New York City Department of Sanitation

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BACKYARD COMPOSTING IN NEW YORK CITY

A COMPREHENSIVE PROGRAM EVALUATION

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GLOSSARY OF SELECTED TERMS AND ABBREVIATIONS

(Note: definitions specifically regard the Backyard Composting Pilot Program)

B	Marine Park, Brooklyn Census Tract number 658
backyard	outdoor area behind or *adjacent* to a residential unit
baseline group	randomly selected sample of households whose waste composition was assessed in June 1997 before the Backyard Composting Pilot Program was introduced
baseline waste composition study	waste collection, sorting, and composition analysis that took place in June 1997, before the Backyard Composting Pilot Program had been implemented in the test tracts
bulk	nonrecyclable *small* bulk items commingled with other trash
BWPRR	Bureau of Waste Prevention, Reuse and Recycling
C:N	carbon-nitrogen ratio
capture rate	weight of collected recyclables/total weight of recyclables in the waste stream
CD	Community District
census tract	geographical area designated by the US Bureau of the Census for demographic purposes
Community District	one of the 59 administrative districts of New York City whose boards advise Borough Presidents and City agencies on planning and services
component category	sorted portion of MSW; for this study, component categories were: “recycling”, “food”, “yard”, “bulk”, “lost recyclables”, and “other”
composters	test tract residents who were in the Program, and who were interviewed for market research purposes
Composting Study market research	focus group/telephone survey project conducted in March 1998 to study recycling and composting attitudes within the test census tracts
control tract	the census tract in Little Neck, Queens in which selected households underwent waste composition analysis for comparative purposes; this area was not targeted for participation in the Backyard Composting Pilot Program
designated	specified as recyclable under the New York City Recycling Program (all paper, all metal, glass jars and bottles; plastic jugs and bottles; milk and beverage containers)
diversion rate	weight of collected recycling/total weight of MSW (trash + recycling)
DOS	Department of Sanitation
follow-up waste composition studies	waste collection, sorting, and composition analysis that took place in October 1997 and June 1998, after the Backyard Composting Pilot Program had been implemented in the test tracts
food waste	animal and vegetable products, beverages, and food-soiled napkins and paper towels
garbage	MSW not set out for recycling
general public	population of New York City residents throughout the five boroughs who are over the age of 18, actively recycling, and responsible for making household decisions about recycling, from which a survey sample was drawn for market research purposes
grasscycling	the practice of leaving grass clippings on the lawn to decompose after mowing, rather than bagging and disposing of them (also known as leaving-it-on-the-lawn)

in-vessel system	a composting system in which decomposition takes place within an enclosed vessel
L	Little Neck, Queens Census Tract number 1507.01
lost recyclables	metal, paper, and recyclable glass and plastic improperly discarded in and commingled with trash
master composter	an individual who has been trained in composting methods and who voluntarily promotes composting, often as part of an organized program, throughout his or her community
mixed waste processing	the separation of MSW into recyclable, compostable, and disposable fractions at a centralized location, after collection has taken place
MSW	municipal solid waste
mulching mower	a lawn mower that permits grasscycling by ejecting grass clippings onto the mowed lawn rather than bagging them
noncomposters	test tract residents who chose not to join the Backyard Composting Program (who may or may not have been subject to waste assessments), from which a sample was drawn for focus group and survey purposes
nonparticipant	resident of one of the four test tracts who was randomly selected for three waste composition assessments in June 1997, October 1997 and June 1998, was solicited for participation in the Backyard Composting Pilot Program, and did not join the Program. Also referred to as a nonvolunteer
nonvolunteer	see "nonparticipant"
NYCHA	New York City Housing Authority
other waste	all materials that are not yard, bulk, food waste or recyclables, including hygiene products; nonrecyclable glass and plastic; and other residue
participant	resident of one of the four test tracts who was solicited for participation in the Backyard Composting Pilot Program, joined in the Summer-Fall of 1997, purchased a compost bin, received education/follow-up support from the Botanical Gardens and was subject to two waste composition assessments in the Fall 1997 and Summer 1998, and may have also been assessed in Summer 1997. Also referred to as a volunteer.
participation (rate)	the number of voluntary Program participants/number of qualifying households solicited
Q	St. Albans, Queens Census Tract number 280
recycling	waste component comprised of items set out for recycling
S	West Brighton, Staten Island Census Tract number 121
Sanitation District Section	geographical area corresponding to a subsection of a Sanitation District designated by the New York City Department of Sanitation for operational/administrative purposes
Sanitation District	geographical area corresponding to a Community District designated by the New York City Department of Sanitation for operational/administrative purposes
source separation	the act of separating recyclables from trash at the source of generation, so that each stream is disposed of separately

target areas	the four census tracts in Morris Park, the Bronx; Marine Park, Brooklyn; St. Albans, Queens; and West Brighton, Staten Island targeted for participation in the Backyard Composing Pilot Program in which selected households underwent waste composition analysis; also referred to as test tracts
test tracts	see "target areas"
trash	see "garbage"
volunteer	see "participant"
waste composition study	the act of collection, sorting into component categories, recording of weight data, and data analysis for the purposes of determining the breakdown of waste components in a selected waste stream
the Wave 1 Study market research	focus group/telephone survey project conducted in March 1998 to study recycling and composting attitudes Citywide
X	Morris Park, Bronx Census Tract number 250
yard waste	bagged grass, leaves, prunings, dirt, etc.

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Robert Lange
Director, BWPRR

EXECUTIVE SUMMARY

The New York City Department of Sanitation has concluded a one year study of backyard composting in New York City. Taking a comprehensive approach to the evaluation of composting food and vegetable waste in backyard bins, the Department worked with the City's Botanical Gardens to implement a Pilot Program in four test neighborhoods in the Bronx, Brooklyn, Queens, and Staten Island. At the same time, the Department systematically researched resident receptivity, program participation rates, and waste composition impacts of the Pilot. With the aid of expert consultants in market research and waste analysis, the Department developed realistic estimates of how widely a backyard composting program might be implemented in New York City, as well as the diversion impacts and costs and benefits that would result if a program were promoted citywide.

This research revealed some important information about the potential for backyard composting as part of New York City's waste management strategy:

- After an intense and creative volunteer recruitment effort, **9.4%** of households in the test areas elected to buy a bin and join the Backyard Composting Program. Market research suggests that these volunteers, and others like them throughout the City, are persons who enjoy gardening and working in their yards much more than the average resident. Even more important, the research suggests that those who compost feel that this activity will benefit them personally. Such self-interest appears to be the key factor in recruiting a composting volunteer;
- After controlling for extraneous factors that might have affected waste composition, it was found that volunteers disposed of **2.5** pounds per household per week less in food waste than nonvolunteers. This is the amount that can be assumed to be going into the compost bin weekly. Results for the composting of yard waste were not statistically significant. 2.5 pounds per week translates to 130 pounds per household per year, a figure comparable to other jurisdictions' estimates of food waste composting potential;
- The Department's market research suggests that only one-third of all New York households, or approximately 930,000 homes, have some form of backyard access. If 9.4% of the residents in these households composted, this would result in a diversion of 109 tons per week, or 5,668 tons **per year**, ***in total***, from the waste stream. This would represent 0.15% of the total tonnage of residential waste and recyclables managed by the Department of Sanitation each year — an amount that would have negligible consequences for collection, transportation, or disposal costs and impacts;
- Despite its minimal effect on the waste stream, backyard composting bin distribution programs can be cost-effective if outreach methods are streamlined and more purchasers are recruited. Backyard composting also has educational benefits in that it promotes awareness of where waste goes and how it is managed. As such, the Department is committed to continue to promote bin programs in partnership with the Botanical Gardens.

LOCAL LAW 19, THE RECYCLING PROGRAM, AND COMPOSTING

New York City's Recycling Program formally began in 1989 with the passage of Local Law 19. Local Law 19 directed the City's Department of Sanitation (the "Department")— the agency responsible for the collection and disposal of nearly 13,000 tons of residential and institutional refuse per day — to design, implement, and manage a program to promote waste prevention, reuse, and recycling. Local Law 19 also set specific tonnage requirements for the diversion of six recyclable materials from the waste stream and provided guidelines for designing and implementing policies to achieve these requirements. In 1992, the Department issued the *Citywide Comprehensive Solid Waste Management Plan* which laid the groundwork for the recycling programs in place today.

New York's Residential Recycling Program currently includes curbside and containerized collection of mixed paper, newspapers, magazines, catalogs, corrugated cardboard, milk and juice cartons, household metal, plastic bottles and jugs, glass bottles and jars, metal cans, and aluminum foil wrap and trays from houses, apartment buildings, schools, and public institutions. Other recycling programs provide for the collection of recyclable bulk metal, construction and demolition debris from City construction projects, abandoned automobiles, tires, and dirt from lot cleaning. In fiscal year 1997, these programs diverted 1,233,677 of the 5,043,417 tons of refuse collected, yielding a diversion rate of 24.5%[1].

Since the passage of Local Law 19 and the enactment of its 1992 Solid Waste Management Plan, New York has also established a number of organic waste recycling programs. In 1990, the Department began collecting approximately 3,000 tons of autumn leaves on Staten Island each year, to be composted at an outdoor facility located within the Fresh Kills landfill. This program is now being expanded to the Bronx, Brooklyn, and Queens. The estimated 22,000 tons of leaves to be collected yearly will be composted at Department facilities, as well as in City parks that are in need of topsoil. A separate seasonal program for Christmas tree collection has been in place citywide since 1994, and an average of 1,500 tons of trees are collected yearly and made into mulch. In 1996, the Department began operating an enclosed food waste composting facility on Rikers Island. This facility, designed in collaboration with the New York State Energy Research and Development Authority and the Tellus Institute, utilizes agitated bays to compost between 400 and 500 tons per month of food waste generated at four of the ten Rikers Island prison facilities. Finished compost is used to remediate the poor quality soil on the island, which is primarily landfill.

The Department began funding a composting outreach and education program at each of New York City's four Botanical Gardens in 1993. Through an agreement developed with the Department of Cultural Affairs, staff was hired at each Garden to promote backyard composting and yard waste reduction for residents, institutions, and businesses throughout the five boroughs. Current Botanical Garden projects include events such as: compost give-backs and the sale of subsidized backyard compost bins, compost and lawncare workshops, outreach to civic groups and community gardens, establishing a Master Composter program, landscaper education, and teacher training workshops, as well as ongoing assistance to the New York City Housing Authority (NYCHA), which as of 1997 has composted an estimated 6,500 cubic yards of leaves per year at 115 of its 339 developments.

FRESH KILLS CLOSURE AND THE TASK FORCE REPORT

In 1996, responding to years of opposition to the Fresh Kills Landfill from the residents of Staten Island, Mayor Rudolph Giuliani, along with Staten Island Borough President Guy Molinari and Governor George Pataki, issued a joint agreement for its closure by December 31, 2001. Because Fresh Kills is the City's only active landfill, and because of strong opposition to the construction or use of waste-to-energy facilities within City borders, New York plans to dispose of the garbage that remains after waste prevention, recycling, and composting by exporting it to localities outside the metropolitan area.

In May of 1996, the Mayor and the Governor established a joint Task Force to explore waste management options in light of the Fresh Kills closure. The Task Force consisted of representatives from the Mayor's and Governor's Offices; Federal, City and State agency staff; Staten Island Borough President Guy Molinari; Congresswoman Susan Molinari; and representatives from the Environmental Defense Fund and Staten Island Citizens for Clean Air. After six months of research, analysis, and discussion, the Task Force issued its report, *A Plan to Phase Out the Fresh Kills Landfill*. This report provided an overview of the City's current waste management system; discussed the technological, economic, and logistical aspects of waste reduction, recycling, and unrecycled waste disposal; and addressed operational, closure,

and post-closure issues for the landfill. It was in response to a recommendation of the Task Force that the City began the expansion of its leaf collection and composting program, as well as additional recycling and waste prevention programs. Among the report's many recommendations was one that specifically addressed backyard composting, which reads as follows:

> ...composting may be an appropriate waste prevention measure in some areas of the City. Food wastes account for 13 percent of New York City's waste stream. Yard waste accounts for an additional 3 percent. Household food waste, and leaf and yard waste can be composted efficiently in relatively simple backyard composting bins. This organic waste is reduced in the proportion of eight-parts-to-one in as little as two weeks with a properly maintained compost mix. The resultant compost is then a material easily used on the lawns and in the gardens of the respective household. Composting can, therefore, have significant impacts on the reduction of the waste stream that must otherwise be collected and processed for recycling or export.[2]

The recommendations of the Task Force reflect the consensus among New York's environmental community that backyard composting should be actively pursued as part of the Department's overall solid waste management policy. The Backyard Composting Pilot Program ("the Program") was developed as a result of the Task Force recommendations, and seeks to assess, in a systematic way, the impacts on waste stream reduction and the potential for backyard composting as a solid waste management option in New York City.

CHAPTER II. COMPOSTING AS A SOLID WASTE MANAGEMENT OPTION

Before discussing the Backyard Composting Pilot Program and its evaluation, it is important to be clear about what composting is and how it is practiced as a waste management policy by local government. The remainder of this section will address these topics.

DEFINITION AND DESCRIPTION OF COMPOSTING

Composting — as opposed to natural decomposition — is the biological decay of organic matter under *controlled* conditions that produces a finished product similar to humus, the naturally occurring organic fraction of soil. The compost process uses as its raw material organic matter, which can be loosely defined as plant and animal substances. In composting, decomposition is carried out primarily by microorganisms such as bacteria, molds, and fungi; this is aided by physical breakdown of material by small insects such as mites, millipedes, and earthworms.

Optimal conditions for composting are formed by three principal parameters: moisture content, carbon : nitrogen (C:N) ratio, and oxygen. Ideally, the composting mix will have a 55% moisture content, and a blend of both carbon-rich materials ("brown" substances such as wood, paper, and dried leaves) and nitrogen-laden wastes ("green" plant cuttings, grass clippings, and food wastes) so that the carbon to nitrogen or C:N ratio is about 30:1. Additionally, the mix should be kept well aerated. Such conditions promote the efficient breakdown of organic wastes over a period of months, while preventing anaerobic and/or unbalanced conditions which result in the formation of noxious or odoriferous compounds such as hydrogen sulfide, cadaverine and putrescine, as well as alcohols and acids that can harm plants.

Once produced, compost is used to enrich and stabilize soil. It promotes availability of nutrients to plants, and prevents erosion in sandy or clay soils by holding moisture and inorganic materials. Compost attracts and nourishes earthworms, whose tunnels aerate the soil and improve drainage, bringing up minerals from the subsoil. Although compost is not considered fertilizer, it contains plant nutrients and essential trace elements which release slowly into the earth. Compost may be applied as mulch or mixed into soil on farms, in residential yards and gardens, in street tree planters, or in parkland or other property.

Composting Methods

Composting can be carried out on various scales, ranging from a residential backyard composting bin to large, enclosed facilities for municipal or commercial waste. The biological process of decomposition is the same at either extreme; however, the methods utilized to control this process will depend on the materials being composted, the desired rate of decomposition, and the level of odor control required.

Outdoor composting, a relatively slow method, can be effective on a large scale using windrow (elongated pile) systems, which are turned periodically by a front end loader to promote aeration and control temperature. Another option is static pile systems, in which organics are heaped over a network of perforated pipes that force air through the pile. The Department's leaf and Christmas tree composting sites utilize the windrow method, as do — on a smaller scale — many of the New York City Housing Authority's (NYCHA) public housing sites.

Several technological options for large-scale composting exist. The most sophisticated include in-vessel and agitated bay systems, which process organic material in confined, regulated structures. Such systems, which typically take the form of large, enclosed drums or tubs, or covered concrete bays, were initially developed on farms to treat manures and other agricultural wastes. The technology was then adapted for sewage sludge composting. More recently, both private and public concerns have experimented with using in-vessel systems to compost high proportions of food wastes, typically in combination with agricultural manure, yard waste, and/or sewage sludge.

The Department of Sanitation's Rikers Island compost facility is the first in-vessel system in North America to process large volumes of food wastes only. Incoming material is loaded into two concrete bays together with a predetermined ratio of woodchips, which provide a source of carbon to the high-nitrogen food waste material, as well as porosity to the otherwise dense mix. A mechanical agitator travels on tracks above the bay walls, blending and pushing the material forward through the bays, while air is blown through the floors of the bays to regulate temperature and oxygen flow. The material is moved through the length of the bays in 15 days, at which time the food waste has broken down substantially. The mix is then moved to aerated piles for additional decomposition and curing, which can take several months.

MUNICIPAL COMPOSTING PROGRAM OPTIONS

As municipalities across the country strive to attain often ambitious recycling diversion rates, they soon come to realize that organic material, in the form of food scraps and yard trimmings, constitutes a significant portion of residential municipal solid waste (MSW). Establishing a composting program therefore seems an obvious solution. However, while the process of composting itself is relatively well understood, isolating and collecting the organic portion of MSW is not as simple. Three principal options are available to municipalities wishing to capture organics for composting: source-separation and collection of organic wastes; encouragement of backyard compost bin use; and mixed waste, or MSW composting. The benefits and drawbacks to each program option are explored below.

Organics Separation

Municipalities may request or require that residents separate designated organic materials from their waste as they do now in many locations for such items as metal, glass, plastic, and newspapers. While this method generally ensures a clean stream of organics for composting, it also poses logistical difficulties, including the need for intensive education and outreach, efficient collection in truck routes, and storage, especially in the hot summer months. The Department initiated a pilot to test the feasibility of residential source-separation of organics in Park Slope, Brooklyn in 1992. The pilot demonstrated that residents in medium density ("brownstone") housing, when educated through extensive and constant outreach programs, are willing to source-separate their organic waste. In fact, the Park Slope program achieved food-waste capture rates that approximated 50%. However, the cost of adding a fourth truck route, at maximum load rates of 5 tons per truck (compared to an average of 10 tons per truck for solid waste, 8 tons per truck for paper recycling, and 7 tons per truck for leaf collection) precluded consideration of this program for citywide expansion. Perhaps more significantly, a similar pilot conducted in Starrett City, Brooklyn, which has higher density housing more typical of the City, resulted in minimal food waste diversion that was so heavily contaminated that it could not be composted. Such findings indicate that the expense and difficulty of collecting source-separated food waste in densely populated areas make such programs unlikely for cities such as New York. In fact, even in countries such as Germany and Holland, where source-separated composting plays a significant role as a waste management strategy, such programs are not carried out with equal success in high-rise buildings in the larger, denser cities such as Berlin and Amsterdam[3].

Mixed Waste Composting

Mixed waste composting means composting materials that have not been explicitly source-separated to isolate their organic portion. Ideally, if recycling programs are in place, residential MSW will tend to be high in organic material anyway, as much of the inorganic fraction will have been captured in recyclable metal, glass and plastic.

Sevier County, Tennessee, is an example of a municipality using mixed waste composting to manage solid waste[4]. With a tourist population of over 9 million per year, the county has determined that a source-separation based recycling program is not practicable. County wastes are transported to be composted at the county's mixed waste composting facility. After large, non-compostable items — such as mattresses and car batteries — have been removed, 200 tons of waste per day are loaded into rotary digester drums and mixed with 80 - 100 tons of sewage sludge. Air is pumped into the system to keep the decomposition process aerobic.

