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**Recycling Technical Assistance Project
#429**

**Borough of Mount Carmel,
Northumberland County**

**Comparative Cost Analysis of
Curbside Collection
with and without
Drop-off Augmentation**

February 2008



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Introduction

The Recycling Technical Assistance Program is sponsored in partnership by the Pennsylvania Department of Environmental Protection (DEP) through the Solid Waste Association of North America (SWANA), the Pennsylvania State Association of Township Supervisors (PSATS) and the Department of Community and Economic Development (DCED) Governor's Center for Local Government Services. Qualifying municipalities wishing to enhance their recycling, composting, and waste reduction programs are provided with professional support to assist them achieve their goals and objectives.

Mount Carmel Borough, Northumberland County, requested technical assistance to evaluate the current curbside collection program and to explore potential improvements for future consideration. Additionally, the Borough sought support in comparing a variety of alternatives with which to supplement its curbside program with drop-off collection sites. The project was to address four issues: 1) determining the cost versus benefits of curbside collection methods; 2) weighing the value of those methods against the current all volunteer system; 3) establishing the impact of providing supplemental drop-off sites on the cost and performance of curbside collection; and 4) targeting the equipment most compatible with the local processing outlets and Borough finances.

As the consultant selected to manage the project, Nestor Resources, Inc. is pleased to submit to the Borough of Mount Carmel our findings and recommendations. This report includes background data, resources and references, as well as explanations and justifications for the consultant's suggestions.

Background

The Borough of Mount Carmel qualifies as a community mandated to recycle by the Municipal Waste Planning, Recycling and Waste Reduction Act of 1988, Act 101. The Act requires larger municipalities in the Commonwealth to implement mandatory residential curbside collection programs for recyclables and leaf waste and to ensure that commercial, institutional, and government establishments also manage recyclables and leaf waste accordingly. Municipalities with populations over 10,000 and those with populations between 5,000 and 10,000 that also have a population density of 300 persons per square mile must comply. Additionally, mandated communities are subject to the provisions of Act 140, which specifies conditions for receiving and utilizing Section 904 Performance Grant funds.

Currently, the Borough provides residential curbside collection of recyclables once per month via a network of volunteer organizations. To supplement these efforts, the Borough offers a somewhat primitive recycling drop-off site at the municipality's maintenance garage. The drop-off site also accepts brush and twigs. Waste collection occurs through subscription services between homeowners and a variety of local haulers. Commercial and institutional establishments also contract directly with local haulers, however, unlike residents, recycling is required to be included in that service.

An Act 101, Section 902 Implementation Grant was recently awarded to the Borough. The grant was for the purchase of equipment to advance Mount Carmel's recycling efforts, primarily through expansion of drop-off collection sites. More detailed information on collection costs and efficiencies exists since submission of the grant request. Therefore, rather than forge ahead with the ideas proposed in the original application, Mount Carmel officials took a more prudent approach and sought technical assistance prior to finalizing any purchases or implementing any programs changes.

Project Scope of Work

Task #1: Nestor Resources, Inc met with the Borough Manager , a representative from Council and the Northumberland County Recycling Coordinator to discuss the current and proposed collection practices, perceived problems, budgetary requirements, political constraints, compliance issues, overall performance of the recycling and leaf collection program and future expectations. In addition, the consultant and the Recycling Coordinator made field observations in the municipality in order to become familiar with proposed drop-off locations, logistical limitations of curbside and/or drop-off collection; and gain an overall understanding of the demographics of the community.

Task #2: Nestor Resources, Inc. reviewed material provided by the Borough including; annual reports, and ordinances relevant to solid waste management and recycling. The consultant compared current recovery/recycling results to those that could be expected, based on national studies, for the types of materials collected in a municipality with similar demographics. The consultant provided projections of potential recovery that could be expected with a comprehensive curbside collection system.

Task #3: Nestor Resources, Inc. conducted a cost comparison of a variety of curbside collection options. The consultant used current gross payroll rates for Borough public works employees as the basis to estimate potential costs of curbside collection of recyclables. These projections will enable the Borough to weigh competitive bids via a contract scenario. The consultant conferred with the Borough to establish those costs associated with the Borough labor crew. Using that information together with industry standards for productivity, fuel and maintenance and equipment costs, the consultant projected the comparative cost of collection. The pros and cons of utilizing a supplemental drop-off collection system in addition to curbside collection were also provided by the consultant. In addition, the consultant provided a cost comparison of purchasing and operating the Haul-All equipment system to other conventional methods. The impact of local processing constraints and capabilities was considered in the equipment comparison

Task #4: The consultant provided a draft memo of the preliminary findings to the Borough Manager. The consultant then met with the Borough Manager and the Council to present the findings and to address any questions and concerns.

Task # 5: Nestor Resources, Inc prepared and submitted to the Pennsylvania Department of Environmental Protection (PADEP) for review and comment, a draft project report, which summarized the consultant's findings and recommendations. Based on the PADEP's input, the consultant revised and finalized the report. Both the Borough and the Department were provided with the report in electronic format. In addition, a hard copy of the document was submitted to the Borough.

Summary of Recommendations

Primarily, the purpose of this project was to provide Mount Carmel Borough with a tool to evaluate the collection system for recyclables that made the most economic sense. More specifically, the project was to provide a detailed cost comparison of the system, which was proposed in a recently approved grant request, to other methodologies. Additionally, it was to offer a mechanism to evaluate the results of a competitive bid in the event the Borough would be inclined to contract for the collection services.

Nestor Resources, Inc. conducted a cost analysis of five curbside collection systems that may or may not be augmented by drop-off collection sites. One of the sites was configured with the equipment and locations as proposed in the grant application. The other four options used conventional equipment with historical success in the industry and were designed to be compatible with local processing or market outlets. Detailed projections of material that could be available for recovery based on national trends were used to determine the equipment capacity and frequency of service requirements in the analysis. Officials were provided with a table outlining the results of the analysis. The consultant offered commentary on the positive and negative aspects of each model featured. The results of the cost comparison analysis offer two "least cost" options. Improvements to ensure full compliance and avoid costs overruns were noted by Nestor Resources, Inc.

The following is a summary of the consultant's findings and suggestions:

- Mount Carmel should consider the affordability of collection options for garbage, leaf waste and recyclables due to the number of residents on fixed incomes.
- In reviewing the options provided in this report, the Borough should consider that its current volunteer program is not truly free and likely has hidden costs that are incorporated into the public works budget. The unpredictability of volunteers creates a situation in which the Borough often falls short of compliance through missed or inadequate collections. Borough Council should consider using its own employees or contracting for service.
- It has been suggested that the Mount Carmel School District would realize savings if the Borough could provide this service. Based on the analysis, when equipment purchases and vehicle operating costs are considered in addition to labor, it is doubtful that the Borough could offer a more competitive rate.
- Based on the findings of this report, Mount Carmel could add more materials to its collection program without significant cost increases.
- At face value, the Borough's reported residential performance shows success. However anomalies in the reported figures indicate that much of the reported volume is coming from commercial sources. The options used in the analysis were designed to handle the volume of material expected to be available for recovery from residential sources. Use of any of the drop-off systems by commercial businesses would have a negative impact on the available capacity and result in cost overruns.

