0	
Mixed Paper						
Total Paper	160.0	149.5	2524.3	231.6	2553.9	844.0
Glass:						
Clear Glass			296.6	76.3	514.9	64.4
Green Glass			32.3	9.7	54.8	5.7
Brown Glass			38.1	8.2	65.8	5.0
Glass, Unspecified	87.5	50.5				
Total Glass	87.5	50.5	367.0	94.2	635.5	75.1
Plastic:						
Soda Bottles only (PET)						17.0
Milk Jugs only (HDPE)						15.6
Soda Bottles & Milk Jugs						
All PET & HDPE Containers			99.3	21.9	144.7	
Plastic, Hard (1,2,5, some 4.7)						
Plastic, Soft (LDPE, some 7)						
Other Plastic (PVC/LDPE/PP)						
Total Plastic	0	0	99.3	21.9	144.7	32.6
Metal:						
Aluminum	2.5	2.0	58.6	4.3	35.9	9.9
Steel Cans			32.6	5.2	33.0	21.2
Total Metal	2.5	2.0	91.3	9.5	68.8	31.1
Recovered Material Composition (% of Total Recd. Materials)						
Paper, %	64.0%	74.0%	81.9%	64.8%	75.1%	85.9%
Newspaper Only %	64.0%	74.0%	81.9%	64.8%	72.6%	82.4%
Glass, %	35.0%	25.0%	11.9%	26.4%	18.7%	7.6%
Plastic, %	0.0%	0.0%	3.2%	6.1%	4.3%	3.3%
Metal, %	1.0%	1.0%	3.0%	2.6%	2.0%	3.2%
Total Materials Collected (TPY)	250.0	202.0	3081.8	357.2	3402.8	982.8
Percent Diversion, Target Area	3.45%	1.95%	3.67%	1.87%	2.31%	1.24%
Percent Diversion, Total Waste	3.45%	1.95%	3.67%	1.87%	2.24%	0.88%

Table II-4. Results Measure: Diversion in Pounds Per Capita Per Year

PARTICIPATING COMMUNITY	Burnaby, B. Columbia	Vancouver, B. Columbia		Santa Monica, California	Southeast, Colorado	Largo, Florida	Tampa, Florida		Blue Ash, Ohio
Program Type	Drop-off	Main Depot	Mini Depots	Drop-off	Drop-off	Drop-off	Drop-off	Buy-back	Drop-off
Target Area Population (est)	158,858	244,770	244,470	86,905	111,727	38,400	229,712	229,712	13,629
Paper, lbs./person/year:									
Newprint	2.32	3.42	1.01	61.34	16.15	90.31	22.02		63.17
Office Paper	0.30								
Magazines	0.56								
Phone Books									
Mixed Paper	3.41	7.05	0.65						
Total Paper	6.6	10.46	1.65	61.34	16.15	90.31	22.02		63.17
Glass: Clear Glass	0.53	0.94	0.22		5.14				10.84
Green Glass	0.53	1.02	0.24						4.49
Brown Glass	0.13	0.17	0.04		1.09				3.45
Glass, Unspecified				9.17		13.81	4.1		
Total Glass	1.19	2.14	0.5	9.17	6.23	13.81	4.1		18.78
Plastic:									
Soda Bottles only (PET)									4.09
Milk Jugs only (HDPE)									5.36
Soda Bottles & Milk Jugs						1.06			
All PET & HDPE Containers		0.34	0.08	1.63			2.25		
Plastic, Hard (1,2,5, some 4.7)	0.33								
Plastic, Soft (LDPE, some 7)	0.36								
Other Plastic (PVC/LDPE/PP)				0.04					
Total Plastic	0.68	0.34	0.08	1.66		1.06	2.25		9.45
Metal: Aluminum	0.06			0.15	0.26	1.06	0.12		4.25
Steel Cans	0.25			1.65	1.06				7.22
Total Metal	0.31			1.8	1.32	1.06	0.12		11.47
Total Materials Collected	8.78	12.94	2.23	73.97	23.7	106.25	28.49	14.63	102.87

Table II-4(cont). Results Measure: Diversion in Pounds Per Capita Per Year

PARTICIPATING COMMUNITY	Rhode Island	Southern Maine		Philadelphia, Pennsylvania		Central Virginia			SPSA Norfolk
Study Area	West Greenwich	Falmouth	Freeport	Queen Village	Cedar Park	Chester-field	Petersburg	Henrico	
Program Type	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Buy-back	Drop-off
Target Area Population (est)	2,749	7,610	7,043	9,443	13,461	225,100	38,400	230,000	261,229
Paper, lbs./person/year:									
Newprint	79.3	70.70	25.27	33.89	22.21	22.43	12.06	21.49	6.20
Office Paper			8.52						0.26
Magazines		5.52	1.99					0.36	
Phone Books		0.79	0.28					0.36	
Mixed Paper		1.05	30.67						
Total Paper	79.3	78.06	66.73	33.89	22.21	22.43	12.06	22.21	6.46
Glass: Clear Glass	10.91					2.63	3.98	4.48	0.49
Green Glass	6.55					0.29	0.50	0.48	0.04
Brown Glass	3.64					0.34	0.43	0.57	0.04
Glass, Unspecified		1.05	10.51	18.53	7.5				
Total Glass	21.1	1.05	10.51	18.53	7.5	3.26	4.91	5.53	0.57
Plastic:									
Soda Bottles only (PET)									0.13
Milk Jugs only (HDPE)		2.89	7.67						0.12
Soda Bottles & Milk Jugs	5.09								
All PET & HDPE Containers						0.88	1.14	1.26	
Plastic, Hard (1,2,5, some 4.7)									
Plastic, Soft (LDPE, some 7)									
Other Plastic (PVC/LDPE/PP)									
Total Plastic	5.09	2.89	7.67			0.88	1.14	1.26	0.25
Metal: Aluminum				0.53	0.3	0.52	0.22	0.31	0.08
Steel Cans	8.0	6.83	5.96			0.29	0.27	0.29	0.16
Total Metal	8.0	6.83	5.96	0.53	0.3	0.81	0.49	0.6	0.24
Total Materials Collected	113.5	88.83	90.87	52.95	30.01	27.38	18.61	29.59	7.52

Table II-5. Results Measure: Costs of Diversion
(U.S. $ per ton[1])

PARTICIPATING COMMUNITY	Burnaby, B. Columbia	Vancouver, B. Columbia		Santa Monica, California	Southeast, Colorado	Largo, Florida	Tampa, Florida		Blue Ash, Ohio
Program Type	Drop-off	Main Depot	Mini Depots	Drop-off	Drop-off	Drop-off	Drop-off	Buy-back	Drop-off
Public or Private Operation	Public	Public	Public	Public	Private	Public	Public	Private	Private
Total Material Collected (TPY)	697.2	1,583.7	273.0	3,214.2	1,324.0	2,040.0	3,272.7	1,680.0	701.0
Drop-off Program Costs:									
Operation & Maintenance Costs[2]	$101,617	$38,077	$87,690	$152,509	$111,159	$82,250	$193,200	($2,400)	$18,000
Education & Admin. Cost[3]	16,146	22,204	22,338	74,778	3,997	118,871	118,500		$18,000
Annualized Capital Costs[3]	4,355	15,150	23,076	10,025	27,479			$28,476	
Gross Drop-off Program Costs:	$122,118	$75,431	$133,104	$237,312	$142,635	$201,121	$311,700	$26,076	$36,000
Revenues[3]	14,390	34,254	6,516		47,664	35,000			
Net Drop-off Program Costs	$107,728	$41,177	$126,588	$237,312	$94,971	$166,121	$311,700	$26,076	$36,000
O&M Cost/Net of Admin. & Ed.	$91,582	$18,973	$104,250	$162,534	$90,974	$47,250	$193,200	$26,076	$18,000
Total Cost, $/ton diverted	$154.52	$26.00	$463.69	$73.83	$71.73	$81.43	$95.24	$15.52	$51.36
O&M Cost, $/ton diverted[4]	$131.36	$11.98	$381.87	$50.57	$68.71	$23.16	$59.03	$15.52	$25.68
Overhead Cost, $/ton diverted[3]	$23.16	$14.02	$81.82	$23.26	$3.02	$58.27	$36.21		$25.68

[1]All Canadian dollars converted to U.S. dollars at a rate of $1.30 Canadian to $1.00 U.S. All Canadian metric tonnes converted to U.S. (short) tons.
[2]In Tampa and Largo, this number is adjusted to reflect revenue from sale of materials. Blue Ash, Ohio receives no revenues.
[3]If available.
[4]New of Administration and Education (Overhead) costs.

Table II-5(cont). Results Measure: Costs of Diversion
(U.S. $ per ton[1])

PARTICIPATING COMMUNITY	Rhode Island	Southern Maine		Philadelphia, Pennsylvania		Central Virginia			SPSA Norfolk
Study Area	West Greenwich	Falmouth	Freeport	Queen Village	Cedar Park	Chester-field	Peters-burg	Henrico	
Program Type	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off	Drop-off
Public or Private Operation	Private	Private	Private	Public	Public	Private	Private	Private	Public
Total Material Collected (TPY)	156.0	338.0	320.0	250.0	202.0	3,081.8	357.2	3,402.8	982.8
Drop-off Program Costs: Operation & Maintenance Costs[2] Education & Admin. Cost[3] Annualized Capital Costs[3]	$11,459 2,000	$22,811 6,668	$36,864 20,510	$0	$0	$140,245 2,403	$14,186 390	$141,790 25,196	$67,981 5,162 15,438
Gross Drop-off Program Costs: Revenues[3]	$13,459	$29,479	$57,374 7,677	$15,000	$12,120	$142,648 15,227	$14,576 1,506	$166,986 26,248	$88,581 4,060
Net Drop-off Program Costs	$13,459	$29,479	$49,697	$15,000	$12,120	$127,421	$13,070	$140,738	$84,521
O&M Cost/Net of Admin. & Ed.	$11,459	$22,811	$29,187	$15,000	$12,120	$125,018	$12,680	$115,542	$79,359
Total Cost, $/ton diverted	$86.28	$87.22	$155.30	$60.00	$60.00	$41.35	$36.59	$41.36	$86.00
O&M Cost, $/ton diverted[4]	$73.46	$67.49	$91.21	$60.00	$60.00	$40.57	$35.50	$33.95	$80.75
Overhead Cost, $/ton diverted[3]	$12.82	$19.73	$64.09			$0.78	$1.09	$7.40	$5.25

[1]All Canadian dollars converted to U.S. dollars at a rate of $1.30 Canadian to $1.00 U.S. All Canadian metric tonnes converted to U.S. (short) tons.
[2]In Tampa and Largo, this number is adjusted to reflect revenue from sale of materials. Blue Ash, Ohio receives no revenues.
[3]If available.
[4]Net of Administration and Education (Overhead) costs.

III. ANALYSIS AND FINDINGS

A. ANALYSIS OF CASE STUDY DATA

The definition of the target area served by each drop-off program presented several challenges (i.e., the jurisdictions studied indicated that drop-off users were not monitored and anyone in the community could use the sites). Consequently, the diversion achieved by the drop-off programs as measured against the entire residential MSW stream was also considered.

Relationships between diversion and cost and the following independent variables were examined in tabular format:

- Effect of collection technology (e.g., type of container used);
- Effect of legislative influences;
- Effect of competing recycling programs (defined as programs targeting some or all of the same materials or population);
- Effect of site staffing;
- Effect of program operator (public or competitively procured private);
- Effect of collecting commingled versus separated containers;
- Effect of site evaluation rating; and
- Effect of level of education.

Scatter diagrams were prepared to plot the relationship between each of the independent variables considered and the results measures (percent diversion, total average costs per ton of diversion, and average operating and maintenance costs per ton). Single variant regression analyses and multi-variant regression analyses were performed to identify statistically significant relationships between the independent variables and results measures.

B. RESULTS OF ANALYSIS

As the first step in this process, the communities were listed in order of their ranking with regard to the results measures. Tables III-1,III-2, and III-3 present the rankings for diversion (percentage and per capita) from the target area and total average cost per ton of diversion, respectively.

Table III-1. Percent Diversion in Target Area

Case Studies	Percent Diversion Target Area
Santa Monica, CA	15.61%
Falmouth, ME	13.55%
Freeport, ME	12.30%
Blue Ash, OH	10.79%
West Greenwich, RI	9.73%
Largo, FL	7.89%
Chesterfield, VA (CVWMA)	3.67%
Queen Village, PA	3.45%
Southeast Colorado	3.32%
Tampa, FL (Drop-off)	2.38%
Henrico, VA (CMWMA)	2.31%
Vancouver, BC (Main Depot)	2.09%
Cedar Park, PA	1.95%
Petersburg, VA (CVWMA)	1.87%
Burnaby, BC	1.44%
Norfolk, VA (SPSA)	1.24%
Vancouver, BC (Mini Depots)	0.36%
Tampa, FL (Buy-back)	NA

Table III-2. Per Capita Diversion in Target Area

Case Studies	Per Capita Diversion (lb/person/year)
West Greenwich, RI	113.50
Largo, FL	106.25
Blue Ash, OH	102.87
Freeport, ME	90.87
Falmouth, ME	88.83
Santa Monica, CA	73.97
Queen Village, PA	52.95
Cedar Park, PA	30.01
Henrico, VA (CMWMA)	29.59
Tampa, FL (Drop-off)	28.49
Chesterfield, VA (CVWMA)	27.38
Southeast Colorado	23.70
Petersburg, VA (CVWMA)	18.61
Tampa, FL (Buy-back)	14.63
Vancouver, BC (Main Depot)	12.94
Burnaby, BC	8.78
Norfolk, VA (SPSA)	7.52
Vancouver, BC (Mini Depots)	2.23

Table III-3. Drop-off Program Per Ton Total Cost

Case Studies	Percent Diversion Target Area
Tampa, FL (Buy-back)	15.52
Vancouver, BC (Main Depot)	26.00
Petersburg, VA (CVWMA)	36.59
Chesterfield, VA (CVWMA)	41.35
Henrico, VA (CMWMA)	41.36
Blue Ash, OH	51.36
Cedar Park, PA	60.00
Queen Village, PA	60.00
Southeast Colorado	71.73
Santa Monica, CA	73.83
Largo, FL	81.43
Norfolk, VA (SPSA)	86.00
West Greenwich, RI	86.28
Falmouth, ME	87.22
Tampa, FL (Drop-off)	95.24
Burnaby, BC	154.52
Freeport, ME	155.30
Vancouver, BC (Mini Depots)	463.69

Table III-4 presents the community rankings showing area-wide diversion percentages (not target area only). While there was a slight shift of ranking for some programs, the top six programs continued to rank highest regardless of how diversion was calculated.

In addition, when reviewing cost data from each of the programs, wide variances were found in the portion of program spending dedicated to education and administration (overhead costs). To examine the impact of these overhead costs on system cost performance, community rankings were developed based on operating and maintenance costs only (Table III-5) and overhead costs only (Table III-6).

Table III-4. Area-wide Percent Diversion

Case Studies	Percent Diversion Area-wide
Falmouth, ME	13.55%
Freeport, ME	12.30%
Santa Monica, CA	10.81%
Blue Ash, OH	10.79%
West Greenwich, RI	9.73%
Largo, FL	4.10%
Chesterfield, VA (CVWMA)	3.67%
Queen Village, PA	3.45%
Southeast Colorado	3.32%
Henrico, VA (CMWMA)	2.24%
Cedar Park, PA	1.95%
Tampa, FL (Drop-off)	1.91%
Petersburg, VA (CVWMA)	1.87%
Burnaby, BC	1.44%
Tampa, FL (Buy-back)	0.98%
Norfolk, VA (SPSA)	0.88%
Vancouver, BC (Main Depots)	0.78%
Vancouver, BC (Mini Depot)	0.13%

Table III-5. Drop-off Program Per Ton O&M Costs

Case Studies	O&M Costs ($/ton)
Vancouver, BC (Main Depot)	11.98
Tampa, FL (Buy-back)	15.52
Largo, FL	23.16
Blue Ash, OH	25.68
Henrico, VA (CMWMA)	33.95
Petersburg, VA (CVWMA)	35.50
Chesterfield, VA (CVWMA)	40.57
Santa Monica, CA	50.57
Tampa, FL (Drop-off)	59.03
Queen Village, PA	60.00
Cedar Park, PA	60.00
Falmouth, ME	67.49
Southeast Colorado	68.71
West Greenwich, RI	73.46
Norfolk, VA (SPSA)	80.75
Freeport, ME	91.21
Burnaby, BC	131.36
Vancouver, BC (Mini Depots)	381.87

Table III-6. Drop-off Program Per Ton Overhead Cost

Case Studies	Overhead Cost ($/ton)
Tampa, FL (Buy-back)	NA
Cedar Park, PA	NA
Queen Village, PA	NA
Chesterfield, VA (CVWMA)	0.78
Petersburg, VA (CVWMA)	1.09
Southeast Colorado	3.02
Norfolk, VA (SPSA)	5.25
Henrico, VA (CMWMA)	7.40
West Greenwich, RI	12.82
Vancouver, BC (Main Depot)	14.02
Falmouth, ME	19.73
Burnaby, BC	23.16
Santa Monica, CA	23.26
Blue Ash, OH	25.68
Tampa, FL (Drop-off)	36.21
Largo, FL	58.27
Freeport, ME	64.09
Vancouver, BC (Mini Depots)	81.82

Tables III-7 through III-14 (placed at the end of this section) show the results of analyzing diversion and independent variables. A wide range of percent diversion (less than 0.36 percent to 15.61 percent) was observed in the programs studied. Similarly, a wide range of costs per ton was also noted ($26.00 per ton to more than $463.00 per ton). To understand the relationship between diversion and costs, graphic plots were developed (see Figures III-1 through III-3 at the end of the section). Based on these plots, groupings were noted of programs that achieved high diversion at low costs.

The following discussion of Tables III-7 through III-14 and graphics is undertaken with the caveat that the programs studied were not selected as a random sample, but as a group of programs that display variable circumstances (e.g., urban versus rural). Consequently, the implications of the data are not necessarily universally true. It should also be noted that the cost elements for the Vancouver, British Columbia Mini Depot are unusually high, and thus have been omitted in calculating average total and O&M costs on these tables unless otherwise noted.