After three days in the digester, the very immature compost is put through a screen to remove materials that have not broken down. Aluminum and ferrous scrap is removed at this stage and sent to be recycled. The other materials removed by the screen are primarily plastics and textiles, which are landfilled. After screening, the immature compost continues curing for an additional six weeks and is then screened prior to distribution. The finished compost is sold to a soil mix company, used for strip mine reclamation, and distributed to local residents for use as a soil amendment.

Such MSW composting would appear to be advantageous because it allows for high diversion without necessitating separate collection programs. Current research in this technology is directed towards improving the quality of compost produced from MSW while reducing capital and operating costs.

Backyard Composting

The third municipal program option avoids the need for a separate collection route. Backyard composting programs typically involve the subsidized or free distribution of backyard compost bins to residents in a community. Compost bins, commercial or homemade, come in a variety of shapes and sizes, but are essentially partially or fully enclosed structures used to contain the materials to be composted in a defined, compact area. These can range from a simple hoop of chicken wire, to a more sophisticated, commercially available "stack" system. Most municipal programs use a

commercial-type bin, which is of standard size, can be shipped in bulk, and is easy for the average resident to set up. Smaller bins can accommodate all food scraps and a portion of the yard trimmings of a typical household, while larger models can accept higher volumes of yard waste. With backyard composting, residents manage their organic wastes at home. This process raises people's awareness of solid waste issues, often leading to a re-evaluation of purchasing decisions and disposal habits. In this respect, backyard programs address the "magic box" concern of environmentalists; residents realize that the waste they produce does not magically disappear when it is taken away in a garbage truck.

Because residents separate organic material from the rest of their waste, backyard composting, like a source-separation based policy option, provides for a clean stream and avoids the "garbage in, garbage out" concern regarding a mixed waste program. Backyard programs also avoid the necessity of providing for a separate pick-up associated with the source-separation based option. However, despite the immediate appeal of a backyard program, the efficacy of this option depends on voluntary participation of a majority of residents. In addition, it makes a basic presupposition that residents have access to "backyards". In a busy and densely populated city like New York, both of these factors bespeak the need for a cautious approach to this policy option.

NEW YORK CITY - A UNIQUE ENVIRONMENT

With over seven million residents, 2.8 million households, and a population per square mile of over 20,000, New York City is the most densely populated city in the country[5]. New York's demographic and geographic features make for an atypical profile in terms of characteristics relevant to municipally sponsored backyard composting: housing stock and fraction of organics in the waste stream.

While there are no official data about how many New York City residences have access to a backyard, Department of Sanitation market research suggests that around one-third have some yard access. Furthermore, US Census data show that 22% of dwellings are single or two-family structures. These figures contrast with housing characteristics of other large cities, as shown in Table 1.

Table 1

Comparative Demographic Data Among Selected Major U.S. Cities

	Total Persons	Total Housing Units	Owner Occupied		Renter Occupied	
New York	7,322,564	2,992,169	807,378	*27.0%*	2,012,023	*67.2%*
Chicago	2,783,726	1,133,039	425,259	*37.5%*	599,915	*52.9%*
Los Angeles	3,485,398	1,299,963	479,868	*36.9%*	737,537	*56.7%*
Boston	574,283	250,863	70,544	*28.1%*	157,920	*63.0%*
Seattle	516,259	249,032	115,709	*46.5%*	120,993	*48.6%*
Portland	437,398	198,368	99,206	*50.0%*	88,062	*44.4%*

	1 Unit Detached		1 Unit Attached		2 Units		3 Units or More		Other	
New York	250,967	*8.4%*	177,713	*5.9%*	384,372	*12.8%*	2,128,189	*71.1%*	50,928	*1.70%*
Chicago	264,216	*23.3%*	31,291	*2.8%*	212,696	*18.8%*	611,712	*54.0%*	13,124	*1.16%*
Los Angeles	509,429	*39.2%*	76,855	*5.9%*	41,946	*3.2%*	649,171	*49.9%*	22,562	*1.74%*
Boston	27,633	*11.0%*	11,491	*4.6%*	36,033	*14.4%*	172,654	*68.8%*	3,052	*1.22%*
Seattle	128,344	*51.5%*	3,639	*1.5%*	10,599	*4.3%*	102,968	*41.3%*	3,482	*1.40%*
Portland	123,825	*62.4%*	3,808	*1.9%*	9,001	*4.5%*	58,657	*29.6%*	3,028	*1.53%*

Source: 1990 U.S. Census

A comparison of MSW composition nationwide to that for New York City also highlights the City's uniqueness, especially in terms of yard and food waste:

Table 2

National vs. New York City Residential Waste Composition

Waste Stream Component	Nationwide Statistics[6]	New York City Residential Only[7]
yard	20.1%	4.9%
food and other organic*	17.9%	38.3%
metal	8.9%	5.4%
glass	8.4%	5.5%
paper	35.6%	33.5%
plastic	7.3%	9.5%
other inorganic	1.8%	2.9%

* this includes lumber, fines, hygiene products, rubber, textiles and other organic substances that are not yard waste or paper. For New York City, the food-only fraction of this component is estimated at 15%, as per the Department's ***1992 Comprehensive Solid Waste Management Plan***.

With a recycling rate of nearly 25% in 1997, New York City is comparable to jurisdictions nationwide, who on average recycle at a rate of 26.8%[8]. Waste composition statistics reveal, however, that New York is atypical in terms of its low percentage of yard waste as well as its high percentage of food and other organic waste.

In looking at composting programs' effectiveness in New York, it is therefore important to know that the City is unusual in its concentrated housing density, limited number of backyards, and preponderance of food in the organics stream. As will be discussed in the following chapters, the Backyard Composting Pilot Program was designed and evaluated with these considerations in mind.

CHAPTER III. PROGRAM DESCRIPTION

The Department had been promoting residential and institutional small-scale composting through an agreement with the City's four Botanical Gardens since 1993, and had treated backyard composting primarily as a public education program, with limited impact on the waste stream. In light of the Fresh Kills Task Force recommendation to evaluate residential backyard composting as an option for waste management, the Department proposed implementing a pilot to be conducted during the New York City Fiscal Year 1998. The Pilot would feature the systematic evaluation of the impact of backyard composting on New York City's waste stream, as well as assess the willingness of New York City residents to participate in this practice.

The Pilot was designed to meet several objectives:

- Pilot participants would be asked to compost *food scraps primarily*. Although residents were encouraged to use leaves as a carbon source, composting food scraps would be emphasized because prior waste composition studies show this material to comprise approximately 15% of the New York City residential waste stream, while the yard waste portion is only 5% (see Table 2) . In addition, the typical New York City backyard is too small to allow residents to compost all their leaves, brush, and prunings, while (in theory at least) all of a household's compostable food scraps could be diverted from curbside collection for backyard composting. Finally, the Department already had a program in place for collecting large volumes of autumn leaves and yard waste from Staten Island and was in the process of expanding this program to other low-density neighborhoods throughout the City;

- The Pilot would be conducted in four separate neighborhoods, one each in the Bronx, Brooklyn, Queens, and Staten Island. These would be low-density neighborhoods by New York City standards, including not only the single-family housing typical of Staten Island and much of Queens, but also the two- and even three-family housing, *with backyards*, that is more common in the Bronx and Brooklyn. Because such housing is practically nonexistent in Manhattan, this borough was excluded from the Pilot;

- The Pilot would be designed and managed by the Department, but staffed by employees of the City's four Botanical Gardens. As mentioned, the Department holds agreements with the New York Botanical Garden in the Bronx, the Brooklyn Botanic Garden, the Queens Botanical Garden, and the Staten Island Botanical Garden to provide their boroughs with outreach and education on composting. Project staff at each Garden have expertise in teaching residents to compost and are familiar with the sensibilities unique to the various neighborhoods in their boroughs. It was for this reason that the Department had decided in 1993 to promote composting through the Botanical Gardens rather than utilizing an outside contractor; in addition, the Department would most likely continue utilizing the Gardens if it decided to expand its Backyard Composting Pilot Program based on the results of the Pilot;

- The Pilot would feature extensive solicitation and outreach, so that all eligible residents could learn about backyard composting and determine their interest in installing and using a compost bin. Program volunteers would furthermore receive personalized follow-up instruction on composting techniques, to ensure that their continued participation would depend solely on their willingness to compost, and not be influenced by lack of understanding or misinformation;

- The Pilot would be designed to generate reliable data to be used for estimating potential waste diversion. While municipalities across North America have long promoted backyard composting through bin distribution programs, these have tended to be evaluated through surveys or other subjective analyses for estimating diversion. The Department, wishing to obtain more reliable data, designed its Pilot so that diversion from food waste composting could be measured in a statistically sound manner. To this end, the Botanical Gardens sought consultant services from Waste Tech Inc., a firm that has long specialized in waste composition evaluation and statistical analysis of waste stream impacts;

- The Pilot would also be designed to generate equally reliable market research data on residents' attitudes towards backyard composting. As with the waste composition analyses, such data would be obtained professionally, in this case through focus groups and surveys conducted by Grey Advertising, which is under contract with the Department to provide advertising and market research pertaining to recycling. The market research studies would be utilized not only to gauge attitudes on backyard composting, but also on food waste collection programs and other methods of organic waste management. In addition, findings from the market research would assist the Department in determining

the potential for expanding backyard composting beyond the Pilot phase. The methodology and results of these studies will be detailed in Chapters V and VI of this Report.

PROJECT PHASES

The Pilot was planned between November 1996 and April 1997. The Department worked with Botanical Gardens staff to develop an outreach and bin distribution program, which was modeled on similar projects conducted throughout the US and Canada. The Department also sought advice from its consultants in determining the methodology for quantification and market research, which helped influence the Pilot design.

The Pilot timetable was as follows:

Table 3

April to May 1997	Pilot neighborhood selection; compilation of qualifying household address lists
June to July 1997	Preliminary focus group and telephone market research among residents Citywide about attitudes towards organic waste recycling
June 1997	Initial (Baseline) waste composition study in the test areas
July to August 1997	Intensive recruitment of Program volunteers by mail, phone, and door to door canvassing; installation of compost bins in volunteer households
October 1997	First follow-up waste composition study of volunteers and nonvolunteers in the test areas
November 1997	Focus group discussions with volunteers from the test areas and randomly selected New York City residents with backyards
March 1998	Focus group discussions with volunteers and nonvolunteers living in the test areas
	Telephone survey of randomly selected New York City residents, gauging Citywide attitudes towards composting
	Telephone survey of volunteers and nonvolunteers living in the test tracts
June 1998	Final follow-up waste composition study of volunteers and nonvolunteers in the test areas

Selection of the Areas for Study

Residential backyard composting can be carried out anywhere people have access to an outdoor area. This includes apartment buildings, but in such cases tenants and building managers must work cooperatively and on a much larger scale, and the effort is consequently much more difficult to implement and maintain. For this reason, the Department decided to concentrate its first investigative efforts in areas in which single- or two/three-family residences with backyards predominated. As mentioned, Manhattan was therefore excluded from initial consideration because such housing is practically nonexistent in the borough.

The Department needed to select test areas compatible with the outreach, waste composition analysis, and market research plans of the study. Besides having a majority of single- or two-family homes with backyards, each test area needed to be small enough to allow for intensive house-by-house recruitment and tracking efforts (since all households would be targeted by mail, phone, and site visits for participation), yet large enough to ensure an adequate sample size of volunteers and nonvolunteers. In addition, ideal test areas would be those for which demographic information and, if possible, waste collection data were available. Several options were considered:

Sanitation Truck Routes

Since waste collection routes comprise approximately 650 households* in neighborhoods with housing densities suitable for this pilot, they would be a manageable study size. In addition, since tonnage data for specific routes have been

**Numbers of households served on collection routes vary widely. This estimate is derived from information from the Department's Bureau of Cleaning and Collection about the number of trucks that serve Sanitation Districts in which the test tracts are located, divided by the number of households in these districts (per US Census data).*

tracked by the Department for a number of years, it would be useful for comparative purposes. However, truck route designations are based on considerations such as traffic patterns, exclusion of mechanized collection sites or commercial waste, and historical collection patterns. Routes may skip adjacent blocks or cover only portions of one block, which would make it difficult to identify a contiguous neighborhood for Pilot outreach. Routes are extended, contracted, or otherwise modified to account not only for variations in trash generation within the week or season-by-season, but also in response to unpredicted, sporadic increases or decreases in trash or recyclables set-out. In addition, trash collection routes do not correspond to recycling collection routes, which are longer and may not cover all the stops of one given trash route. Finally, demographic data are not collected or available for households on Sanitation collection routes. For these reasons, routes were not considered as Pilot Target areas.

Sanitation Districts

The City of New York is subdivided into 59 administrative units known as Community Districts, whose boundaries are utilized by the Department of Sanitation for the designation of its own operational districts. Waste and recyclables collection data spanning many years are readily available for Sanitation/Community Districts. In addition, the Department of City Planning aggregates US Census Data to conform with Community District boundaries. However, Community Districts comprise between 11,576 and 121,715 households and they vary considerably in housing density from one neighborhood to the next within the same district. As such, they were not considered as Pilot Target Areas.

Sanitation District Sections

The 59 Sanitation Districts described above are each further divided by the Department into Sections, again for administrative purposes. While data on waste and recyclables generation are maintained for each Section, corresponding demographic data are not available. In addition, while Sections are smaller, they still comprise too many households for the type of outreach and recruitment effort that was being planned for the Pilot. They were also discounted as Target Areas.

US Census Tracts

Demographic information from the 1990 US Census was compiled for all relevant tracts in New York City. These tracts are clearly identified in maps, and census data for each tract are readily available from numerous sources. While historical waste and recyclables generation data are not available on a census tract basis, tracts are small enough (typically 8-10 blocks, though larger in the lowest density neighborhoods) to be considered in their entirety as areas where all households could be approached and asked to participate in the Pilot. As the availability of demographic data and the size of the Pilot neighborhoods were considered important factors, 1990 US Census tracts were designated as the pool for selecting the four Target Areas.

Selection of US Census Tracts

Neighborhood selection was based on the recommendation of the Botanical Garden in each borough. The neighborhoods selected by the Gardens — Morris Park in the Bronx, Marine Park in Brooklyn, St. Albans/South Jamaica in Queens, and Silver Lake/West Brighton in Staten Island — are composed primarily of one- or two-family houses with backyards. While backyard composting had never been promoted specifically in these areas, they were similar to other neighborhoods where the Gardens had already publicized composting and distributed bins. The Department then selected census tracts in each neighborhood, based on logistical considerations. Specifically, tract selection was restricted to those where all or most residents received trash collection on the same two weekdays, and where all or most residents were on the same alternate week recycling schedule. These considerations ensured that waste and recyclables sampling could be conducted on the same days for all selected households within each target area, and during the identical week for all four target areas; in this manner, data collection was facilitated and a common baseline could be established. It should be noted that when the Pilot was initiated, each of the four target areas was receiving alternate week recycling collection; by June 1998, weekly recycling collection had been established in the Staten Island and Brooklyn neighborhoods where the Pilot tracts were located.

Listed below are the four target areas, as well as an additional census tract identified in Queens (Little Neck) that would serve as a control:

Table 4

Pilot Area Specifics

Borough	Area	CD	Census Tract	Housing Units	Refuse Collection	Recycling Collection*	Pilot Code
BRONX	Morris Park	11	250	959	Tue/Fri	Tue - B	X
BROOKLYN	Marine Park	18	658	640	Tue/Fri	Tue - B	B
QUEENS	St. Albans	12	280	445	Tue/Fri	Tue - B	Q
STATEN ISLAND	West Brighton	01	121	1,104	Wed/Sat	Wed - B	S
QUEENS (Control Area)	Little Neck	11	1507.01	1,058	Tue/Fri	Fri - B	L

**"B" stands for the DOS designation of "B week" for recycling collection.*

As noted, each target area was assigned a one letter "Pilot Code." These codes were utilized during the waste sampling exercises and appear throughout this report.

Table 5 summarizes the demographic characteristics of each tract, as compared to New York City as a whole.

Table 5

Comparative Demographic Data

at the New York City, Borough, and Census Tract Level

CODE	BOROUGH	AREA	SANITATION DISTRICT	CENSUS TRACT
B	Brooklyn	Marine Park	B 18	658
L	Queens	Little Neck	Q 11	150701
Q	Queens	St. Albans	Q 12	280
S	Staten Island	West Brighton	S 01	121
X	Bronx	Morris Park	X 11	250

AGE DISTRIBUTION

AREA		TOTAL PERSONS	<5 YEARS	5-17 YEARS	18-34 YEARS	35-44 YEARS	45-64 YEARS	65+ YEARS	% < 18 YEARS	% > 18 YEARS
ENTIRE CITY		***7,322,564***	***9%***	***16%***	***29%***	***15%***	***19%***	***13%***	***23%***	***77%***
Brooklyn		2,300,664	8%	19%	28%	15%	18%	12%	26%	74%
	Marine Park	1,662	6%	14%	27%	14%	22%	17%	20%	80%
Queens		1,951,598	6%	15%	29%	15%	21%	15%	21%	79%
	Little Neck	2,895	4%	15%	21%	15%	27%	19%	19%	81%
	St. Albans	1,322	7%	18%	28%	12%	21%	15%	24%	76%
Staten Island		378,977	7%	17%	28%	16%	20%	11%	25%	75%
	West Brighton	3,050	7%	16%	23%	16%	22%	16%	23%	77%
Bronx		1,203,789	8%	19%	29%	14%	18%	12%	28%	72%
	Morris Park	2,263	4%	11%	27%	12%	23%	23%	16%	84%

HOUSING DENSITY

AREA		TOTAL POPULATION	TOTAL UNITS	ACRES	PERSONS PER ACRE	UNITS PER ACRE
ENTIRE CITY Y		***7,322,564***	***2,992,169***	***205,952***	***36***	***15***
Brooklyn		1,203,769	873,671	52,330	23	17
	Marine Park	1,662	640	38	44	17
Queens		1,951,598	752,690	71,780	27	10
	Little Neck	2,895	1,058	214	13	5
	St. Albans	1,322	445	43	31	10
Staten Island		378,977	139,726	38,507	10	4
	West Brighton	3,050	1,104	179	17	6
Bronx		1,203,789	440,955	28,165	43	16
	Morris Park	2,263	959	45	50	21

Table 5 (continued)

Comparative Demographic Data

ETHNICITY

AREA		TOTAL POPULATION	WHITE	BLACK	HISPANIC	ASIAN	AMERICAN INDIAN	OTHER	FOREIGN BORN
ENTIRE CITY		***7,322,564***	***43%***	***25%***	***24%***	***7%***	***0%***	***0%***	***28%***
Brooklyn		2,300,664	40%	35%	20%	5%	0%	0%	29%
	Marine Park	1,662	94%	0%	4%	2%	0%	0%	10%
Queens		1,951,598	48%	20%	20%	12%	0%	0%	36%
	Little Neck	2,895	86%	0%	4%	10%	0%	0%	26%
	St. Albans	1,322	1%	95%	3%	0%	1%	0%	8%
Staten Island		378,977	80%	7%	8%	4%	0%	1%	12%
	West Brighton	3,050	93%	1%	3%	3%	0%	0%	6%
Bronx		1,203,789	23%	31%	43%	3%	0%	0%	23%
	Morris Park	2,263	96%	0%	2%	1%	0%	0%	22%