- Mount Carmel should make a greater effort to enforce its commercial recycling ordinance. Not only will it keep the Borough in compliance with Act 101, but also it will control costs in the Borough's residential program and increase the tonnage eligible for PADEP Act 101, Section 904 Performance Grants. Alternatively the Borough should include businesses in the program and institute user fees.
- Educating residents and commercial, institutional and municipal establishments about the features of the recycling program and the requirements of the recycling ordinance at least once every six months would ensure the Borough's compliance with Act 101 and also increase participation.
- While the Haul-All system has had success in many areas, the layout of the system proposed for Mount Carmel raises some issues. Three of the materials, glass, aluminum and bi-metal cans, are already collected at curbside. The drop-off configuration is redundant and excessive based on the municipality's mandate to provide curbside collection. Borough Council should eliminate these materials from any drop-off portion of its collection program.
- The location of the drop-off sites proposed in the Haul-All System is also of concern. The Borough should consider one centrally located site that can be kept under surveillance. Alternatively, the Borough should include as many materials as possible in its curbside program, thus eliminating the need for drop-off collection.
- The Borough is surrounded by Mount Carmel Township on all sides. The Township has neither curbside nor drop-off collection for recyclables. Use across municipal borders is not a great issue if this were intended to be a joint municipal program. The Township and the Borough should consider future discussions to optimize joint programs and avoid duplication of efforts and equipment. In a contract/bid scenario, the higher volume of customers would offer a lower rate than if each jurisdiction sought stand alone service.
- Residents are more likely to participate in a recycling or waste reduction program if doing so is convenient. Mount Carmel should opt for the most convenient system within its budget.
- Curbside programs in which materials are collected more frequently are more successful than those that only collect once per month or on a less consistent cycle. Borough Council should consider a more frequent and consistent collection schedule.
- The capacity available to store materials at drop-off sites in between collections can have a positive or negative affect on costs and public perception. Lesser capacity results in the need for more frequent collections. Mount Carmel should look closely at these cost variables as it reviews the options presented in this report.
- Vehicle capacity is just as crucial in controlling costs. Even with sufficient container capacity, a vehicle too small to handle the stored material will result in increased costs. Capacity is also important in curbside collection, where multiple materials are collected on the same vehicle. Mount Carmel should avoid small capacity vehicles for use in its program and look to those options requiring the least circuits per route.

- During the time that this study was conducted, inquiries were made to determine what if any revenue could be generated from the resale of materials in any of the options. The results were negligible when compared to the costs of collecting separated materials. Therefore the need to separate material to generate revenue may not outweigh the costs.
- The Haul-All system and its proposed configuration resulted in the highest cost option in the analysis. Costs to operate this system in Mount Carmel would be \$531.49 per ton, \$247,846.35 annually, or the equivalent of \$5.69 per home per month. Even by altering some of the components, costs cannot be reduced enough to compete with the less costly alternatives. Therefore, Borough Council should look to other equipment options and collection methodologies.
- The system that costs less than others in the category of separated material collects glass, metal, plastic and newspaper at the curb, augmented by a 30 cubic yard drop-off container for cardboard. Costs to operate this system would be \$383.39 per ton, \$178,783.67 annually, or the equivalent of \$4.11 per home per month. This option is compatible with the Coal Township Recycling Facility and could provide opportunities for the Borough to market material to other outlets.
- The overall least cost option in the analysis is the full curbside dual stream collection in which commingled aluminum, bi-metal and plastic is collected commingled once per month and newspapers and magazines are collected once per month on the alternating service week. Glass is not collected in this option. No drop-off sites would be necessary in this option. This option provides limited outlets for materials because of the commingled collection. Likewise, in a competitive bidding situation, the field of contractors could be narrow depending on open access to the recycling facility willing to accept this material. Costs to operate the system would be \$198.98 per ton, \$69,625.49 annually, or the equivalent of \$1.60 per home per month.
- The full curbside dual stream system is roughly 40% less than the cheapest curb sorted system and approximately 72% less costly than the Haul-All system. Therefore, Borough Council should explore this option further to determine if it is limited to implementation only through contracted services or if utilizing Borough employees is also a feasible alternative.

The Community

Mount Carmel Borough is located in Northumberland County deep in the Coal Regions of Eastern Pennsylvania. Here the progressive decline of anthracite mining is still evident in spite of minor resurgence in the industry. Although rural counties in Eastern Pennsylvania are growing three times faster than rural counties in Central and Western Pennsylvania, the influx of migration from New York and New Jersey has yet to reach Northumberland County or Mount Carmel. That it is surrounded on all sides by Mount Carmel Township has impact on the Borough's ability to expand. In fact, the Borough experienced a population decline over the last few decades directly proportional to decreasing job opportunities, but also because land to build new homes is more readily available in the surrounding municipality.



Nevertheless, a strong sense of heritage and community pride is displayed throughout the town. A respect and concern for the local environment is seen in attempts to sustain and revamp aging neighborhoods. Homes are relatively well maintained, with many showing recent improvements. Roadways and yards have little debris. Several historic buildings have been preserved as businesses and offices. Communities displaying "sustainable behaviors" such as these are generally more favorable toward recycling programs.

The layout of the town is appealing. Wide easily navigable streets reduce the effect of the sloping hillsides upon which the town was constructed. They provide a feeling of space, in spite



of the 3,629 housing units located within the 0.7 square miles of the Borough limits, and an average housing density of 5,483.6/square mile. The close proximity of homes combined with streets that allow for passage of larger vehicles is a bonus for the implementation of curbside collection programs. Additionally, the distance to and from any point within the municipality is short enough to minimize the amount of drop-off sites necessary to service the needs of all residents.

Today the median income for a household in the Mount Carmel is roughly \$22,168, similar to 39 percent of all homes in rural Pennsylvania. Studies by the U.S. Bureau of Economic Analysis show that these homes are becoming increasingly dependent on unearned income. In fact, data indicates nearly 40 percent of all personal income in rural Pennsylvania originates from sources such as interest, Social Security and Unemployment Compensation. Homes on such fixed incomes are increasingly sensitive to the cost of utilities and public services. Therefore, ensuring the affordability of collection for garbage, leaf waste and recyclables is important in Mount Carmel.

Current Programs

Ordinances establish the requirements for solid waste disposal and recycling in Mount Carmel. Residents are required to separate recyclables and leaf waste from garbage and place them at the curb for collection on designated days or take them to a drop-off site. There are no provisions for mandatory residential waste collection. Multi-family dwellings are required to have containers for the collection of recyclables available to residents. Commercial establishments must separate for recycling cardboard, high grade office paper, and aluminum and leaf waste. There are no requirements that businesses contract for waste collection, however, it is the responsibility of the establishment to see that the recyclables make it into the “recycling system”. Haulers must receive “written authorization” to operate within the Borough limits. The ordinance does specify that the Borough can enter into contracts or franchise the collection of recyclables. No such authority is specified for waste collection, however, municipal code does grant that authority.

Solid Waste

Three waste haulers are dominant in Mount Carmel. These include Mostick Brothers, Moser’s Sanitation and Waste Management. Rates are established by each company and paid directly by their residential and commercial customers. Residential customers primarily pay by the bag and commercial customers’ rates are based on container volume/weight and frequency. It is likely that less than 100% of residents and businesses actually contract for waste collection.

Recycling

Recyclables are collected at the curb one time per month in each ward of the Borough. The materials collected are limited to brown and clear glass bottles, aluminum beverage cans and foil as well as steel/bi-metal cans. Volunteers from the local Cub Scout Pack and Boy Scout Troop as well as the Lions and Rotary Clubs provide this service. Each organization is assigned a specific week and ward. The Borough donates \$2400 per year to each organization for their service. The material collected, as well as associated revenue, remains the property of the Borough. Revenues from last year’s sales amounted to a little over \$1000. Collection methodologies used by the volunteers are very labor intensive. Materials are hand sorted at the curb. Since conventional collection equipment is not available the volunteers have improvised using pick-up trucks and 55 gallon drums. Borough employees transport the materials to market once per week.

The once per month curbside collection technically meets the minimum regulatory frequency requirements. However, the unpredictability of volunteers can create a situation in which the Borough might fall short of compliance through missed or inadequate collections. The minimum schedule and unreliable service also has a negative impact on participation and recovery.

That all commercial and institutional establishments contract for collection of recyclables is unlikely. There is some evidence that certain types of small businesses may take advantage of the curbside and drop-off programs. This is most apparent in the reported quantity of glass recycled in 2006, which was 110% of the quantity one might expect to see recovered based on national trends. Furthering suspicions that the material was generated by businesses, particularly

bars and restaurants, about 2/3 of the quantity reported is identified as brown rather than the clear glass more commonly found in homes.

Leaf Waste

Leaves are collected at the curb in the fall. Other forms of leaf waste can be dropped at the Borough’s Maintenance Facility. Providing a drop-off site for leaf waste only partially meets the regulatory requirement. The disposition of that material is equally important. Adequate provisions for chipping, shredding and composting seem lacking in the Borough. To be in compliance with Act 101, the Borough needs to provide for collection of leaf waste at least twice annually and must provide or make available a drop-off location for leaf waste during the months when there is no leaf waste collection. However, issues related to leaf waste management are outside the scope of work for this project.