Table III-7, Effect of Collection Technology on Drop-off Recycling, shows that the type of containers used on-site for collection of materials brought by residents does not appear to affect the percent diversion achieved in the target area. Roll-off containers, igloos, and compacting collection equipment (e.g., dumpsters, front-end loader trucks, etc.) show average diversion percentages in the target area and per capita diversion at similar rates. The remaining technologies have lower average rates, but the small sample sizes makes comparison unhelpful.

As shown on Table III-8, of the communities studied, only Southeast Colorado does not have any type of legislative influence on recycling efforts. The communities with the highest average per capita diversion are those with mandated recycling requirements; however, it should be noted that a slightly higher percent diversion in the target area is achieved by communities where only a recycling goal has been set by the state. Average program costs do not appear affected by recycling legislation.

Table III-9 shows that competing recycling programs have no effect on the percent diversion (both in the target area and area-wide) or on the amount of material brought to the drop-off (per capita diversion). This finding is not what one would expect since a competing recycling program presumably would collect some of the materials that would otherwise show up at a drop-off facility. The presence of a competing recycling program may provide additional publicity for recycling in general, thus increasing overall participation. The resultant higher participation rate would serve to maintain drop-off collections at rates similar to drop-offs where no competing program is present. Another factor may be that all eight of the programs that have competing recycling operations are also facilities that scored high on the Site Evaluation Rating (see Table III-13). Four of these eight sites rated 20 or more points, while the remaining four are in the upper middle range (16.50 to 19.50 points).

The effect of whether a site is staffed or not is evaluated in Table III-10. The presence of on-site staff to assist residents does not show significantly higher diversion, either as a percent of waste diverted or as per capita diversion. It should be noted that two communities with high percent diversion (Falmouth and Freeport, Maine) have a mix of staffed and unstaffed sites. As expected, average per ton O&M costs are $16.57 higher for staffed sites (an increase of 39 percent over average unstaffed sites).

Table III-11 shows the effect of public versus private operation on diversion rates and program costs. The average percent diversion in the target area for publicly operated facilities is 4.05 percent, while the rate for privately operated facilities is 7.20 percent (a 78 percent increase). At the same time that privately operated facilities show increased target area diversion, they also keep costs down, averaging roughly $15.00 less per ton in total costs and $10.00 less per ton in O&M costs. However, it should be noted that the program with the highest target area percent diversion, Santa Monica, California, is a publicly operated program whose O&M costs are comparable to average private operation O&M costs. Santa Monica is a large-scale program, with 104 sites serving almost 90,000 people. It may be that the cost savings achieved by the privately operated sites have more to do with the efficiencies of scale available to private vendors serving multiple communities than with the type of operation.

The effect of commingled container collection on drop-off recycling shown in Table III-12 is a measure of whether the amount of separation required of residents impacts their willingness to bring materials to a site. Fourteen of the 18 programs require residents to separate containers (glass, plastics, and steel and aluminum cans) to some degree. The remaining four sites allow residents to drop off commingled containers that are separated later. Requiring residents to separate containers does not seem to discourage participation, although it should be noted that O&M costs for separate collection of containers averages $11.30/ton higher than commingled collection. The commingled cost average is based on a sample of only three sites (excluding Vancouver Mini Depots) and consequently attention should be paid to the range of O&M costs for commingled collection ($11.98 to $73.46/ton).

Table III-13 compares the overall site evaluation rating (see Glossary and Definition of Terms) with the diversion rates for the eighteen communities. The communities are listed in descending order based on the total site evaluation score received. The table is divided into those sites receiving a total of 20 or more points, those with at least 15 but less than 20 total points, and those below 15 points. Unlike other tables, the low number scores on this variable represent sites that were rated highest for site cleanliness, convenience, safety, etc. As expected, the sites rating below 15 points show higher costs; however, average total and operating costs for those systems with 20 or more points (low-ranking sites) show higher costs than the middle range sites. The average target area percent diversion is higher for the sites scoring below 15 (7.81 percent diversion compared to 4.60 or 5.33), and the average pounds of material diverted per capita in the target area increases as the site evaluation rating becomes more favorable. It appears that

making a drop-off site attractive, convenient and safe could increase the amount of material diverted by a drop-off facility.

It should be noted that the drop-off sites for Southeastern Colorado were rated a "1" (the highest rating) for convenience, despite the fact that residents have to travel considerable distances to reach the sites. The communities have sited facilities near Post Office branches, which residents must visit to collect mail and post letters. This siting strategy guarantees that the drop-offs are close to a location used by every resident on a regular basis.

Table III-14 shows the effect of the community level of education on the diversion rate and amount of material collected by drop-off programs. The table is divided into those communities where 80 percent or more of the population has a high school degree (this group also includes the highest rate of college educations as well, averaging 33.98 percent of the population), those where more than 70 but less than 80 percent have high school educations, and those where less than 70 percent of the population graduated from high school. In those seven communities where 80 percent or more of the population had high school degrees, the percent diversion in the target area and area-wide are significantly higher than the remaining programs. The amount of material collected per person (pounds per capita) is more than double for this group. This table was prepared omitting the three Canadian programs studies (Burnaby and the two Vancouver programs) because comparable census data was lacking for these communities.

The scatter diagrams shown in Figures III-1 through III-3 plot the relationship between selected independent variables and the results measures (percent diversion, total average costs per ton of diversion, and average operating and maintenance costs per ton). Figure III-1 shows the relationship between total cost and percent diversion. Sixty percent of the community systems studied (11 of 18) cluster in the lower left-hand quadrant, which represents the lower percent diversion (less than eight percent diversion in the target area) at the lowest costs (less than $200.00 per ton). Of the six communities with the higher percent diversion (Santa Monica, California; Blue Ash, Ohio; Falmouth and Freeport, Maine; Largo, Florida; and West Greenwich, Rhode Island), all have achieved these rates while keeping costs per ton in the same range. Burnaby, British Columbia is the only study community (except, as noted, Vancouver Mini Depots) that expends a relatively high cost per ton for a low percent diversion.

Figure III-2 explores the relationship between Operations and Maintenance (O&M) costs per ton and percent diversion. Of the eighteen programs shown on the diagram, Santa Monica, California; Blue Ash, Ohio; and Largo, Florida show the highest percent diversion for the lowest O&M costs per ton.

Figure III-3 graphically depicts the relationship between per ton overhead costs (administration and education costs) and percent diversion. The Vancouver Mini Depots lie by themselves in the lower right-hand quadrant which represents high overhead costs and low percent

diversion. Most (11 of 18) programs occupy the lower left-hand corner, showing lower diversion and lower overhead costs per ton. Santa Monica, California; Falmouth, Maine; Blue Ash, Ohio; and West Greenwich, Rhode Island have the highest percent diversion at the lowest overhead costs per ton.

Table III-7. Effect of Collection Technology on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
Roll-off Containers	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	$41.36	$33.95
	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	36.59	35.50
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	86.00	80.75
	West Greenwich, RI	9.73%	9.73%	113.50	86.28	73.46
	Falmouth, ME	13.55%	13.55%	88.83	87.22	67.49
	Freeport, ME	12.30%	12.30%	90.87	155.30	91.21
	Average	**6.38%**	**6,32%**	**53.76**	**$76.30**	**$60.42**
Igloos	Largo, FL	7.89%	4.10%	106.25	$81.43	$23.16
	Southeast Colorado	3.32%	3.32%	23.70	71.73	68.71
	Average	**5.61%**	**3.71%**	**64.98**	**$76.58**	**$45.94**
Compacting Collection (Dumpsters, FELs, etc.)	Queen Village, PA	3.45%	3.45%	52.95	$60.00	$60.00
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Burnaby, British Columbia	1.44%	1.44%	8.78	154.52	131.36
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average[1]	**5.60%**	**4.76%**	**45.14**	**$79.94**	**$65.52**
Central Collection	Tampa, FL (Buy-back)	NA	0.98%	14.63	$15.52	$15.52
Multiple Technologies	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	$95.24	$59.03
	Vancouver, BC (Main Depot)	2.09%	0.78%	12.94	26.00	11.98
	Average	**2.24%**	**1.35%**	**20.72**	**$60.62**	**$35.51**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-8. Effect of Legislative Mandates on Drop-off Recycling

Legislation	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
No Legislative Influence	Southeast Colorado	3.32%	3.32%	23.7	$71.73	$68.71
Recycling Goal or Target Established	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	$41.36	$33.95
	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	36.59	35.50
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	86.00	80.75
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Falmouth, ME	13.55%	13.55%	88.83	87.22	67.49
	Freeport, ME	12.30%	12.30%	90.87	155.30	91.21
	Average	**7.22%**	**6.47%**	**48.11**	**$74.52**	**$57.15**
Mandate for Recycling Program Development	Burnaby, British Columbia	1.44%	1.44%	8.78	$154.52	$131.36
	Vancouver, BC (Main Depots)	2.09%	0.78%	12.94	26.00	11.98
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average	**3.67%**	**3.29%**	**31.71**	**$77.29**	**$56.34**
Mandate for Curbside Recycling Program	Queen Village, PA	3.45%	3.45%	52.95	60.00	$60.00
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Average[1]	**2.70%**	**2.70%**	**41.48**	**$60.00**	**$60.00**
Recycling Mandate	Largo, FL	7.89%	4.10%	106.25	$81.43	$23.16
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	95.24	59.03
	West Greenwich, RI	9.73%	9.73%	113.50	86.28	73.46
	Tampa, FL (Buy-back)	NA	0.98%	14.63	15.52	15.52
	Average	**6.67%**	**4.18%**	**65.72**	**$69.62**	**$42.79**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-9. Effect of Competing Recycling Programs on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
Competing Recycling Program	Burnaby, British Columbia	1.44%	1.44%	8.78	$154.52	$131.36
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	86.00	80.75
	Largo, FL	7.89%	4.10%	106.25	81.43	23.16
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	95.24	59.03
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Tampa, FL (Buy-back)	NA	0.98%	14.63	15.52	15.52
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Average	**6.15%**	**4.32%**	**46.24**	**$74.91**	**$53.33**
No Competing Recycling Program	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	$36.59	$35.50
	West Greenwich, RI	9.73%	9.73%	113.50	86.28	73.46
	Queen Village, PA	3.45%	3.45%	52.95	60.00	60.00
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	41.36	33.95
	Vancouver, BC (Main Depots)	2.09%	0.78%	12.94	26.00	11.98
	Freeport, ME	12.30%	12.30%	90.87	155.30	91.21
	Falmouth, ME	13.55%	13.55%	88.83	87.22	67.49
	Southeast Colorado	3.32%	3.32%	23.70	71.73	68.71
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average[1]	**5.09%**	**4.93%**	**46.32**	**$69.39**	**$55.81**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-10. Effect of Site Stafffing on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
Unstaffed	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	$95.24	$59.03
	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	36.59	35.50
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	41.36	33.95
	Largo, FL	7.89%	4.10%	106.25	81.43	23.16
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Southeast Colorado	3.32%	3.32%	23.70	71.73	68.71
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average[1]	**5.36%**	**4.32%**	**45.90**	**$61.61**	**$42.15**
Staffed	Tampa, FL (Buy-back)	NA	0.98%	14.63	$15.52	$15.52
	Queen Village, PA	3.45%	3.45%	52.95	60.00	60.00
	West Greenwich, RI	9.73%	9.73%	113.50	86.28	73.46
	Burnaby, BC	1.44%	1.44%	8.78	154.52	131.36
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Vancouver, BC (Main Depots)	2.09%	0.78%	12.94	26.00	11.98
	Average	**3.73%**	**3.06%**	**38.80**	**$67.05**	**$58.72**
Some Staffed, Some Unstaffed	Freeport, ME	12.30%	12.30%	90.87	$155.30	$91.21
	Falmouth, ME	13.55%	13.55%	87.22	88.83	67.49
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	86.00	80.75
	Average	**9.03%**	**8.91%**	**62.41**	**$109.51**	**$79.82**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-11. Effect of Program Operator on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
Public Operation	Queen Village, PA	3.45%	3.45%	52.95	$60.00	$60.00
	Burnaby, BC	1.44%	1.44%	8.78	154.52	131.36
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Largo, FL	7.89%	4.10%	106.25	81.43	23.16
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	95.24	59.03
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Vancouver, BC (Main Depot)	2.09%	0.78%	12.94	26.00	11.98
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	86.00	80.75
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average[1]	**4.05%**	**2.83%**	**35.90**	**$79.63**	**$59.61**
Private Operation (Competitively Procured)	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	$36.59	$35.50
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Falmouth, ME	13.55%	13.55%	88.83	87.22	67.49
	West Greenwich, RI	9.73%	9.73%	113.50	86.28	73.46
	Freeport, ME	12.30%	12.30%	90.87	155.30	91.21
	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	41.36	33.95
	Southeast Colorado	3.32%	3.32%	23.70	71.73	68.71
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Tampa, FL (Buy-back)	NA	0.98%	14.63	15.52	15.52
	Average	**7.19%**	**6.49%**	**56.66**	**$65.19**	**$50.23**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-12 Effect of Commingled Container Collection on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb/person/yr)	Total	O&M Only
Containers Collected in Separate Compartments	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	$86.00	$80.75
	Henrico, VA (CVWMA)	2.31%	2.24%	29.59	41.36	33.95
	Falmouth, ME	13.55%	13.55%	88.83	87.22	67.49
	Freeport, ME	12.30%	12.30%	90.87	155.30	91.21
	Blue Ash, OH	10.79%	10.79%	102.87	51.36	25.68
	Petersburg, VA (CVWMA)	1.87%	1.87%	18.61	36.59	35.50
	Chesterfield, VA (CVWMA)	3.67%	3.67%	27.38	41.35	40.57
	Burnaby, BC	1.44%	1.44%	8.78	154.52	131.36
	Cedar Park, PA	1.95%	1.95%	30.01	60.00	60.00
	Queen Village, PA	3.45%	3.45%	52.95	60.00	60.00
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	95.24	59.03
	Largo, FL	7.89%	4.10%	106.25	81.43	23.16
	Southeast Colorado	3.32%	3.32%	23.70	71.73	68.71
	Tampa, FL (Buy-back)	NA	0.98%	14.63	15.52	15.52
	Average	**5.09%**	**4.46%**	**45.03**	**$74.12**	**$56.64**
Containers Collected in Commingled Fashion	West Greenwich, RI	9.73%	9.73%	113.50	$86.28	$73.46
	Vancouver, BC (Main Depot)	2.09%	0.78%	12.94	26.00	11.98
	Santa Monica, CA	15.61%	10.81%	73.97	73.83	50.57
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	463.69	381.87
	Average[1]	**6.95%**	**5.36%**	**50.66**	**$62.04**	**$45.34**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-13 Effect of Site Evaluation Rating on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Total Site Evaluation Rating	Program Cost ($/Ton)	
		Target Area	Area-wide	(lb./person/yr)		Total	O&M Only
Below 15	Queen Village, PA	3.45%	3.45%	52.95	13.00	$60.00	$60.00
	Freeport, ME	12.30%	12.30%	90.87	13.34	155.30	91.21
	Cedar Park, PA	1.95%	1.95%	30.01	14.00	60.00	60.00
	Falmouth, ME	13.55%	13.55%	88.83	14.00	87.22	67.49
	Average	**7.81%**	**7.81%**	**65.67**		**$90.63**	**$69.68**
Above 15 but less than 20	Southeast Colorado	3.32%	3.32%	23.70	15.50	$71.73	$68.71
	West Greenwich, RI	9.73%	9.73%	113.50	16.00	86.28	73.46
	Vancouver, BC (Main Depot)	2.09%	0.78%	12.94	16.00	26.00	11.98
	Blue Ash, OH	10.79%	10.79%	102.87	16.50	51.36	25.68
	Largo, FL	7.89%	4.10%	106.25	16.88	81.43	23.16
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	17.50	86.00	80.75
	Henrico, VA	2.31%	2.24%	29.59	18.50	41.36	33.95
	Vancouver, BC (Mini Depots)	0.36%	0.13%	2.23	18.50	463.69	381.87
	Chesterfield, VA	3.67%	3.67%	27.38	19.50	41.35	40.57
	Average[1]	**4.60%**	**3.96%**	**47.33**		**$60.69**	**$44.78**
20 and above	Petersburg, VA	1.87%	1.87%	18.61	20.00	$36.59	$35.50
	Santa Monica, CA	15.61%	10.81%	73.97	20.00	73.83	50.57
	Burnaby, BC	1.44%	1.44%	8.78	20.00	154.52	131.36
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	20.06	95.24	59.03
	Tampa, FL (Buy-back)	NA	0.98%	14.63	21.00	15.52	15.52
	Average	**5.33%**	**3.40%**	**28.90**		**$75.14**	**$58.40**

[1] Averages for costs do not include Vancouver Mini Depots.