HOUSING TYPES

AREA		UNITS	1 FAMILY DETACHED	1 FAMILY ATTACHED	2 FAMILY	3 or 4 FAMILY	5 to 9 FAMILY	10 to 19 FAMILY	20 to 49 FAMILY	>50 FAMILY	OTHER
ENTIRE CITY		***2,992,169***	***9%***	***6%***	***13%***	***9%***	***7%***	***7%***	***17%***	***32%***	***2%***
Brooklyn		873,671	4%	7%	19%	16%	11%	6%	14%	21%	2%
	Marine Park	640	9%	60%	26%	2%	0%	0%	0%	0%	3%
Queens		752,690	19%	9%	19%	10%	6%	4%	10%	22%	2%
	Little Neck	1,058	79%	2%	5%	5%	0%	0%	0%	8%	1%
	St. Albans	445	54%	25%	15%	1%	0%	5%	0%	0%	1%
Staten Island		139,726	34%	20%	25%	4%	2%	2%	3%	8%	2%
	West Brighton	1,104	80%	4%	11%	3%	0%	0%	0%	0%	1%
Bronx		440,955	5%	5%	8%	6%	3%	6%	27%	38%	2%
	Morris Park	959	13%	14%	37%	11%	6%	1%	6%	11%	2%

EDUCATIONAL ATTAINMENT (PERSONS 25 AND OVER)

AREA		PERSONS 25 AND OVER	NOT HS GRADUATE	HS GRAD ONLY	SOME COLLEGE	ASSOC. DEGREE	BACHELORS OR MORE
ENTIRE CITY		***4,884,274***	***32%***	***26%***	***19%***	***5%***	***23%***
Brooklyn		1,457,904	36%	19%	19%	5%	17%
	Marine Park	1,155	21%	35%	17%	3%	24%
Queens		1,350,456	29%	30%	21%	5%	21%
	Little Neck	2,048	14%	22%	16%	5%	43%
	St. Albans	892	24%	33%	30%	2%	11%
Staten Island		245,575	21%	35%	23%	5%	21%
	West Brighton	2,097	10%	23%	22%	6%	39%
Bronx		735,022	41%	28%	18%	4%	12%
	Morris Park	1,755	32%	45%	5%	3%	15%

ECONOMIC INDICATORS

AREA		MEDIAN INCOME PER HSHOLD	HSHOLDS BELOW POVERTY LINE	HSHOLDS RECEIVING PUBLIC ASSIST
ENTIRE CITY		***$29,823***	***19%***	***13%***
Brooklyn		$25,684	23%	16%
	Marine Park	$36,042	8%	3%
Queens		$34,186	11%	7%
	Little Neck	$56,721	6%	2%
	St. Albans	$29,130	14%	20%
Staten Island		$43,861	8%	6%
	West Brighton	$57,129	1%	3%
Bronx		$21,944	29%	23%
	Morris Park	$28,807	6%	7%

OCCUPANCY STATUS AND TENURE

AREA		TOTAL UNITS	VACANT UNITS	OCCUPIED UNITS	PERCENT OWNERS	PERCENT RENTERS	PERSONS PER OCCUPIED UNIT
ENTIRE CITY		***2,992,169***	***172,768***	***2,819,401***	***29%***	***71%***	***2.6***
Brooklyn		873,671	45,472	828,199	26%	74%	2.8
	Marine Park	640	26	640	77%	23%	2.6
Queens		752,690	32,541	720,149	42%	58%	2.7
	Little Neck	1,058	39	1,058	88%	12%	2.7
	St. Albans	445	7	445	71%	29%	3.0
Staten Island		139,726	9,207	130,519	64%	36%	2.9
	West Brighton	1,104	41	1,104	88%	12%	2.8
Bronx		440,955	16,843	424,112	18%	82%	2.8
	Morris Park	959	46	959	44%	56%	2.4

Source: 1990 U.S. Census

Maps 1 through 5, appended to this Report, show each tract location.

Participant Recruitment and Compost Bin Distribution

As mentioned previously, the Backyard Composting Pilot was based on similar pilots and programs conducted in US and Canadian municipalities during the past decade. Such programs typically feature distribution of backyard composting bins to all households in a small city or town, or within selected neighborhoods or districts. The compost bins are often distributed free of charge or sold at extremely subsidized rates. The township of Brielle, New Jersey, had initiated such a program in March 1996, which had been described in trade publications such as *Resource Recycling* (January 1997). As the program appeared to be one of the more thorough to date, and as both Department and Botanical Garden staff had contacts with Brielle Township representatives and with the contractor the township had hired to implement the program, compost bin distribution was modeled in part after the Brielle pilot. (This program is discussed in detail in Chapter IV of this Report.)

While many backyard composting programs feature the allocation of bins to entire towns or neighborhoods regardless of individual household interest in composting, the New York City Pilot methodology ensured that all target area residents would receive information on composting, but that only households actually willing to compost would receive compost bins. This approach was taken to avoid the wasteful purchase of compost bins that would only be set aside or discarded. Along these lines, the Department elected to sell the compost bins rather than distribute them at no cost. The cost to Program participants was set at $10 per bin, an amount that would not deter purchase but would prevent anyone from taking a bin simply because it was free. Again, this measure was seen as a way to make the Pilot a realistic model for program expansion. The Department had in fact experienced an analogous situation when it piloted its Residential Recycling Program in selected neighborhoods and streets. At that time, blue recycling bins were distributed to all households in selected areas. When the Recycling Program began to be phased in citywide, it was not feasible to consider purchasing and distributing blue bins to over 3,000,000 households; however, residents in these areas who did not receive blue bins expressed dissatisfaction at not having been part of the original promotional effort. It is significant to note that residents who had received complimentary bins associated their recycling compliance with can distribution, and expected damaged or missing bins to be replaced by the Department as incentive for continued program participation.

Recruitment was initiated in each target area through a mailing to all eligible households. The package, which was sent via priority mail during the first week in July, contained the following:

1) A one page letter (Exhibit 1), signed by the director of the Botanical Garden in each Target Area's borough, which briefly described the Pilot and asked residents to participate. The letter mentioned the cost of the composting bin, and that participants would be given personalized instruction on its use, as well as access to "compost hotlines" for additional information. As further incentive, the letter informed prospective participants that they would receive a complimentary membership to their local Botanical Garden; 2) A packet of seeds; 3) A two-sided flyer (Exhibit 2) with basic information on backyard composting; and 4) A pre-stamped envelope addressed to the household's local Botanical Garden, along with a response card (Exhibit 3) to indicate interest in Pilot participation.

Three weeks after the initial mailing, Botanical Gardens staff initiated a second recruitment round by placing "door hangers" (Exhibit 4) on the doorknobs of all target area eligible households that had not already joined the Pilot. The door hangers mentioned that a Pilot had been initiated in the neighborhood, that local households had begun participating in the Pilot, and that residents could indicate their interest by completing and sending the attached postcard or calling their Botanical Garden directly.

The third recruitment phase consisted of a telemarketing campaign, conducted by Botanical Gardens staff and interns. The telephone script (Exhibit 5) was developed in consultation with PhonePro, a firm specializing in telemarketing; in addition, a PhonePro representative conducted a one-day training session for all staff and interns who would be conducting the telephone campaign. All published telephone numbers (approximately 50% of the eligible households in each target area) were contacted during the campaign at least twice. Given the current oversaturation of telemarketing, more aggressive solicitation was avoided.

The active recruitment phase was concluded by the end of August, though residents continued sending in reply cards and "door hanger" postcards until October 1997. Table 6 lists the responses that were received to each solicitation method:

Table 6

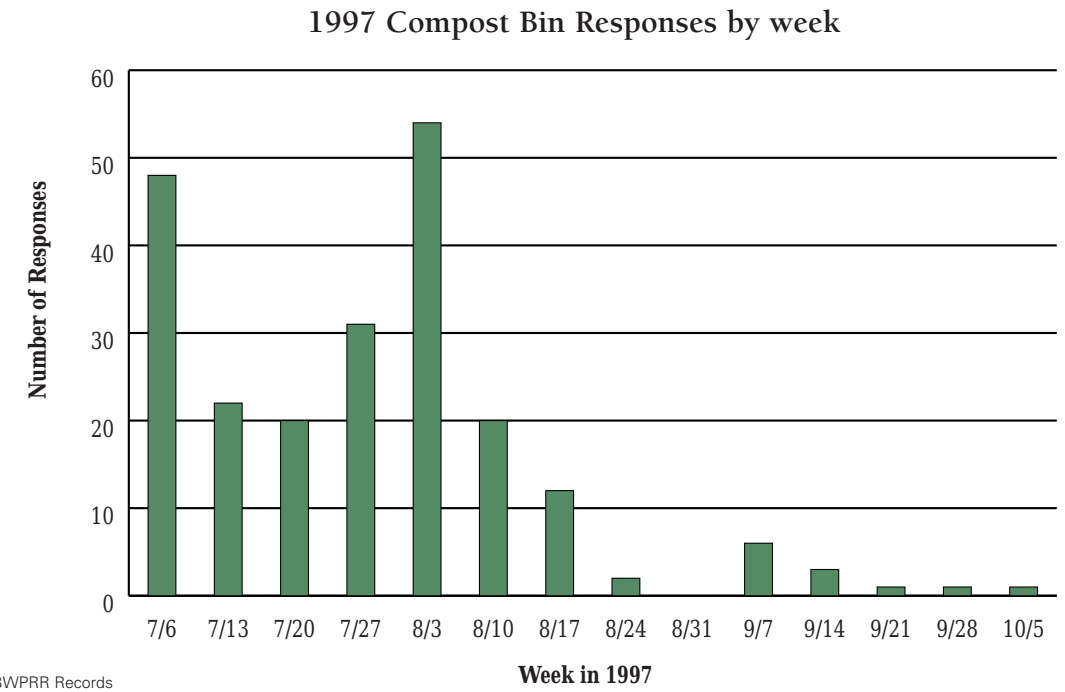
Participation by Solicitation Method

	Mail Card	Call-In	Door Hanger	Tele-Market	Other	Number of Volunteers
Bronx	27.0%	10.8%	16.2%	**37.8%**	8.1%	38
Brooklyn	**30.0%**	16.7%	30.0%	20.0%	3.3%	36
Queens	**33.3%**	27.8%	22.2%	16.7%	0	18
Staten Island	**35.5%**	29.7%	21.0%	10.0%	2.9%	129
Total	**33.2%**	24.7%	21.5%	17.0%	3.6%	221

The most effective outreach methods are in BOLD for each tract.

Figure 1 illustrates participation by date of recruitment.

Figure 1



Source: BWPRR Records

Compost bins were distributed throughout the recruitment period. Unless participants elected to handle pick-up and installation themselves, compost bins were delivered at a time convenient to the participant by a team of two or three Botanical Gardens staff and interns. Gardens staff helped find a suitable spot for the bin in the back or front yard, installed the bin, and gave instruction on its use. Participants were also given a copy of the Department's *Urban Home Composting* brochure, a copy of the *Home Composting* instructional video also produced by the Department, and a small bucket for kitchen food scraps collection which listed the name and telephone number of each Botanical Garden compost "hotline," as well as which materials should be placed in or kept out of compost bins. In late fall 1997, all participants were mailed a refrigerator magnet (Exhibit 6) that again listed "Yes" and "No" materials for composting and provided Botanical Garden "hotline" numbers.

CHAPTER IV. EVALUATION METHODOLOGY

"**Program Evaluation**" is a structured method used to measure how successfully public programs are implemented, to assess how well they have achieved their intended outcomes, and to present results that aid public decision making. Many municipalities in North America administer backyard composting programs; however, fewer have conducted formal evaluations of these programs' effectiveness. When backyard composting program evaluations are undertaken, effectiveness may be measured by counting numbers of bins sold, composters trained, publicity generated, seminars conducted, or other reflections of successful implementation. While evaluating program success in such terms is important, the most relevant measure of effectiveness for New York City's Department of Sanitation is **diversion** — or tons of waste diverted away from the landfill, export, or other final disposal — as a result of the program. As the Fresh Kills landfill closes, New York's move to waste export will entail new operational and environmental challenges. At this crucial time in New York City's history, it is essential for the Department to have a clear idea of how each of its waste prevention, reuse, and recycling programs will affect diversion, and at what cost. The Taskforce Report itself calls on the Department to study whether, "[backyard] composting can...have significant impacts on the reduction of the waste stream that must otherwise be collected and processed for recycling or export."[9]

Underlying any evaluation of program effectiveness is an understanding of **participation**. This is relevant not only to assess how well outreach methods recruit volunteers; participation rate is also implicit in measuring diversion, environmental benefits, or other impacts, because the number of residents actively composting will determine the program's impacts for any of these measures. Furthermore, in order to understand why volunteers join the program, and to gain insight into how programs can be improved, it is essential to gather qualitative and quantitative data on habits, attitudes, and opinions about composting, the program, and related subjects. Measurement of participant numbers and research into resident behavior are both essential components in studying program participation.

RESEARCH IN OTHER JURISDICTIONS

Before we present the evaluation methodology that the Department chose to use for the Backyard Pilot, it will be useful to look at other backyard composting program evaluations undertaken elsewhere in the United States. Table 7 summarizes the information the Department has been able to gather about backyard composting programs among major US cities, although it does not begin to cover the many states, counties, smaller localities, community organizations, and other countries that administer programs for their residents*.

Table 7

City	State	Has Program?*	Evaluation Method
Atlanta	GA	Yes	+
Baltimore	MD	Yes	+
Boston	MA	Yes	telephone survey of bin sales
Chicago	IL	Yes	+
Cincinnati	OH	Yes	plans to track activity of master composters after certification
Cleveland	OH	No	+
Columbus	OH	Yes	+
Dallas	TX	Yes	follow up phone calls to track how many people the volunteers teach
Denver	CO	Yes	tracks bin sales and estimates that each composts 600 lbs per year
Detroit	MI	No	+
Houston	TX	Yes	+
Indianapolis	IN	Yes	+
Jacksonville	FL	Yes	+
Los Angeles	CA	Yes	surveys the quality of workshops and every 2-4 years survey bin owners on how and what they are using in bins
Memphis	TN	Will	+
Miami	FL	No	+
Milwaukee	WI	No	+
Minneapolis	MN	Had	+
Philadelphia	PA	Had 7-8 years ago	+

continued...

**The Department was unable to find any comprehensive published lists of backyard composting programs and evaluation methods among jurisdictions and organizations nationwide. Consequently, Table 7 was compiled by telephoning each major city and asking a brief set of questions. The information provided in this Table is summarized from available information and is not intended to be definitive. It should be used for comparative purposes only. The Department invites feedback on this Table from all interested parties.*

Table 7 (continued)

City	State	Has Program?*	Evaluation Method
Phoenix	AZ	No	+
Pittsburgh	PA	No	+
Portland	OR	Yes	surveys bin purchasers and those who request brochures. extrapolates from waste compostion studies using published methodology
Sacramento	CA	Yes	informal telephone evaluation about bin use
San Antonio	TX	Developing now	plans to survey participants in training courses and updates
San Diego	CA	Yes	+
San Francisco	CA	Yes	surveys are mailed to workshop attendees and bin purchasers
San Jose	CA	Yes	tracks education efforts, participation rate
Seattle	WA	Yes	waste composition studies, direct weighing of composted food waste, and extensive surveys
St. Louis	MO	Had	+
Washington	DC	No	+

* Municipal Government sponsored Backyard Composting Program
+ after telephoning this jurisdiction, the Bureau was not able to obtain information about program evaluation methods.

The Department's research suggests that while many municipalities have backyard programs, far fewer conduct formal program evaluations. Of those that do, five stand out as being particularly relevant for comparison with New York City's Pilot. They include studies carried out by: Seattle Public Utilities for the **City of Seattle**, Washington; Organic Waste Recycling, Inc. for the town of Brielle, **Monmouth County**, New Jersey; the New York State Energy Research and Development Agency (NYSERDA) for **Orange County**, New York; and by Portland Metro for the City of **Portland**, Oregon; as well as a comparative cost-benefit analysis of programs throughout the United States conducted by Applied Compost Consulting, Berkeley, California for the Composting Council.

The City of Seattle, Washington

Seattle's 1995 backyard composting program evaluation report, entitled *"City of Seattle, 1995 Home Organics Management Survey,"* opens with the assertion that, "for the past 10 years, the Seattle Solid Waste Utility (SWU) has been a national leader in home organics waste management."[10] Seattle is indeed known for its extensive and well-established composting programs, which include curbside collection of yard waste, a strong master composter network, home composting demonstration sites, and a backyard bin distribution and education program. Landfilling of yard waste was banned in the City in 1989; the City's promotion of backyard composting began for yard waste in that same year. After 1993 backyard food composting began to be encouraged as well, with worm bins and rodent-proof containers added to the selection of bins available at subsidized prices to residents.

Throughout this period, SWU has issued a number of program evaluation reports discussing Seattle's backyard composting programs' participation rates, diversion potential, technical details, and future prospects. These reports have drawn on several sources of information in their assessment of program impacts. Sources have included waste composition studies, which were first conducted in 1988 (before the yard waste ban and composting programs were introduced), and have been repeated several more times. Such studies have provided information about the overall composition of the City's waste stream, with samples taken from aggregated MSW in waste collection trucks. To supplement these studies, in 1993 SWU conducted a voluntary pilot program in which 250 composting households were asked to record the weights of composted and discarded food at home over a six month period, and to mail in results each month. Furthermore, in order to learn about residents' composting habits and attitudes, SWU has conducted numerous phone and mail surveys. The 1993 Food Waste Pilot included a mail questionnaire about composting behavior. In 1996, SWU published the results of a home organics management survey.

The results of SWU's program evaluations have yielded a great deal of information specific to Seattle, which differs considerably from New York in terms of housing density, proportion of single family houses, yards, home ownership, and other demographic and cultural characteristics (as shown in Table 1, above). Presentation of these results is not within the scope of this Report. Of relevance to New York City's study of backyard composting is the methodology with which SWU estimates diversion.

Diversion

Seattle evaluates yard and food waste diversion separately. The fraction of yard waste existing in the City's refuse stream before the 1989 yard waste ban is known from a waste composition study conducted at that time on waste being hauled by trucks for disposal. As of the *1996 Home Organics Management* study, it stood at 67,500 tons, or roughly 24% of the single-family residential waste stream*. A survey of 610 randomly selected City residents estimated that 11% of total yard waste is composted in the backyard, 2% is grasscycled, 64% is collected at curbside for centralized composting, 18% is dropped off at composting sites by residents, and the remainder (around 4%) is disposed of as garbage. The study estimates that 8,000 tons per year of yard waste is backyard composted by 60,000 households, yielding a per household composting rate of 267 pounds per year or 5 pounds per week. The 1995 study also examined food waste composting. It estimated that 27,200 tons or 19.2% of the single-family residential stream is food waste. Of this, 3,300 tons (1.2%) is being composted by 39,000 residents, at a rate of 170 pounds per year or 3.25 pounds per week. In predicting future diversion from composting, Seattle has applied these composting estimates not only to the number of households in the City that could potentially compost in the backyard (assumed to be single-family residences), but has also taken into account the number of households *already* composting (known from telephone surveys). Thus future changes in diversion from expansion of composting programs are estimated realistically, given Seattle's already high composting participation rate (in 1995, out of all single-family households in Seattle, 25% already composted food waste, and 41% composted yard waste.)

It should be noted that in 1992 SWU conducted two studies in which volunteers were asked to track weights of food and yard waste composted in backyard and worm bins for six months. These studies estimated roughly double the annual rate of composting (500 pounds per year for yard waste; 300 pounds per year for food waste).