Projected Recovery

Mount Carmel Borough is mandated by Act 101 to provide to residents collection of recyclables at the curb. The minimum collection frequency to comply with the Act is once per month. Utilizing a volunteer labor force, Mount Carmel currently meets that criterion. These efforts are supplemented with a small drop-off site. Currently glass bottles, aluminum and bimetal cans are collected at the curb one time per month in each ward. Table 1 shows the expected yearly quantity of these materials and others that might be collected in a curbside recycling program, if the materials were collected at the same rate as the national average. A more detailed explanation can be found in Appendix A.

Table 1 Residential Performance Comparison to National Trends

Material	Expected Generation tons per year	Current Reported Recovery tons per year	Percent of Expected Recovery	Expected Recovery tons per year	Expected Recovery per Household lbs/pickup*
Glass	259	71.5	110%	65	1.38
Aluminum	44	2.98	19%	16	0.34
Bi-Metal Cans	57	21.18	59%	36	0.76
Plastic #1 and #2	159	n/a	n/a	27	0.57
Newspapers	281	n/a	n/a	247	5.24
Magazines	58	n/a	n/a	24	0.51
Cardboard	71.4	n/a	n/a	51.4	0.04

* Tpy x 0.02119677 e.g. [2000/ (3629 x 26)], includes all homes not just those participating.

Opportunities for Improvement

Overall, the Borough’s reported residential performance shows success. The degree of success should be closely examined. Program improvements might be needed more than the data would indicate because some anomalies are notable in the reported figures. Specifically, glass recovery

is 110% of the national average. A significant portion of the reported recovery is brown glass. Brown glass is generally more prevalent in bars and restaurants than it is in households. This points to use of a system by commercial businesses that was designed to serve the needs of residents. The higher volume shown in bi-metal cans might also be indicative of participation by similar businesses. That no commercial tonnage is reported to the Borough by haulers is another indicator that few businesses use outlets for recyclable material other than the residential program.

At face value, the current weekly collection appears to adequately recover residential materials. However, it is likely that a higher residential recovery rate would result with a few changes. Bi-weekly collection presents the most promising opportunity for change. Based on findings from the *National Diversion Rate Study* conducted by SERA, Inc., a dramatic improvement in recovery occurs when collection frequency is increased from once per month to every other week. The study also documents that the addition of paper to a collection program provides higher recycling percentages.

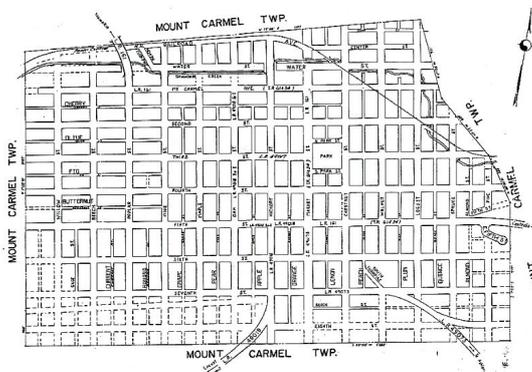
Table 1 illustrates the expected recovery in pounds per pickup per home assuming bi-weekly collection or 26 pickups per year and collection at the national average rate. Not only does it show the potential increase in recovery for those materials currently collected, but also the increase due to the addition of new materials.

Local Benchmarks

In order to evaluate the different alternatives available to Mount Carmel Borough for the collection of recyclables, it was necessary to establish baseline criteria that could be applied in a comparative analysis. The community size, layout and quantities of recyclable materials that may be collected in a curbside collection program were all considered. That some of the materials could potentially be collected at supplemental drop-off sites was also a consideration.

Borough Collection Characteristics

Mount Carmel Borough has 3,629 homes and a land area of 0.7 square miles. The Borough street map shows that street layout is a grid pattern with main streets alternating with smaller streets or alleys. Assuming that a vehicle in one pass could service homes for recycling pickup on both sides of the smaller streets or alleys, the total route miles required to service all residences is about 7 miles.



The time required to collect recyclables from all homes in the Borough was assessed using a 65% maximum set out rate and a 6 hour collection period. A 65% maximum set out rate means that for an average collection period, about 2 out of every 3 homes will have bins placed at the curb for collection. Assuming that the collection crew will work 8 hours, this allows 2 additional hours for tipping, pre and post trip inspections, paperwork and lunch.

In such a high density area like Mount Carmel, collection crews should be able to service 1.5 homes per minute or 90 homes per hour. Assuming the 65% maximum set out rate allows for a total of 135 homes (both with and without bins at the curb) to be routed per hour. This represents 3.72% of the total homes in the Borough. Although 22.3% of the Borough or 810 homes would be routed during a 6 hour collection period, it is likely that no more than 527 homes would place bins at the curb for collection. To service all of the homes would require 26.9 hours, or 4.5 days. The average route distance traveled per collection period would be 1.56 miles.

With bi-weekly collection, if the Borough were to continue collecting glass, aluminum and bimetal and attain the national averages, crews could expect to encounter 2.48 pounds per home per pickup. During a 6 hour period, they would collect 2,008.8 pounds or about 1.0 ton. Using an average waste density of 300 pounds per cubic yard for the three uncompacted materials would require 6.7 cubic yards of vehicle body space, or 3.35 cubic yards if compacted at 2:1. Specifically glass would occupy 4.09 cubic yards and weigh .61 tons; aluminum would occupy 0.17 cubic yards and weigh .026 tons; and bi-metal cans would occupy 1.21 cubic yards and weigh 0.18 tons.

Additional materials may be considered for inclusion in Mount Carmel's program. Many factors will have impact on the final decision to add them to the program. These are the overall weight of each material; the volume each material will occupy in a vehicle or container; the availability of local outlets for the material; and the ease of handling and storing material.

Loose newspapers are considerably heavy and they are generated in sufficient quantities by residents. It is expected that crews would collect 7.72 pounds per home per pickup. During a 6 hour collection period the route would yield 6,253.2 pounds, or about 3.1 tons. At 400 pounds per cubic yard this increases the required vehicle capacity by 10.6 cubic yards (4244 lb @ 400 lb/cy) to 17.3 cubic yards, nearly full capacity on a typical 18-20 cubic yard compartmentalized vehicle. If a compaction unit was available the paper would occupy 8.65 cubic yards at a 2:1 compaction ratio. Depending on the vehicle capacity, adding newspapers at the curb could increase the tipping trips required than if only glass, aluminum and bi-metal cans were collected. Similar in density to newspapers, magazines could be another likely material to consider for collection, adding another 10% in volume.

High volume low density material like plastic will require greater container and vehicle capacity if a compaction unit is unavailable. This could result in low weight and more frequent tipping. Likewise cardboard has similar capacity and density issues as well as a lower household generation rate as compared to businesses.

Expected recovery of plastic #1 and #2 is 450 pounds per 6 hour collection day. The reported density of mixed plastic #1 and #2, uncompacted is 32 pounds per cubic yard. Compacted the average density increases to 375 lb/cy. Therefore, a 6 hour collection period would yield 14 loose cubic yards. If well compacted, the required volume would be 1.2 cubic yards. Depending on the vehicle capacity and compaction capabilities, adding plastics at the curb could increase the tipping trips required than if only glass, aluminum and bi-metal cans were collected.

Commercial businesses are the source of 90% of the corrugated cardboard generated. Therefore the capacity required to service the needs of just the residents in Mount Carmel is less than if the intent of the system were to provide service to the commercial sector. Recovery of corrugated cardboard from residential sources, if Mount Carmel were to attain the national averages, is

expected to be 51.4 tons per year. Density is about 100 pounds per cubic yard loose; 400 pounds per cubic yard compacted. This is the equivalent of 0.4 tons per bi-weekly collection day or 8.8 loose cubic yards per collection day. Compacted this would represent 2.2 cubic yards per collection day. Cardboard can be collected at the curb. However, it could increase the tipping trips required depending on the vehicle capacity and compaction capabilities, the other materials collected curbside.