Table III-14 Effect of Level of Education on Drop-off Recycling

	Case Studies	Percent Diversion		Per Capita Diversion	Percent HS Degree	Percent College Degree
		Target Area	Area-wide	(lb./person/yr)		
80 Percent and above HS Degree	Santa Monica, CA	15.61%	10.81%	73.97	87.5	43.4
	Falmouth, ME	13.55%	13.55%	88.83	87.5	44.0
	Freeport, ME	12.30%	12.30%	90.87	86.0	32.0
	Blue Ash, OH	10.79%	10.79%	102.87	84.2	40.0
	Chesterfield, VA	3.67%	3.67%	27.38	84.2	29.2
	Henrico, VA	2.31%	2.24%	29.59	81.3	19.0
	West Greenwich, RI	9.73%	9.73%	113.50	81.0	21.0
	Average	**9.71%**	**9.01%**	**75.29**		
70 Percent and Above HS Degree	Largo, FL	7.89%	4.10%	106.25	77.1	13.8
	Southeast Colorado	3.32%	3.32%	23.70	75.7	7.0
	Norfolk, VA (SPSA)	1.24%	0.88%	7.52	72.7	16.8
	Tampa, FL (Drop-off)	2.38%	1.91%	28.49	70.6	18.7
	Tampa, FL (Buy-back)	NA	0.98%	14.63	70.6	18.7
	Average	**3.71%**	**2.24%**	**36.12**		
Below 70 Percent HS Degree	Queen Village, PA	3.45%	3.45%	52.95	64.3	31.0
	Cedar Park, PA	1.95%	1.95%	30.01	64.3	31.0
	Petersburg, VA	1.87%	1.87%	18.61	62.2	13.5
	Average	**2.42%**	**2.42%**	**33.86**		

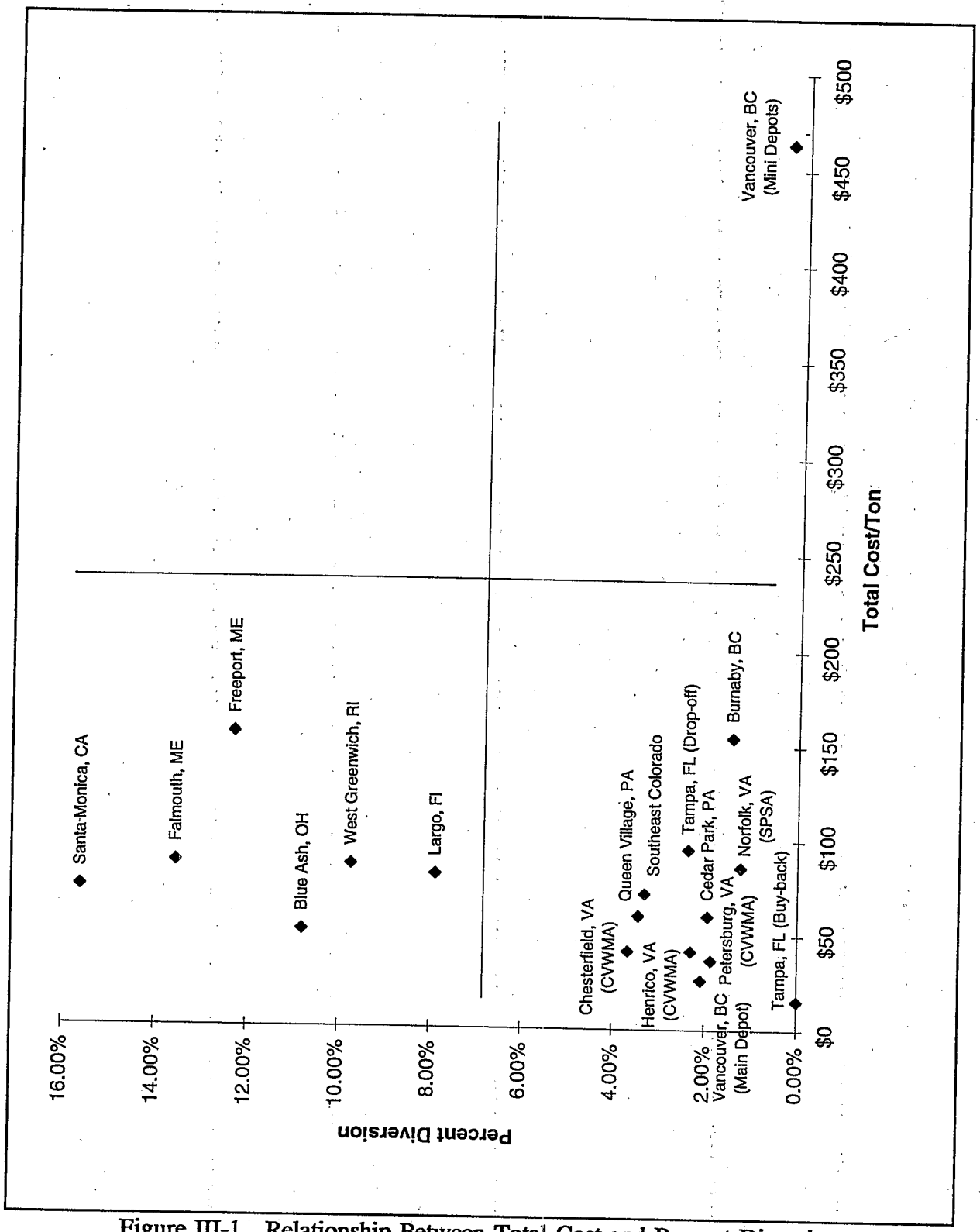


Figure III-1. Relationship Between Total Cost and Percent Diversion

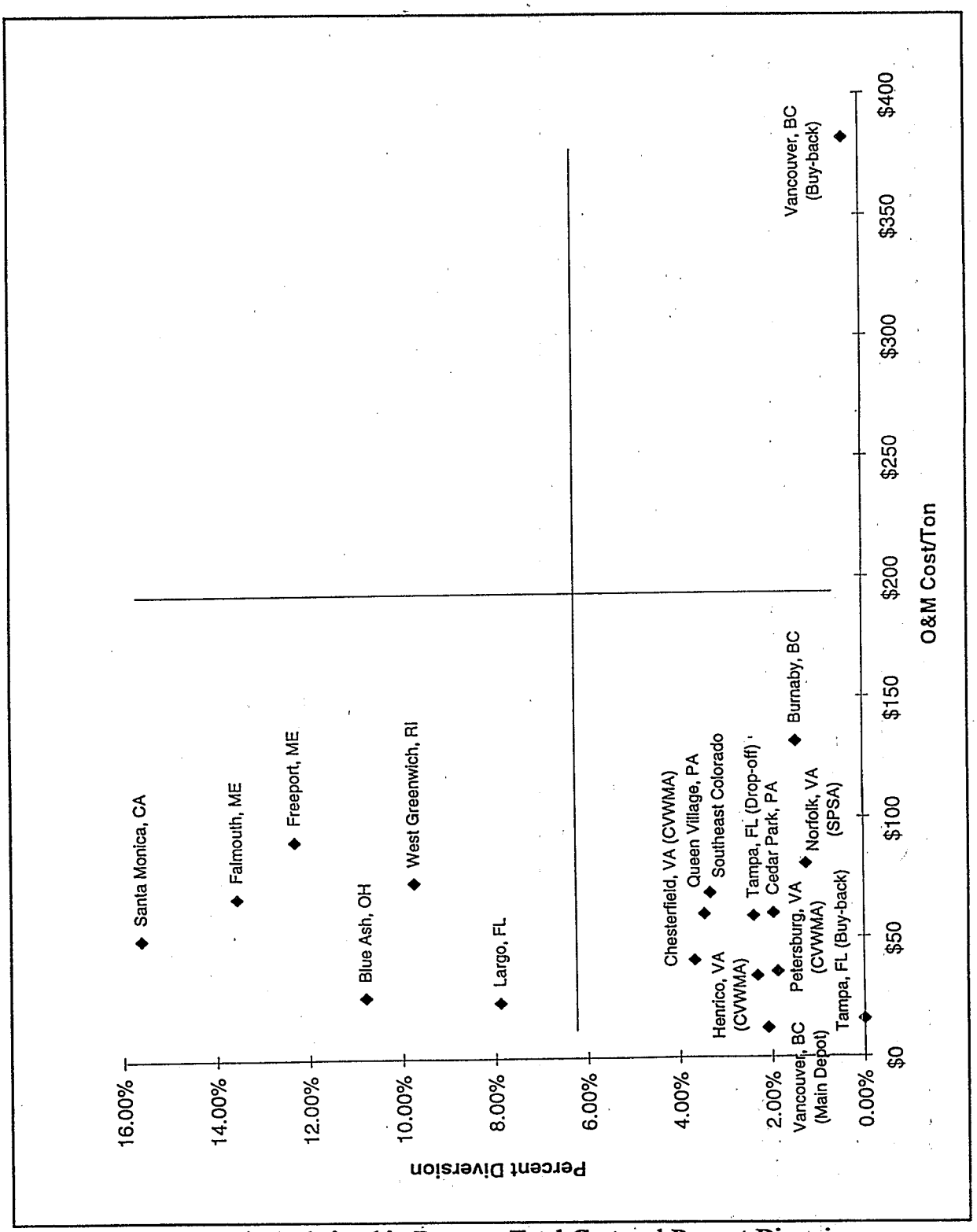


Figure III-1. Relationship Between Total Cost and Percent Diversion

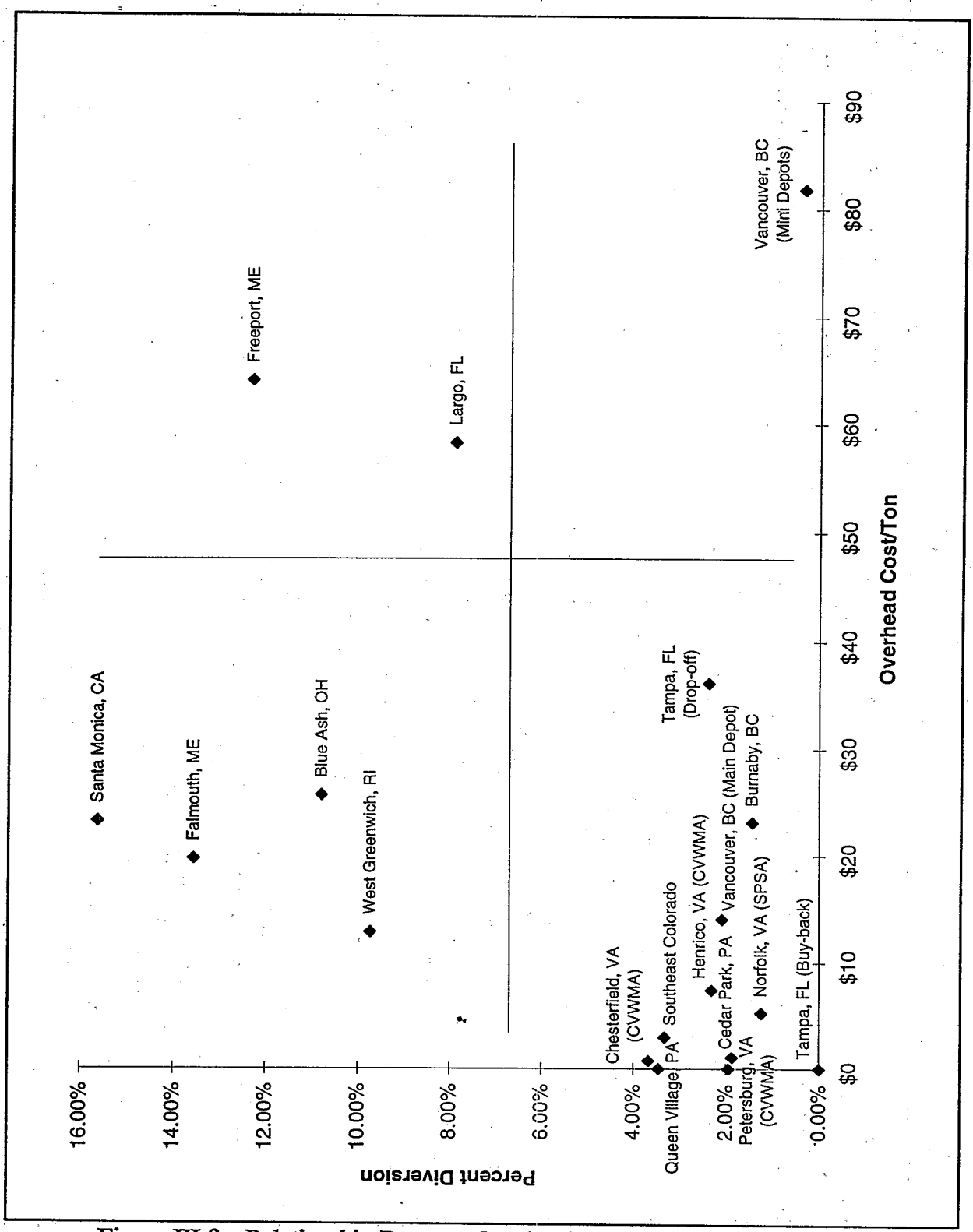


Figure III-3. Relationship Between Overhead Cost and Percent Diversion

C. FINDINGS AND OBSERVATIONS

Because of the limited sample size, statistically significant relationships were not identified among the collected data points, with the exception of the relationship between percentage of the population completing high school and diversion percentage. There was a statistically significant relationship between these variables, so that diversion could be explained or predicted by high school education completion (within a plus or minus six percent range) according to the following formula:

Diversion rate = (% of population with high school x .58) - 35.6

Identifying what constitutes a "successful" drop-off program depends on the aims of the program sponsors in developing the project. A community may be willing to expend a higher cost per ton diverted through a drop-off program, for example, in order to provide an opportunity to recycle to an underserved portion of the population (e.g., multi-family housing that does not receive curbside service). In such a case, the amount of materials diverted from disposal is useful in evaluating the service, but is not the only benefit of the program. For some communities, keeping costs down while meeting the requirements of state recycling legislation is a success. If the drop-off program is the only recycling service available in a community, then the percent diversion becomes the best measure of success.

In terms of the largest amounts of materials diverted from disposal, Table III-1 showed the percent diversion in the target areas. There is a distinct break between the twelve programs achieving less than four percent diversion and the six that range from 7.89 percent (Largo, Florida) to 15.61 percent (Santa Monica, California). What do these six programs have in common? Of the independent variables for program characteristics (Table II-1), no distinguishing characteristics can be determined. However, in looking at the target populations served (Table II-2) and the number of drop-off sites (Table II-1), it appears that these drop-off sites are truly neighborhood programs serving relatively small populations each, as broken out below:

	Target Area Population	Number of Sites	Average Population per Site	Percent Diversion
Santa Monica	86,905	104	836	15.61
Falmouth	7,610	2	3,805	13.55
Freeport	7,043	3	2,348	12.30
Blue Ash	13,629	6	2,272	10.79
West Greenwich	2,749	1	2,749	9.73
Largo	38,400	9	4,267	7.89

Other programs range from an average of 2,108 people per site in Southeastern Colorado (spread out over an extremely large territory) to 158,858 people served by a single site in Burnaby, British Columbia. The two Philadelphia programs (Queen Village and Cedar Park) are neighborhood locations, but are modest volunteer-run drop-off sites that did not score well on convenience or access hours.

In general, the factors driving costs could not be determined. Some other relationships observed -- though not statistically significant -- were of enough interest to warrant further investigation, including:

- Higher rates of expenditures on overhead (administration and public education), do not appear to increase the percent diversion of materials.
- Total spending was not positively correlated with diversion;
- There was no apparent relationship between materials selection (i.e., the types or number of recyclables targeted for recovery) and diversion;
- The types or number of recyclables targeted for recovery did not appear to affect total costs in general. The inclusion of plastics, in particular, did not positively correlate with total costs;
- Site characteristics and program design decisions (safety, lighting, access periods, users per site, convenience, etc.) may be related to diversion, especially in programs that are achieving high diversion at low costs; and
- Some program managers may trade off costs in one area for savings in another; for example, the Town of Freeport, Maine used to conduct their own recycling collection program, and retained revenues from the sale of materials. On joining the RWS program, the Town no longer receives a revenue return from the materials; however, the value of the materials to RWS translates into a lower per ton cost for participating communities. Because of the boundaries of the study investigations, analogous situations may exist in other Case Study communities that were not identified.

In order to test these observations, additional study would be required, including:

- Identifying ten to twenty additional communities that are achieving high diversion at low costs;
- Developing hypotheses based on preliminary findings;
- Collecting needed data; and
- Testing hypotheses.

IV. CASE STUDIES

A. CITY OF BURNABY, BRITISH COLUMBIA[1]

In 1993, the Provincial Legislature of British Columbia adopted a waste reduction goal of 50 percent by 2000. This goal has also been adopted by the Greater Vancouver Regional District (GVRD), a district government established by the Provincial Legislature which has the responsibility for initiating waste reduction programs (including recycling) among all waste generating sectors.

A ten-year solid waste management plan developed by the GVRD became a part of Provincial law after its approval by the Provincial Ministry of Environment, Lands, and Parks. This plan update was completed in 1994. Following plan approval, the GVRD has the authority to direct waste and recyclables flow to designated facilities.

Because of stringent City planning department rules, a drop-off site (Depot) can only be operated as a "temporary" site, which means no permanent structures, compactors, or balers may be installed on-site without the construction of a building to house them.

Demographics

- Burnaby is a suburban community bordering the eastern edge of the City of Vancouver and covering an area of 40 square miles.
- Although the official language is English, Italian and Chinese are also spoken by some residents.
- The 1992 population of the City was estimated at 158,858.
- There are approximately 36,000 single family residences and 26,000 multi-family households in Burnaby.
- The Depot program target area is the entire City, or 62,000 single family and multi-family households.
- In 1990, the median annual household income in the City was $32,106 Canadian per year, or approximately $24,697 U.S.

Description of Municipal Solid Waste (MSW) Management System

- Residential MSW from all single family and 50 percent of the multi-family residences is collected by the City.

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[1]All Canadian dollars are converted to U.S. at a rate of $1.30 Canadian to $1.00 U.S. Canadian metric tonnes are equivalent to 1.10 U.S. tons. All dollar and weight amounts are given in their U.S. equivalents to facilitate comparison of systems.

- Private contractors provide waste collection from the remaining 50 percent of multi-family households as well as the commercial/industrial sector.
- Residential MSW from the City is delivered to a GVRD-owned mass-burn incinerator in Burnaby, which charges a tipping fee of $69 (Canadian) per metric tonne (approximately $58.38 U.S. per ton).
- The costs of solid waste and recyclables collection, processing, and disposal are paid through property taxes (i.e., the City general fund).
- The total amount of residential MSW (including recyclables) generated within the Depot service area in 1993 was approximately 48,288 U.S. tons per year.

Description of Drop-off System

- The City's main Depot has been in place since 1990 and accepts a greater variety of materials than the curbside or mini-depot programs.
- Retired (stationary) waste packers from the City's collection fleet are used at the Depot to collect residential recyclables; a fourth packer will be added to handle yard waste beginning July 1, 1994. The packers are tipped into roll-offs for transport to markets. Materials collected in the packers include:
  - -- Corrugated cardboard;
  - -- "Hard plastic" (mostly PET, HDPE, PP, some plastics coded "Other"); and
  - -- "Soft plastic" (some LDPE and "Other").
- Separate containers are used for color-separated (clear, green and brown) glass, tin and aluminum, scrap metal, glossy magazines, phone books, mixed paper, and newsprint. Depot users are required to sort materials into the individual containers.
- Drop-off areas are also available for waste oil, auto batteries, and white goods.
- City staff operate compactors and maintain grounds.
- In 1992, the main Depot was used by an average of 200 vehicles per day; this dropped to 161 per day in 1993 with the start of multi-family recycling programs in October 1992.
- Processing contracts for materials collected at the Depot are let on an annual, material-by-material basis, independent of other City recycling programs.