Program Critique

The evaluation methods Seattle uses to predict yard and food waste diversion from composting are more sophisticated than most jurisdictions' in their use of survey data and waste composition information. Seattle has a history of strong cultural commitment to environmentalism, and is physically — in terms of housing stock and density — more equipped for backyard composting than is New York. Using self-reported composting estimates from a small sample of residents may therefore be a realistic way for Seattle to estimate diversion. However, New York's heterogeneous culture and its high population density make it necessary to measure diversion more directly.

Orange County, New York

Another study chosen for comparison to New York City's backyard Pilot is the *Backyard Composting Waste Reduction Demonstration and Evaluation Project* overseen by the New York State Energy Research and Development Authority (NYSERDA) and published in March of 1998.

This project was developed and implemented in Orange County, New York. The County's population was counted at 307,647 as of 1990. Over half (59%) of county residents live in areas termed "urban" (with a population density of more than 500 people per square mile), while 41% live in rural areas. The County has banned yard waste from disposal at its solid waste facilities; residents are instead required to dispose of it through backyard composting, municipal collection (where available), private landscapers, personal transport to a county facility for composting, or private facilities. NYSERDA's report notes that data on waste composition for Orange County is not available, but uses data from neighboring counties (Onandaga and Steuben) to estimate a **post-ban** yard waste percentage of 6 to 7%, and an 18% food waste component.

The objective of NYSERDA's project was to directly measure composting of food and yard waste by both experienced composters and novices. For the study, 150 participants were recruited, with 143 completing the test period. All were pre-screened by questionnaire, asked to compost food and yard waste, instructed to record data about the weights of composted waste for one year, and were re-evaluated using the same questionnaire. Participants were divided into eight groups. Four "intensive" groups participated in a rigorous sorting, weighing, and volume estimation procedure for food scraps, yard clippings, recyclables, and mixed household waste. A separate, less demanding program for four other groups was also conducted, in which participants were asked to estimate the volume of each waste component composted.

A residential waste stream of roughly 250,000 tons per year for Seattle was reported in the **US EPA's Characterization of Municipal Solid Waste, 1995.*

Questionnaires

Pre- and post-program questionnaires collected information about the demographic makeup of the groups, measured participants' yard and lawn care and recycling habits, and evaluated the success of the program in terms of whether the participants intended to continue composting. All the recruited participants responded to the pre-program questionnaire, while 127 participants completed it post-program.

Diversion

Estimation of diversion began with tracking of pounds composted over the study period. Data were reported by each participant and submitted twice a month to NYSERDA, where they were reviewed and compiled into a database. The results showed that approximately 22 tons of yard clippings and 14 tons of food scraps were composted by the 96 participants who provided data throughout the year-long program. A final total of 32 tons of yard clippings and 19 tons of food scraps composted was calculated by extrapolating the data from participants who regularly provided totals to the 137 participants who continued to compost but did not consistently submit their data sheets.

From these results, NYSERDA calculated an average total waste generation of 694 pounds per capita over the year long program, or 1.9 pounds per capita per day. NYSERDA's report notes that this figure is lower than the per capita rates of waste generation quoted in solid waste planning documents such as the *Orange County, New York. Solid Waste Management Plan (April 1991)* and the Environmental Protection Agency's *Characterization of Municipal Solid Waste in the United States, 1994 Update*. Both of these sources' estimated unit rate of residential waste generation was greater, varying in difference by .5 pounds to 1.26 pounds. Several reasons were postulated to explain this discrepancy. The first was that not all waste generated by participants may have been weighed. Because of the discipline and dedication required to segregate and weigh all the waste, especially during the severe winter months when little composting activity was under way, NYSERDA suspected that some data might have been under reported. Second, the average number of people in program participants' households was 3.34 compared to the County-wide average of 2.89 people. Clearly, the per capita rate of waste generation decreases as the number of people in the household increases. Finally, the report suggested that those interested in composting tend to have a resource conservation mindset and, therefore, may not generate as much waste as average residents.

In all, project participants composted 32 tons of yard clippings and 19 tons of food scraps, recycled 37 tons of material, and disposed of 66 tons of material as solid waste. This translated into 20% yard clippings and 15% food scraps composted (all of which were placed in the compost bin, for a total of 35% composted), 23% recyclable, and 42% disposed waste. However, because it was suspected that the volunteers' extraordinary dedication and commitment to the environment might have skewed the results, especially by minimizing the amount of disposed waste, NYSERDA applied their composition percentages for composted and recycled materials to the County estimate of 3.26 pounds per capita per day, instead of the 1.9 pounds per capita per day measured among the volunteers.

The results thus derived were multiplied by the number of residents in urban and rural areas in Orange County. Different projected composting participation rates were assigned to urban residents (50% for yard waste composting and 5% for food waste) and those who lived in rural neighborhoods (60% and 10%, respectively). These participation levels were derived from a 1992 survey conducted in Orange County about home composting practices. Finally, the per capita composting estimates were multiplied by the estimated number of composting participants to predict an annual diversion tonnage for food and yard waste countywide.

Program Critique

Like Seattle, this program relied on a self-selected group of volunteers to self-report composting rates. It is to the report's credit that it recognizes this and attempts to control for the volunteers' "extraordinary dedication" by adjusting its estimates, although it would be difficult to tell whether such adjustment accurately reflects what the composting rates would be were the program in force countywide. The report also does not go into detail about how participation projections were derived, which is a crucial component to calculating potential annual diversion.

Monmouth County, New Jersey

In February 1996, the Planning Board of Monmouth County, New Jersey, began a pilot program to demonstrate the effectiveness of a concerted campaign to divert organic waste from the overall waste stream within one community of the County. Through the promotion of home composting and the source separation of organics at the institutional, commercial, and industrial level (ICI), the pilot sought to determine:

- the rate of acceptance and the use of home composters by residents when they are provided and installed at no cost to the resident;
- the organic waste diversion potential for the ICI sector when it is asked to separate organic wastes for collection; and
- the economic feasibility of organics waste diversion countywide.

The Borough of Brielle, with 454 single-family and 56 multi-family residential units, was selected to host the pilot Home~Works™ Program due to the demographic similarity of the Borough to the County as a whole. Brielle, along with other Boroughs of Monmouth County, applied to be considered as a host of the program. An important deciding factor in its selection was its "enthusiastic interest" in hosting the program and its commitment to meeting the County's recycling goal. The program began in March 1996 and continued through the end of October 1996.

Home composting bins were supplied and installed, at no cost to the resident, in single-family homes at the beginning of the program. Approximately 77% of the 454 households that were contacted either accepted the bins or were composting prior to the program.

Waste Composition Study

In an attempt to measure the diversion rate of organic material achieved by home composting, three waste composition studies were conducted. The first was undertaken in March, prior to the compost bin distribution, in order to establish baseline waste generation rates. The second was conducted at the midpoint of the program in July, and the third after the program's completion in October. The timing of these took into account the fact that there would be seasonal variations in waste, such as higher levels of fruits and vegetables in the summer months.

These composition studies were performed on 53 sample single-family homes located in what the program's designers deemed to be a representative section of the demonstration area. Some of the factors that led to the selection of these particular homes included an early morning trash collection time and contiguous homes located in a typical area of town, where there was no evidence of multiple families living in a single housing unit.

Waste was collected in packer trucks but was not compacted. The waste was then sorted by hand into 28 different categories using a protocol developed by HDR Engineering, solid waste consultants for Monmouth County.

Residential Diversion Results

Results from truck sorts were divided by number of households from which waste was collected and multiplied by an annual rate to arrive at a "pounds per household per year" estimate. When comparing results from March and July, the report attributed a 26% overall increase in waste generation to a normal seasonal increase illustrated by similar trends in past disposal receipts for the same area. This increase was 10 percentage points lower than the countywide increase of 36% for the same time period. During this period, the amount of readily compostable food found in the waste stream decreased by 1%. The report cited this reduction as significant in the context of the 4% increase of food waste that a household typically generates during the summer season.

A comparison of the waste composition studies of the baseline month of March to October revealed a 3% decrease in waste generation overall, as well as a 33% decrease in food waste. This percentage was calculated by assuming that the total waste stream did not change from March to October, despite historical data suggesting that the amount of waste generated in the study area *increases* over this time period. Therefore, the estimated decrease of 33% is actually a conservative estimate. This 33% estimate corresponded to a per household reduction of 97.1 pounds per household per year.

Change in yard waste, which actually increased by 115% between March and July and 125% between March and October, was not counted as a program impact, presumably because of its high seasonal variability during these months and the fact that it is collected under municipal programs for centralized composting. However, the report did conclude that:

> an...associated benefit of backyard composting [of food] is the expected diversion of leaves, grass, and other yard waste from municipal yard waste collection programs. Leaves are used as the primary bulking agent and carbon sources in backyard composting at a ratio of one to one, by weight. This use results in approximately 97.1 pounds of yard waste (per household, per year) being diverted from curbside collection.[11]

Program Critique

This program is one of the few in the country to incorporate "before" and "after" waste composition analyses into the evaluation of program effects. As such it laid the groundwork for the methodology the Department ultimately used for its Backyard Pilot. Because of the importance of precisely estimating program effects in New York City, the Department felt it necessary to more fully control for effects of seasonal variation, and to understand waste composition changes at the household level, rather than in aggregate "off the truck" as was done in this study.

Portland, Oregon

Metro is the regional government serving over 1.2 million residents in three counties and 24 cities in the Portland, Oregon metropolitan area. As yard waste comprises 26% of the area's waste stream, Metro and local governments produced a *Regional Yard Debris Recycling Plan* in 1991 in an attempt to divert a greater portion of this material from the landfill. The intent of the plan was to increase the amount of yard waste recycled at large, centralized, commercial processors via curbside collection from residential customers. Home composting was viewed in this plan as an important but supplementary method of dealing with yard waste, whose primary benefit was source reduction, or preventing the material from ever entering the waste stream. Most of the region's composting planning process did not target food waste, although this topic was addressed by Metro in workshops, demonstration sites, and informational brochures. In 1992 Metro published a *Program Summary and Interim Evaluation of the Home Composting Demonstration Program*. This report describes the methodology Metro employed in evaluating the effectiveness of their program, focusing especially on diversion rate estimates.

Methods of Evaluation

With the aid of Portland State University, three methods were developed to assess the program's impact: total numbers of people reached, reported differences in behavior due to the program, and estimates of the amount of material diverted from the waste stream.

To track the number of people contacted by the program, Metro kept records of the number of workshop participants, number of people attending community presentations, visitors to the leaf composting clinics, number of brochures left weekly at each demonstration site, and an estimate of the number of monthly calls relating to home composting received by the Recycling Information Center. These records were used to estimate the number of people directly contacted by the program. The report states that it was difficult to account, however, for the number of people that might have been reached indirectly. It postulated that a "ripple effect" — characterized by such undocumentable events as people seeing their neighbor composting and becoming involved, or viewing program advertising but purchasing a bin through a local retailer — might have added to the number of residents composting on their own, outside of the program.

Metro's resident surveys focused on assessing *changes* in composting behavior as a result of the program, rather than recruitment of composting novices. Surveys were distributed to two groups of composters: workshop attendees and residents who requested informational brochures. Surveys were mailed to 142 workshop participants, with 75 (53%) responses returned. Of the 165 surveys mailed to those who requested brochures, 35 (21%) completed surveys were returned. The results of these surveys revealed that most residents were already doing some form of home composting before contact with the program. Only 15%, for example, of the brochure recipients had never composted before. Behavioral changes were gauged in the workshop surveys by asking about materials composted and composting methods the participants used before and after joining Metro's program.

The surveys also sought to determine how residents disposed of yard waste. According to the results, residents home-composted 61% of their yard waste, delivered 21% to commercial processors, and left 23% at curbside. The report notes, "although these are rough estimates that don't total exactly 100% due to incomplete data on some of the survey forms, it is evident that most people estimate that they are composting more material at home than what they allow to leave their property."[12] However, the report also notes that "participants had a very difficult time estimating the amounts of yard debris composted."[13] Direct pound estimates of home composting diversion were therefore not gathered by the survey.

Diversion

Instead, Metro used results of its *"1989/1990 Waste Characterization Study"* to estimate the percent composition of organics (food plus yard waste) in the residential waste stream (34%). This percentage was applied to another municipal estimate of daily residential household waste generation (4.2 pounds per household per day) to reach a figure of 1.41 pounds per household per day of food and yard waste that is potentially compostable. In order to translate this into a diversion estimate, Metro used a methodology developed by Craig Benton, planning director of Sound Resource Management Group, Inc. as reported in the April 1991 issue of *Biocycle* magazine. Metro states, "assuming one-third of the residential waste stream is food and yard debris, and that one third of the households will compost half their food and yard wastes, about six percent of the residential waste stream could be diverted (33% x 33% x 50% = 6%)."[14] This 6% was then applied to Metro's annual residential waste stream figure of 350,971 tons to estimate a diversion of 21,058 tons annually from home composting. As a program note, Metro mentions that no attempt was made to actually physically measure the amounts of material the participants were composting.

Program Critique

Perhaps because backyard composting was seen as a small component in a larger regional plan focused on centralized yard waste composting, Metro's evaluation was limited to surveys of resident behavior, with some self-estimates of composting activity. Direct measurement of waste composition was not carried out. Instead, published evaluation protocols were used to estimate diversion from basic information about the City's waste stream. As mentioned throughout this report, the unique nature of New York City's waste makes direct measurement essential.

Applied Compost Consulting

In 1995, Applied Composting Consulting prepared a report for The Composting Council titled *Cost-Benefit Analysis of Home Composting Programs in the United States*. The goal of this economic analysis was to develop a composite view of the costs and benefits of composting, based on results of a nationwide survey of home composting programs. Until this study, according to Applied Composting Consulting, the direct fiscal and quantified benefits of home composting had not been well documented. Constructed to provide analytical information regarding overall program costs and benefits, the study sought to provide program managers the ability to determine the appropriate priority level for home composting educational efforts, and to justify budgetary requests.

A second goal of this study was to look at how home composting programs were influenced by such factors as: population size, diversity in demographics, and the quality of different program elements and data. The results presented in the study were based on an August, 1995 survey of 137 home composting programs across North America. A total of 43 completed surveys were returned in time for tabulation and analysis. New York City was not among the municipalities surveyed.

Survey Results and Analysis

A total of 43 jurisdictions in North America, varying in population size, housing characteristics, and income levels, responded to the survey. The absence of any trends in the survey results did not allow for a prediction as to whether or not a community would implement a home composting program, nor how extensive it might be. However, from the information received, Applied Compost Consulting was able to create a generalized portrait of home composting programs found in communities of various sizes. The results demonstrated, through the frequency of element use, that programs in larger communities tended to have a greater variety of program elements. They also found that home composting programs tend to have a similar set of basic elements, including brochures, workshops, telephone information lines, and outreach to schools.

The only notable variation found within regions was differences in cost savings resulting from various regional tipping fees. The study ascertained that home composting is a cost-effective way to handle residential organic materials, such as yard trimmings and vegetable food scraps in comparison with other solid waste management strategies. The data determined that home composting programs spent an average of $12 for every ton diverted from landfills. This figure represents only program-related costs, and excludes avoided costs, program benefits, and life cycle costing of subsidized compost bins. It was noted that the above mentioned figure did not include any private costs borne by residents, such as the purchase of commercially available compost bins or pitchforks.

The cost-effectiveness of home composting programs ranged from $1 to $134 per ton diverted, based on the information provided by only 20 respondents. In the low-cost category, grasscycling (mulch mowing) figures prominently, and education efforts for this activity focus on developing and distributing brochures. High-cost program efforts include subsidized bin distribution and conducting composting workshops, which require a more concerted effort than promoting grasscycling.

There was no life-cycle cost analysis of home composting programs performed. Since home composting bins last for several years, and educational efforts can lead to life-long behavioral changes in how residents manage their household organics, counting benefits beyond the short term would likely yield a lower estimate of dollars expended per ton diverted. For the purpose of simplification and program planning, however, the $12 per ton figure is used as the report's conclusion of the average direct budgetary cost of home composting programs nationwide.

Diversion Rates

In an attempt to arrive at the average number of pounds per year participating households composted at home, Applied Composting Consulting combined the amount reported by the participants themselves, along with best estimates provided by home composting program managers. The survey of 35 respondents yielded an average of 646 pounds per year, with a confidence interval at the 95% level between 467 and 825 pounds per year. Only twelve programs supplied information on measured data; the rest supplied estimates, which were included in the configuration of the average pounds per year in order to generate a more complete number.

The high level of variability in the amount of materials composted by participating households is evident in the range reported. The minimum reported value was 75 pounds per year, while the maximum was 2,656 pounds per year. According to Applied Compost Consulting, this variability can be accounted for, in part, by how broad or narrow a definition was used by respondents for home composting, and whether partial or complete information was available to them. Several jurisdictions reported pounds per year data from un-named published sources that focus solely on amounts composted in home composting bins. Other jurisdictions used a broader definition of home composting and included tonnage attributed to grasscycling and other organic source reduction methods. Clearly, the tremendous variability in results makes it difficult to conclude that a typical community can expect a certain level of diversion per participating household.

Summary - Comparison of the Evaluations

The four local evaluations of backyard composting (those carried out for Seattle, Orange County, Portland, and Monmouth County) had several elements in common. Each utilized data from a composition study of aggregated waste (i.e. garbage in a truck destined for the landfill) to study the magnitude and composition of yard debris, food scraps, and other components in the waste stream. Each used surveys to look at participation rates, as well as to understand participant behavior. Each combined these sources of data to come up with an annual per household diversion estimate. And each quantified final results at the household level, so they could be applied to certain sections of the locality or adjusted for participation rate, population growth or decrease, or composting efficiency.

These evaluations, however, also differed in their approaches. Seattle and Portland's waste composition studies were carried out as part of the area's normal waste management planning, while Orange county borrowed estimates from neighboring counties and Monmouth county conducted a direct before-and-after waste composition analysis specific to the study. Seattle and Orange County's surveys asked residents to directly report the amount they were composting, Portland estimated this from published research, but Monmouth county extrapolated from the measured change in waste generation and composition before and after the program. Seattle and Portland examined changes in existing rates of composting; Orange and Monmouth counties, on the other hand, looked at new programs. And Seattle and Orange County looked at yard and food waste composting separately, while Portland and Monmouth County examined these components together.

These different approaches yielded widely varying composting diversion estimates, as summarized below:

Table 8

Diversion Estimates from Different Jurisdictions

Jurisdiction	Yard Waste Composting Diversion Estimate	Food Waste Composting Diversion Estimate	Total Composting Diversion Estimate
Seattle	267 pounds/household/year	170 pounds/household/year	437 pounds/household/year
Orange County*	398 pounds/household/ year	303 pounds/household/ year	701 pounds/household/year
Monmouth County	N/A	97.1 pounds/household/year	194.2 pounds/household/year
Portland Metro	N/A	N/A	511 pounds/household/year

These conflicting findings are reinforced by Applied Compost Consulting's extremely variable estimates of composting diversion, ranging from 75 to 2,656 pounds per household per year. After reviewing these and other evaluation methods as models, the Department concluded that a more refined methodology would be needed for New York to obtain a realistic estimate of the diversion potential of a backyard program for its waste.