Collection Scenarios

Once the anticipated volume and weight of material is established, it becomes easier to compare the efficiency and cost of various collection methodologies. Understanding capacity and weight limitations is crucial in planning for equipment purchases and labor requirements. Errors can occur at both ends of the spectrum. Underestimating capacity needs often results in operational cost overruns. These occur due to excessive time servicing overflowing drop-off sites, or, in curbside programs, time spent off-route to unload more frequently. Overestimating capacity requirements typically leads to costly and unwarranted equipment purchases as well as time spent servicing empty containers or tipping half full loads. Therefore, the benchmarks established in the analysis of Mount Carmel's waste generation and composition will factor heavily into the evaluation of the different available collection scenarios.

Existing System

Residents of Mount Carmel Borough receive curbside collection for glass, aluminum and bi-metal cans one time per month. Additionally, the Borough offers a drop-off site for the same materials. Volunteers collect material and Borough employees transport it to market. Labor costs for this program are nearly \$43,000 annually; \$10,000 for volunteers and \$32,889 for employees. Other expenses that should be allocated to the program, such as fuel, maintenance, insurance, tires, etc are currently not easily accounted for as they are integrated into the public works budget. Mount Carmel School District currently allows residents within the district to utilize drop-off containers located at the High School. Containers are available for aluminum and bi-metal cans, newspaper, magazines and plastic. The School District pays a local hauler to service these containers. It is estimated that the annual cost to the School District is approximately \$5000. Access to both the Borough's and also the School District's drop-off sites are somewhat limited and not available 24/7.

Proposed Haul-All System

Mount Carmel Borough was recently awarded a PADEP Act 101, Section 902 Recycling Development and Implementation Grant from the Recycling Fund. The original grant application requested \$61,855 to purchase bins for residential curbside collection and community venues. Also requested was \$279,020 to purchase two vehicles and sixteen 6 cubic yard side loading containers. The vehicles were to be used for curbside collection and also to service the side loading containers at a series of drop-off sites located in and just outside the Borough in neighboring Mount Carmel Township. One of the proposed sites was intended to service the needs of the local Mount Carmel High School, which is located in the Township. Table 2 shows the locations of the proposed sites; the materials to be collected in each 6 cubic yard container at the site; the total cubic yards available for each material; and the total cubic yards of available capacity in the system. All sites would be available 24/7.

Table 2 Proposed Haul-All Site Locations, Configurations and Capacity

Mount Carmel East	Mount Carmel West	Mount Carmel High School	Cubic Yards per Commodity
Aluminum Cans	Aluminum Cans	Aluminum Cans	18
Bi-Metal Cans	Bi-Metal Cans		12
Glass	Glass		12
Newspaper and Magazines	Newspaper and Magazines	Newspaper and Magazines	18
Plastics	Plastics	Plastics	18
Cardboard	Cardboard	Cardboard	18
Total Available Capacity			96

The table helps to illustrate some issues that must be questioned in the proposed layout of the system. Three of the materials, glass, aluminum and bi-metal cans, are already collected at curbside. The grant proposal indicates that three plastic bins would be distributed to residents to separate these items for continued collection at the curb. If Mount Carmel were to attain the national averages, the projected bi-weekly recovery from residents for all of these materials, would be 32.16 loose cubic yards. The proposed configuration offers 42 yards of drop-off capacity. Even if one were to take the 6 cubic yard container at the High School out of the equation, the drop-off configuration is redundant and excessive based on the municipality’s mandate to provide curbside collection. It is possible that the containers could be serviced in conjunction with the curbside program. However, other influencing factors, which will be discussed later in this narrative, could make that prohibitive.

Typical Site Configuration of Haul-All Containers



It is projected that Mount Carmel would recover roughly 51 loose cubic yards bi-weekly if the national averages for newspaper and magazine recovery were attained. That is more than the capacity proposed in the Haul-All configuration. Based on the projected recovery, the 14 cubic yard vehicle capacity and the total container capacity available, three 6 yard containers would need to be serviced at a minimum 2 times per week. Based on operation of the system with similar configurations in other counties, a 3 time per week collection schedule would be more prudent. With three

locations, there is no guarantee that the volume of material will be distributed evenly at each site. Therefore, overflows and a need for more frequent service could result in cost overruns. Adding additional 6 yard containers would lessen site overflow. However, it would not resolve the issue of service frequency as the vehicle capacity is already less than the sum total of the containers.

This study has demonstrated that with bi-weekly frequency and a conventional 18-20 yard compartmentalized vehicle body with no compaction, there would typically be just enough capacity to add newspapers and magazines to the curbside collection program. Compaction capabilities would double the available capacity. The average recovery projected for a 6 hour collection day is 11.17 loose cubic yards. To collect paper at the curb with the Haul-All system would require operating a second 14 cubic yard vehicle or collecting paper on alternating weeks from the glass, aluminum and bi-metal cans. This is necessary because the first vehicle has only three compartments and 11.17 cubic yards of paper alone would nearly fill the Haul-All vehicle. Cost comparisons with alternative site configurations and/or equipment will best determine whether to collect paper at the curb or via a supplemental drop-off location.

Plastics are not collected at the curb or the Borough's drop-off site in the current system. However, residents from within the School District, and not just Mount Carmel Borough, are permitted access to the containers at the High School. If Mount Carmel were to attain the national averages it would recover 63 loose cubic yards of plastics with a bi-weekly collection frequency, or 14 loose cubic yards per day. Based on the proposed configuration of the Haul-All sites the 6 cubic yard containers would require a minimum of twice per week collection. The proposed vehicle is not the more costly model that is equipped with Haul-All's auger system that reduces the volume of plastic and cardboard. Therefore a minimum of three collections per week will be required due to the limited onboard capacity of 14 cubic yards. Likewise, due to these

Haul-All Split Body Collection Vehicle



limitations, it would be difficult to add plastics to curbside collection without eliminating another material or, adding another vehicle. Most compaction units on conventional compartmentalized vehicles can handle 22 loose cubic yards of plastic. It would be possible to add plastic to such an equipped vehicle already carrying glass, aluminum, and bi-metal cans as well as newspaper.

In the current system, corrugated cardboard is not collected at the curb. Neither is it collected at the Borough's or High School's drop-off sites.

Cardboard can be collected at the curb. However, vehicle capacity, and sorting capabilities of the processing facility factor heavily into the costs. It is likely that Mount Carmel would find it prohibitive to collect cardboard in their curbside program. Therefore the capacity required to service the needs of just the residents in Mount Carmel is lesser than if the intent of the system were to provide service to also the commercial sector. Recovery of corrugated cardboard from residential sources, if Mount Carmel were to attain the national averages, is expected to be 51.4 tons per year. Density is about 100 pounds per cubic yard loose; 400 pounds per cubic yard compacted This is the equivalent of 0.4 tons per bi-weekly collection day or 8.8 loose cubic yards per collection day. Compacted this would represent 2.2 cubic yards per collection day.

Based on residential capacity needs, the containers for glass, aluminum and bi-metal cans would require less than once per month service even if the curbside option were not available. However, it is highly possible that unauthorized use could quickly consume capacity and lead to

cost overruns due to needs beyond the planned levels of service. The reported figures for the current collection system raise suspicion that local businesses already take advantage of the free drop-off sites and/or the monthly curbside collections, rather than pay for the service required to collect recyclables that they generate. Providing unmanned drop-off containers, with even greater capacity, and accessibility 24/7 as well as adding corrugated cardboard to the mix is an open invitation for unauthorized use at the Borough's expense. Because newspapers and magazines as well as plastics are generated in lesser quantities by businesses, they do not pose the same problems.

The location of the drop-off sites is also of concern. Mount Carmel Borough is only .7 miles across from border to border. Studies have confirmed that drop-off sites are successful in servicing a population within a 5 mile radius and to a somewhat lesser degree up to a 10 mile radius. The Borough is surrounded by Mount Carmel Township on all sides. The Township has neither curbside nor drop-off collection for recyclables. The placement of drop-off sites at the outer perimeters of the Borough and also at the High School would likely create a scenario in which Township residents reap the benefits at the expense of Borough tax dollars. Similar to the situation caused by unauthorized commercial users, the material from outside the Borough limits would increase the service frequency requirements and cause cost overruns for the Borough.