Convenience and Site Aesthetics

- The main Depot is located near the GVRD Compost Demonstration Garden and Burnaby Environmental Classroom on the south side of the City.
- There are only a few street signs directing residents to the Depot; therefore, residents must either look at a City brochure or call for directions if they are unfamiliar with the Depot location.
- Residents must make a special trip to use the site. In addition, a high level of materials separation is required. However, Depot patrons did not appear to have

any difficulty determining which containers to use. Staff are available to provide assistance.

- On-site signs are large and very visible.
- The site is well maintained, with sufficient space for a number of vehicles to maneuver.

Public Education

- The City relies on "free" advertising as much as possible. Public education consists primarily of public service ads, graphics on recycling bins and bags, hand-outs, and City publications.
- The City has an information request form available and will provide specific information as requested.
- Public education materials rely on graphics to the greatest extent possible as a means of overcoming language barriers.
- The City uses a volunteer language resource bank to call persons who need recycling information translated into another language; the bank handles about 80 recycling-related calls per year at an estimated average of five minutes per call.
- The City budgeted $10,200 Canadian ($7,846 U.S.) for Depot advertising and promotions, which does not include volunteer language resource bank time.

Other Recycling Opportunities

- Curbside recycling is provided by the City to 36,000 single-family households. HDPE and PET, newspapers, mixed paper, glass containers, and tin and aluminum containers are collected in the blue box/bag program.
- The City also provides a special curbside white goods collection service on an on-call basis.
- The multi-family recycling program is being developed. The City currently provides collection to approximately 77 percent of City's 16,000 eligible multi-family residences.
- BFI provides processing for the City's blue box and multi-family recycling programs.
- Increasing levels of commercial/industrial recycling collection and processing are becoming available through the private sector (essentially three major processing facilities and a number of smaller private marketers).

Table IV-1. City of Burnaby Main Depot
Recovered Recyclables (1993)
(Tons Per Year)

Material	Quantities[1]
Newsprint	184.26
Magazines	44.81
Mixed Paper	271.25
Office Paper	23.75
Clear Glass	41.84
Green Glass	41.84
Brown Glass	10.51
Plastic, Soft	28.53
Plastic, Hard	25.84
Aluminum Cans	4.68
Tin Cans	19.89
Total	**697.20**

[1]Short tons; converted from metric tonnes at rate of 1.10 U.S. (short) ton per metric tonne.

Diversion

- Total tons of materials recovered at the City's main Depot in 1993 was 697.2 U.S. tons. A summary of these materials is shown in Table IV-1.
- Based on the residential solid waste disposed from the Depot service area, the program is achieving a diversion rate of 1.44 percent.

Program Costs

- The City's total provisional solid waste budget in 1993 was $8.27 million Canadian ($6.36 million U.S.).
- The City spent $158,753 Canadian ($122,118 U.S.) for Depot operations in 1993, which included overhead, annualized capital costs, advertising/promotions, site improvements, and O&M.
- Material revenues paid to the City by contract processors totalled $18,707 Canadian ($14,390 U.S.).
- The net cost of the Depot to the City was $140,046 Canadian ($107,728 U.S.).
- The cost to the City per recovered ton in the Depot program in 1993 was $154.52 U.S.
- Table IV-2 provides a summary of annual cost elements.

Table IV-2. City of Burnaby Main Depot
Annual Costs (1993)
($U.S.)

Component	Annual Cost ($ U.S.)
Operating and Maintenance	$101,617
Education and Administration	16,146
Annualized Capital	4,355
Gross Total Costs	**$122,118**
Revenue from Sale of Materials	14,390
Net Total Costs	**$107,728**

B. CITY OF VANCOUVER, BRITISH COLUMBIA

In 1993, the Provincial legislature of British Columbia adopted a waste reduction goal of 50 percent by 2000. This goal has been adopted by the Greater Vancouver Regional District (GVRD), a district government established by the Provincial legislature that has the responsibility for initiating waste reduction programs (including recycling) among all waste generating sectors. As a member municipality of the GVRD, the City of Vancouver also has adopted this goal.

The ten-year solid waste management plan developed by the GVRD became a part of provincial law after its approval by the provincial Ministry of Environment, Lands, and Parks. This plan update was completed in 1994. Following plan approval, the GVRD has the authority to direct waste and recyclables to designated facilities.

Demographics

- The City of Vancouver, which covers an area of 43.65 square miles, has an estimated population of 475,000 people in 22 distinct neighborhoods.
- There are 95,000 single family residences and 101,000 multi-family units in the City.
- Approximately 23.1 percent of the residents over 15 years of age have completed high school; 16.3 percent have university degrees.
- The median per family income is $32,414 (Canadian), or approximately $24,934 per year (U.S.).
- The official language is English; five other languages (French, Vietnamese, Chinese, Punjabi, and Hindi) are also spoken by some residents.
- The primary drop-off program target area includes those multi-family households within metropolitan Vancouver (101,000 units).

Description of Municipal Solid Waste (MSW) Management System

- Municipal solid waste (MSW) from single family residences, co-op buildings, some "strata" buildings (which are similar to condominium associations), and basement suites is collected by City crews.
- The City collects three containers (cans or bags) of solid waste at single family residences and five containers at duplexes at no charge (cost covered through general taxes). Stickers for additional containers cost $1.50 each.
- Solid waste from institutional, commercial, and industrial (ICI) generators and all multi-family residences other than duplexes (e.g., income/rental buildings) is collected through an open private collection system. The City collects about 15 percent of this waste using front-loading trucks.
- The City owns and operates a transfer station and a landfill that accept the City's solid waste as well as some waste generated by specified areas of the GVRD.

- Residential collection costs of about $90 Canadian ($69.23 U.S.) per year are covered through the general tax fund.
- Transfer station and landfill operations costs are covered by a tipping fee of $69 Canadian per metric tonne (about $58.38 U.S. per ton); the tip fee is established by the GVRD and adopted regionwide for all regional disposal facilities.
- The landfill tipping fee generates additional revenue used to pay host community benefits, as well as recycling and waste reduction program costs.
- Approximately 460,000 metric tonnes (506,000 tons) of MSW were delivered to the Vancouver Landfill (VLF) in 1993. Approximately 40 percent of the waste entering the VLF is residential; the remaining 60 percent is a combination of institutional, commercial, and industrial.
- The total amount of residential MSW originating from the multi-family drop-off target area is estimated at 68,792 metric tonnes per year (75,672 tons). This is about 15 percent of the overall waste delivered to the VCF.
- The City collected 79,000 metric tonnes (86,900 tons) of refuse and 15,900 tonnes (17,500 tons) of bluebox recyclables from single family residences in 1993.

Description of Drop-off System

There are two components of the City's drop-off recycling system: (1) a main drop-off "Depot" at the City transfer station; and (2) six multi-family residence "mini-depot" sites.

- Main Drop-off Depot
  - -- This program, operating since 1974 and redesigned in 1989, targets all residential and small commercial users in the City.
  - -- The site is designed as a drive-through system in which residents pull up alongside separate containers for each material. An average of 1,500 cars per week use the site; typical drop-off time is three to five minutes.
  - -- The containers used to collect recyclables vary. Plastics, corrugated cardboard, and mixed paper go into compactors; newsprint is placed in roll-offs; and glass is collected in mailbox-type drawers. City staff (1.5 full time employees) monitor drop-off separations for quality control.
  - -- Materials collected include clear, green, brown, and blue container glass; steel and aluminum containers (cans, pie plates, etc.) and foil; HDPE and PET plastic containers; mixed paper (magazines, corrugated cardboard, writing paper, junk mail, boxboard, and telephone books); and newspaper. In addition, the main Depot accepts white goods, scrap aluminum, waste oil, and other types of household plastics except PVC (#3) and plastic bags (#2 or #4).
  - -- The City markets materials collected at this site through one-year contracts with local processors. Processors guarantee a cost for processing and a percent return on revenue to the City.
- Six multi-family residence "mini-depot" sites

- Each mini-depot has three four-cubic yard modified dumpsters. These dumpsters have a metal extender welded to the top with small openings (i.e., 6-10 inches) through which recyclables can be passed one or two at a time to minimize contamination. Each dumpster handles a separate recyclables stream, e.g., commingled containers, mixed paper, or newspaper.
- Materials collected include clear, green, brown, and blue container glass; steel and aluminum containers (cans, plates, etc.) and foil; HDPE and PET plastic containers; mixed paper (magazines, corrugated cardboard, writing paper, junk mail, boxboard, and telephone books); and newspaper.
- These sites are unstaffed, although local volunteers monitor and maintain sites under the terms of a placement agreement.
- Hours of operation vary; Table IV-3 presents a listing of sites and access periods.
- Mini-depots are serviced Mondays, Wednesdays, and Fridays. In addition, a City employee visits each site three times per week to ensure that dumpsters are not overflowing and unacceptable material has not been dumped, to clean up littering, and to load recyclables left by elderly, handicapped people, or children.
- Recyclable streams (commingled containers, mixed paper, and newspaper) are loaded and transferred separately; a City truck visits each site three times (for each of the streams) on service days.
- Materials are processed and marketed under the City's curbside blue box processing/marketing contract with a private contractor.

Table IV-3. City of Vancouver Depot Sites and Hours of Operation

Site[1]	Hours Of Operation
Gordon Neighborhood House	9:00 a.m.-7:00 p.m., Monday-Friday; 1:00 p.m.-7:00 p.m., Saturday
Vancouver Aquatic Centre	Dawn to dusk, daily
Kits House	9:00 a.m. - 7:00 p.m., Monday - Saturday
Mt. Pleasant Community Centre	Dawn to dusk, daily
Champlain Heights Community Centre	Dawn to dusk, daily
Britannia Community Services Centre	Dawn to dusk, daily
City Recycling Depot[2]	7:00 a.m. - 7:00 p.m., Monday - Sunday

[1] All mini-depot sites are located in outdoor parking lots except the Gordon Neighborhood Site, which is in an undergound parkade.
[2] Located at the City's South Transfer Station.

Convenience and Site Aesthetics

- The City's mini-depots are sited in areas where multi-family dwellings are concentrated.
- Use of most sites requires a special trip or a combined trip to a local community center, although mini-depots are located within reasonable distance (about 10 minutes) of major traffic arteries.
- The modified dumpsters at these sites may be difficult to use, especially for children or the elderly. Consequently, the City advises these individuals to leave materials outside dumpsters for volunteers or City staff to load (all sites visited daily).
- Mini-depot dumpsters are generally in good condition and clearly labelled.
- Containers at the main drop-off Depot are being repainted and retrofitted with new signage consistent with graphics used in other parts of the recycling system.
- There are no street or road signs to direct people to mini-depots.
- The location of the main drop-off Depot is noted on transfer station signs on a major traffic artery.
- As a method of discouraging dumping, no refuse bins are provided at any site.

Public Education

- Specific public education efforts for the depot programs are primarily the responsibility of the City, although GVRD undertakes "umbrella" 3Rs (reduce, reuse, recycle) education programs regionwide.
- The City does not use the media heavily to promote the program; instead it relies upon brochures, local community centers and their public education activities, press releases to community newspapers, and word of mouth.
- All mini-depot graphics are standardized with those used in the blue box program and those being installed at the main Depot.
- Brochures are sometimes printed in up to six languages to ensure information availability.

Other Recycling Opportunities

- Curbside (i.e., blue box) recycling is available for 95,000 single-family residences. This program uses a blue box for commingled containers; a 22-inch x 22-inch blue plastic bag for newsprint; and a 22-inch by 22-inch yellow plastic bag for mixed paper products. The same materials are collected in the blue box program as are collected in the mini-depot program.
- The blue box program recovered about 15,900 metric tonnes (17,500 tons) in 1993.

- Commercial/industrial recycling services are increasingly being offered by private sector contractors.

Diversion

- The total quantity of targeted residential materials estimated to be recovered through the drop-off programs in 1993 was 1,856.7 tons; Table IV-4 presents the breakdown of these materials. Note that the programs target scrap metal and other materials not evaluated as part of this study.
- Based on the amount of residential solid waste disposed in the drop-off service area, the diversion rate is calculated at 2.45 percent.

Table IV-4. City of Vancouver Drop-off Recycling Program Recovered Recyclables (1993) (Tons Per Year)

Material	Mini-Depot (Tons)	Main City Depot (Tons)	Total Tons
Newsprint	123	418	541
Mixed Paper	79	862.6	941.6
Glass	61.21	261.32	261.3
Plastic	9.8	41.8	41.8
Total	**273**	**1583.7**	**1856.7**

[1]Includes approximately 26.9 tons of clear, 29.4 tons of green, and 4.9 tons of brown glass.

[2]Includes approximately 115 tons of clear, 125.4 tons of green, and 20.9 tons of brown glass.

Program Costs

- The Vancouver Landfill generated total 1993 revenues of $22.9 million Canadian ($17.6 million U.S.), of which $6.6 million Canadian ($5.08 million U.S.) was available to the City for waste reduction and recycling program services and contributions to the capital reserve fund.
- Main Drop-Off Depot

-- Total capital costs for main drop-off Depot renovations, approximately $160,500 Canadian ($123,462 U.S.), were incurred as part of a $9 million transfer station development. The annualized capital cost is estimated to be $15,150 U.S.

-- The estimated cost of City on-site operations: $49,500 Canadian ($38,077 U.S.).
-- The estimated cost of administrative and education program support from other budget areas (project engineer, recycling coordinator, foreman, etc.) was $28,865 Canadian ($22,204 U.S.).
-- The revenue to City from main drop-off Depot operations was estimated to be $44,530 Canadian ($34,254 U.S.).

- Mini-depot costs
-- Total annualized capital cost for six sites was approximately $30,000 Canadian (approximately $23,076 U.S. or $3,846 U.S. per depot site).
-- The annual operating costs for these sites was $19,000 Canadian ($14,615 U.S.) per site per year, which includes $20 Canadian per ton processing fees ($15.38 per ton U.S.).
-- The estimated cost of administrative and educational program support from other budget areas (project engineer, recycling coordinator, secretarial support, etc.) was $29,040 Canadian ($22,338 U.S.).
-- The total annual cost of the mini-depot program to the City was approximately $173,035 Canadian ($133,104 U.S.).
-- The net revenue to the City from materials collected at the mini-depots was $8,471 Canadian ($6,516 U.S.).
- Table IV-5 presents a summary of annual costs for the Main Depot and mini-depot sites.

Table IV-5. City of Vancouver Drop-off Recycling Program Annual Costs (1993)

Component	Main Depot	Mini Depots	Total
Operating & Maintenance	$38,077	$87,690	$125,767
Education & Administration	22,204	22,338	44,542
Annualized Capital	15,150	23,076	38,226
Gross Total Costs	**$75,431**	**$133,104**	**$208,535**
Revenue from Sale of Materials	34,254	6,516	40,770
Net Total Costs	**$41,177**	**$126,588**	**$167,765**

C. CITY OF SANTA MONICA, CALIFORNIA

Through the enactment of AB 939, the California legislature established waste reduction goals of 25 percent by 1995 and 50 percent by 2000. California also has container deposit legislation (AB 2020), under which bottlers pay the State a deposit for all carbonated beverages sold. This mechanism ensures that the State receives revenue on all containers sold rather than only containers redeemed. The current redemption amount is set at 2.5 cents per container under 24 ounces and 5 cents per container 24 ounces or larger. According to some program representatives, drop-off programs in the State, including Santa Monica's "recycling zone" program in its multi-family neighborhoods, have been adversely affected by this legislation because of scavenging from the sites.

Demographics

- The City of Santa Monica, which covers an area of 8.3 square miles, is bordered on the west by the Pacific Ocean and on the north, east, and south by the City of Los Angeles. The 1990 population was 86,905.
- There are approximately 7,500 single family residences and 40,000 multi-family units in the City.
- Approximately 87.5 percent of the City's residents have completed high school and 43.4 percent have completed at least four years of college.
- The median annual household income in the City is $35,997.
- The drop-off program service area includes those high-density multi-family households that do not receive curbside collection (about 87.5 percent of all multi-family dwellings, or approximately 35,000 households). This service area comprises a distinct 150 square block area in the City.

Description of Municipal Solid Waste (MSW) Management System

- The City collects municipal solid waste (MSW) from all single-family and multi-family residences in the City.
- The City has a variable rate fee structure for residential waste collection. The basic container sizes and costs are:
  - -- 40 gallons: $13.04 per month;
  - -- 68 gallons: $15.60 per month; and
  - -- 95 gallons: $18.51 per month.

The City bills residents bi-monthly. Revenues from these fees cover costs of solid waste collection and disposal, street sweeping, litter removal, recycling, and household hazardous waste programs.

- The City competes with the private sector for commercial/industrial waste collection.

- All City-collected MSW is delivered to a City-owned and operated transfer station and hauled to a publicly-owned landfill approximately 30 miles away, which has a tipping fee of $15.95 per ton.
- The total amount of residential MSW (including recyclables) generated from the drop-off target area (35,000 units) in 1993 was estimated to be 20,584 tons.

Description of Drop-off System

- Each of the City's 104 drop-off areas is defined as a "recycling zone."
- The typical recycling zone has a minimum of three color-coded two-cubic yard dumpsters. Zones in high-traffic or high-visibility areas may have more than three dumpsters to meet increased usage.
- Materials collected in all zones include: newsprint; mixed clear, green, brown, and blue container glass; and commingled tin and aluminum cans and plastic containers (PET, HDPE, PVC, LDPE, and PP accepted).
- Dumpsters used to collect newspaper have three narrow slots in a locked lid to deter illegal dumping. Dumpsters used to collect plastic and metal containers have two rectangular openings with rounded centers through which most large plastic containers will fit. The glass collection dumpsters have two 12-inch diameter holes fitted with slides on the inside of the bin. Slides are fitted at an angle to minimize scavengers' ability to withdraw containers from the dumpster. These angled slides have not been totally effective in preventing scavenging.
- Some recycling zones, particularly those near commercial areas, also have dumpsters for mixed paper (catalogs, magazines, phone books, boxboard, junk mail, aseptic packaging, and paper bags) and corrugated cardboard.
- Zones are unstaffed. Signage on the dumpsters states that hours of operation are 8:00 a.m. to 8:00 p.m., although these access periods are not always observed.
- Complaints about noise and use of sites after hours have resulted in some zones being relocated or removed altogether.
- A survey crew checks zones every Monday and Thursday. Dumpsters are reported as being 25, 50, 75, or 100 percent full. Collection crews service 100 percent full dumpsters on same day they are checked; 75 percent full dumpsters are serviced the next day, and so forth. Usually, all dumpsters marked at least 50 percent full are pulled within three days.
- Empty containers are left when full containers are pulled.
- Contamination is reported at 5 to 10 percent total in all City recycling programs.