HOW OTHER JURISDICTIONS' EVALUATION METHODS COMPARE TO THE BACKYARD COMPOSTING PILOT PROGRAM IN NEW YORK CITY

As described throughout this report, because New York City has a unique environment, an evaluation tailored to its needs will necessarily be different from others carried out throughout the United States. In designing its own waste composition and survey evaluation methodology, the Department took into account the housing and population characteristics that make it different from other US cities — namely housing density, lack of backyard access, minimal precedent for the practice of backyard composting, extremely high quantities of waste, and mix of existing mandatory and voluntary waste management programs. The methodology that the Department chose, which will be detailed in the chapters to come, includes a waste composition study, resident surveys, measures of program participation rate and composting behaviors, and estimates of diversion. It is unlike other studies, however, in three important ways:

- first, it **directly** measures waste composition **at the household level**;
- second, it uses **control and comparison groups** to isolate non-Program and indirect Program effects from Program effects on the waste stream; and
- third, it examines Program impacts on waste components **other than food and yard waste**.

Household Level Analysis

With a population of over seven million as of 1990, an annual residential waste stream of over five million tons, and a housing stock that is dense, multi-family, and relatively sparse in backyards, New York is a city in which it is difficult both to promote backyard composting and to measure its effects. This is very different from the situation in suburban areas such as Orange or Monmouth County, or even in less dense, less populated cities such as Seattle and Portland. Using published estimates of household organics diversion potential, or even conducting aggregate, off-the-truck waste composition studies and attempting to calculate a household rate would likely yield unrealistic results for New York City. However, if waste composition studies are carried out house-by-house among residences that have backyards, the effect of a backyard composting program on waste composition can be directly measured without the interference of data from apartment buildings or other residences that cannot accommodate bins. In addition, more precise results about variability in generation at the household level can be obtained than would be gathered by an aggregate study. As will be described in detail in later sections, this is the waste composition analysis methodology adopted by the Department.

**Orange County's results were expressed "per capita." We have adjusted this by the County's estimate of 2.89 persons per household to arrive at a per household estimate.*

Looking Beyond Participant Impact on Organics

Furthermore, each of the backyard composting evaluations detailed above focused on the effects of home composting among program participants who chose to compost. None included a comparison of results to a "control group," nor to households with backyards who — after being solicited for participation — chose not to join a program. Use of a control group is necessary to rule out citywide trends in waste generation as confounding factors when looking at backyard composting impact. Comparison of results from Program participants and nonparticipants exposed to the Program is also important in terms of understanding indirect effects on waste generation that the Program may have. Furthermore, while the studies reviewed above discussed non-organic fractions of the waste stream, they did not examine Program effects on changes in the generation or composition of these fractions. While reduction in organics is the direct goal of backyard composting, it is possible that Program promotion and changes in attitudes or behaviors among participants may nevertheless have "spillover" effects on items that do not go in the compost bin.

Because of the limited open land available to New York City, the pending closure of its landfill places capacity for disposal of all waste stream components at a premium not comparable to most other localities. It is therefore necessary to be all the more specific about the impacts that home composting can realistically have in such an environment. In order to address these questions, the Department opted for a whole systems approach to studying the effects of the Backyard Composting Pilot Program. Factors extraneous to volunteer composting would be accounted for by examining waste composition changes in control areas where the Program was not being promoted, and among Program nonparticipants. Furthermore, by measuring changes in other waste components such as recycling, bulk, and "other" in the waste stream, spillover effects of the Program could be identified. This approach would yield results that took into account a wide range of factors that intersect with backyard composting to affect waste composition, yet focused more precisely on households than prior studies of composting had.

CHAPTER V. THE WASTE COMPOSITION STUDY

The waste composition study component of the Backyard Composting Pilot Program was meant to provide the Department with directly measured, statistically sound information about the effect of the Program on the waste stream in the four test tracts. Specifically, this would lead to an understanding of:

- the Baseline waste composition of the tract population, before the Program was implemented;
- whether food waste decreased significantly among Program volunteers;
- Program effects on other waste components for volunteers, such as yard waste and recycling;
- spillover Program effects for food, yard waste, recycling, and other waste components among nonvolunteers.

These goals were consistent with the conceptual model upon which the Backyard Pilot was based. In designing a Backyard Composting Program for New York City, the primary objective (in terms of impacting diversion) was first and foremost to encourage residents to compost their **food** waste. Composting yard waste was secondary. While it was understood that yard waste composting would be an important component of backyard composting, this category would not be entirely addressed by this activity because grass is not conveniently backyard composted, heavy prunings do not break down well in the compost bin, and many homeowners have too many leaves to compost in the bin. Thus, while residents were educated to use some of their yard waste in their bins, the remainder was meant to be addressed by other DOS programs such as leaf collection, grasscycling, and drop off at self-help sites. A third objective of the Backyard Composting Pilot Program was to encourage residents, however indirectly, to think about what they were throwing away and to subtly heighten their awareness of recycling — in all its forms — and the impact of solid waste on landfills.

The Department and the Gardens contracted Waste-Tech, a nationally recognized waste management consulting firm with extensive experience analyzing waste in New York City, for this portion of the study. Waste-Tech was charged with developing an experimental design to test the Program's impact on waste composition, carrying out physical sorts of collected waste, compiling and analyzing waste composition data in a statistically sound manner, and presenting findings in a series of detailed reports. After reviewing outreach and implementation plans for the Backyard Composting Pilot Program, Waste-Tech recommended that the Department conduct a study that would begin with a **baseline** measurement of waste composition among randomly selected households who qualified for program participation. The Baseline measurement would be taken before the Backyard Composting Program was implemented, to be followed up with two post-program implementation assessments of **volunteers'** and **nonvolunteers'** refuse. For the purposes of the study, a "**volunteer**" was defined as a resident of a test tract neighborhood who, after purchasing a compost bin, was taught to compost by Botanical Gardens' staff; while a "**nonvolunteer**" was defined as a resident of a test tract neighborhood with backyard access who elected not to purchase a bin or otherwise participate in the Program. Finally, in order to control for seasonal and other effects not related to the Backyard Composting Program, concurrent waste assessments would be conducted in a fifth area of the City in which the Program was not being carried out at all. Measurements in this control tract, in Little Neck, Queens, would be used to account for changes in waste composition that may have been going on throughout the City in neighborhoods similar to the test tracts. The impact of the Program, in terms of food waste diverted from the waste stream, and changes in other waste components over the course of the study period, would be measured by comparing volunteers' and nonvolunteers' waste composition — controlling for extraneous factors — to the Baseline.

SUMMARY OF RESULTS

The study was carried out as planned. The Baseline waste assessment took place in June of 1997, followed by two post-implementation assessments in October 1997 and June 1998. This work resulted in the following key findings:

- At Baseline, a sample of 116 randomly selected households (all of whom had backyards) were generating 45.6 pounds of trash and 16.3 pounds of recyclables per household per week on average. Dividing recyclables by trash plus recyclables translated into a diversion rate of 26.3%, and broke down into components as follows:

Table 9

Baseline Waste Composition

Waste Component	Average Pounds per Household per week	Percent of total
Recycling (source separated for collection by DOS)	16.3	26.3%
Yard waste (bagged grass, leaves, prunings, dirt, etc.)	12.1	19.6%
Bulk* (nonrecyclable small bulk items commingled with other trash)	1.83	3.0%
Food (animal and vegetable products, beverages, and soiled napkins and paper towels)	12.5	20.2%
Lost Recyclables (metal, paper, and recyclable glass and plastic improperly discarded in and commingled with trash)	8.74	14.1%
Other (all remaining materials, including hygiene products; nonrecyclable glass and plastic; and other residue)	10.4	16.7%
Total	61.9	100%

** Note: for the purposes of this study, larger bulk items were not sampled and are therefore not included.*

- After the Baseline assessment, all qualifying households in the tracts (i.e. those with backyards) were solicited to join the Program. The resulting participation rate was 9.4% overall, with 221 out of 2,346 qualifying households signing on. This rate varied among the tracts, with West Brighton, Staten Island showing the highest participation (12.8%) and St. Albans, Queens the lowest (4.7%).
- Food waste decreased significantly among volunteers after the program was implemented. Four months after Baseline assessment, volunteers were disposing of around 1 pound per household per week less than nonvolunteers. After another eight months had passed (one year from Baseline), this difference had grown to 2.5 pounds. With a participation rate under 10%, this averaged out to .24 pounds of food each week for all qualifying houses in the tracts, or 563 pounds per week, on average, for all 2,346 households in the four test tracts.
- Volunteers threw out 1.5 pounds fewer recyclables in the trash, but also placed less material out for recycling (also 1.5 pounds per week), as compared to nonvolunteers.
- The Program had significant and substantial effects on waste composition of nonvolunteers. After controlling for seasonal and other non-Program factors that could have influenced waste generation, between Baseline and Summer 1998 there was a statistically significant decrease in food of 3.7 pounds per household per week and lost recyclables of 3.3 pounds per household per week among *nonvolunteers*. Furthermore, recycling increased for this group by 3.7 pounds per household per week. These results suggests that the Backyard Composting Program may have influenced waste generation practices of those who chose not to volunteer. The improvement in recycling compliance may have been due to spillover effects of conducting the Program and the waste composition study in the tracts. The reasons for the decrease in food waste among households not composting were, however, not studied within the scope of this project.
- Changes in yard waste and bulk waste were not statistically significant for volunteers or nonvolunteers, because of the high degree of fluctuation in how much yard waste and bulk households generated, even among those living in the same census tracts. The variability in the amount of grass clippings, tree prunings, dirt, and bulky items such as toys and appliances that were discarded meant that no statistically sound conclusions could be drawn from the changes measured.
- Generation of material classified as "other" *increased* among volunteers and nonvolunteers over the course of the study. While reasons for this are unclear, a detailed subsort of this "other" material confirms that the methods used to categorize waste components were consistent throughout the study. It is therefore unlikely that decreases in the food, lost recyclables, yard, or bulk categories corresponded to increases in "other."

- After excluding changes in yard and bulk waste, which were not statistically significant, it was found that changes in total waste were negligible among nonvolunteers, but very pronounced among volunteers, whose total waste fell by 8.8 pounds per household per week between June 1997 and June 1998. However, with a participation rate under 10%, this resulted in ***no substantial overall waste reduction***.
- Because of the large amount of variation among tracts for all categories of waste generation, it was suspected that housing, income, or other demographic factors specific to each area may have influenced how the Program affected waste composition. For this reason, Waste-Tech strongly recommended against extrapolation to other areas of the City without further study of how demographics and the Program interact.
- Nevertheless, the Department calculated its own extrapolation of results that suggested that a Backyard Composting Program would divert roughly 5,700 tons of food waste per year for all of New York City, *if the same participation and composting rates seen in the Pilot were achieved citywide.* This rate corresponds to 130 pounds per year per participating household.

These findings were arrived at through a large scale data collection effort and a careful statistical analysis. A full discussion of the data collection and analysis can be found in Appendix I. Findings of the waste composition study and implications for the Backyard Composting Program and the waste stream are presented below.

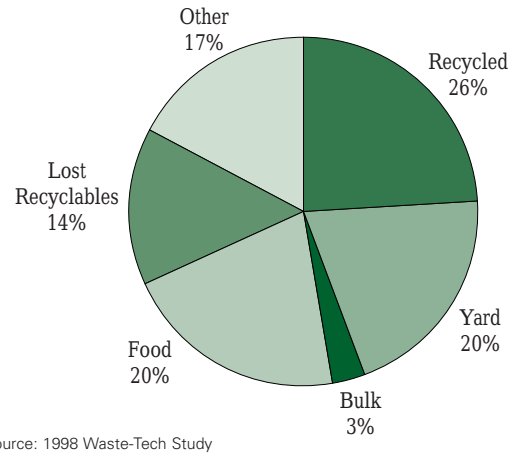
THE BASELINE WASTE ASSESSMENT

The waste composition percentages calculated from the Baseline waste sorts provide a snapshot of the waste stream of qualifying households during the first week of June 1997. As shown in Figure 2, the fraction of organic materials (yard waste plus food waste) totaled around 40%. If the percentage of recycled materials and lost recyclables is added to the organic fraction, the percentage that could potentially be reduced by **all** DOS recycling and composting programs (including those addressing curbside paper and MGP recycling, leaf collection, grasscycling, and backyard composting) rises to 80% (see Figure 3).

Figure 2

Baseline Waste Composition

sample of 116 households in test tracts, June 1997

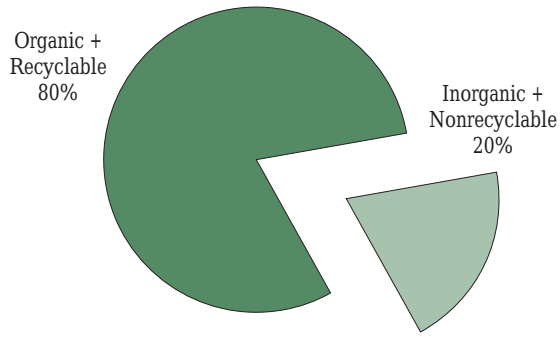


Source: 1998 Waste-Tech Study

Figure 3

Fraction of Waste that Could be Targeted for Diversion

among sample of 116 households in test tracts



Source: DOS calculations based on 1998 Waste-Tech study

This *potential*, however, should be interpreted with caution. First and foremost, it was calculated from **a sample of one week's worth of waste in atypical areas of the City**. It is likely that composition analyses undertaken Citywide and in months other than June would yield a different breakdown. Furthermore, to divert this 80% from the waste stream in those areas would require all citizens to **recycle or compost 100% of what could potentially be recycled or composted**. The Department's ongoing tracking of recycling "capture rates" (rates at which recyclables are correctly being placed in the recycling bin instead of the trash) range from 19% to 60%, depending on the area. Although continued public education and enforcement efforts aim to increase this rate to 75%, a 100% capture is unheard of in the field of waste management.

As far as composting is concerned, a sizeable fraction of food waste (meats, cheeses, oils) cannot be prudently composted in the backyard, and is not currently collected under any of the Department's other composting programs. Technology

(such as mixed waste processing or in-vessel systems) for facilities that can handle odoriferous animal products for composting is much more complex than for plant matter, and siting of such facilities is extremely difficult.

Because of the atypical characteristics of the test tracts, comparison with past waste composition analyses the Department has conducted, or that are published nationwide, is not appropriate. Instead, the Baseline waste assessment is meant to be used to provide average waste generation rates in the absence of a backyard program, against which program effects can be measured.

PARTICIPATION RATE

After intense outreach by letter, telephone, and door hanger, the following numbers of participants were recruited in each of the tracts:

Table 10

Participants Recruited in Each Tract

Tract	Code	Qualifying Households	Volunteers	Participation Rate
		from US census data, 1 and 2 family units	from direct observation during outreach	
Bronx, Morris Park	X	432	38	8.8%
Brooklyn, Marine Park	B	526	36	6.8%
Queens, St. Albans	Q	384	18	4.7%
Staten Island, West Brighton	S	1,004	129	12.8%
Total		2,346	221	9.4%

"Qualifying Households" were considered homes with backyard access. For the purpose of calculating the participation rate, this number was approximated from published US Census data on single- and two-family residences.

PROGRAM IMPACTS ON FOOD

The changes in food waste from the Baseline period in June 1997 to October 1997 and June 1998 are summarized in Table 11 below.

Table 11

Program Impact on Food Waste

(in pounds per household per week)

Baseline waste composition	June 1997 - **12.5** pounds of food per household week	
Changes relative to Baseline*	October 1997	June 1998
Impact on individual households		
Nonvolunteers only	-2.7	-3.7
Volunteers only	-3.8	-6.3
Volunteers relative to Nonvolunteers	**-1.0**	**-2.5**
Impact on tracts as a whole		
Program Impact (changes accounted for by volunteers and nonvolunteers), with 9.4% participation rate	-2.9	-4.0
Program Participation Impact (changes accounted for by volunteers only), with 9.4% participation rate	-0.16	-0.25

**Adjusted to control for non-Program factors that might affect waste generation, including seasonal and weather fluctuations, economic conditions, and any other possible socio-environmental factors that would change waste generation patterns in neighborhoods with backyards Citywide.*

When looking at the effect that the Backyard Composting Program had on the amount of food disposed of in the trash, it is important to take **two perspectives**. The **first** is to look at how the average volunteer's food waste generation changed after joining the Program relative to the average nonvolunteer during this same period. The "Impact on individual households" section of Table 11 shows that food waste declined for both groups. Furthermore, this section of Table 11 shows that food waste of volunteers decreased *more* than that of nonvolunteers, specifically one pound more by the Fall of 1997, and 2.5 pounds more by June of 1998 (one year after the Baseline study). These are the amounts that can be assumed to have been placed in the compost bin, instead of being disposed of as trash. Identification of this amount is central to the goal of the Pilot study, because it permits quantification of diversion impacts and calculation of Program costs and benefits.

The fact that a statistically significant decrease of 2.7 pounds in the Fall and 3.7 pounds in June was seen among nonvolunteers *suggests* that aspects of the Program ***ma***y be indirectly affecting food disposal, although no mechanism by which this might take place has been established. One possible explanation is that nonvolunteers, as they improved their recycling, were more diligent about emptying and washing recyclable containers. Because leftover liquid in containers in the trash counted as "food" weight, improvement in recycling might have decreased the food weight component as well. Another possible explanation is that there were trends in waste generation occurring in the test tracts that would have decreased food waste even if the Program had not been introduced, and that the use of the fifth tract was not sufficient to control for such non-Program factors. Such trends might include fluctuations in food purchasing, dining out, use of insinkerators, or other socioeconomic and environmental phenomena.

The **second** section of the Table 11, entitled "Impact on tracts as a whole" presents a different way of looking at the food waste decrease. This perspective takes into account that only 9.4% of the total population of qualifying households were volunteers, and the balance, 90.6%, were nonvolunteers. To assess the total decrease in food waste in the tracts overall, changes were averaged out among *all* qualifying households in the four test tracts. "Program Impact" refers to changes seen among both volunteers and nonvolunteers, while "Program Participation Impact," refers only to changes brought about by volunteers. What results is an overall decrease that is largely made up of changes seen among nonvolunteers, **with volunteers accounting for less than one quarter of a pound of the decrease**.

CHANGES TO OTHER COMPONENTS

Waste-Tech's study also measured changes in materials placed in the recycling bin, lost recyclables incorrectly thrown out in the garbage, yard waste, small bulk items disposed of in the trash, and "other" materials. Specific impacts on each waste component were examined in three separate ways, looking at the average waste composition changes for **(1) volunteers as a group, (2) nonvolunteers as a group**, and (3) for the **tract as a whole** (that is, for a tract population composed of 9.4% volunteers and 90.6% nonvolunteers).

Recycling

As shown in Table 12 below, recycling **increased** between Baseline and June 1998, after the Program had been in effect for one year. Furthermore, while both nonvolunteers and volunteers increased recycling, nonvolunteers showed more of an increase.

Table 12

Program Impact on Recycling

(in pounds per household per week)

Baseline waste composition	June 1997 **16.3** pounds of recycling per household week		
June 1998	pounds of recycling per household per week	change from Baseline	percent change from Baseline
Nonvolunteers only	20.0	3.8	23.3%
Volunteers only	18.6	2.3	14.1%
All sampled households (9.4% volunteers, 90.6% nonvolunteers)	19.8	3.5	21.5%

Note: changes between Baseline and Fall 1997 were not statistically significant.

More improvement in recycling among nonvolunteers than volunteers may, at first examination, seem unexpected. Intuitively, one might assume that if there *were* a difference between volunteers' and nonvolunteers' recycling rates, it would be the volunteers — who had joined the Program and were possibly more conscientious about their waste in general — who would show a greater improvement in recycling. A subsort conducted by Waste-Tech of some of the recycled fraction collected in the waste composition clarified the initial findings. Waste-Tech found evidence to suggest that contamination in the recycling was actually *higher* among nonvolunteers than volunteers. Because pounds of "recycled" materials were recorded simply as the weight of all items placed in the recycling bin, contamination may have contributed to the total weight of the recycled category during the initial sort. Volunteers, it appears, were recycling less, but recycling "better."