This may not be a great issue if this were a joint municipal program. Three factors do not lead to that conclusion. One, the Borough and the Township have no formal or informal arrangements or legal agreements for cost or equipment sharing. Two, subsequent to the Borough's grant, Mount Carmel Township submitted an identical grant application with drop-off locations more distant from the Borough. This indicates that the Township probably recognized the budgetary advantage of the proximity of Borough serviced drop-off locations. Lastly, no discussions occurred between the municipalities to determine equipment needs or service requirements.

Alternatives

A series of other methods and route configurations were examined to determine if any would be more effective and affordable than the system proposed in the grant. A vast number of potential scenarios are available, but only those that were compatible with the geography and the capabilities of the processing facilities were considered. While there are many variables in the methodologies, the constants are that material would be collected curbside every other week and the labor expenses are reflective of the Borough's average gross payroll costs. The differences are reflected in: the design and capabilities of the equipment; the capacity of containers and vehicles; the materials collected at curbside versus those at drop-off; and number of sorts required for the materials.

Labor Options

To implement its program, the Borough has three potential sources of manpower. Volunteers, public works crews, or private sector contracted labor. The current system uses a combination of all three. Volunteers and Borough employees serve the Borough's system, while the School District contracts with a private hauler to service its site. In order to compare the various collection alternatives, the average gross payroll costs of a Borough worker was used throughout the analysis. Because private sector rates differ from company to company, these costs were used as an equalizer regardless of whether the Borough opts to contract for services or to utilize its own employees. Obviously, if the Borough were to use volunteers, these costs would not

apply. It is doubtful, however, that a volunteer labor force could be relied upon to provide the level and frequency of service required in any of the proposed options.

Dedicated vs. Allocated Equipment

For Mount Carmel to implement its program using its own employees or a volunteer labor force, it would be necessary to acquire vehicles and containers. Although Mount Carmel has a current grant to fund these purchases, it is inevitable that equipment reaches the end of its useful life and must be replaced. Therefore, the full cost of the equipment is factored into the route analysis to demonstrate the true cost of the program and the reserves the Borough will need to set aside for future equipment replacement. For the purpose of consistency, this assumption was used in every option. It is important to note that in scenarios where the Borough contracts for services, the full cost of the equipment would be allocated based on a percentage of usage. In other words, if a contractor used a vehicle in the Borough one week per month, and was able to build routes in other towns, during the other three weeks then typically only 25% of that vehicle's depreciation would be allocated to the collection costs.

Sorting Methods

According to *Cutting the Waste Stream in Half: Record Setting Communities Show How*, a report prepared for the USEPA by the Institute for Local Self Reliance (ILSR), residents are more likely to participate in a recycling or waste reduction programs if doing so is convenient. The study asserts that even the perception of inconvenience of recycling has a strong influence on those opting not to recycle than among those who did. It has been demonstrated that the degree of effort required by individuals to separate recyclables from the household waste has a direct impact on the level of participation in recycling. Convenience and simplicity in the preparation of materials and delivery to the point of collection increase the amount of material recovered and the number of people that will recycle.

Traditional programs have always required participants to separate glass, metals, plastics and papers for placement at the curb in individual bins. Collection crews then manually deposited materials into separate compartments on the vehicle. These procedures were designed to be compatible with the low tech processing capabilities of the recycling facility. Additionally, they offered the collector an opportunity to off load specific materials at various locations. Mount Carmel Borough's current program uses these methods.

Multiple sort programs are labor intensive for both the homeowner and the collection crew. Because materials must be transported separately from one another, the need for compartments in curbside programs restricts the use of on board capacity. Likewise in drop-off programs separate routes are required for each commodity collected. Both result in more frequent trips to the processing facility. Consequently, the cost of collection in traditional programs is typically high. It is common that limitations of the receiving facility offer the collector no option. However, these costs are often off-set by lower processing costs or higher resale value for materials. If the collector benefits from such cost reductions or increased revenue, the upfront expense can be justifiable.

Processing facilities with newer technology have automated the sorting process. Electronic magnets, optical readers, screens and forced air mechanically sort materials. Rather than requiring participants to separate items individually, materials can be stored and placed at the

curb in the same bin. The term used for this process is commingled collection. Materials are collected and hauled together in the common body of the vehicle.

Dual Stream Collection
Paper is separated from other materials



In some programs bottles, cans and jugs are collected together but paper is separated. This is referred to as dual stream collection. In the most modern programs, even the paper is placed together with glass, metals, and plastics into one common container and hauled in a similar fashion. This is called single stream collection.

Whether the system is commingled, dual or single stream, the cost of collection is decreased with the removal of each sort at the curb. Likewise, in drop-off programs, these methods reduce the number of routes and costs required to service each commodity. Automation does add expense to the processing end. This can be offset by sufficient material volumes to provide the return on investment. In these situations, the overall cost of the program is lower.

Separated, commingled and dual stream options are presented in the analysis.

Point and Frequency of Collection

Just as with the effort required preparing and sorting materials for recycling, where recyclables are collected also has impact on participation and recovery. The ILSR report documented that curbside collection is generally a more effective way to maximize the amount of recyclable materials collected. The study demonstrates that curbside programs tend to result in higher participation and recovery rates than do drop-off programs. Curbside programs in which materials are collected more frequently are more successful than those that only collect once per month or on a less consistent cycle. The *National Diversion Rate Study* an analysis conducted by SERA, Inc, found that increasing the frequency of collection had the most dramatic impact on recovery in programs that changed from once per month to every other week collection.

Both fully curbside collection options as well as curbside collection augmented with drop-off sites are presented in the analysis.

Container and Vehicle Capacity

The capacity available to store materials at drop-off sites in between collections can have a positive or negative affect on costs and public perception. Lesser capacity results in the need for more frequent collections. It can contribute to a situation in which containers overflow resulting in blowing litter and unsightly locations.

The analysis compares options in which two types of collection containers are used. The Haul-All containers each have a capacity of 6 cubic yards. Multiple containers are placed at a site to hold materials separately. The contents of the container are emptied into the body of a collection vehicle and transported for processing. Multiple sites and containers can be serviced by one truck on a circuited route.

Detachable containers are serviced with either a roll-off or a hook-lift truck. These are typically 20 to 30 cubic yards. The container functions like the portable body of a truck. Rather than empty the container to transport material, the entire

Detachable Containers
Typical capacity is 20 to 30 cubic yards

container is transported to the processing facility. Often a container is left behind to eliminate the need for a return trip. The containers can be configured to handle one or multiple materials. These collection routes function in a spoke and hub fashion.



Vehicle capacity is just as crucial in controlling costs. Even with sufficient capacity on the ground, a vehicle too small to handle the stored material will require multiple trips to service the containers. Capacity is just as important in curbside collection, where multiple materials are collected on the same vehicle. The vehicle must be able to provide for a balanced load even



when some materials are generated in greater volumes than are others. Compaction units for one or more materials can greatly increase the capacity and therefore the distance a vehicle can travel before having to unload.

Compartmented Vehicles
One or more compaction units
optimize capacity

The analysis compares options in which four types of collection vehicles are used. One utilizes the Haul-All 14 cubic yard vehicle as proposed in the grant. Two options use a 20 cubic yard compartmented vehicle with one or more compaction units. Two scenarios use a 32 cubic yard common body rear loading compaction vehicle in which materials will be collected commingled or dual stream in alternating weeks. Three options in conjunction with the curbside vehicle also either use a roll-off or hook lift truck to transport detachable containers.

Commingled Collection
Rear Loading Compaction Vehicle



Comparing the Systems

The purpose of this project was to help Mount Carmel Borough compare the costs and effectiveness of a collection system proposed in its grant to other available methods. Five scenarios were selected for evaluation including the method proposed in the grant application. The options were designed to handle the volume of material expected to be available for recovery from residential sources. A brief description of each system follows.