Convenience and Site Aesthetics

- Recycling dumpsters are typically sited in alleys between multi-family housing buildings, although some are in high-traffic locations (City libraries, parks, fire stations, at the corners of major traffic arteries, Santa Monica Beach).
- A special trip, although short, is required to use most of the sites.

- Recycling dumpsters in alleys are intended for use by area residents within a five-minute walk or drive.

- There are no street or building signs directing people to recycling zone locations; a potential recycler must make a concerted effort to locate the nearest recycling zone.
- Some recycling dumpsters are in poor condition. The City spends approximately $12,500 per year on repairs and maintenance, which includes painting, graffiti removal, wheel repair, and so forth.
- Collection crews are responsible for cleaning up illegally dumped trash; this trash collection is not always accomplished as quickly as desired by area residents.
- The City uses several criteria in selecting recycling zones, including:
  - -- Preferably public property;
  - -- Collection truck access;
  - -- Dumpsters can be placed against a high wall and away from windows, meters, garages, and so forth; and
  - -- Hard, level surface.
- Lighting and other site characteristics vary depending on location.

Public Education

- Public education for recycling zones is solely the responsibility of the City.
- The City uses a local graphic artist to produce brochures and other public education pieces.
- The recycling zones are shown on a City map that is usually sent out to about 35,000 multi-family residences per year. The map has not been sent out for the past two years. These zone maps are also available at libraries and City Hall.
- The City relies on word of mouth and phone calls to City offices to inform multi-family residents of changes in collection programs or zone locations.

Other Recycling Opportunities

- Curbside recycling is provided by the City to 7,500 single family households and about 5,000 low-density multi-family units located in single family neighborhoods. The same materials are collected in the curbside program that are targeted at the recycling zone locations.

Diversion

- The total amount of materials recovered from targeted multi-family units in 1993 was estimated at 3,214.2 tons. Table IV-6 presents a summary of these quantities.
- Based on the amount of solid waste disposed by targeted multi-family units, the drop-off program achieved a residential MSW diversion rate of 15.61 percent in 1993 in the target area.

Program Costs

- The City estimates it has capital costs of approximately $61,000 in collection equipment and $119,000 in dumpsters, locks, and signage for a current capital cost of $180,000. This includes approximately $1,000 per recycling zone ($300 per dumpster, $10 per lock and $50 for signage at each site) and $15,000 in replacement dumpsters.
- City has received two capital assistance grants, one for $30,000 to identify and plan appropriate recycling programs, and another $260,000 to purchase equipment

Table IV-6. City of Santa Monica Drop-off Recycling Program Recovered Recyclables (FY 1993) (Tons Per Year)

Material	Estimated Quantities[1]
Newsprint	2,665.2
Glass (All Colors)	398.7
PET	16.4
HDPE (Milk Jugs only)	54.3
PVC, LDPE, PP	1.5
Aluminum Cans	6.6
Steel Cans	71.5
Total	**3,214.2**

[1]Based on FY 1993 material percentages (excluding mixed, white and computer print-out paper) and CY 1993 drop-off recycling zone tonnage estimate provided by City (46 percent of all residential recyclables collected).

for the curbside and multi-family collection programs. Of this, an estimated $90,000 was spent on the multi-family recycling zone program.

- The City's total recycling budget in 1993, including the recycling zone program, curbside collection, miscellaneous commercial collections, processing and administration, was $737,000, the equivalent of 8.33 percent of the total solid waste budget.

- Of this amount, $221,037 is attributed to the drop-off recycling program. About another $16,275 per year is expended through dumpster maintenance and repair and equipment depreciation, bringing the total annual cost to approximately $237,312.
- Unlike previous years, the recycling program did not generate any market revenues in 1993. Processing fees for materials delivered to the processor are included in the total cost. (A new five-year contract extending from June 1, 1994, to May 31, 1999, will pay the City revenues of $6 per ton of newsprint and $10 per ton of cans, glass, and plastics.)
- The net cost of the recycling zone program to the City in 1993 was $237,312.
- The net cost per recovered ton in this program in 1993 was $73.83.
- Table IV-7 provides a summary of annual costs.

Table IV-7. City of Santa Monica Drop-off Recycling Zones Annual Costs (FY 1993)

Component	Annual Cost ($)
Operating and Maintenance	$152,509[1]
Education and Administration	74,778
Annualized Capital	10,025
Total	**$237,312**

[1]No revenue from sale of materials in FY 1993.

D. SOUTHEAST COLORADO JOINT RECYCLING PROGRAM

The Southeast Colorado Recycling Pilot Program began as a joint project of Bent, Kiowa, Otero and Prowers Counties and several communities located in those counties to reduce the waste stream requiring disposal through increased recycling efforts.

Due to the rural nature of the area, none of the jurisdictions could individually collect a sufficient amount of recyclable materials to afford a proper consolidation and densification facility. In addition, communities were concerned that the cost of recycling collection from this large area could outweigh the avoided costs of landfill disposal. In order to devise a successful program, the communities determined to band together to increase the volume of materials and find an efficient method of collection to keep the costs down.

These considerations led to the formation of the Southeast Colorado Joint Recycling Pilot Program in June 1992. This pilot effort was established as a joint venture between the public and private sectors and was intended to run over a two-year period to provide operating data and results to the participants.

Initially, the program involved 22 sites in eight counties; by June 1993, the program had expanded to 53 sites in 40 communities spread over 13 counties. Table IV-8 provides a listing of the participating communities The communities are in the process of forming a district or authority to keep the drop-off recycling program going indefinitely. The program is presently run by a joint committee made up of representatives from each of the participating jurisdictions and organizations. In addition, each participating jurisdiction has a committee that oversees operations in their community.

Currently, the State of Colorado is one of the few states that has no mandatory or voluntary recycling goals. None of the Counties served by the Southeast Colorado Joint Recycling Pilot Program have adopted recycling goals or legislation, and only one municipality in the service area (with a population of 726 residents) has passed a mandatory recycling ordinance.

Table IV-8. Southeast Colorado Recycling Program Participants

Original Southeast Colorado Program Started June 1, 1992		
Community	**Number of Containers**	**Type of Containers[1]**
Branson	1 1	2 yd News 3 Way
Bents Ford	1 3	2 yd News 2 yd Other

Original Southeast Colorado Program Started June 1, 1992		
Community	**Number of Containers**	**Type of Containers[1]**
Ft. Lyon	3 3	2 yd News 4 yd Other
VA Hospital	2 4	3 Way 4 yd Other
Eads	1 3	2 yd News 2 yd Other
Haswell	1 1	2 yd News 3 Way
Holly	1 3	2 yd News 2 yd Other
Kim	1 3	2 yd News 2 yd Other
La Junta	5 15	4 yd News 2 yd Other
La Junta Newspaper	1	4 yd News
Lamar	4 12	4 yd News 2 yd Other
Lamar Newspaper	1	2 yd News
Las Animas	2 6	2 yd News 2 yd Other
La Veta	1 4	4 yd News 4 yd Other
Manzanola	1 1	2 yd News 3 Way
Ordway	1 3	4 yd News 2 yd Other
Pritchett	1 2	2 yd News 2 yd Other
Rocky Ford	3 3	2 yd News 3 Way
Sugar City	1 3	2 yd News 2 yd Other

Original Southeast Colorado Program Started June 1, 1992		
Community	**Number of Containers**	**Type of Containers[1]**
Trinidad	5 6	4 yd News 4 yd Other
Walsenburg	1 3	4 yd News 2 yd Other
Wiley	1 3	2 yd News 2 yd Other
East Central Colorado Program Started June 1, 1993		
Agate	1 2	2 yd News 2 yd Other
Arapahoe	1 2	2 yd News 2 yd Other
Arriba	1 2	2 yd News 2 yd Other
Bethune	1 2	2 yd News 2 yd News
Burlington	2 4	4 yd News 2 yd Other
Burlington Newspaper	1	4 yd News
Cheyenne Wells	1 2	4 yd News 2 yd Other
Elbert	1 2	2 yd News 2 yd Other
Elizabeth	1 2	2 yd News 2 yd Other
Flagler	1 2	2 yd News 2 yd Other

[1]3-way containers are compartmentalized igloos accepting glass and steel and aluminum cans.

Background and Demographics

- The 13 counties in the program cover an area of 36,200 square miles with a population of 111,727 residents. Table IV-9 shows population and household data for each of the participating counties, based on data provided by the State of Colorado Office of Business Development.
- The average per capita income in the region (calculated as a weighted average from Census data provided for each participating County) is $11,530. Approximately 14 percent of the families in the region fall below the poverty level.

Table IV-9. Southeast Colorado Participating County Population and Household Estimates

COUNTY	Population (1990)	Households (1990)
Baca	4556	1896
Bent	5048	1838
Cheyenne	2397	901
Crowley	3946	1164
Elbert	9646	3352
El Paso -- Black Forest Payton Division	19471	6684
Huerfano	6009	2486
Kiowa	1688	648
Kit Carson	7140	2786
Las Animas	13765	5476
Lincoln	4529	1823
Otero	20185	7625
Prowers	13347	4990
Total	**111727**	**41309**

- On average, approximately 76 percent of the population over 25 years of age is estimated to have completed high school, and just under 7 percent have completed 16 or more years of education.

Description of Municipal Solid Waste (MSW) Management System

- The traditional method of handling MSW in the 13 participating counties has been landfill disposal. Many facilities do not meet Subtitle D standards and the State of Colorado estimates that approximately 70 percent of the existing landfills will need to close in the State. County Commissioners in the region are confident that they will receive exceptions to the Subtitle D regulations.
- Most landfills in the region are not equipped with scales, and only incomplete reports of cubic yards of waste received are available. Based on a review of information provided by the Colorado Department of Health and a review of waste characterization data from other rural localities, it has been assumed that the average per capita MSW generation rate in the region is 3.15 pounds per day, yielding a total MSW generation rate of 64,243 tons per year. In addition, it has been assumed that approximately 60 percent of the MSW generated in the region is residential (including multi-family waste that may be collected as commercial waste). Therefore, it is estimated that approximately 38,546 tons per year of residential MSW are generated in the region.
- Because there are few opportunities to recycle in the region outside of the Southeast Colorado Joint Recycling Program, the drop-off recycling target area is defined as the entire region.

Description of Drop-off System

- The drop-off program uses two- and four-cubic yard fiberglass recycling containers for collecting newspaper, clear glass, brown glass, and steel and aluminum cans. The containers are free-standing, with openings for targeted materials. Newspaper containers are treated with a fire-retardant material to minimize fire hazards.
- The drop-off containers are serviced by a private contractor. Recyclables are unloaded into a compartmentalized trailer, which is towed by a truck equipped with a crane and a special fixture, called a Kinshofer Attachment, that allows one person to operate the crane and discharge the contents of the recycling containers without additional labor assistance.
- The participating jurisdictions have a committee, appointed by City or Town Council, that oversees the drop-off program within that community. These committees are responsible for:
  - -- Securing funding for the containers from the community;
  - -- Determining the locations where the drop-off containers are placed;
  - -- Ensuring that the drop-off sites are maintained; and
  - -- Providing signs at the drop-off sites and educational material to schools and the public.
- All communities of up to 500 residents provide at least one container to match the State-supplied container.

- Communities of 500 to 1,500 residents are required to have a total of four containers at each site, with the local community supplying three of those containers.
- Communities of over 1,500 residents are recommended to have more than one site, at the local committees' discretion.
- Extra containers were obtained through a variety of means, including individual and business contributions, funds from the communities' sanitation programs, and lease/purchase options.
- As new sites join the program, these communities or businesses are required to obtain their own containers. In addition, the program is structured to allow communities to trade smaller containers for larger ones as the programs evolve.
- In the "Request for Proposal" to obtain a contractor for the program, the Joint Committee made a provision that the Committee would meet with the contractor every six months to discuss modifications to the agreement. Modifications could include adding communities to the program with the contractor's approval, or, in the event that the contractor was losing money on the program through no fault of the contractors' own, attempting to modify the program to cut these losses. Modifications might include cutting the number of trips or length of the routes or finding additional funding to offset the losses.
- A standby proposal was developed that allows the Joint Committee to obtain a maximum of $0.05 per capita per month from each community to be used to offset losses to the contractor. The $0.05 per capita would be a maximum and any losses suffered by the contractor beyond that amount would be the Contractors' responsibility.
- The original contract with the program's collector/processor calls for a fee of $1,200 per month to be paid to the contractor to cover mileage (assuming approximately 1,000 miles per month) and $1,000 per month to be paid by the participating counties as a processing fee. A contract extension is in the negotiation process; the extended terms would allow the processor a 20-percent profit margin.

Convenience and Site Aesthetics

- Convenience is seen as a key issue for the success of the Southeast Colorado program. Because this program serves rural communities -- many of which have little or no commerce -- drop-off sites are typically located at Post Office branches. Towns without a Post Office do not have a recycling drop-off center, based on the assumption that residents, by necessity, will travel to another community to pick up and deposit their mail.
- Site maintenance is the responsibility of each participating community. All sites are equipped with trash receptacles to reduce litter concerns.

Public Education

- The two main components of the public education program for the drop-off system are: (1) a monthly newsletter prepared by Ray LaRiviere, the Director of Prowers County Development, Inc.; and (2) presentations and talks given by Committee members to schools, civic groups, professional associations, and conferences.
- Over 200 copies of the newsletter are distributed each month. The audience includes Joint Committee members, media outlets in the region, and other interested parties. The newsletter has resulted in press coverage for the program.
- Copies of articles about the program have also been distributed throughout the region to promote its success and answer questions about the effectiveness of the drop-off recycling concept.
- Recently, a grant request was submitted to the Farmers Home Administration to develop a video about the program, along with pamphlets that would supplement the content of the video. The target audience for this effort is school-aged children (K-12).

Other Recycling Opportunities

- Few other recycling programs exist in the region. Two communities indicated that aluminum cans were being collected as part of a volunteer fundraising effort for local hospice programs. Another drop-off program, sponsored by a community in Baca County, was discontinued due to lack of ongoing volunteer commitment.

Diversion

- Approximately 1,324 tons of recyclables were estimated to be recovered from the program in FY 93-94 (the second year of program operation).
- Table IV-10 presents a summary of recovered tons. Records are kept based on cubic yard volume, and results of a limited weighing program were used to calculate estimated tonnages.
- Based on this estimate, and the quantity of residential MSW estimated to have been generated in the region, the program's diversion rate is calculated to be 3.32 percent.

Table IV-10. Southeast Colorado Joint Recycling Program
Recovered Recyclables (FY 1993)
(Tons Per Year)

Materials	Estimated Quantities
Newspaper	902
Clear Glass	287
Brown Glass	61
Cans (Steel & Aluminum)	74
Total	**1,324**

Program Costs

- As shown in Table IV-11, the estimated annual program costs for FY 93-94 total $142,635. Revenues from the sale of materials during that period were $47,664, resulting in a net cost of $94,971 per year.

Table IV-11. Southeast Colorado Joint Recycling Program Annual Costs (FY 1993)

Component	Annual Cost
Container Costs[1]	$ 27,479
Collection Costs	73,378
Densification Costs	33,021
Shipping Costs	2,747
Education/Administrative Costs[2]	3,997
Start-up Costs	2,013
Gross Total Costs	**$142,635**
Revenues from Sales of Materials	47,664
Net Total Costs	**$94,971**

[1] Estimated annual cost of containers/lease-purchase.

[2] Includes volunteer labor for newsletter production.

- The total cost per recovered ton was $71.73. It should be noted that this does not include local volunteer time for site maintenance.

E. CITY OF LARGO, FLORIDA

Largo, located in Pinellas County, is a middle class and retirement suburban community. The County is principally responsible for meeting the State of Florida's mandate to develop a recycling plan and to achieve a 30 percent waste reduction by 1995.

Demographics

- Largo covers 14.3 square miles.
- The City's population ranges from 67,000 to 80,000 residents seasonally.
- The City's residential mix is one-third single family, one-third multi-family and one-third trailers and mobile homes.
- The target population for the drop-off program is 22,100 households, or 38,400 residents.
- Approximately 77.1 percent of the City's residents have completed high school and 13.8 percent have completed at least 16 years of school.
- The median annual household income is $24,296.

Description of Municipal Solid Waste (MSW) Management System

- Largo's Solid Waste Department manages and operates virtually all solid waste and recycling services in the City.
- The City collects garbage, recyclables and yard waste at the curb from single family residences and small apartment complexes. These residents are charged $13.35 per month for these services.
- Larger multi-family households receive container waste service and have access to drop-off recycling centers. Container waste service is billed to the multi-family complex owners; this waste is considered part of the commercial waste stream.
- Residential waste is delivered to the County's waste-to-energy facility at a tip fee of $37.50 per ton.
- Residential MSW (including recyclables) from the target population is estimated to be 25,840 tons per year.

Description of Drop-off System

- Largo's drop-off recycling program consists of nine multi-material sites and seven newspaper sites.
- Seven of the multi-material sites are in high-traffic locations. Igloos are used at these centers. The remaining two sites are at multi-family complexes; compartmentalized roll-offs are used at these locations.
- One of the newspaper collection sites is located at a library; the remaining newspaper sites are in multi-family complexes. Six- and/or 8-cubic yard containers are used for newspaper at all but one of these sites. (The news-only sites account

for less than 10 percent of the total tonnage collected at drop-off sites and are not included in site performance evaluations.)

- Drop-off sites are policed daily to monitor contamination and need for service. Most sites have separate containers for waste.
- Materials are collected by the City separately and transported to a City-owned processing facility, where they are consolidated with curbside-collected materials and marketed. The City avoids the need for a special truck to service the igloo sites by replacing the grapple on the arm of its yard waste collection truck with a lift mechanism.