Lost Recyclables

At both the Fall 1997 and the June 1998 waste assessments, it was found that items designated by DOS as recyclable — but discarded in the trash — had decreased significantly among nonvolunteers, and even more so among volunteers. In other words, residents were less likely, overall, to place designated metal, glass, plastic, and paper in the garbage.

In order to comment on whether decreases in lost recyclables were *directly attributable* to increases in recycling within the same households, Waste-Tech turned to the results of a correlation analysis it had conducted. This statistical approach was used to test the consistency in individual households' generation rates, and also whether there were relationships between generation rates for any two components in the same household. The results of these tests indicated that households tended to be either consistently high or consistently low recyclers, and that an increase in a household's recycling rate did not directly result in lowered lost recyclables, or vice versa.

The Effect of Expansion on Changes in Recycling and Lost Recyclables

The Department's Expanded Recycling initiative (which added mixed paper and household metal to the list of designated recyclables) was introduced in Brooklyn and Queens in September 1997 *after* the Baseline sampling period, but was in place in Staten Island and the Bronx *before* Baseline. This meant that uneven implementation of Expanded Recycling could potentially have caused recycling rates to increase in Brooklyn and Queens for reasons unrelated to the Backyard Composting Pilot Program.

Waste-Tech accounted for this by applying an adjustment factor to the recycling rate measured in the control tract in Little Neck, Queens. This factor compensated for the recycling increase (and decrease in lost recyclables) observed in Little Neck between the Baseline and Fall 1997 sampling periods to account for possible effects of Expansion. As a result, the adjusted recycling rate may have slightly overestimated the recycling increase (and lost recyclables decrease) in the Brooklyn and Queens test tracts, since no such correction would have been necessary to compare the control tract to these two tracts. However, because of the small weights of the sample sizes for these two tracts relative to the Staten Island and the Bronx tracts, applying the control adjustment factor to the Brooklyn and Queens samples would not change the magnitude or significance of the overall study results. The methodology and calculations for this adjustment factor are detailed in Waste-Tech's final report.

Other

The "other" category included materials not designated for inclusion in the City's Recycling Program, such as nonrecyclable glass and plastic; personal hygiene products; and all remaining residual materials after yard waste, food, recyclables, and bulk had been sorted out. This category actually increased significantly over the course of the study. This increase was seen less among volunteers than nonvolunteers, and overall accounted for a rise of 4.1 pounds in Fall 97 and 3.5 pounds in June 98 above the Baseline 10.4 pounds per household per week. In discussing this result, Waste-Tech notes:

> One possible reason for these increases could be unintended changes in the sorting methodology that result in the classification of some lost recyclables (i.e. wet paper) as "other." This would skew the results and would require a correction or adjustment to the lost recycling rates...the "other" fraction was further sorted for all sampling periods. [However,] the subsort data do not indicate that any one component increased disproportionally for either Post Implementation period, as would be expected if the increase were due to poor sorting procedures.[15]

Waste-Tech also notes that a possible reason for the increase in "other" could be changes in waste generation behavior associated with weather or seasonality that were not captured by adjusting for the control tract. Waste Tech states that a subsort of "other" material revealed that most of the increase was made up of "junk" plastic objects, such as toys, knickknacks, and other small items. Why this category of refuse increased between June 1997 and 1998 is of course

unknown, but it is difficult to imagine that the Program could have caused such a change. In the end, Waste-Tech concludes that, "in the absence of further data...the reasons for the increase in the 'other' category remain unexplained."[16]

Yard and Bulk

In general, variability in these categories (how much yard and bulk waste fluctuated from house to house) was simply too high to yield significant results. The one exception is the decrease in yard waste between Baseline and Fall 1997 periods, which was highly significant and sizeable. For the tract as a whole, yard waste decreased from roughly 12 pounds at Baseline to around 3 pounds in October, a difference of 9 pounds. A negligible portion of this decrease (less than .01 pounds per household per week, on average), however, was attributable to volunteers' activities.

The variability observed in these waste components makes sense, intuitively. Yard waste (such as bags of grass in the spring, or bins full of branches after tree pruning) will not be disposed of consistently from week to week, nor will bulky, unusual items such as large toys or appliances. Because of the lack of statistical significance, these categories should not be included in the analysis of overall changes to the waste stream. Instead, statistical practice dictates that we concentrate on categories that were more consistently disposed of and, not coincidentally, for whom waste stream changes were significant — namely food, lost recyclables, and "other."

ADDING THE CHANGES TOGETHER

Method

Looking at how waste stream changes affect diversion is not a matter of simply adding together changes in trash and changes in recycling. It is important to understand that, in general, an *increase* in recycling and a *decrease* in trash both go in the same direction in terms of reducing what ends up in the landfill. An increase in recycling often comes about because trash is redirected to recycling; however, it may be attributable to other effects such as increased newspaper readership, receipt of junk mail, etc. Similarly, a decrease in trash may come about as a result of improved recycling, or alternately because of waste prevention or reuse practices, or trends in commercial packaging.

To examine total changes in the waste stream in a way that is meaningful to our understanding of diversion and impacts on the landfill (or, in the future, export), it is therefore essential to take into account the fact that waste materials may shift over time between trash and recycling, and, in addition, will be affected by composting or waste prevention initiatives. This concept can best be illustrated with an example. If a household generates 50 pounds of trash and recycling per week, with 20 pounds being recycling and 30 pounds being trash, the quantity of waste in total does not change if the next week this household recycles 25 pounds and throws out 25 pounds of trash, or generates 10 pounds recycling and 40 pounds trash, etc. The total waste **decreases**, however, if the 50 pounds of trash plus recycling fall to 40 pounds, or any lower amount, in total.

Table 13

An Example of How Trash and Recycling Changes Break Down

	trash	recycling	trash + recycling
week 1	30	20	50
week 2	15	25	40
change in recycling		+5	
change in trash	-15		
change in all waste			- 10

5 pounds of the 15 pound drop in trash was transferred to the recycling bin, the remaining 10 pounds were prevented from being generated in the first place. The total impact on the landfill is to divert 15 pounds away from it.

Using this example of an overall change of 50 to 40 pounds, we can say that 10 pounds met some other end than the trash can or the recycling bin. Such an end might include waste prevention (e.g. buying less, feeding food scraps to pets), reuse (e.g. utilizing jars for storage), home composting, or may simply be the result of normal fluctuation that occurs from week to week. Continuing with this case, if the change is from 50 pounds total with 20 pounds recycling and 30 pounds trash to 40 pounds total with 25 pounds recycling and 15 pounds trash, then we can say that recycling increased by 5 pounds and trash decreased by 15 pounds. Once again this calculates out to a decrease of 10 pounds overall. To look at impacts on the amount of waste going to the landfill or to export — which are achieved either through transfer of recyclable materials from the trash to the recycling bin, ***or*** reduction of total waste — we should combine the total decrease of 10 pounds with the recycling increase of 5 pounds to calculate a diversion impact of 15 pounds [-10-5]. Adding impacts this way avoids double-counting trash that has moved to recycling, and measures diversion properly. Table 13 above summarizes this logic.

Data Summary

Tables 14 and 15, which are derived from Waste-Tech's full report, summarize measurements of changes to **all** waste and recycling components between Baseline and Summer 1998 (Table 14) and Baseline and Fall 1997 (Table 15). The "Gross Total" column represents the sum changes in all components, including recycling, yard, bulk, food, lost recyclables, and "other." The next section, entitled "Net of Yard and Bulk," summarizes changes to recycling and trash components for which changes were significant (food, lost recyclables, and "other"), adding them together in the "Net Total" column. The final section, called "Net of Recycling," looks at changes in trash components only, summing them in "Total Refuse," and breaking each component out into its own category.

"Total Change" shows the gross shift in waste composition that was measured, while "Program Effects" show the changes after having been adjusted to account for non-Program factors. Changes among nonvolunteers and volunteers as a group are calculated by weighting volunteer observations at 0% and 100%, respectively. This allows identification of how each volunteer's Program participation affects the tract population as a whole. Tables 14 and 15 provide the basic data that is presented in this report, and are discussed in detail in Waste-Tech's full report.

Table 14

Waste Stream Changes, in pounds per household per week

Baseline to Summer 1998		Net of Yard and Bulk			Net of Recycling					
Total Change, Program Effects, and Program Participation Impacts	Gross Total (Refuse + Recycling)	Net Total	Recycling	Net Refuse	Total Refuse	Yard	Bulk	Food	Lost Recyclables	Other
(1)TOTAL CHANGE (Unadjusted)										
Summer 1997	61.85	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Summer 1998 Actual Participation	59.67	49.10	20.84	28.26	38.83	9.54	1.03	8.87	5.17	14.22
Average Reduction for All Households	**-2.17**	**1.22**	**4.57**	**-3.34**	**-6.74**	**-2.59**	**-0.80**	**-3.64**	**-3.56**	**3.86**
Significance of Change*	N	H	H	H	N	N	N	H	H	H
(2)PROGRAM EFFECTS (Adjusted)										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Summer 1998 Actual Participation	57.63	47.41	19.82	27.59	37.81	9.19	1.03	8.52	5.22	13.84
Program Impact for All Households	**-4.21**	**-0.46**	**3.54**	**-4.01**	**-7.76**	**-2.95**	**-0.80**	**-3.99**	**-3.51**	**3.49**
Significance of Change*	N	S	H	S	N	N	N	H	H	S
(3) PROGRAM PARTICIPATION IMPACTS										
Program Impact On Nonvolunteers										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Summer 98 0% Participation	58.66	48.12	20.03	28.09	38.63	9.57	0.97	8.77	5.36	13.96
Change with No Volunteer Participation	**-3.19**	**0.24**	**3.75**	**-3.51**	**-6.94**	**-2.57**	**-0.86**	**-3.74**	**-3.38**	**3.61**
Significance of Change*	N	N	S	N	H	N	N	H	H	S
Program Impact on Volunteers										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Summer 98 100% Participation	49.54	41.36	18.55	22.81	30.99	6.99	1.20	6.25	3.90	12.65
Change with 100% Volunteer Participation	**-12.30**	**-6.52**	**2.28**	**-8.79**	**-14.57**	**-5.15**	**-0.63**	**-6.26**	**-4.83**	**2.30**
Additional Participation Impact Per Volunteer										
Change with 100% Volunteer Participation	-12.30	-6.52	2.28	-8.79	-14.57	-5.15	-0.63	-6.26	-4.83	2.30
Change with No Volunteer Participation	-3.18	0.25	3.76	-3.51	-6.94	-2.56	-0.86	-3.74	-3.37	3.61
Participation Impact per Volunteer+	**-9.12**	**-6.77**	**-1.48**	**-5.28**	**-7.64**	**-2.59**	**0.23**	**-2.52**	**-1.46**	**-1.30**
Volunteers' Impact On Study Population										
Program Impact for All Households (from (2))	-4.21	-0.46	3.54	-4.01	-7.76	-2.95	-0.80	-3.99	-3.51	3.49
Change with 0% Participation (from(3))	-3.18	0.25	3.76	-3.51	-6.94	-2.56	-0.86	-3.74	-3.37	3.61
Participation Impact Per Household	**-1.04**	**-0.71**	**-0.21**	**-0.50**	**-0.82**	**-0.38**	**0.06**	**-0.25**	**-0.14**	**-0.12**

NOTES:

* Change different from 0: H=Highly Significant, S=Significant, N=Not Significant

Statistical significance for volunteers is not shown because all volunteer households were sampled.
Thus, the rates for volunteers are not statistical estimates and are known without error.

\+ Participation Impact per Volunteer = Change with 100% Participation - Change with 0% Participation

Source: 1998 Waste-Tech Study

Table 15

Waste Stream Changes, in pounds per household per week

Baseline to Fall 1997		Net of Yard and Bulk			Net of Recycling					
Total Change, Program Effects, and Program Participation Impacts	Gross Total (Refuse + Recycling)	Net Total	Recycling	Net Refuse	Total Refuse	Yard	Bulk	Food	Lost Recyclables	Other
(1)TOTAL CHANGE (Unadjusted)										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Fall 1997 Actual Participation	53.54	47.44	19.52	27.92	34.02	2.75	3.35	7.41	4.96	15.55
Average Reduction for All Households	**-8.30**	**-0.44**	**3.24**	**-3.68**	**-11.54**	**-9.39**	**1.52**	**-5.10**	**-3.78**	**5.20**
Significance of Change*	N	N	N	H	H	H	N	H	H	H
(2)PROGRAM EFFECTS (Adjusted)										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Fall 1997 Actual Participation	54.02	48.56	19.52	29.04	34.50	3.07	2.39	9.62	4.96	14.46
Program Impact for All Households	**-7.82**	**0.69**	**3.24**	**-2.56**	**-11.07**	**-9.07**	**0.56**	**-2.89**	**-3.78**	**4.11**
Significance of Change*	N	N	N	H	H	H	N	H	H	H
(3) PROGRAM PARTICIPATION IMPACTS										
Program Impact On Nonvolunteers										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Summer 98 0% Participation	54.93	49.31	19.66	29.64	35.27	3.07	2.56	9.78	5.17	14.69
Change with No Volunteer Participation	**-6.91**	**1.43**	**3.39**	**-1.96**	**-10.30**	**-9.07**	**0.73**	**-2.73**	**-3.57**	**4.34**
Significance of Change*	N	N	N	H	H	H	N	S	H	H
Program Impact on Volunteers										
Summer 1997	61.84	47.87	16.28	31.60	45.57	12.14	1.83	12.51	8.74	10.35
Adj Summer 98 100% Participation	48.39	44.59	19.84	24.75	28.55	2.76	1.05	8.74	3.16	12.84
Change with 100% Volunteer Participation	**-13.45**	**-3.29**	**3.56**	**-6.85**	**-17.01**	**-9.38**	**-0.78**	**-3.77**	**-5.58**	**2.49**
Additional Participation Impact Per Volunteer										
Change with 100% Volunteer Participation	-13.45	-3.29	3.56	-6.85	-17.01	-9.38	-0.78	-3.77	-5.58	2.49
Change with No Volunteer Participation	-6.91	1.43	3.39	-1.96	-10.30	-9.07	0.73	-2.73	-3.57	4.34
Participation Impact per Volunteer+	**-6.54**	**-4.72**	**0.17**	**-4.90**	**-6.71**	**-0.31**	**-1.51**	**-1.04**	**-2.01**	**-1.85**
Volunteers' Impact On Study Population										
Program Impact for All Households (from (2))	-7.82	0.68	3.24	-2.56	-11.07	-9.07	0.56	-2.89	-3.78	4.11
Change with 0% Participation (from(3))	-6.91	1.43	3.39	-1.96	-10.30	-9.07	0.73	-2.73	-3.57	4.34
Participation Impact Per Household	**-0.91**	**-0.75**	**-0.15**	**-0.60**	**-0.77**	**0.00**	**-0.17**	**-0.16**	**-0.21**	**-0.23**

NOTES:
* Change different from 0: H=Highly Significant, S=Significant, N=Not Significant
Statistical significance for volunteers is not shown because all volunteer households were sampled.
Thus, the rates for volunteers are not statistical estimates and are known without error.

+ Participation Impact per Volunteer = Change with 100% Participation - Change with 0% Participation

Source: 1998 Waste-Tech Study

Calculation of Total Changes

These data allow us to calculate total effects on the landfill and recycling over one year, as follows:

Table 16

Adding the Changes Together

Changes Added Together Net of Yard and Bulk* (BASELINE TO JUNE 1998)	Change in Total Waste*	Change in Recycled only	Diversion Impact
	A	B	[A-B]
in pounds per household per week			
Program impact, adjusted for the control tract, with 9.4% participation	-0.5	3.5	-4.0
Nonvolunteers only	0.3	3.8	-3.5
Volunteers only	-6.5	2.3	-8.8
Volunteers relative to nonvolunteers	**-6.8**	-1.5	**-5.3**
Program participation impact, with 9.4% participation	-0.7	-0.2	-0.5

** Includes food, lost recyclables, 'other' and recycled. Yard and Bulk components were excluded from the analysis because the changes measured between Baseline and June 1998 were not statistically significant.*

Table 16 presents several interesting results. The first is that there was a very small decrease in total waste for the tracts as a whole, given 9.4% Program participation. In total, food, lost recyclables, "other", and recycling only decreased by .5 pounds per household per week. For nonvolunteers as a group, the change was similarly minuscule; the total actually rose by .3 pounds. Among volunteers, however, the total fell dramatically, by 6.5 pounds. If we take into account that nonvolunteers waste increased by .3 pounds, we can then say that one year after joining the Program, volunteers were generating 6.8 pounds less waste (looking at food, lost recyclables, "other", and recycling only) per household per week than nonvolunteers.

In order to look at how volunteers' participation affected waste going to the landfill or export, we add the 6.8 pound total change to the change in recycling. In this case, recycling among volunteers *fell* relative to nonvolunteers. This reduces the net change to 5.3 pounds per household per week for volunteers, relative to nonvolunteers — still a substantial reduction.

Of course, as with all waste stream changes calculated for this analysis, we must also look at the effect of volunteers and nonvolunteers combined, given a 9.4% participation rate, on the population of the tract as a whole. As mentioned above, the overall change in trash alone is negligible — only .5 pounds. Most of this impact comes from the increase in recycling that was seen among nonvolunteers and volunteers alike. Summing the change in trash with the change in recycling yields a diversion impact of 4 pounds. Essentially, we can say that 4 pounds of material per household per week was composted, otherwise reduced, or recycled (with most recycled) by residents (volunteers and nonvolunteers) in the test census tracts, as compared to the control tract, after the Program was implemented.

Effects Among Nonvolunteers

The fact that nonvolunteers were sending 3.5 pounds per household per week less to the landfill after the Program had been implemented than they had at Baseline, even when normal Citywide variations in waste generation were controlled for, was an unexpected result of the Pilot. Clearly, this was not caused by composting or participating in the Program. In the field of program evaluation, when changes are observed in a group of program nonparticipants there are generally two explanations. The first is that **factors extraneous to the program** happened to cause a change in nonparticipants at the same time that the program was being implemented. For example, if the price of food rose sharply during the time the program was being put into place, nonvolunteers might have bought less and therefore reduced their food waste output. This would have nothing to do with composting, but would affect food waste generation at the same time that composting was taking place. A second explanation that the **act of implementing the program and measuring its effects** influences program nonparticipants and participants alike. Under this scenario, the presence of experimenters causes those who come into contact with them to alter their behavior.

It is never possible to know with certainty what causes a nonparticipant effect. In the case of the Backyard Pilot, however, it is probable that it was the acts of implementation and measurement, rather than extraneous factors. We can say this for two reasons. First, extraneous factors were controlled for by looking at data from a fifth tract (Little Neck) that was similar in terms of demographics and housing stock, but had not had any composting program introduced. As described earlier, changes in waste composition seen in Little Neck were subtracted from changes in the test tracts, in order to remove these effects from the analysis. After this adjustment, however, substantial and significant changes were still seen among nonvolunteers. More important, yet, is what we know about the Program outreach, implementation, and measurement effort. As discussed in earlier chapters, the intense mail, phone, and door-to-door recruitment campaign was noticed by many residents in the test tracts, even causing some backlash against the Program among those who chose not to participate.