OPTION A – Curbside and Drop-off Haul-All System

The Haul-All System offers both curbside and drop-off collections. Curbside collection of glass, aluminum and bi-metal cans would occur bi-weekly. Three 18 gallon plastic curbside bins would be provided to each housing unit. Two 14 cubic yard vehicles would provide service on 4 routes. Sixteen 6 cubic yard containers would be available at three drop-off locations. One route would provide curbside collection as well as service the glass, bi-metal and aluminum containers at three drop-off sites. This route would operate on a biweekly basis. Route Two would service the plastic containers located at three drop-off sites. Route Three would service the newspaper and magazine containers located at three drop-off sites and lastly the Fourth route would service the cardboard containers located at three drop-off sites. The three drop-off routes would each have to service the drop-off sites three times weekly in order to collect the volume of material that could be available from the residential sector.

OPTION B – Curbside separated glass, metal, plastic. Drop-off ONP and OCC

In this system, glass, aluminum and bi-metal cans would be collected bi-weekly at the curb along with plastic bottles. Three 18 gallon plastic curbside bins would be provided to each housing unit. Three routes would be needed. Route One would collect at the curb and be serviced by a 20 cubic yard vehicle with 5 compartments and 1 compaction unit for plastic. Route Two and Three would be serviced by a roll-off or hook lift truck. Each route would require a 30 cubic yard detachable container to hold cardboard and newspaper respectively. These containers would be located centrally within the Borough limits, probably at the maintenance facility. It is anticipated that the detachable containers would require service nearly 4 to 5 times per month each.

OPTION C - Curbside separated glass, metal, plastic, and ONP. Drop-off OCC

Newspaper and magazines would be added to the glass, aluminum and bi-metal cans and plastic bottles collected bi-weekly at the curb in this system. Three 18 gallon plastic curbside bins would be provided to each housing unit. Newspapers and magazines could be bundled. Only two routes would be necessary. Route One would collect at the curb with a 20 cubic yard vehicle with 4 compartments and 2 compaction units for plastic and newspaper. Route Two would utilize a roll-off or hook lift truck to service a 30 cubic yard detachable container to hold cardboard. This container would be located centrally within the Borough limits, probably at the maintenance facility. It is anticipated that the detachable container would be serviced nearly 4 times per month.

OPTION D - Curbside Commingled glass, metal, plastic. Drop-off ONP and OCC

Commingled glass, aluminum and bi-metal cans and plastic bottles would be collected bi-weekly at the curb in this system. One 32 gallon plastic bin would be provided to each housing unit. Only two routes would be necessary. Route One would use a 32 cubic yard compaction vehicle to collect at the curb. Route Two would use a roll-off or hook lift truck to service a 30 cubic yard detachable container that would contain newspaper, magazines and cardboard. This container, like the other detachable options, would be located centrally within the Borough limits, probably at the maintenance facility. It is anticipated that the detachable container would be serviced nearly 9 times per month.

OPTION E - Curbside Dual Stream. Alternating Service Weeks. No Glass

All material, except glass would be collected at the curb in this system. No drop-off sites would be required. Two 32 gallon plastic bins would be provided to each housing unit. Collection would occur every other week. Route One would collect aluminum, and bi-metal cans and plastic one week. The next week would have no service. Route Two would then collect newspaper and magazine on the other week. The next week would have no service and then the cycle would begin over again. In other words, all commingled material would be placed at the curb one week. On the next collection week newspaper and magazines would be set-out. On route one it would be possible to use a smaller 20 cubic yard compaction vehicle, however Route Two would require a 32 cubic yard compaction vehicle.

Clarifications and Comments

Table 3 and Table 4 provide the details of the systems and the costs associated with each. Assumptions are also provided. A few important comments are necessary to clarify the results.

- The options were designed to handle the volume of material expected to be available for recovery from Mount Carmel's residential sources. Use of any of the drop-off systems by commercial businesses or from persons outside the Borough would have a negative impact on the available capacity and result in cost overruns.
- Because some months have more than 4 weeks, an average of 4.33 weeks was used to calculate the service requirements. This may cause the routes in Table 3 to be shown as partial circuits. This is more an indicator of how many times the container or vehicle would fill to capacity during that timeframe, rather than when it is actually serviced.
- Tons available for recovery are shown as a constant in Table 4. Realistically, changes in convenience; frequency and point of collection; and materials, cause volume fluctuations.
- Options for dual and commingled collection would likely be contract services. In such situations the capital outlays and depreciation would not be designated 100% to one program. Operators would use the equipment in other municipalities and allocate the costs on a percentage based. This would apply in the other scenarios if they were to be contracted or a joint municipal project

Assumptions for Route Cost Estimates

DROP-OFF CONTAINERS

Each container = 6 or 30 cubic yards
 Number based on capacity required to store loose cubic yards between collections

LOOSE CUBIC YARDS

Based on projected recovery per commodity

WEEKS

4.33 weeks per month

ROUTE MILES

1 6 yd drop-off circuit = 34.4 miles
 1 30 yd drop-off circuit = 30.3 miles
 1 curbside circuit sort = 31.5 miles
 1 curbside circuit commingle = 35 miles

CURBSIDE SERVICE TIME

0.66 minutes per curbside unit sort
 0.33 minutes per curbside unit commingle/dual
 Man-hours = Curbside x1 Driver and 1 Helper

DROP-OFF SERVICE TIME

8 minutes per 6 cyd drop-off container lift
 30 minutes per 30 cyd drop-off container lift
 Man-hours = Drop-off x 1 Driver

TIPPING TIME

Time to drive roundtrip, weigh and unload at MRF = 60 minutes per route

Man-hours = Curbside x1 Driver and 1 Helper
 Man-hours = Drop-off x 1 Driver

OFF-ROUTE TIME

Pre and Post Trip
 Paperwork/Inspections/Lunch = 1.5 hours route day
 Man-hours = Curbside x1 Driver and 1 Helper
 Man-hours = Drop-off x 1 Driver

COMBINED ROUTE SERVICE HOURS

Curbside Service Time + Drop-off Service Time + Tipping Time +Off Route Time

VEHICLE COSTS

Fuel = \$3.40 per gallon @2.6 miles per gallon
 Tires = 1 set per year @ \$1200 per set
 Tags = \$200 per year per vehicle
 Insurance = \$10,000 per routed vehicle per year
 \$7,000 per spare vehicle per year
 Maintenance = \$12.98 per route hour based on similar costs from other PA county programs

LABOR COSTS

2008 average gross payroll = \$30.27 per man hour (based on Mount Carmel Wages)

CAPITAL RECOVERY

Straight line depreciation
 Based on 7 years of useful life

COLLECTION SCENARIOS

OPTION A

**Proposed Haul-All
 Curbside Bi-weekly
 14 cyd 4 Compartments
 Drop-off 16 6 cyd
 4 routes
 Glass, aluminum, bi-metal curbside & drop-off combined**

OPTION B

**Curbside Bi-weekly
 20 cyd 5 Compartments
 & 1 compaction unit
 Drop-off 2 30 cyd
 3 routes**

OPTION C

**Curbside Bi-weekly
 20 cyd 4 Compartments & 2 compaction units
 Drop-off 1 30 cyd
 2 routes**

OPTION D

**Curbside Bi-weekly
 Commingle 32 cyd Packer
 Drop-off Fiber 1 30 cyd
 2 routes**

OPTION E

**Curbside Bi-weekly
 Dual Stream Each Once Per Month
 32 cyd Packer
 Commingle No Glass 1 week
 Newspaper 1 week
 2 routes**