Convenience and Site Aesthetics

- As mentioned, most of the multi-material sites are located in high-traffic areas. Others are located at multi-family complexes.
- Sites are policed daily to maintain appearance.

Public Education

- Largo's full-time recycling coordinator is responsible for public education.
- Newsletters, flyers, presentations and newspaper articles are used to increase awareness of and participation in the program.

Other Recycling Opportunities

- The City provides curbside recycling service to approximately half of the City's households once a week using three compartmentalized trucks with two-person crews. Participation is voluntary.
- Residents place commingled materials at the curb in 14-gallon blue bins. Materials are curb sorted, and collection vehicles are equipped with on-board compactors for plastic bottles.

Diversion

- Table IV-12 presents a summary of recyclables recovered through the drop-off system annually.
- Based on these figures, the County is estimated to achieve a 7.89 percent diversion rate for residential MSW from the target area.

Program Costs

- Table IV-13 presents a summary of system costs.
- Estimated avareage total cots per recovered ton were $81.43.

Table IV-12. Largo, Florida Recycling Program
Recovered Recyclables (1993)
(Tons Per Year)

Material	Quantities
Newsprint	1,734.0
Glass, unspecified	265.2
PET and HDPE (Soda Bottles and Milk Jugs)	20.4
Aluminum	20.4
Total	**2,040.0**

Table IV-13. Largo, Florida Drop-Off Recycling Program
Annual Costs (1993)

Component	Cost ($)
Operating & Maintenance	82,250
Education & Administration	118,871
Gross Total Costs	**201,121**
Revenues from Sale of Materials	35,000
Net Total Costs	**166,121**

F. CITY OF TAMPA, FLORIDA

Tampa is a medium-sized city in Hillsborough County, Florida. The County has primary responsibility for meeting the State of Florida's mandate to develop a recycling plan and achieve a 30 percent reduction in its waste stream by 1995. Tampa reports its program results through the County.

Demographics

- The City of Tampa has a population of 290,000.
- The City occupies a large land area for its population -- 150 square miles.
- Tampa has approximately 100,485 households. Sixty percent of the City's residences are single-family dwellings.
- Although the City is a manufacturing, transportation and finance center, 18 percent of its population is below the poverty level.
- The median annual household income is $35,997.
- Approximately 70.6 percent of the City's population graduated from high school, and approximately 18.7 percent have completed four years of college.
- The drop-off target population is defined by the City as 229,712.

Description of Municipal Solid Waste Management System

- Tampa's Solid Waste Department provides waste collection for approximately 60 percent of the City's single family and multi-family residences and manages and operates the City's drop-off recycling program, as well as the McKay Bay transfer station and waste-to-energy facility.
- The City contracts for waste collection from the remaining 40 percent of single family and multi-family residences, all curbside single-family recycling services, and an experimental apartment recycling program.
- 80,000 households receive individual waste service and are charged $16 per month. Of these households, 24,515 receive curbside recycling at no extra charge.
- Multi-family households receive containerized waste service, which is billed to the owners. Multi-family waste is managed as part of the commercial waste stream.
- All City-collected waste material is transported to the McKay Bay facility, where it is burned or transferred to the County's landfill. The tip fee at McKay Bay is $65 per ton.
- Total residential MSW (including recyclables) from the drop-off recycling target area was 137,596 tons. Citywide residential MSW was estimated to be 171,139 tons.

Description of Drop-off System

- There are 20 drop-off centers located throughout the City; six of these are located in curbside collection areas.

- The drop-off centers accept newspaper, phone books, glass, aluminum, and PET and HDPE plastic containers. Two of the sites are accepting corrugated cardboard on a trial basis.
- Plastic bottles, newspaper, and corrugated cardboard are collected in 6- and 8-cubic yard containers; glass and aluminum are collected in igloos; and phone books are placed in roll-off containers.
- The sites are serviced by City crews.
- Collected materials are marketed by the City, and all revenues are retained.
- Buy-back recycling is offered by the Tampa Metropolitan Housing Authority at a center established in a low-income housing location. The Authority owns the space and equipment and leases it to a private operator for $250 per month. The center pays customers (primarily scavengers) for newspaper, metal, glass and plastic. Approximately 140 tons per month are collected from this program.
- Table IV-14 provides a summary of materials collected in 1993.

Table IV-14. City of Tampa, Florida Drop-Off Recycling Program Recovered Recyclables (1993) (Tons Per Year)

Materials	Drop-Off	Buy Back[1]	Total
Newsprint	2,528.7		2,528.7
Glass, unspecified	471.3		471.3
PET and HDPE containers	258.5		258.5
Aluminum	14.2		14.2
Total	3,272.7	1,680.0	4,952.7

[1]Breakout of material composition from buyback center not available.

Public Education

- Tampa's recycling programs are promoted through an active educational campaign consisting of flyers, brochures, presentations, and public displays.
- One food store chain, Kash 'n Karry, has been particularly active; several of the high volume drop-off centers are sited at Kash 'n Karry locations.

Other Recycling Opportunities

- The City contracts with Waste Aid to provide curbside collection of newspaper, clear glass, mixed colored glass, and aluminum from 24,515 households. Waste Aid is paid $41,700 per month plus 50 percent of revenues from collected materials. From October 1992 through August 1993, the program was diverting an average of 326 tons per month. Total revenues from sale of materials during this same time period averaged $1,618 per month.
- The City also contracts with Waste Aid to provide recycling collection to 17 apartment buildings with 3,100 units. Materials collected are the same as in the curbside program. Waste Aid is paid $2,640 per month for this service. This program collects an average of 15 tons per month; revenues average $220 per month.

Program Costs

- Table IV-15 represents a summary of system costs.
- Total average net cost per ton diverted was $95.24 for the City's drop-off program.

Table IV-15. City of Tampa Drop-Off Recycling Program Annual Costs (1993)

Component	Drop-Off	Buy-Back	Total
Operating & Maintenance	$193,200	<2,400>[1]	$190,800
Education & Administration	$118,500		$118,500
Annualized Capital		$28,476	$ 28,476
Total	**$311,700**	**$26,076**	$337,776

[1]Represents amortization of capital costs.

- The buyback program costs (building amortization less lease payments) were $26,076, with an average cost per ton of $15.52.

G. SOUTHERN MAINE (TOWNS OF FALMOUTH AND FREEPORT)

The State of Maine is one of the fifteen least densely populated states in the nation, with about 40 percent of its population residing in one of four metropolitan areas. The State has established a 50 percent recycling goal to be achieved by 1994. In addition, the State has enacted mandatory deposit legislation. Only dairy product containers are excluded. Liquor containers require a 15 cent deposit; all others require 5 cents. The Maine Waste Management Agency calculates a 93.6 percent capture rate for deposit containers.

Regional Waste Systems, Inc. (RWS) is a not-for-profit corporation based in the Portland, Maine area that is owned by 21 communities in southern Maine. The corporation operates under the direction of a 28-person Board, representing cities and towns in the service area. RWS provides solid waste management services to its member jurisdictions, as well as to ten associate members, for a total service population of 234,000 people.

RWS's services include a 500 ton per day waste-to-energy facility, ash and bale landfill capacity, leaf composting, and a recycling system that includes a materials recovery facility (MRF). RWS provides basic educational material support with a curriculum manual, video tape, and tour programs, as well as an annual publicity and promotion event. The drop-off component of RWS's recycling system was begun in 1990 and provides the framework for the two member town programs reviewed in detail as part of this study -- the Towns of Falmouth and Freeport.

1. Town of Falmouth, Maine

Demographics

- Falmouth is a suburban town occupying 29.6 square miles on the northern border of Portland. The Town has a population of 7,610 people.
- There are 3,076 households, including 2,601 single-family households and 475 multi-family dwelling units.
- Approximately 87.5 percent of Town residents have graduated from high school, and 44 percent have completed at least four years of college.
- The median annual household income is $44,863.
- The drop-off program target area is defined by the Town as the entire Town.

Description of Municipal Solid Waste (MSW) Management System

- The Town provides contracted curbside collection of residential trash and leaves.
- The Town charges residents for trash collection by selling plastic bags to be used for trash set-out. Bag sale fees and trash fees are estimated to recover 59 percent of the cost for managing solid waste in the Town. The balance of solid waste funding comes from property taxes.

- Residential trash is handled through RWS; 88.8 percent is incinerated at the waste-to-energy facility and the remainder is landfilled.
- In 1992-3, residential solid waste generated in the Town totalled 2,494 tons, including recyclables.

Description of Drop-off System

Falmouth is one of 30 towns that participates in RWS's drop-off "Silver Bullet" program, which is designed to be self-contained, easy to institute, and effective. Many towns augment the RWS program with programs to collect materials not targeted by the RWS system.

- Falmouth has two drop-off locations, one at the Bucknam Road Fire Barn and the other at the Transfer Station. Only the Transfer Station site is staffed.
- Covered compartmentalized roll-offs are used to collect materials. These standardized containers have special slots for filling and side gates for emptying and are painted bright silver (hence the name "Silver Bullet").
- Each roll-off container has four compartments for collecting the following materials: newspaper and kraft paper; magazines and phone books; glass bottles and jars (all colors) and aluminum and steel cans; and plastic milk and water bottles (natural HDPE).
- RWS owns all the roll-offs, as well as the roll-off transport truck. RWS contracts with a private hauler to transport the roll-offs, when full, to a low-tech materials processing facility, also owned by RWS. Some roll-offs are serviced on a schedule; others are transported and replaced on an on-call basis. Participating municipalities are responsible for contacting the contract hauler to schedule collection; different amounts are paid for this service, depending on distance travelled to the processing center.
- Residents using the Transfer Station location can also deposit trash; however, there are no containers for trash available at the Bucknam Road Fire Barn site. Drivers servicing the drop-offs are responsible for cleaning up spillage they encounter at the sites.
- In addition to the RWS drop-off sites, Falmouth provides drop-off opportunities for other materials not addressed in this study, including wood waste, yard waste, corrugated cardboard, white goods, reusable household items, and used motor oil.

Convenience and Site Aesthetics

- Both of Falmouth's RWS drop-off sites are convenient locations. The Bucknam Road Fire Barn location is open 24 hours per day; the Transfer Station site is open four 8-hour days for a total of 24 hours per week.
- No special lighting for the sites is provided.

- The only signage for the sites is placed on the bins themselves, indicating which materials are accepted.

Public Education

- Falmouth developed a major promotional campaign when it instituted recycling programs in the early 1980's; however, the Town employed only minimal promotion for the Silver Bullet drop-off program.
- The Town spends approximately $1,200 per year on recycling education, which includes a packet of information given to new residents, an annual newsletter, and a brochure explaining the Town's solid waste management system.

Other Recycling Opportunities

- As mentioned, the Town has a drop-off programs for certain commodities not covered by this study, including wood waste, yard waste, corrugated cardboard, white goods, reusable household items, and used motor oil.
- Except for the additional materials targeted by the Town's drop-off program, no competing recycling programs are available in the Town.

Diversion

The RWS program does not track composition or residue by town. System averages have been used to convert total Falmouth-collected recyclables to net diversion by commodity.

- In 1992, Falmouth's drop-off program diverted a total of 338 tons of residential materials (after allowing for residue and not including those commodities not covered in this study), for a net diversion rate of 13.55 percent of the residential waste stream.
- Table IV-16 provides a summary of recovered materials from both drop-off sites.
- RWS does not return revenues from sale of materials to the participating communities. Revenues are used by RWS to reduce operating costs charged to communities based on waste disposal tipping fees.

Table IV-16. Town of Falmouth Drop-off Recycling Program Recovered Recyclables (1992) (Tons Per Year)

Material	Quantity
Newsprint	269
Magazines	21
Phone Books	3
Mixed Paper	4
Glass (All Colors)	4
HDPE (Milk Jugs only)	11
Steel Cans	26
Total	**338**

Program Costs

- Total net annual costs for the drop-off program were $29,479 in FY 1993.
- The net cost per recovered ton is estimated to be $87.22, which includes total Town and RWS costs.
- Table IV-17 presents a summary of cost components.

Table IV-17. Town of Falmouth Drop-off Recycling Program Annual Costs (FY 1993)

Component	Annual Cost ($)
Operating and Maintenance	22,811[1]
Education and Administration	6,668
Total Costs	**29,479**

[1]Adjusted for revenue from sale of materials.

2. Town of Freeport, Maine

Demographics

- Freeport is a suburban town occupying 34.7 square miles 15 miles north of Portland. The Town has a population of 7,043 people.
- There are 2,666 households, including 2,159 single-family households and 507 multi-family units.
- Eighty-six percent of Town residents have graduated from high school, and 32 percent have completed at least four years of college.
- The median annual household income is $37,150.
- The drop-off program target area is the entire Town.

Description of Municipal Solid Waste (MSW) Management System

- The Town contracts with four haulers for curbside collection of residential trash. Residents pay haulers directly for this service, and the Town pays the tip fee at RWS's facility.
- Freeport also has fee-based drop-off collection of demolition debris, white goods and yard waste.
- Residential trash is handled through RWS; 88.8 percent is incinerated at the waste-to-energy facility, and the remainder is landfilled.
- In 1992-93, residential municipal solid waste handled in the Town totalled 2,601 tons, including recyclables.

Description of Drop-off System

Freeport is one of the 30 towns that participate in RWS's drop-off "Silver Bullet" program. Until January 1992, the Town operated its own aggressive recycling program, independent of the RWS system.

- Freeport has three drop-off locations. Two of these are unstaffed RWS sites; the third is the staffed Recycling Center, located at the old landfill.
- At the RWS sites, covered compartmentalized roll-offs are used to collect materials. These standardized containers have special slots for filling and side gates for emptying and are painted bright silver.
- Each roll-off has four compartments for collecting the following materials: newspaper and kraft paper; magazines and phone books; glass (all colors) and aluminum and steel cans; and plastic milk and water bottles (natural HDPE).
- RWS owns all the roll-offs, as well as the roll-off transport truck. RWS contracts with a private hauler to transport the roll-offs, when full, to a low-tech materials processing facility, also owned by RWS. Some roll-offs are serviced on a schedule; others are transported and replaced on an on-call basis. Participating municipalities are responsible for contacting the contract hauler to schedule

collection; different amounts are paid for this service, depending on distance travelled to the processing center.

- The Town Recycling Center provides drop-off opportunities for all the regular RWS recyclables, as well as paperboard, corrugated cardboard, office paper, used oil, white goods, and yard waste. The site is equipped with two balers for paper products, storage areas and loading docks, as well as office and meeting space.
- Whereas residents using the Recycling Center can also deposit trash, there are no containers for trash available at the RWS sites. Drivers servicing the drop-offs are responsible for cleaning up spillage they encounter at the sites.

Convenience and Site Aesthetics

- Both of the RWS sites are conveniently located near shopping areas. The Recycling Center requires a special trip; however, this site is clean and paved, with ample parking.
- The RWS sites are open 24 hours per day; the Recycling Center is open four days per week.
- The Recycling Center has ample signage directing residents to the site and instructing them on how and where to deliver materials.

Public Education

- The Recycling Center is a major educational center for residents. The Town's Solid Waste and Recycling Director has instituted several approaches to introduce residents to the Center and involve them in recycling, including:
  - -- "Contracts" that require students to take their parents to the Center;
  - -- A well-publicized landfill tour (featured in *What to Do in Maine?*); and
  - -- "Coffee and Questions" on Saturday mornings.

Other Recycling Opportunities

- Except for the additional materials targeted by the Town's drop-off program, no competing recycling programs are available in the Town.

Diversion

The RWS program does not track composition or residue by town. System averages have been used to convert total Freeport-collected recyclables to net diversion by commodity.

- In 1992, Freeport's drop-off program diverted a total of 320 tons of residential materials (after allowing for residue and not including those commodities not covered in this study), for a net diversion rate of 12.3 percent of the residential waste stream.
- Table IV-18 presents a summary of recovered materials.

Program Costs

- Total gross annual costs for the drop-off program in FY 1993 were $57,474.
- Revenue from sale of materials was $7,677; this amount reflects sales prior to joining the RWS program.
- The net annual cost was $49,697.
- The net cost per recovered ton is estimated at $155.30, which includes total Town and RWS costs.
- Table IV-19 presents a summary of cost components.

Table IV-18. Town of Freeport Drop-off Recycling Program Recovered Recyclables (FY 1993) (Tons per Year)

Material	Quantities
Newsprint	89.0
Office Paper	30.0
Magazines	7.0
Phone Books	1.0
Mixed Paper	108.0
Glass (All Colors)	37.0
HDPE (Milk Jugs only)	27.0
Steel Cans	21.0
Total	**320.0**

Table IV-19. Town of Freeport Drop-off Recycling Program Annual Costs (FY 1993)

Component	Annual Cost ($)
Operating and Maintenance	$ 36,864
Education and Administration	20,510
Gross Total Costs	**$ 57,374**
Revenue from Sale of Materials	7,677
Net Total Costs	**$ 49,697**

H. CITY OF BLUE ASH, OHIO

The City of Blue Ash is part of the Hamilton County Solid Waste Management District, which is required by the State to develop a recycling plan and to achieve a 25 percent reduction in its waste by June 1, 1994.

Demographics

- The City of Blue Ash is an upper middle class suburban community with a population of 12,629.
- Blue Ash occupies 7.7 square miles, with a population density of 1,770 people per square mile.
- There are 5,200 households; 3,900 single-family homes and 1,320 multi-family dwellings.
- 84.2 percent of the population has completed high school and 40 percent have at least 16 years of education.
- The median annual household income is $46,339.

Description of Municipal Solid Waste Management System

- Blue Ash contracts with a private hauler (Rumpke) for all waste and recycling collection services. The City's Services Department administers these programs.
- Waste (garbage, trash, and brush) is collected from single family households once per week at a cost to the City of $4.20 per household per month. All payments to the hauler are made from the City's general fund.
- Rumpke also provides container waste service for multi-family residences and commercial establishments up to three times per week at no charge to the apartment complex or business.
- The target population for the drop-off program is the entire City.
- It is estimated that 6,496 tons per year of residential MSW (including recyclables) are generated by the target population.