A confounding factor to interpreting increases in recycling is the fact that measurement carried out during the waste composition studies was both unusual and visible. For one week in June 1997, then again in October 1997, and finally for two weeks in June 1998, Sanitation personnel, in official cars, moved slowly through the tract neighborhoods, placing selected households' trash in distinctive yellow bags and affixing code numbers to these bags for collection by special trucks. More than one resident remarked to staff that they believed this operation to be an enforcement effort. It is important to note that the same measurement activities (bagging and special collection) that were used in the test tracts were also employed in the control tract (Little Neck). After controlling for changes in recycling seen in Little Neck, there were still significant increases among nonparticipants in the test tracts. This suggests that any perceived step-up in Sanitation enforcement activities may have caused a greater increase in recycling compliance when experienced in conjunction with Backyard Composting Program outreach and education.

The effect of intensified enforcement on recycling compliance has been confirmed in a *separate* pilot study conducted by the Department's Bureau of Planning and Budget in 1998. This project targeted single, two-family and multi unit dwellings throughout the five boroughs to test the effects of enforcement on "part-time recyclers," residents who do recycle but who also discard considerable amounts of recyclables in the trash as well. In this study, which was reported in the November 1998 issue of *Resource Recycling*[17] , Sanitation recycling police sorted through the waste of selected residents and removed non-soiled recyclables from the garbage. These items were placed in a clear bag on the home-owners' steps, along with a warning if more than five recyclable items were found. This procedure was repeated four times over a two week period, and resulted in a substantial improvement in recycling compliance among residents regardless of geography, income, housing density, and other demographic factors, as shown below:

Table 17

Percent of Residents Recycling Properly

Borough	Before Inspections	After Inspections
Staten Island	20%	78%
Queens	28%	79%
Brooklyn	24%	74%
Bronx	13%	54%

Source: Bureau of Planning and Budget, New York City Department of Sanitation, 1998

Variability Among the Census Tracts

One of the qualitative aims of the Backyard Composting Pilot was to allow Botanical Gardens staff to participate in outreach and learn from the experience of implementing the Program in their boroughs. Furthermore, selection of four census tracts throughout the City made for a study base that, while not representative of the City as a whole, was more diverse than if only one tract had been the focus. However, this approach involved a trade-off in that choosing four census tracts, instead of focusing on one, meant that fewer samples could be collected in each area. Table 18 summarizes the number of housing units, qualifying households, volunteers, and sample members there were in the tracts. It shows that since the sample sizes ranged from 15 to 112, they were too small to consistently yield significant results for each tract in isolation. Comparison of results among tracts was therefore not within the scope of this report.

Table 18

Summary of Sample Sizes

Total Households and Qualifying Households

				Occupied Housing Units		
Code	Borough	Neighborhood Name	Census Tract No.	Total Units	Percent Qualifying	Number Qualifying
X	Bronx	Morris Park	250	959	45%	432
B	Brooklyn	Marine Park	658	640	82%	526
Q	Queens	St. Albans	280	445	86%	384
S	Staten Island	West Brighton	121	1,104	91%	1,004
TOTAL FOR TARGETED TRACTS				**3,148**	**75%**	**2,346**
L	Queens	Little Neck	1507.01	1,058	94%	990

Program Participation Rates

Code	Borough	Qualifying Units	Volunteers	Percent	Nonvolunteers	Percent
X	Bronx	432	38	8.8%	394	91.2%
B	Brooklyn	526	36	6.8%	490	93.2%
Q	Queens	384	18	4.7%	366	95.3%
S	Staten Island	1,004	129	12.8%	875	87.2%
TOTAL		**2,346**	**221**	**9.4%**	**2,125**	**90.6%**

Number of Samples Used in the Analysis*

Targeted Census Tracts		Nonvolunteers	Volunteers
X	Bronx	22	28
B	Brooklyn	24	32
Q	Queens	25	15
S	Staten Island	22	110
TOTAL		**93**	**185**
L	Little Neck	23	N/A

*Note that some original of the 150 nonvolunteer samples and 221 volunteer samples were discarded as unrepresentative on the basis of field observations (i.e. evidence of commerical, construction, or demolition waste, etc.)

Source: 1998 Waste-Tech Study

Waste-Tech's analysis did produce statistically significant results for some of the individual tracts with respect to changes in waste composition. Nevertheless, in its report Waste-Tech stressed that tract-by-tract comparisons may be misleading. This is because the *differences* among individual tracts were not statistically significant, even if a change within certain tracts was significant in and of itself.

Waste-Tech also cautioned that it would be inappropriate to extrapolate the overall, average results of the study to other tracts. This was because the calculations for the tracts as a whole weighted Staten Island more heavily than the other areas, and also because Staten Island had more pronounced changes than the other tracts. The number of qualifying households in Staten Island accounted for nearly 43% of all households in the study population. In addition, the participation rate was higher in Staten Island (12.9% vs. between 4.7% and 8.8% for the other tracts). This means that Staten Island had a disproportionate impact on the overall results of the study.

The Efficacy of the Control Tract

As discussed in this Report, data from the control tract in Little Neck, Queens was used to factor out changes in waste generation that were not related to the Program. Although this tract was similar to the test tracts in terms of housing type and density, and demographics, it is possible that the changes measured in Little Neck did not fully reflect trends that were going on in similar areas throughout the City. As Waste-Tech states:

> Differences in the average waste generation rate and composition between the Baseline and Post Implementation periods may include factors other than the impact of the Program's implementation. Those factors include seasonal changes and changes in the materials designated as recyclable by the DOS. Efforts have been made to adjust the results presented in the Report to compensate for those changes. Those adjustments would not compensate for pre-implementation differences between Volunteers and Non Volunteers and may not fully compensate for the impact of increased advertising for the DOS Recycling Program [a citywide campaign was mounted in the Fall of 1997, around the time of the Backyard Composting Pilot Program], increased public awareness of the impending closure of... the landfill, and other changes which may affect the targeted tracts and seasonal control group to varying degrees.[18]

In order to assess how "good" Little Neck was as a control tract, it is useful to compare the Pilot results to trash and recycling tonnage data that the Department's Bureau of Cleaning and Collection tracks daily as part of its collection and disposal operations. This data is organized by **Sanitation District Section**. Sanitation District Sections are subdivisions of Sanitation Districts, which correspond to Community Board Districts and are used for administrative purposes to plan and implement DOS waste collection operations throughout the City. Sanitation District Sections are larger than census tracts, and therefore represent more data.

If one compares waste stream changes measured in the one Sanitation District Section that contains the control tract to changes seen in the four Sanitation District Sections in which the test tracts were located, one can test how closely the tracts reflected the general trends that were going on in their District Sections. As shown below, both the Pilot and the Bureau of Cleaning and Collection figures show an overall decrease in the waste stream during the time period in which the Pilot was being conducted. However, the rate of decrease in the test tracts is more pronounced than in the District Sections that contain them, while the rate of decrease in the control tract is very similar to that of its District Section. This would be expected because the Backyard Composting Program was being conducted only in the test tracts, and not in the control tract.

While data for all residences and institutions in Sanitation districts is not strictly comparable to that collected for only qualifying households, this information does suggest that the control tract was successful in measuring general waste generation trends occurring in the tract areas.

Table 19

Comparison of Census Tract and District Waste Generation Rate Changes

Percent Decreases from Baseline (June 1997) to Follow-Up (October 1997 and June 1998)

	October 1997	June 1998
COMPARISON OF TEST TRACTS TO THEIR DISTRICTS - CHANGE IS MUCH MORE PRONOUNCED IN TRACTS THAN DISTRICTS		
Test Tracts in Bronx, Brooklyn, Queens and Staten Island - qualifying households	-25.3%	-14.8%
Sanitation District Sections BXE 111, QS 125, BKE 187, and SI 012 - all residences and institutions	-16.6%	-10.5%
difference	-8.7%	-4.3%
COMPARISON OF CONTROL TRACT TO ITS DISTRICT - CHANGE IS SIMILAR		
Control Tract in Little Neck, Queens - qualifying households	-14.6%	-6.4%
Sanitation District Section QN 114 - all residences and institutions	-14.3%	-8.8%
difference	-0.3%	2.4%

Source: Bureau of Cleaning and Collections Data for the test weeks in June 1997, October 1997, and June 1998.

ESTIMATES OF CITYWIDE DIVERSION FROM BACKYARD COMPOSTING

In its report, Waste-Tech presents a series of caveats to interpreting data and analysis arising from the Backyard Pilot. Waste-Tech notes that, "the results of the statistical analysis presented here cannot and do not imply a cause and effect relationship between backyard composting activities by Pilot Program Volunteers and the observed changes,"[19] and goes on to point out that the variability of results among the census tracts, the nonvolunteer and non-food component effects measured, and the unique demographic characteristics of the tract would make it, "inappropriate to use the average changes in waste composition and generation rate observed for the population examined for this study for a valid extrapolation of the impact of backyard composting for other census tracts of any other population."[20]

A complete and reliable forecast of diversion from a citywide composting program, therefore, would require an analysis of the effect of demographics on waste generation and, in addition, a detailed mapping of households with backyards in census tracts throughout the City. While such information may yet be compiled, at this time not enough data is available to make any forecast that includes these informing factors.

Nevertheless, the results of the Pilot do, in the Department's opinion, require a preliminary attempt to estimate diversion. The market research surveys conducted in 1997 and 1998 suggest that one-third of New York City households report access to a backyard. US Census data count approximately 2.8 million occupied households in the City, which would mean that roughly 930,000 may have backyards. If we compare these figures to the percentage of single- and two-family homes in the City, again per US Census data, the match is not exact: 21% of New York City dwellings are one- or two-family, as opposed to the survey results of 33% with backyards. It is therefore probable that backyard access is found among some multi-family homes.

Table 20 presents several scenarios for a rough extrapolation of impacts of a citywide backyard composting program, limiting its predictions to **impacts measured among volunteers only**. This limitation is placed for several reasons. The first is that the "spillover" effects of the Program on nonvolunteers in the census tracts are not clearly understood, and may possibly be the result of other DOS programs or outside events that were not captured by the control tract measurements. Another reason is that nonvolunteer effects which were, in reality, associated with the Backyard Pilot may not be replicated if the Department targets future outreach efforts more diffusely.

Three possible participation rates have been chosen for evaluation: the measured participation rate of 9.4%, a more optimistic doubled participation rate of 20% (which is comparable to the 25% food composting participation that exists in Seattle, Washington[21]), and an upper limit of 60% participation. This last rate is comparable to the percentage of randomly selected New Yorkers with backyards who report enjoying gardening "somewhat" or a "great deal," as

measured in the 1998 Composting Survey. Since nearly 100% of volunteers in the test tract report enjoying gardening to the same extent, 60% represents a more reasonable upper boundary for extrapolation, although such a level of participation would likely be unattainable. Extrapolation to tons diverted per year, citywide, among homes with backyards are calculated for two weekly composting rates. The first, 2.5 pounds per household per week, corresponds to what was measured in the Pilot. The second, 5 pounds per household per week, is an optimistic increase that might be attainable if further outreach and education increased the amount of material each participating household composts.

Table 20

Extrapolation of Results Citywide

Projected Residential Waste - Curbside and Containerized *(Source: Table 3-3 of the 1998 Comprehensive Solid Waste Management Plan Draft Modification)*	**FY 1998**	**FY 2002**
DIVERSION: tons per year diverted under existing recycling programs (not including backyard composting)	599,815	953,311
DISPOSAL: tons per year of residential waste to be disposed of	3,078,106	2,724,610
TOTAL: tons per year total residential waste	**3,677,921**	**3,677,921**

New York City Demographic Data

total occupied households in New York City	2,819,401 (from US Census Data)
% with backyard access	33% (from BWPRR market research)
estimated number households with backyard access	930,402

Assumptions:
1. the 33% estimate accurately reflects the number of households with backyards in the NYC population
2. all households with backyards can compost
3. waste composition measurements from the Backyard Pilot hold true for all households with backyards

Diversion Potential of Backyard Composting

(Diversion from volunteer activities only. Nonvolunteers Program effects are not counted in this analysis)

participation rate	number of qualifying households in NYC that would participate	pounds per household per week of composting	pounds per week diverted, for all participating households	tons per year diverted, for all participating households	diversion rate (percentage of total residential waste stream)
If food waste is composted at backyard Pilot levels (at 2.5 pounds per week or 130 pounds per year)					
9.4%	**87,458**	**2.5**	**218,644**	**5,685**	**0.15%**
20%	186,080	2.5	465,201	12,095	0.33%
60%	558,241	2.5	1,395,603	36,286	0.99%
If food waste is composted at double backyard Pilot levels (at 5 pounds per week or 260 pounds per year)					
9.4%	87,458	5.0	437,289	11,370	0.31%
20%	186,080	5.0	930,402	24,190	0.66%
60%	558,241	5.0	2,791,206	72,571	1.97%

Observations in bold were directly measured in the Pilot. All others are projected for comparative purposes only.

The results of this initial extrapolation of diversion vary widely, from 5,685 to over 72,000 tons per year for all qualifying households. It is important to keep in mind that any of these estimates will likely **overstate** the potential impact of backyard composting, considering the uncertainty surrounding how many NYC households have backyard access, as well as lack of knowledge about the effect of demographic and other neighborhood variations have on participation composting rates. This method furthermore does not attempt to factor in proximity of houses with backyards to one another, which would be crucial to study in detail to understand the effects of a Backyard Composting Program on DOS collection routes. Nevertheless, this rough extrapolation of results does shed some light into the magnitude of what could be expected from a citywide Backyard Composting Program.

Comparisons

To place the diversion estimates into perspective, it should be remembered that the City collects over 3.6 million tons of residential waste per year, and plans to collect 22,000 tons per year of leaves for composting by 2002. Comparative data on annual diversion rates from backyard composting in urban areas is scarce. Seattle, a major city with an established backyard composting program and an ongoing Program evaluation (see Chapter IV) provides one of the few comprehensive sources for comparison with New York at the municipal level:

Table 21

Comparison of Seattle and New York's Program Evaluations and Diversion Extrapolations

	Seattle	New York
CITY DATA *(approximate)*		
population	500,000	7,300,000
number of housing units	250,000	3,000,000
tons of residential waste per year	250,000 tons	3,600,000 tons
% of food waste in residential stream	11.8%	15.0%
% of yard waste in residential stream	11.7%	4.9%
PROGRAM DATA		
administration	Seattle Public Utilities	New York City Dept. of Sanitation
evaluation study	"City of Seattle, 1995 Home Organics Waste Management Survey"	"Backyard Composting Program Pilot, 1998"
description of Program evaluated	Master composter, hotline, demonstration sites, bin distribution and education	Bin distribution and education Pilot program
implementation year	1986 - yard waste; 1993 - food waste	1997
definition of "eligible" household for backyard composting	buildings with four or fewer units	access to backyard or sideyard
number and percent of "eligible" households	155,000 or 62%	990,000 or 33%
estimate of eligible households participating in yard waste backyard composting	41% as of 1995, Citywide	9.4% as of 1997, Pilot areas
estimate of eligible households participating in food waste backyard composting	25% as of 1995, Citywide	9.4% as of 1997, Pilot areas
source of estimates	telephone survey	tracking of participants recruited in Pilot areas
estimate of pounds per household per week yard waste diversion	5 pounds	could not be determined because of extreme variability
estimate of pounds per household per week food diversion	3.2 pounds	2.5 pounds

(continued on next page)

Table 21 (continued)
Comparison of Seattle and New York's Program Evaluations and Diversion Extrapolations

source of this estimate	telephone survey + Seattle's estimates of yearly yard and food waste composting potential	waste composition study before and after Program implementation
tons diverted annually from backyard composting, yard waste	8,000 tons	N/A
percentage of residential waste stream (yard waste backyard composting diversion rate) - extrapolated from participation rate and per household diversion estimate	3.2%	N/A
tons diverted annually from backyard composting (food waste) - extrapolated from participation rate and per household diversion estimate com	3,300 tons	5,668 tons
percentage of residential waste stream (food waste composting diversion rate)	1.3%	0.15%

A discussion of how the waste composition study results affect the City's waste management planning will be presented in the final chapter of this Report.

CHAPTER VI. MARKET RESEARCH

PRELIMINARY MARKET RESEARCH

In early 1997, Grey Advertising ("Grey"), one of the City's leading advertising firms, was contracted by the Department to conduct preliminary market research about New Yorkers' attitudes towards organic waste recycling. The survey sought to gauge residents' perceptions of the subject in general, as well as their receptivity to backyard composting, source separation of food waste, and in-sink disposals (also known as insinkerators). Grey conducted initial qualitative research among residents in small discussion groups, then went on to survey more than 800 New Yorkers by telephone. The results of the research suggested that City residents view organic waste recycling, in its various forms, as positive and think the City should consider organic waste recycling programs as a policy option. There was, however, general concern that such a program would create unsanitary conditions, attract vermin, and add to the burden New Yorkers currently feel imposed on them by the current Recycling Program.

Study Design

Grey began by convening several focus groups of residents to participate in open-ended discussions about their understanding of and attitudes toward recycling, organic waste, composting, user-based fees, and insinkerators. Four groups were composed of persons living in Park Slope, Brooklyn (an "intensive" recycling zone where a voluntary program of separation of organics had been in place for several years). Further research was then conducted among eight groups of men and women recruited from the general public, selected to reflect New York City's diverse range of incomes, ethnic groups, dwelling types, household sizes, and boroughs of residence. Some, but not all, of the members of these groups had backyard access.

Issues identified in the focus group discussions were used to structure a survey questionnaire on the same topics. This was administered by telephone to approximately 500 demographically diverse City residents (100 per borough). In addition, 100 Housing Authority residents and 200 Spanish-speaking New Yorkers were targeted for the survey, to learn about attitudes of these groups in particular. Results of the surveys were quantified and summarized, with statistically significant trends and differences among respondents noted at the 90% confidence level (meaning that when "significant" differences were found among the samples there would be only a 10% chance that such a result would not be found if every City resident in the population had been polled).

Qualitative Results

The focus group discussions suggested that City residents resisted the idea of having to comply with additional programs to reduce waste (such as composting), which they deemed burdensome and not justified by tangible benefits demonstrated so far from the City's existing Recycling Program. Moreover, few were familiar with the terms 'organic waste' and 'composting'; those who did know these terms usually had first- or second-hand experience composting.

Members of the general public with access to a backyard expressed little enthusiasm for backyard composting, largely because they considered it a bother and were concerned about odors and vermin. Home gardeners and many Park Slope residents, however, were far more receptive to the idea.

Nearly all strongly resisted the idea of separation of organic waste for collection, which they considered good for the environment, but unrealistic as a waste management option in New York City. Objections to this policy option centered around expectations that unsanitary conditions, odors, and mess would result from separating organics and storing them for pickup. This was compounded by the fact that those interviewed assumed that organics would be picked up with the same frequency as recyclables: i.e., once every two weeks. Residents expressed strong support for the idea of using insinkerators as an organic waste disposal method, considering them cleaner and more convenient than other options.

Quantitative Results

After the focus group discussions, quantitative measures were taken for the same topics by telephone survey. The results revealed a number of widely held attitudes among the 800 persons interviewed, and suggested a more positive attitude towards organic waste recycling than expressed in the focus groups.