CODES

G=Glass A=Aluminum
 B=Bi-Metal P=Plastic
 N=News & Mags C=Cardboard

Table 3 Curbside Route Options Using Supplemental Drop-off Sites

COLLECTION SCENARIO	OPTION A	OPTION B	OPTION C	OPTION D	OPTION E
MATERIALS COLLECTED					
Route 1 curbside material(Option A is also drop-off)	G,A,B	G,A,B,P	G,A,B,P,N	G,A,B,P	A,B,P,
Route 2 drop-off material (Option E is curbside)	P	N	C	N C	N
Route 3 drop-off material	N	C			
Route 4 drop-off material	C				
ROUTE CIRCUIT FREQUENCY					
Route 1 # circuits per month	10.8	10.8	10.8	3.24	1.08
Route 2 # circuits per month	13	3.74	2.83	6.6	2.16
Route 3 # circuits per month	13	2.83			
Route 4 # circuits per month	13				
Total Circuits Per Month	49.8	17.37	13.63	9.84	3.24
CONTAINERS ON SITE					
Total Containers Required	16	2	1	1	0
LOOSE CUBIC YARDS COLLECTED					
Route 1 # cubic yards per circuit	6.02	18.63	28.68	64.21	17.6
Route 2 # cubic yards per circuit	10.5	30	30	30	50.26
Route 3 # cubic yards per circuit	8.37	30			
Route 4# cubic yards per circuit	6.6				
ROUTE MILES					
Total Route Miles Per Month	1713.12	539.71	425.94	313.38	113.4
CURBSIDE SERVICE TIME					
Total Service Hours Per Month	87.09	86.23	86.23	43.11	21.56
DRIVER DROP-OFF SERVICE TIME					
Total Service Hours Per Month	22.53	3.29	1.42	3.30	0.00
OFF ROUTE TIME					
Total Pre/Post Lunch Hours Per Month	35.70	10.50	9.00	5.25	3.24
CURBSIDE TIPPING TIME					
Total Tipping Hours Per Month	10.80	10.80	10.80	3.24	3.24
DROP-OFF TIPPING TIME					
Total Tipping Hours Per Month	38.7	8.70	3.74	8.70	0
COMBINED MAN HOURS					
Total Man Hours Per Month	308.90	240.90	232.67	116.90	51.75
COMBINED ROUTE SERVICE HOURS					
Total Route Hours Per Month	194.82	119.51	111.18	63.60	28.04

Table 4 Cost Estimates for Curbside Route Options Using Supplemental Drop-off Sites

COLLECTION SCENARIO	OPTION A	OPTION B	OPTION C	OPTION D **	OPTION E**
MONTHLY TONS AVAILABLE FOR RECOVERY					
	38.86	38.86	38.86	38.86	29.16
EQUIPMENT REQUIRED					
# curbside containers for service	12000	12000	12000	4000	8000
# drop-off containers for service	16	4	2	2	0
# routed vehicles	2	2	2	2	1
# spares	1	1	1	1	1
EQUIPMENT PURCHASE					
Curbside Containers	59,880	59,880	59,880	19,960	39,920
Drop-off Containers	109,200	20,000	10,000	10,000	0
Routed vehicles	169,820	205,000	212,000	197,000	145,000
Total purchases	338,900	284,880	281,880	226,950	184,920
VEHICLE					
\$ per route hour	37.31	39.80	40.48	58.73	72.56
\$ per ton	187.05	122.41	115.80	96.12	69.76
\$ annually	91,868.76	66,418.44	62,882.28	48,614.04	28,240.68
LABOR					
\$ per hour	30.27	30.27	30.27	30.27	30.27
\$ per ton	240.62	187.65	181.24	91.06	53.72
\$ annually	112,204.87	87,504.09	84,513.72	42,462.39	18,798.40
CAPITAL RECOVERY					
\$ per route hour	20.71	28.38	30.18	42.48	78.52
\$ per ton	103.82	87.27	86.35	69.53	75.49
\$ annually	48,414.29	40,697.14	40,268.57	32,422.86	26,417.14
TOTAL COSTS COLLECTION, LABOR & CAPITAL RECOVERY					
\$ per ton	531.49	397.34	383.39	256.71	198.98
\$ annually	\$247,846.35	\$185,285.41	\$178,783.67	\$119,709.55	\$69,625.49
COST PER HOME PER MONTH					
	\$5.69	\$4.25	\$4.11	\$2.75	\$1.60

** These costs would be significantly lower in a contract situation because the vehicle and capital recovery costs would be allocated on a % of usage basis.

Conclusions

Findings of this report provide Mount Carmel Borough with several issues for consideration. The first is to consider abandoning the volunteer efforts to provide stability and continuity to the program. The second is to utilize Borough employees or to contract for service. Moving from a once per month to a bi-weekly collection frequency to increase participation and material recovery is another consideration. The addition of more materials for curbside collection is yet another. Lastly, but most importantly is for Borough Council to determine to what degree the benefits of those changes impact the Borough's cost threshold, whether through taxes or user fees.

The cost comparison examined two basic curbside categories; one in which materials were separated at the curb; and the other in which materials were commingled to some degree. The systems ranked as follows:

The Haul-All system and its proposed configuration resulted in the highest cost option of any category in the analysis. It also presents the least opportunity to avoid cost overruns. Costs to operate this system in Mount Carmel would be \$531.49 per ton, \$247,846.35 annually, or the equivalent of \$5.69 per home per month. Even by altering some of the components, costs cannot be reduced enough to compete with the less costly alternatives. Therefore, Borough Council should look to other equipment options and collection methodologies.

The system that costs less than others in the category of separated material is one that collects glass, metal, plastic and newspaper at the curb, augmented by a 30 cubic yard drop-off container for cardboard. Costs to operate this system would be \$383.39 per ton, \$178,783.67 annually, or the equivalent of \$4.11 per home per month. This option is compatible with the Coal Township MRF and could provide opportunities for the Borough to market material to other outlets.

The overall least cost option in the analysis is the full curbside dual stream collection in which commingled aluminum, bi-metal and plastic is collected commingled once per month and newspapers and magazines are collected once per month on the alternating service week. Glass is not collected in this option. No drop-off sites would be necessary in this option. Costs to operate the system would be \$198.98 per ton, \$69,625.49 annually, or the equivalent of \$1.60 per home per month.

During the time that this study was conducted, inquiries were made to determine what if any revenue could be generated from the resale of materials in any of the options. The results were negligible when compared to the costs of collecting separated materials. Therefore the need to separate material to generate revenue may not outweigh the costs.

The full curbside dual stream system is roughly 40% less than the cheapest curb sorted system and approximately 72% less costly than the Haul-All system. This option provides limited outlets for materials because of the commingled collection. Likewise, in a competitive bidding situation, the field of contractors could be narrow depending on open access to the recycling facility willing to accept this material. Therefore, Borough Council should explore this option further to determine if it is limited to implementation only through contracted services or if utilizing Borough employees is also a feasible alternative.

Nestor Resources is confident that background information provided in the report, the detailed analysis of the collection options, and the discussions of the benefits, limitations and constraints of various methodologies, will simplify for Mount Carmel Borough the decision whether or not to purchase the equipment requested in the approved grant. The findings will also help the Borough justify their final selection of a collection system.

Appendix A



Nestor Resources, Inc.

Generation and Composition of Mount Carmel Borough Recyclables

Following is a review of the performance of the Mount Carmel Borough recycling program as it compares to national trends. It demonstrates the reported weight of material collected against the weight that could be recovered if Mount Carmel recycled at the average rate of communities across the nation. It includes a discussion of additional materials that may be considered in expanding the program.

Mount Carmel Borough, located in Northumberland County, Pennsylvania, is mandated under the provisions of Act 101 to provide for its residents curbside collection of recyclables. The current curbside and drop off program collects aluminum and bimetal cans, clear and brown glass jars and bottles. Other commonly recycled materials such as newspaper, magazines, cardboard, office paper and plastics are not currently collected. The Borough also conducts a leaf collection program. At other times of the year, yard waste is collected along with other municipal waste for disposal without recovery.

An analysis of the Mount Carmel Borough's municipal solid waste generation, composition and as compared to national figures was performed. It was based on data from a report commissioned by the U.S. Environmental Protection Agency, commonly known as the Franklin Study, but officially entitled *Municipal Solid Waste in The United States: 2006 Facts and Figures*.

The Franklin Study, initiated in 1960, is a periodic review of the national waste generation and recycling activities. It presents information on the composition of the nation's municipal solid wastes and the amount of the various wastes that are generated, recovered and disposed. These figures serve as a basis for determining the expected composition of the various materials included in the municipal solid wastes generated in Mount Carmel. The Franklin Study also provides a basis for comparing Mount Carmel's performance in recovering materials through recycling to the national norm. Data for 2006 from the Franklin Study were used as a basis for this analysis. These are the most recent data available and were used as a basis of comparison to Mount Carmel's 2006 data.