Description of Drop-off System

- The City's waste hauler, Rumpke, also provides drop-off recycling service at five City-selected sites.
- Rumpke provides the containers, services the sites, and retains ownership of the collected materials.
- Rumpke charges the City $300 per month per site ($1,500.00) for these services.
- Containers or compartments are provided for glass bottles and jars, metal cans, plastic bottles (#1 and 2), newspapers, and polystyrene.
- Although signage on the drop-off containers is somewhat confusing and variable among sites, Rumpke's practice is to combine all materials, except newspaper, during collection. Rumpke achieves greater transportation efficiencies by

commingling recyclable containers (glass, metal and plastic). The company has built a merchant MRF designed to process mixed recyclables.

- Rumpke reports that contamination of materials is reduced by requiring users to sort materials into separate compartments at the drop-off sites.
- One supermarket (Krogers) serves as a sixth drop-off site. This center, configured similarly to the other Blue Ash sites, is also serviced by Rumpke, but at no charge to the City.

Convenience and Site Aesthetics

- All of the City's drop-off sites are in moderate to high traffic locations that are well lit and easily accessible. These include a municipal building, two recreation centers, a community college parking lot and a shopping center.
- City employees check the sites daily for cleanliness and need for services.

Public Education

- Blue Ash maintains a moderate public education effort using flyers, the community newsletter, and occasional special events to publicize the drop-off centers.

Other Recycling Opportunities

- Rumpke also offers voluntary curbside recycling services once a week to its single family customers. Materials collected include mixed containers and newspaper. Participating households are charged $1.25 per month.
- It should be noted that the City of Blue Ash added single-family curbside recycling service after the study period described in this document. The recycling drop-off program has been retained and the volume of materials it collects remains steady. The addition of the curbside program has raised total diversion of materials to 33 percent, and the combined program costs are $61.00 per ton ($12.00 per household per year).

Diversion

- Table IV-20 presents a summary of recovered materials from the City's drop-off system.

Table IV-20. City of Blue Ash, Ohio Drop-Off Recycling Program Recovered Materials (1993) (Tons Per Year)

Material	Quantities
Newsprint	430.5
Clear Glass	73.9
Green Glass	30.6
Brown Glass	23.5
PET Soda Bottles	27.9
HDPE Milk Jugs	36.5
Aluminum	28.9
Steel Cans	49.2
Total	**701.0**

- Based on recovered quantities, it is estimated that the City's drop-off program is responsible for diverting 10.79 percent of the residential MSW from the target population.

Program Costs

- The annual costs to operate the City's drop-off system are summarized in Table IV-21.

Table IV-21. City of Blue Ash Ohio Drop-Off Recycling Program Annual Costs (1993)

Component	Cost ($)
Operating & Maintenance	$18,000
Education & Administration	18,000
Total	**$36,000**

- The average total cost per recovered ton is $51.36.

I. CITY OF PHILADELPHIA, PENNSYLVANIA

The City of Philadelphia is a major eastern city with an aging infrastructure, diverse population, and a neighborhood-oriented culture. Although it functions as a metropolitan government, the City is viewed by the State as equivalent to a county in terms of solid waste management issues. As are other Pennsylvania counties, the City is required to achieve a waste reduction goal of 25 percent by January 1, 1997. Curbside collection of at least three designated recyclable materials is mandated as well.

A major concern for the City's recycling program has been the cost of curbside recycling. Experience in 25 percent of the City indicated that curbside collection of recyclables (commingled newspaper, glass, aluminum and bimetal cans, and plastic bottles) is more expensive than waste collection (reportedly $184/ton versus $144/ton). Although the City has been reluctant to expand the program, the State has taken legal action to force the City to comply with the curbside collection mandate. The City has responded by expanding a less expensive version of the original curbside program (plastic bottles have been eliminated and collection frequency has been decreased from once a week to every other week).

In addition to its problematic curbside program, the City has a successful block corner drop-off recycling program that began in the mid 1980's. Two block corner systems, Queen Village and Cedar Park, were examined as part of this study.

Demographics

- The City of Philadelphia has a population of 1,600,000.
- Philadelphia is densely populated, with an approximate area of only 120 square miles. Residential streets tend to be narrow with restricted traffic flow.
- The Queen Park neighborhood has a population of 9,443, with 3,984 total households.
- The Cedar Park neighborhood has a population of 13,461 with 5,679 total households.

Description of Drop-off System

Currently, there are 24 block corner drop-off programs, one in Queen Village and 23 in Cedar Park. Although these programs differ operationally, given that they are organized at the community level, the overriding approach is similar. Key similarities include:

-- Residents bring glass, newspaper and aluminum to designated block corners at a designated time (Saturday mornings). Recyclables are brought in bags and piled up; no containers are used.

-- Volunteers are used to spot check delivered materials for contamination.

-- Two City trucks, each with two person crews, collect the bagged recyclables from each of the designated block locations. A packer truck collects newspaper; a compartmentalized truck collects sorted glass and aluminum.

-- Recyclables are transported directly to market.

- Individual program differences include:

-- Collection frequency (i.e., the oldest program in Queen Village operates weekly, whereas a newer program in Cedar Park collects materials every other week).

-- Targeted materials (i.e., the newer Cedar Park program collects mixed paper in addition to newspaper, and glass and aluminum containers. Queen Village only targets newspaper and glass and aluminum containers).

- It is estimated that 7,250 tons of residential MSW (including recyclables) are generated in the target area for the Queen Village Program and 10,336 tons in the target area for the Cedar Park Program.

Other Recycling Opportunities

- As mentioned, the City is in the process of expanding its curbside program. It is reported that drop-off participation declines in neighborhoods when citizens find out that they will be receiving curbside collection.
- Other types of drop-off programs exist in Philadelphia. Of note is a program that specializes in mixed paper and plastic, neither of which are included in the curbside or most block corner programs. This program was developed by the Recycling Advisory Committee and is managed by the Weavers Way Cooperative with heavy volunteer participation.
- Neither of the above programs directly compete with the drop-off programs serving the Queen Village or Cedar Park target areas.

Diversion

- Table IV-22 presents a summary of recovered materials from the two block corner

Table IV-22. Philadelphia Block Corner Program (Queen Village and Cedar Park) Recovered Recyclables (FY 1993) (Tons Per Year)

Materials	Queen Village	Cedar Park	Total
Newsprint	160.0	149.5	309.5
Glass, unspecified	87.5	50.5	138.0
Aluminum	2.5	2.0	4.5
Total	**250.0**	**202.0**	**452.0**

studied.

- It is estimated that the Queen Village Program results in a 3.45 percent diversion rate, while the Cedar Park program achieves a 1.95 percent diversion.

Program Costs

- The annual costs to operate the block corners programs are estimated to be:
  - -- Queen Village: $15,000
  - -- Cedar Park: $12,120
- Average total costs per recovered ton from both systems are $60.00.
- Revenues received from sale of materials were not used to offset program costs, but were returned to the communities to support other projects. FY 1993 revenues, not reflected in Table IV-22, were:
  - -- Queen Village: $1,688
  - -- Cedar Park: $1,105

J. TOWN OF WEST GREENWICH, RHODE ISLAND

Rhode Island has a 70 percent waste processing goal, which is to be achieved through reuse, recycling, commercial and home composting, and generation of power. Two State agencies regulate and enforce solid waste management: the Department of Environmental Management (DEM) and the Solid Waste Management Corporation (SWMC). These agencies provide Statewide leadership and fill roles typically handled by counties in other states.

Each of the State's 39 municipalities is required to pass a mandatory recycling ordinance. In exchange, the municipality receives grants and technical support for implementing recycling programs. The State requires residential source separation of newspaper; glass food and beverage containers; aluminum, tin and steel cans; and PET and natural HDPE bottles.

West Greenwich launched a voluntary recycling program in 1989; a formal program was begun in December of 1990 and became mandatory in 1991. In fact, the Town became the first municipality in Rhode Island to institute a mandatory drop-off program. This program became the prototype for other DEM drop-off programs.

Demographics

- West Greenwich is a rural town southwest of Providence with a 1990 Census population of 3,750 people.
- The Town occupies 51.2 square miles.
- There are approximately 1,316 single family households in the Town and no multi-family residences.
- The median annual household income was $41,250 according to the 1990 Census.
- Eighty-one percent of the population graduated from high school, and 21 percent have at least a four-year college degree.
- Additionally, a Town planning survey revealed that 94 percent of the Town's population own their own home; 54 percent are executives or professionals; 13 percent are skilled laborers; and 10 percent are retired.
- The drop-off target area is comprised of the 73 percent of the Town's households that use the Town Transfer Station to dispose of trash and recyclables (approximately 961 households).

Description of Municipal Solid Waste (MSW) Management System

- Approximately 73 percent of Town residents deliver their trash and recyclables directly to the Town's Transfer Station, which is located at the extreme eastern border of the Town.
- The Transfer Station is open to the public on weekends and on Wednesday nights during the summer.
- The average distance travelled by residents to the Transfer Station is eight miles.

- The remaining 27 percent of residents elect to pay $18.00 per month for private collection and disposal/processing of solid waste and recyclables. Materials collected are taken either to the landfill or the MRF operated by the SWMC.
- The total amount of residential MSW (including recyclables) generated in the Town in FY 1993 was 1,604 tons.
- The Town's drop-off recycling program diverted 156 tons from the SWMC landfill to commercial markets.

Description of Drop-off System

- The Transfer Station serves as the only drop-off site in the Town.
- The site was developed around the basic DEM program, which uses State-designed, low profile, covered roll-offs to collect materials. Newspaper is collected separately from "mixed recyclables," which includes aluminum cans, foil and scrap; glass food and beverage containers; plastic milk jugs and soda bottles; and tin (steel) cans.
- The Transfer Station also accepts other materials for recycling not included in this analysis, such as yard waste, used tires, white goods and other metals, and used oil and oil filters.
- In addition, the Transfer Station provides an opportunity for residents to swap reusable materials.
- The drop-off center is staffed by two people during operating hours.

Convenience and Site Aesthetics

- The drop-off center is conveniently located in that the majority of residents deliver their waste to the Transfer Station anyway.
- The site is neatly maintained with adequate signage.
- The site is not paved, but is surfaced with adequately-draining sand.
- The site is unlighted; however, the facility is only open in daylight hours.

Public Education

- West Greenwich used a customized version of DEM's education package to publicize drop-off recycling. DEM's basic program, developed in conjunction with a public relations firm, has been used across the State.
- DEM estimates that it costs $3,000 to $4,000 to customize its program for a specific community. Out-of-pocket costs to produce and distribute educational literature averages about 29 cents per household.
- Currently, the Town spends almost nothing to publicize drop-off recycling. New residents receive copies of educational brochures distributed during the 1990-91 program start-up.

- The Town relies on word of mouth, an occasional sign at the Transfer Station, reminder in the Town newsletter, and reports to the Town Council. The local elementary school also has a recycling club.

Other Recycling Opportunities

- No competing recycling programs operate in West Greenwich.

Diversion

- The Town's drop-off recycling diverted 156 tons of materials in FY 1993.
- Table IV-23 presents a summary of recovered materials.

Table IV-23. Town of West Greenwich Drop-off Recycling Program Recovered Recyclables (FY 1993) (Tons Per Year)

Material	Quantities
Newsprint	109.0
Clear Glass	15.0
Green Glass	9.0
Brown Glass	5.0
PET and HDPE (Soda Bottles and Milk Jugs Only)	7.0
Metal Cans	11.0
Total	**156.0**

Program Costs

- West Greenwich pays solid waste management costs out of property taxes. In FY 1993, the Town spent $92,300 to manage solid waste. Of this, $13,459 was used to fund drop-off recycling.
- Table IV-24 presents a summary of annual costs for FY 1993.

Table IV-24. Town of West Greenwich Drop-off Recycling Program Annual Costs (FY 1993)

Component	Annual Cost ($)
Operating and Maintenance[1]	$ 11,459
Education and Administration	2000
Total	**$ 13,459**

[1]Net of revenue from sale of recovered materials.

K. CENTRAL VIRGINIA WASTE MANAGEMENT AUTHORITY

The Central Virginia Waste Management Authority (CVWMA) was formed in 1990 under the Virginia Water and Sewers Authority Act of 1973 in response to Virginia State Legislation that established a requirement for recycling planning and required reduction of municipal solid waste by 25 percent by 1994. According to its charter, CVWMA's purpose is to plan, develop and manage solid waste management systems for any one or more of the 13 political subdivisions that make up the Authority's members.

On behalf of its member jurisdictions, CVWMA contracts with the private sector for a variety of services, including residential MSW collection, street sweeping, curbside and drop-off recycling, and yard waste composting. Each member has the opportunity to participate in CVWMA's regional programs. Member jurisdictions pay a $0.50 per capita assessment to CVWMA annually, which funds CVWMA's general administrative functions. In addition, participating jurisdictions pay service fees to CVWMA to cover the costs of the programs in which they are participating. In some cases, a portion of the revenue from the sale of recyclable materials is returned to the participating member.

Because CVWMA's service area is diverse, three jurisdictions that participated in the drop-off program in 1993 were selected for more detailed analysis as part of this study: (1) Chesterfield County (which has aggressively embraced curbside collection for recyclables but maintains drop-off sites for those parts of the County not yet served by curbside); (2) the City of Petersburg (which relies on drop-off sites as its sole recycling mechanism); and (3) Henrico County (which is moving to a subscription approach to curbside recycling while expanding their drop-off locations).

1. Chesterfield County

Demographics

- Chesterfield County is a suburban county covering an area of 446 square miles, located on the northwest border of the City of Richmond. In 1992, the County had an estimated population of 225,100.
- The predominant housing type in the County is single family homes (67,004 residences). There are approximately 10,235 multi-family dwelling units.
- Approximately 84.2 percent of residents have completed high school; 29.2 percent have completed 16 years of education.
- The median annual household income is $43,604 per year.
- The drop-off recycling target area is defined as all residents not receiving curbside collection (75,264 households).

Description of Municipal Solid Waste Management System

- Residential MSW in the County is collected through an open private collection system, in which residents contract with the private hauler of their choice.

- The County owns and operates two landfills within its borders that accept MSW generated in the County. Additionally, there are private disposal facilities outside of the County that accept residential and commercial waste from County sources.
- Total residential MSW generated from the drop-off recycling service area in 1993 is estimated to be approximately 83,881 tons per year.

Description of Drop-off System

The County's drop-off recycling system has three components: CVWMA drop-off sites, school-based drop-off sites, and landfill drop-off sites.

- Eight drop-off sites through the CVWMA drop-off recycling program:
  - -- Compartmentalized 34-cubic yard roll-off containers placed at these CVWMA locations in 1993 are used to collect designated materials. Each roll-off is divided into eight compartments.
  - -- Materials collected include clear, green and brown glass (collected in separate compartments); aluminum cans and foil and steel cans (collected in one compartment); HDPE and PET plastic containers, including clear and colored HDPE containers and wide-mouthed containers of either resin (collected in separate compartments at some sites and single compartment at other locations); and newspaper.
  - -- Roll-off containers are collected when full. An informal pull schedule has been developed at some sites where the volume of collected materials is fairly constant and predictable. At other locations, County staff responsible for monitoring the sites notify the contractor when the containers require servicing. Typically, empty containers are placed when full containers are pulled. Sometimes, however, a shortage of available containers will necessitate picking up a full container and leaving the site vacant until it can be emptied and returned.
- 27 school-based drop-off sites:
  - -- Program was initiated as a cooperative venture between County schools and Southeast Recycling, a local recycling processor.
  - -- Newspaper and aluminum cans are collected in 40-cubic yard roll-off containers sited in parking lots of 27 schools across the County.
  - -- Southeast Recycling collects materials from the containers on a rotating basis, or when notified by the participating schools.
  - -- Containers are serviced at no charge; Southeast Recycling splits revenues from the sale of materials with the participating schools.

-- These sites are maintained by student volunteer groups, parent or community groups, or school maintenance staff.

- Corrugated cardboard recovery at County landfill sites:
  -- Two- to four-cubic yard dumpsters with slots for depositing corrugated cardboard are placed next to the CVWMA drop-off containers already sited at the County's two landfills. Corrugated cardboard is not included as part of this study.
  -- These containers are serviced as part of regular landfill operations.

Convenience and Site Aesthetics

- Some drop-off locations are situated in high traffic areas; others require a special trip by users.
- Signs directing residents to the drop-off locations are small and easily missed; some schools have no signs at all.
- Signage at some of the sites has been confusing; residents are unclear about which compartments to use for what materials. CVWMA has recently invested in new, brightly colored signs with more precise instructions. These signs are expected to reduce confusion and contamination levels.
- Certain operational practices have also resulted in confusion. At locations where more than one container has been sited, County staff have blocked drop-off compartment doors with large metal "C" clamps to ensure that residents fill one container fully before using the second container.
- Roll-off boxes observed were in poor condition, with peeling paint, rust spots and stickers crossed out. The contractor is in the process of repainting the containers and retrofitting each container with brackets for the new signage.

Public Education

- CVWMA has sole responsibility for public education efforts at its drop-off sites in the County. For participating jurisdictions, CVWMA staff will coordinate special "grand opening" events to initiate a new site, sometimes working with local radio stations. CVWMA will also provide a jurisdiction with educational brochures to promote the drop-off sites. As mentioned above, CVWMA has recently updated the signage at its sites in the County.
- Participating schools are responsible for promoting the school-based sites. In most cases, the program has been in place for several years and requires little promotional support.
- No County staff time or funding has been allocated for public education for the drop-off recycling initiative.

Other Recycling Opportunities

- Curbside recycling was available for 1,975 households in the County in 1993. Materials collected were the same as in the drop-off program, as well as poly-coated paperboard and aseptic packaging.

Diversion

- A total of 3,081.8 tons of materials were recovered through the County's drop-off program in 1993. Table IV-25 presents the contribution of the CVWMA and school programs toward this total.
- Based on the residential MSW generated in the drop-off service area in 1993 (80,799 tons), the diversion rate for the drop-off system is calculated to be 3.67 percent.

Table IV-25. Chesterfield County Drop-off Program
Recovered Recyclables (1993)
(Tons Per Year)

Material Collected	CVWMA Sites	School Sites[1]	Total Quantities
Newsprint	529.3	1,995.0	2,524.3
Clear Glass	296.6		296.6
Green Glass	32.3		32.3
Brown Glass	38.1		38.1
PET and HDPE Plastic Containers	99.3		99.3
Aluminum Cans and Foil	26.6	32.0	58.6
Steel Cans	32.6		32.6
Total	**1,054.8**	**2,027.0**	**3,081.8**

[1]School sites only accept aluminum cans and newsprint.

Program Costs

- Table IV-26 presents estimated program costs for the County's drop-off programs in FY 1993.
- Revenue from the sale of materials was $15,227, yielding a net annual cost for the program of $127,421.
- The estimated net cost per recovered ton is $41.35.

Table IV-26. Chesterfield County Drop-off Recycling Program Annual Costs (FY 1993)

Program Element	Annual Cost ($)
CVWMA Administration[1]	$ 2,403
Contractor Costs [2]	57,913
County Costs [3]	12,996
Southeast Recycling Costs (School Sites)[4]	69,336
Gross Total Costs	**$142,648**
Revenue from Sale of Materials	15,227
Net Total Costs	**$127,421**

[1]Chesterfield County pays a $0.50 per capita annual assessment to CVWMA for general operating and administrative expenses, including technical and public education support of the drop-off recycling program. Based on data provided by CVWMA staff, drop-off program expenses that can be allocated to Chesterfield County have been estimated.

[2]Costs paid to Chambers Waste Systems of Virginia for the number of pulls of drop-off containers provided to Chesterfield County in FY 1993.

[3]Estimated costs of recycling coordinator time spent on the drop-off recycling program and site maintenance workers.

[4]Estimated cost based on the cost per ton of servicing the CVWMA containers and the tonnage collected in the school program adjusted to exclude container rental (no charges are actually made; the program is voluntary as part of a community service to the County's schools).

2. City of Petersburg

Demographics

- The City of Petersburg is located approximately 20 miles south of the City of Richmond and covers approximately 23 square miles.
- In 1994, the City had an estimated population of 38,400 residents.
- There are approximately 10,926 single-family residences and 5,270 multi-family residences in the City.
- More than 62 percent of the residents have completed high school, and approximately 13.5 percent have completed 16 years of school.
- The median per family income is $21,309 per year.

Description of Municipal Solid Waste Management System

- The City provides refuse collection to all single-family residences within the City limits.
- City crews and vehicles also collect refuse from those multi-family dwellings and commercial establishments not using dumpster collection. It is estimated that the City provides refuse collection to approximately 20 percent (300 to 400 accounts) of all multi-family and commercial generators in the City.
- The City owns and operates a landfill located within its borders; this site has an estimated life of approximately 10 years.
- The costs of the City's solid waste and recycling management systems are paid through landfill disposal fees and a $7.00 per month refuse fee assessed on all residential units and the commercial and multi-family accounts receiving City-provided refuse service.
- The estimated quantity of MSW delivered to the City's landfill in 1993 was 31,200 tons. This figure also includes waste collected by private haulers from generators not serviced by the City. According to representatives from the City, no MSW from City residents or businesses is disposed in private landfills or out-of-City disposal sites.
- Approximately 60 percent of the MSW entering the City's landfill is from the residential sector and 40 percent is from the commercial sector.
- Approximately 19,077 tons of residential MSW (including recyclables) are generated in the drop-off recycling target area.

Description of Drop-off System

- There are six CVWMA drop-off recycling sites in the City. Three of the drop-off sites are located at schools; one is located at an athletic field; one is located in a neighborhood; and one site is located at a church.
- As with Chesterfield County, all CVWMA drop-off sites in Petersburg use covered 34-cubic yard compartmentalized containers divided into eight compartments.
- Materials collected include: clear, green, and brown glass (collected in separate containers); aluminum and steel cans and foil (collected in one compartment);

HDPE and PET plastic containers (collected in separate compartments); and newspaper.

- Five of the sites are sponsored by a group (i.e., church, school, or civic organization), and each sponsoring group is responsible for maintaining its adopted site. In return, sponsors receive a share of the revenues from sale of materials recovered at the site.
- The one site that has no sponsor is maintained by the City.
- The City monitors all sites on a regular basis to ensure that the sites are being maintained adequately.
- All sites are unstaffed and available for use 24 hours per day.
- Containers at two sites are serviced weekly by the CVWMA contractor; others are serviced as needed. Typically, empty containers are left when a full container is collected.

Convenience and Site Aesthetics

- The City's drop-off sites are located in medium to high-traffic areas considered to be easily accessible to residents. The City feels that the drop-off program provides a high level of convenience.
- As with Chesterfield County, the condition of the roll-off boxes provided by the recycling contractor varies, and the equipment is being cleaned and retrofitted for new signage.
- Three of the City's drop-off sites are paved and two are located on a gravel surface. No lighting or fencing has been installed at any site.

Public Education

- Public education is the sole responsibility of CVWMA. No additional resources of the City are dedicating to promoting the program.
- Informal promotion of the drop-off sites by sponsoring organizations is also assumed to take place.

Other Recycling Opportunities

- No additional residential recycling opportunities are available in the City.

Diversion

- In 1993, approximately 357.2 tons of recyclables were collected through the drop-off program. Table IV-27 presents a summary of the tons collected by type of material.
- Based on an estimated MSW generation rate for residential MSW in the target area of 19,077 in 1993, the drop-off recycling program diverted 1.87 percent in 1993.

Table IV-27. City of Petersburg Drop-off Program
Recovered Recyclables (1993)
(Tons Per Year)

Materials	Tons Per Year
Newsprint	231.6
Clear Glass	76.3
Green Glass	9.7
Brown Glass	8.2
PET and HDPE Plastic Containers	21.9
Aluminum Cans and Foil	4.3
Steel Cans	5.2
Total	**357.2**

Program Costs

- Table IV-28 presents a summary of the City's FY 1993 drop-off recycling costs.
- With revenue from the sale of materials at $1,506, the net cost of the drop-off program is estimated to be $13,070.
- The average net cost per ton of collected materials is estimated to be $36.59.

Table IV-28. City of Petersburg Drop-off Program Annual Costs (FY 1993)

Program Element	Annual Cost ($)
CVWMA Administration[1]	$ 390
Contractor Costs[2]	9186
City Costs[3]	5000
Gross Total Costs	**$14,576**
Revenue from Sale of Materials	1506
Net Total Costs	**$13,070**

[1]The City of Petersburg pays a $0.50 per capita annual assessment to CVWMA for general operating and administrative expenses, including technical and public education support of the drop-off recycling program. Based on data provided by CVWMA staff, drop-off program expenses that can be allocated to the City of Petersburg have been estimated.

[2]Costs paid to Chambers Waste Systems of Virginia for the number of pulls of drop-off containers provided to Petersburg in FY 1993.

[3]Estimated cost of City staff time spent on the drop-off recycling program and site maintenance workers.

3. Henrico County

Background Information and Demographics

- Henrico County is an urban county covering approximately 245 square miles, on the southeast border of the City of Richmond.
- The 1994 population is estimated at 230,000 residents.
- There are 64,070 single-family residences and 36,283 multi-family residences in the County.
- More than 81 percent of the residents have completed high school, and approximately 19 percent have completed 16 years of school.
- The median annual per family income is $35,604 per year.
- Approximately 6,250 single-family households received curbside recycling collection services in 1993; therefore, the drop-off service area has been defined as 94,103 households (57,820 single-family and 36,283 multi-family).

Description of Municipal Solid Waste Management System

- Residential refuse collection in the County is predominantly handled through an open system; however, the County provides refuse collection to approximately 20,000 residences with public crews and vehicles.
- There are two MSW landfills located in the County; one is owned and operated by the County and one is private.

- The County's solid waste system and recycling are funded through landfill disposal and refuse collection fees charged to those generators receiving County refuse service.
- Approximately 435,000 tons of MSW were generated in the County in 1993 and disposed either at one of the two in-County landfills or out-of-County. Of this quantity, approximately 35 percent (152,250 tons) was generated by the residential sector and 65 percent (282,750 tons) by the commercial sector.
- Residential MSW (including recyclables) generated in the target area was 147,656 tons in 1993.

Description of Drop-off System

There are three major components of the County's drop-off recycling program, as described below.

- 15 CVWMA drop-off sites:
  - -- All sites use covered 34-cubic yard compartmentalized containers that are divided into eight compartments.
  - -- Materials collected at all sites include: clear, green, and brown glass (collected in separate containers); aluminum and steel cans and foil (collected in one compartment); HDPE and PET plastic containers (collected in separate compartments); and newspaper.
  - -- Sites are located primarily at fire stations (13 sites) and landfills (2 sites).
  - -- All sites are unstaffed and open 24 hours per day.
  - -- Containers are serviced on a weekly schedule by the CVWMA contractor or as needed, depending on the site.
- Newspaper collection containers:
  - -- There are four 16-cubic yard newspaper collection containers, two of which are located at the landfill sites and two at heavy-traffic CVWMA sites.
- County Landfill:
  - -- There are drop-off opportunities for other materials (scrap metal, yard waste, used oil, corrugated cardboard, batteries, pallets, telephone books, and magazines) at the County Landfill.

Convenience and Site Aesthetics

- CVWMA drop-off sites are located in medium to high traffic areas and are easily accessible to residents.
- Container appearance is maintained by the CVWMA contractor; however, a County staff person must ensure that containers are not overflowing at frequently used sites.
- All sites have lighting, are paved, and have some type of screening from roadway view (per County Zoning Ordinance requirements).

Public Education

- Though public education assistance is available from CVWMA, the County's Department of Public Utilities has also developed a full-color brochure to promote the drop-off sites.

Other Recycling Opportunities

- A CVWMA pilot curbside program serving 6,250 homes has been in operation for 3.5 years. This service may be modified to a subscription program in which residents will be able to sign up for curbside collection services for $2.00 per month. This fee would entitle residents to every-other-week curbside recycling service.

Diversion

- Approximately 3,402.8 tons per year of recyclables were collected from Henrico County drop-off sites in 1993. Table IV-29 presents a breakdown of annual tonnage by material type.
- Based on the tons of residential MSW and recyclables generated, the drop-off program results in a waste diversion rate of 2.31 percent.

Table IV-29. Henrico County Drop-off Recycling Program Recovered Recyclables (1993) (Tons Per Year)

Materials	CVWMA Sites	County Sites	Total (Tons Per Year)
Newsprint	1,431.9	1,040.0	2,471.9
Telephone Books/Magazines[1]		82.0	82.0
Clear Glass	514.9		514.9
Green Glass	54.8		54.8
Brown Glass	65.8		65.8
PET and HDPE Plastic Containers	144.7		144.7
Aluminum Cans and Foil	35.9		35.9.
Steel Cans	33.0		33.0
Total	2,280.8	**1,122.0**	**3,402.8**

[1]Estimated to be 50% telephone books (41 tons) and 50% magazines (41 tons).

Program Costs

- Table IV-30 presents the estimated cost of the County's drop-off recycling system in FY 1993.
- The estimated cost of County support for the CVWMA program and their own drop-off collection activities in 1993 was $20,000 for public education and $50,000 for site maintenance/service.

- Revenues paid by the CVWMA contractor in 1993 were $26,248.
- Total average net cost per recovered ton was $41.36 in 1993.

Table IV-30. Henrico County Drop-off Program Annual Costs (FY 1993)

Program Element	Annual Cost ($)
CVWMA Administration[1]	$ 5,196
Contractor Costs[2]	91,790
County Costs[3]	70,000
Gross Total Costs	**$166,986**
Revenue from Sale of Materials	26,248
Net Total Cost	**$140,738**

[1]Henrico County pays a $0.50 per capita annual assessment to CVWMA for general operating and administrative expenses, including technical and public education support of the drop-off recycling program. Based on data provided by CVWMA staff, drop-off program expenses that can be allocated to Henrico County have been estimated.

[2]Costs paid to Chambers Waste Systems of Virginia for the number of pulls of drop-off containers provided to Henrico County in FY 1993.

[3]Estimated costs of County staff time spent on the drop-off recycling program (including $20,000 for public education) and site maintenance workers.

L. CITY OF NORFOLK, VIRGINIA

The City of Norfolk is a municipal member of the Southeastern Public Service Authority of Virginia (SPSA). Solid waste processing, disposal, and recycling are handled through this agency. Funded through tipping fees only, SPSA owns and operates the drop-off and curbside recycling programs servicing their members, which include: Cities of Norfolk, Chesapeake, Franklin, Portsmouth, Suffolk and Virginia Beach and the Counties of Isle of Wight and Southampton.

SPSA is the lead agency for planning and reporting recycling program progress, as required by Virginia State law, which establishes a waste reduction and recycling goal of 25 percent. The City of Norfolk has been selected for further analysis as one component of the SPSA system. In addition, the City has implemented some drop-off recovery efforts outside of the auspices of SPSA; these efforts will also be addressed.

Demographics

- The City of Norfolk is an aging urban jurisdiction with a 1990 Census population of 261,229 residents.
- Norfolk occupies 65.7 square miles and houses the largest naval base in the world.
- The City has 50,633 single family residences and 28,357 multi-family housing units.
- The drop-off program service area is defined by the City as the households that are not receiving curbside recycling collection services, or 54,990 residences.
- 72.7 percent of the residents have completed at least 12 years of education and 16.8 percent have completed 16 or more years of education.
- The median annual household income is $23,563 per year.

Description of Municipal Solid Waste Management System

- Municipal solid waste (MSW) from all single-family residences, some multi-family dwellings, and some limited commercial generators is collected by the City
- City residential generators are provided with 90-gallon carts, which are collected once-per-week using fully and semi automated collection vehicles. Residents pay $74.04 per household per year for solid waste services.
- Households are receiving separate yard waste collection services, and yard waste from City residents is taken to a SPSA yard waste composting facility.
- City-collected MSW is delivered to a SPSA owned and operated transfer station within the City limits. City MSW is then delivered to a SPSA disposal or processing facility.
- Total MSW disposed from City generators in 1993 was estimated to be 277,644 tons; nearly 60 percent of that amount is assumed to be commercially generated waste. Residential waste is assumed to account for approximately 40 percent of the total.
- Based on number of households in the drop-off service area, residential MSW quantities, including recyclables, generated by households served by the drop-off program are estimated to be 79,091 tons per year.

Description of Drop-off System

- Compartmentalized 30-cubic yard roll-off boxes are used to collect designated materials.
- Most sites are unattended, located in areas of high traffic (such as shopping centers or strip malls)
- For the SPSA program, SPSA personnel use a roll-off truck to collect the full containers and tip them at a nearby processor. City staff unattended sites daily to monitor fullness of containers and call for SPSA pick-up when needed.
- When containers have been emptied, they are returned to the sites. Most sites have more than one container, so sites are typically not left without drop-off capacity.
- Before SPSA began its drop-off recycling program, Norfolk contracted with Tidewater Fibre Corp., a local processor, for a drop-off recycling system. Two sites are still equipped with Tidewater Fibre Corp. containers for paper products. In addition, several sites accept old magazines, using 90-gallon wheeled carts supplied through contract with Tidewater Fibre Corp.
- Contamination from the City's drop-off program is estimated to be 17 to 21 percent. This number is believed to be artificially high because the processing methods used at the processing facility result in contamination of otherwise acceptable materials. An 8 to 10 percent contamination rate is believed to be more accurate.

Convenience and Site Aesthetics

- Recycling drop-off centers have been sited based on availability of land, perceived need for the facility in an area, and suitability of the site. Most sites are in high-traffic areas.
- Some signs have been placed along roadways and thoroughfares to direct participants to the drop-off sites.
- In some areas, vandalism has been a problem with drop-off centers -- from graffiti on the boxes to fires that have been set. These sites are being evaluated to determine if more suitable locations can be found.
- City crews are responsible for maintaining sites.
- Lighting and other site characteristics vary depending on location

Public Education

- Public education is a shared responsibility between SPSA and the City. Each SPSA roll-off site is equipped with at least one metal box that contains brochures describing the program. SPSA supplies these brochures and ensures that the boxes are full.
- The City also produces and distributes flyers about the program; these materials are photocopied and do not represent a significant outlay of funds.
- Predominantly, there is a reliance on word of mouth and phone calls to City offices to inform residents about the program.

Other Recycling Opportunities

- Curbside recycling was provided by SPSA to 24,000 households in City of Norfolk in 1993.
- The curbside program targets newspapers, clear glass, aluminum cans, ferrous cans, plastic milk jugs and soda bottles, and household batteries.

Diversion

- Table IV-31 presents a summary of the total estimated recovered tons from targeted households in 1993.
- Based on residential MSW disposed by households in the service area, the diversion rate from the drop-off program is estimated to be 1.24 percent.

Table IV-31. City of Norfolk Drop-Off Recycling Program
Recovered Recyclables (1992-1993)
(Tons Per Year)

Materials	SPSA Program	Norfolk Program	Total Quantities
Newsprint	551.7	258.0	809.7
Office Paper		34.3	34.3
Clear Glass	64.4		64.4
Green Glass	5.7		5.7
Brown Glass	5.0		5.0
PET (Soda Bottles Only)	17.0		17.0
HDPE (Milk Jugs Only)	15.6		15.6
Aluminum Cans	9.9		9.9
Ferrous Cans	21.2		21.2
TOTAL	**690.5**	**292.3**	**982.8**

Program Costs

- Table IV-32 presents a summary of system costs. Total annual costs are estimated to be $88,581.
- Revenue from materials sales in 1993 was $4,060.

Table IV-32. City of Norfolk Drop-Off Recycling Program Annual Costs (FY 1993)

Component	Costs
SPSA Operating Costs[1]	$27,473
SPSA Administrative Costs[2]	$1,996
City of Norfolk Admin/Misc. Costs[3]	$2,766
City of Norfolk Site Attendants	$38,143
Hauling	$10,670
Container Rental (Tidewater Fibre)	$5,760
Portable Toilets (Rental)	$972
Site Maintenance	$400
Public Education	$400
Gross Total Costs	$88,581
Revenue from Sale of Material	$4,060
Net Total Cost	$84,521

[1]Includes driver's salaries, container cleaning, roll-off operating costs, roll-off truck annualized debt service, drop-off container annualized debt service, container maintenance and repair, and container signage. Total SPSA drop-off system costs have been allocated to City of Norfolk based on number of pulls from Norfolk sites as a percentage of total SPSA drop-off pulls.

[2]Based on percentage of time dedicated to Norfolk drop-off recycling porgram (as reported by SPSA staff) for the following positions: Recycling Coordinator, Public Information Specialist, and Secretary II.

[3]Includes percentage of Clean Community Coordinator and clerical salaries, site maintenance and waste disposal, posting and fabrication of signs, and miscellaneous supplies.

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