Table A-1 presents the results of the analysis. The first column in the table lists categories of materials in municipal solid waste (MSW). Column two entitled "Expected Generation" presents the quantity of the material expected to be generated as waste in Mount Carmel if it were produced at the same rate as it is nationwide. Column three, "Expected Recovery", shows the expected quantity of the material to be recovered in Mount Carmel if it were recycled at the same rate as it is nationwide. Column four entitled "Reported Recovery" presents the various materials documented in the Mount Carmel Borough annual recycling report for 2006. The fifth and final column presents the reported recovery as a percentage of the expected recovery if the materials were recycled at the national rate.

Several materials that are not currently collected are included in the table. The expected generation and recovery quantities are included to show the potential amounts of materials that might be expected to be collected in an expanded recycling program in the Borough. All of these materials are discussed in more detail below.

Table A-1 Mount Carmel Borough Waste Generation and Recovery

Material	Expected Generation tpy	Expected Recovery tpy	Reported Recovery tpy	Percent of Expected Recovery
Glass	259	65	71.5	110%
Aluminum	44	16	2.98	19%
Bi-Metal Cans	57	36	21.18	59%
Plastic #1 and #2	159	27	not collected	n/a
Newspapers	281	247	not collected	n/a
Magazines	58	24	not collected	n/a
OCC	714	514	not collected	n/a
Office Paper	144	94	not collected	n/a
Yard Waste	736	456	126.5	27.7%

To compare Mount Carmel's performance to the results of the Franklin Study, the data in the study needs to be analyzed to derive the figures that are comparable to the recycling rates reported by Mount Carmel. This analysis is required because the Franklin Study groups the materials in the national solid waste profile in categories different from the categories reported by Mount Carmel. For example, Mount Carmel reports numbers for glass recycling that are primarily the result of collection of packaging (jars and bottles) in the municipal wastes. In contrast, the Franklin Study reports glass as the total of glass packaging, (11.39 million tons per year) plus glass contained in durable goods (an additional 1.81 million tons per year). Thus, the numbers from the Franklin Study used for glass generated, recycled and disposed need to be the ones pertaining to glass containers and not all glass contained in the municipal waste stream.

Glass

The estimated annual quantity of waste glass generated nationally in 2006 was 13.20 million tons per year. Of this, 11.39 million tons per year of glass was in the form of clear and colored containers. This figure was used in determining the proportion of waste shown as available discards in the glass category on the table. Glass containers constituted 4.53% of the total municipal waste generated and were recovered nationally at the rate of 21.8%. Residential sources generate about 82% of the glass containers contained in MSW. Based on population it is estimated that 259 tons of waste glass packaging was generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 65 tons would be expected

to be recovered. The reported quantity of glass recycled in 2006 was 71.5 tons, 110% of the expected quantity based on the national norm. About 2/3 of the reported quantity is identified as brown glass. This amount is well above average and may reflect material collected from commercial sources such as bars and restaurants.

Aluminum

The estimated annual quantity of waste aluminum generated nationally in 2006 was 3.26 million tons per year. Of this, 1.32 million tons per year was contained in durable and nondurable goods and was not generally available for recycling. Thus, 1.94 million tons per year of aluminum in the form of packaging was included in determining the proportion of waste shown as available discards in the aluminum category on the table. This material constituted 0.77% of the total municipal waste generated and was recovered nationally at the rate of 35.6%. Residential sources generate about 82% of the aluminum packaging contained in MSW. Based on population it is estimated that 44 tons of waste aluminum packaging was generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 16 tons would be expected to be recovered. The reported quantity recycled in 2006 was 2.98 tons, 19% of the expected quantity.

Bimetal

Bimetal refers to tin cans which are over 99% steel. Bimetal cans are included in the Franklin Study in the category of ferrous metal wastes. The estimated annual quantity of ferrous metal wastes generated nationally in 2006 was 14.22 million tons per year. Of these 11.47 million tons per year was contained in durable and nondurable goods and not generally available for recycling. Thus, 2.75 million tons per year of ferrous metal wastes is in the form of containers and other packaging. Included in this figure are 0.24 million tons per year of steel drums and other steel packaging not included in residential recycling programs. The remaining 2.51 million tons per year was used in determining the proportion of waste shown as available discards in the bimetal category on the table. This material constituted 1.0% of the total municipal waste generated and was recovered nationally at the rate of 62.9%. Residential sources generate about 85% of the bimetal packaging contained in MSW. Based on population it is estimated that 57 tons of waste bimetal cans were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 36 tons would be expected to be recovered. The reported quantity recycled in 2006 was 21.18 tons, 59% of the expected quantity.

Plastic

The estimated annual quantity of plastic waste generated nationally in 2006 was 29.49 million tons per year. Of these 15.26 million tons per year was contained in durable and nondurable goods and was not generally available for recycling. Thus, 14.23 million tons per year of plastic in the form of packaging was included in determining the proportion of waste shown as available discards in the plastic categories on the table. This material constituted 5.66% of the total municipal waste generated and was recovered nationally at the rate of 10.6%. Residential

sources generate about 82% of the plastic contained in MSW. Plastics #1 (PET) and #2 (HDPE) account for about 49% of the plastic in waste packaging and are the types commonly included in recycling programs. Based on population it is estimated that 159 tons of waste plastic #1 and #2 were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 27 tons would be expected to be recovered.

Paper

The estimated annual quantity of waste paper generated nationally in 2006 was 85.28 million tons per year. This figure includes 44.84 million tons per year of nondurable goods such as newspapers, magazines and other printed matter. Also included in this category are about 9.26 million tons per year of material in a form that is not generally available for recycling, such as paper plates, towels, tissue, etc. The other 40.44 million tons per year of waste paper is waste packaging. The largest category of waste packaging is OCC, old corrugated cardboard, generated at a rate of 31.43 million tons per year.

ONP

ONP refers to old newspaper. Included in this category is newsprint and newspaper inserts since the two materials are generally mixed together as disposed or recycled. The estimated annual quantity of ONP generated nationally in 2006 was 12.36 million tons per year. This material constituted 4.92% of the total municipal waste generated and was recovered nationally at the rate of 87.9%. Residential sources generate about 85% of the ONP contained in MSW. Based on population it is estimated that 281 tons of waste ONP were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 247 tons would be expected to be recovered.

Magazines

The estimated annual quantity of waste magazines generated nationally in 2006 was 2.57 million tons per year. This material constituted about 1.02% of the total municipal waste generated and was recovered nationally at the rate of 40.5%. Residential sources generate about 85% of the magazines contained in MSW. Based on population it is estimated that 58 tons of waste magazines were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 24 tons would be expected to be recovered.

OCC

OCC refers to old corrugated cardboard. Materials included in this category are primarily cardboard boxes. Also sometimes included are folding cartons and paper bags. The latter were not included in this analysis. The estimated annual quantity of OCC generated nationally in 2006 was 31.43 million tons per year. This material constituted 12.50% of the total municipal waste generated and was recovered nationally at the rate of 72.0%. Commercial sources generate about 90% of the OCC packaging contained in MSW. Based on population it is estimated that 714 tons of waste OCC packaging were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 514 tons would be expected to be recovered.

Office Paper

Office papers include high quality office paper such as stationary, copy paper and computer paper. The estimated annual quantity of office paper generated nationally in 2006 was 6.32 million tons per year. This material constituted 2.51% of the total municipal waste generated and was recovered nationally at the rate of 65.7%. Residential sources generate about 25% of the office paper contained in MSW. Based on population it is estimated that 144 tons of waste office paper were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 94 tons would be expected to be recovered.

Yard Waste

Yard waste includes grass clippings, brush and leaves. Mount Carmel conducts a leaf collection program only. The quantity of material collected was reported to be 126.5 tons. At other times of the year yard waste is collected along with other municipal waste for disposal without recovery. The estimated annual quantity of yard waste generated nationally in 2006 was 32.40 million tons per year. This material constituted 12.9% of the total municipal waste generated and was recovered nationally at the rate of 62.0%. Based on population it is estimated that 736 tons of yard waste were generated in 2006 in Mount Carmel. If recycled at the national recycling rate, about 456 tons would be expected to be recovered. The reported quantity recycled in 2006 was 126.5 tons, 27.7% of the expected quantity. However, as noted above, grass clippings were not included.