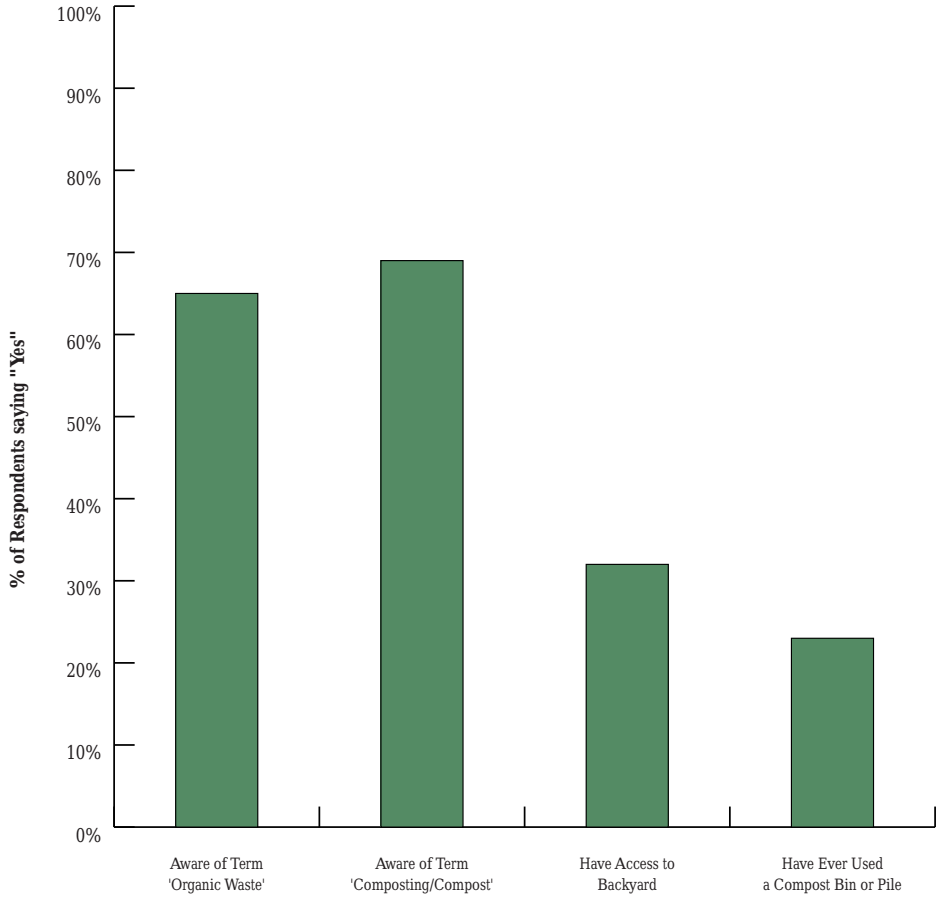
Composting Awareness, Experience and Attitudes

Awareness of the terms 'organic waste' and 'compost or composting' was seen in the majority of respondents. However, those surveyed reported little direct experience composting. As shown in Figure 4, only 23% of residents had ever had first-hand experience composting, with half of these still maintaining their compost bin or pile, and 60% rating the experience as 'excellent' or 'very good'. The small number of active composters was not surprising, as only **one-third** of those surveyed reported having access to a backyard*.

Figure 4

Composting Awareness, Experience, and Attitudes

sample of 812 NYC residents



Source: 1997 Organics Survey

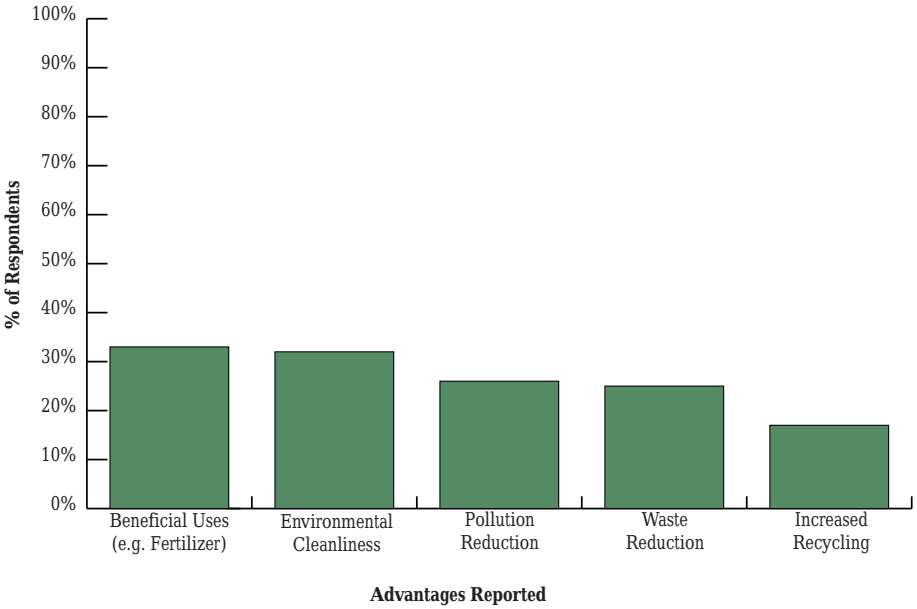
Most of the interviewees saw advantages to organic waste recycling, citing compost's use as fertilizer and overall pollution reduction as benefits. Half of the respondents also saw disadvantages, envisioning unsanitary conditions, odors, and vermin that food waste would attract, and objecting to the labor and time involved in sorting and separating organics. Results are presented in Figures 5 and 6.

**As indicated by a 'yes' response to the question, "Do you currently have access to a backyard or sideyard where you live?"*

Figure 5

Perceived Advantages to Organic Waste Recycling

among sample of 812 NYC residents

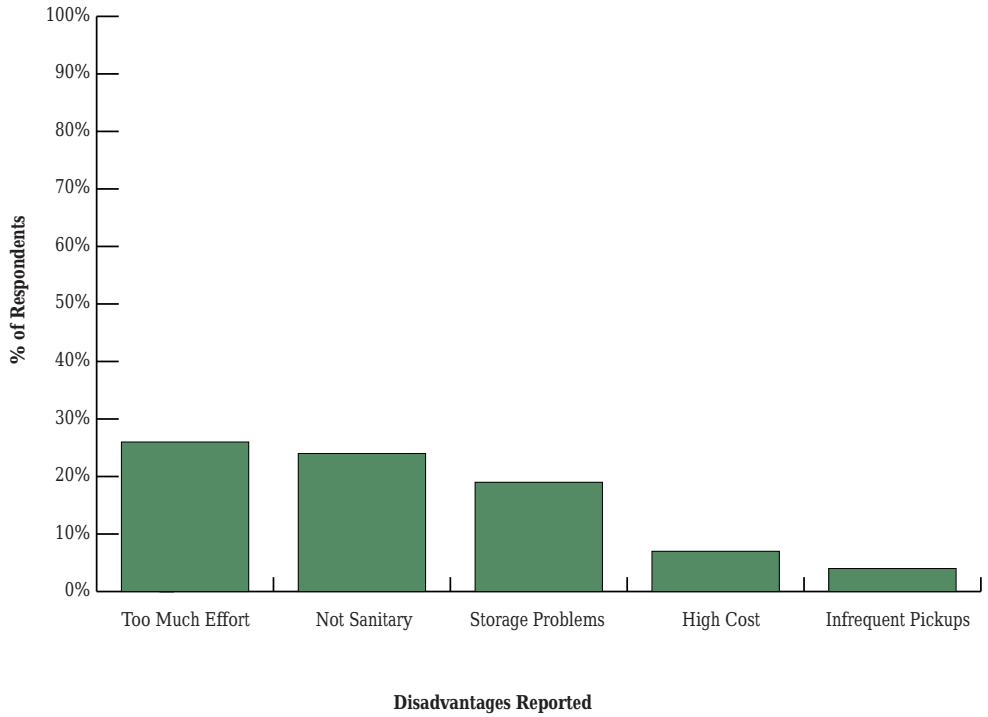


Source: 1997 Organics Survey

Figure 6

Perceived Disadvantages to Organic Waste Recycling

among sample of 812 NYC residents



Source: 1997 Organics Survey

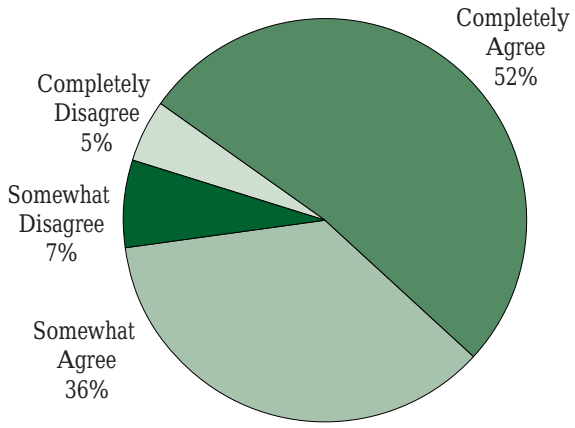
Program Receptivity

In general, residents were more receptive to the idea of New York City government considering new organic recycling waste management programs than the focus groups suggested. As shown in Figure 7, most of those surveyed (88%) "somewhat" or "completely" agreed that organic waste recycling — in general — should be considered in NYC.

Figure 7

Should Organic Waste Recycling be Considered as NYC Policy?

among sample of 812 NYC residents

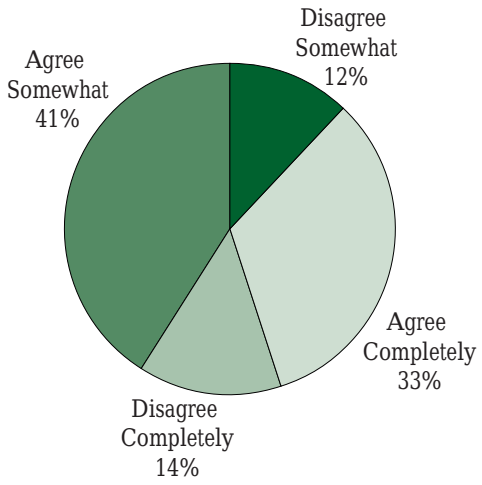


Source: 1997 Organics Survey

Figure 8

Should Backyard Composting be Considered as NYC Policy?

among sample of 812 NYC residents



Source: 1997 Organics Survey

Unlike the focus groups, the vast majority supported considering separation and collection of organics. A full 90% of residents felt that NYC should contemplate such an option. The 10% who disagreed cited lack of citizen cooperation, unsanitary conditions, storage problems, or infrequency of pickups as barriers to such a program — echoing ideas expressed by focus group participants. *In interpreting these findings it is important to keep in mind that the focus group discussions identified the Department of Sanitation as the research sponsor, and addressed receptivity to future program options, while the survey questions were confined to measuring only agreement with the idea that New York City — in abstract — should* ***consider*** *a particular policy. These different contexts may have contributed to the disparity in results.*

Most applicable to the Backyard Composting Pilot Program was the finding that more than 70% of those with backyards agreed that NYC should consider backyard composting as an option for waste management, as shown in Figure 8. This suggested more enthusiasm for this practice than the focus groups revealed. Those who felt it should not be considered as a policy listed the usual problems associated with organics recycling — odors, vermin, storage problems, and lack of compliance.

As with the focus groups, most (80%) agreed that insinkerators should be considered as a policy in New York City, and half of those surveyed stated that they might be willing to pay some or all of the costs of installing an insinkerator. Among the 20% who disagreed, concerns about cost and possible strain on plumbing systems were cited.

Subgroups

In order to identify how results for subgroups of respondents differed from the survey sample as a whole, results were tabulated separately for Spanish-speakers, those living in NYCHA public housing, and general population residents of each borough. In general, the subgroups reflected the overall trends seen among all respondents. Subgroup analysis was also conducted among residents of each borough. This suggested that residents of Staten Island — New York's most suburban borough — were statistically different from residents of the other boroughs. Staten Islanders more frequently reported having access to backyards (75% vs. 33% overall) and composting experience (36% vs. 25% overall). In addition, significantly more of them cited 'pollution reduction' as a benefit than did residents of other boroughs (46% in contrast to 19-30%). Eighty-one percent (81%) of Staten Islanders, and the same percentage of Manhattanites, were familiar with the term 'composting', as opposed to the 58-65% of residents of Queens, Brooklyn, and the Bronx. Aside from these variations, responses from each borough were essentially the same.

POST-IMPLEMENTATION MARKET RESEARCH

The preliminary market research conducted in 1997 suggested that New Yorkers are receptive to the idea of backyard composting, and that roughly one third of them have some form of backyard access and/or experience composting. In March of 1998, the Department commissioned Grey to conduct a second set of market research projects. Grey held a series of focus group interviews and conducted a telephone survey to learn about the successes and failures of the Backyard Composting Program recruitment effort, as well as to understand tract residents' attitudes about composting. Both phases of this research project make up what is called the **"Composting Study.**" During this same period, Grey was also hired by the Department to conduct broad-based research on a wide variety of recycling opinions and behaviors among City residents. This project, the first to be done after a new wave of DOS advertising and public education about recycling had been launched citywide, was entitled the **"Wave 1 Study,"** because it was the first wave of broad-based research to be carried out after the advertising campaign.

Both the Wave 1 and Composting Studies gathered data about residents' demographic characteristics, as well as a number of measures that relate to composting. The Composting Study, furthermore, questioned persons who volunteered for the Program, and those who chose not to, about their experiences with the Backyard Composting Program, and delved deeper into their attitudes about gardening and composting.

The Backyard Composting Pilot Program and accompanying research was conducted over a one year period, according to the following timetable (market research activities are shown in bold):

June - October 1997	*Baseline waste composition study in the test areas; intensive recruitment of Program volunteers; first follow-up waste composition study;*
November 1997	**"Composting Study" focus group discussions with volunteers from the test tracts and randomly selected New York City residents with backyards;**
March 1998	**"Composting Study" focus group discussions with nonvolunteers living in the test tracts;**
	"Composting Study" telephone survey of volunteers and nonvolunteers living in the test tracts;
	"Wave 1 Study" telephone survey of randomly selected New York City residents;
June 1998	*Second follow-up waste composition study.*

The Wave 1 and Composting market research is useful in several ways. First, specific information about volunteers' experiences sheds light on why the Program appealed to those who volunteered, and how it can be improved. Second, data on nonvolunteers can help us understand why some residents chose not to volunteer, and how their habits and attitudes compare to those who did. Comparison of volunteers and nonvolunteers to the New York City public in general, allows for quantification of how each group differs from the "norm," and contributes to creating a distinct volunteer profile. This is useful for planning future backyard composting programs and predicting their applicability in other areas of the city.

Study Design

The Composting Study was divided into two parts — qualitative and quantitative. In the qualitative phase, six focus groups of 8 to 10 persons each were conducted to learn about attitudes of volunteers, nonvolunteers, and randomly selected City residents with backyard access. This research sought to understand how a "novice" resident would react to the Department's outreach materials, as well as what had motivated volunteers and nonvolunteers to make their decisions about joining the Program.

The quantitative phase of the study entailed a telephone survey targeted at a sample of approximately census tracts in Brooklyn, the Bronx, Queens, and Staten Island, and was evenly divided between volunteers and nonvolunteers. This study used a telephone questionnaire that posed questions about demographics and general gardening/composting/food preparation attitudes, but did not seek information about other areas of recycling. In addition, the Composting Study included a special set of questions for volunteers, and another for nonvolunteers, about their specific experiences with Program outreach in their neighborhoods.

The Wave 1 Study surveyed roughly 700 randomly selected members of what is referred to as the "general public" — a cross-section of New Yorkers that is representative of the City population as a whole in terms of age, ethnicity, borough of residence, and other basic characteristics. This research, conducted by telephone questionnaire, sought to measure a wide array of demographics, attitudes, and behaviors. Respondents who indicated that they had access to side or backyards (roughly 270 of the 700) were questioned further about issues specific to composting, gardening, yard care, food preparation, and the environment. Selected questions from the Composting Study, pertaining to backyard access, interest in gardening, and environmental awareness were added to the Wave 1 Study.

Qualitative results were written up in a series of narratives. Quantitative results were tabulated, and differences among volunteers, nonvolunteers, and the general public were tested at the 95% level (meaning that when "significant" differences were found among the sample there would be only a 5% chance that such a result would not be found if every volunteer, nonvolunteer, and City resident in the population had been polled).

Qualitative Research

Small groups of compost Program volunteers, nonvolunteers, and randomly selected members of the general public who had backyards were invited to participate in open-ended discussions about the environment and their use of leisure time. After some conversation about recycling and outdoor activities, each group was shown the outreach materials that had been distributed in the tracts.

Volunteers and nonvolunteers (all of whom had seen these materials before) and City residents from outside the tracts (to whom they were new) were given time to review the items. A discussion ensued about the members' reactions to these materials, and progressed to a general conversation about composting. This exercise generated some important information.

Types Among the Novice Public

The research provided on-the-spot insight into how and why an average person, with a backyard, who had never heard of the Program, would decide whether or not to join. The group interviewer reported that members of the public fell into four distinct personality types, with different composting propensities. The first, the **"compost believer,"** was someone who had a history of composting, had lived where it was common practice (often in the Caribbean or rural US community), and/or had friends or family who had composted. Many of this type had never thrown away organic waste until they moved to the City. They viewed composting as a normal, everyday activity that produced high quality fertilizer that would improve gardens and plants. "Believers" were very enthusiastic about joining the Program.

A second type, **"compost ready,"** enjoyed gardening and the environment. Such persons took pride in their gardens and homes, and reported being more interested in plants than lawns *per se*. Most members of this group were familiar with compost and believed it a very good fertilizer, and were generally receptive to the idea of joining the Program. A third segment, **"compost willing,"** consisted of persons who were not avid gardeners nor were devoted to the idea of backyard composting, but did feel environmentally conscientious and wanted to help reduce waste. Others of this type indicated they would participate in the Program out of civic duty or curiosity. Many of the compost willing expressed the concern that they would not be able to use all of the compost they made, and admitted this might be a barrier to their participation.

The last and largest group, the **"compost unwilling,"** stated that they probably would not join the Program if it were available to them. Such persons did not enjoy gardening and either did not have gardens, or employed landscapers to care for them. They did not readily see the benefits of backyard composting, and felt that they would not need and could not use any compost they produced. Many conceded that composting could have environmental benefits, but were uninterested in participating in a program that would be of no direct use to them. Because they could not understand why anyone not interested in gardening would want to compost, they assumed that DOS's attempt to recruit non-gardeners was part of its Recycling Program, and that composting would soon be made mandatory. Those least interested in recycling were most opposed to composting as a program and expressed negative attitudes towards the Department, especially its enforcement activities.

Qualitative Insight on the Composting Experience

Information gained from the focus groups also shed light on the experiences of those who had actually volunteered for the Program and had been composting for several months. Many of this group reported choosing to join for altruistic reasons, including helping their neighborhood become a "greener, more beautiful place," rather than as a way to purchase a compost bin at a reduced price. This feeling was somewhat contradicted, however, by the fact that a number of volunteers stated that they had been planning to buy a bin anyway when the offer arrived, and also that the free Botanical Gardens membership had been an incentive to join. Many stated that they had been skeptical about what a $10 bin would look like and were pleased at its sturdiness, although they would have liked to have seen a picture beforehand. Most were curious about the results that their efforts would, in time, yield, but felt it was premature to discuss satisfaction with the Program until they had seen the end result in finished compost.

Virtually all volunteers praised the Botanical Gardens' staff, and appreciated the efforts they had made to ensure correct understanding of how to use the bin. Most stated that they had assumed that this assistance would not really be 'in-person' — even though the literature had mentioned that they would be "assisted personally by...staff in setting it (the bin) up and learning how to use it properly" — and had been pleasantly surprised when staff came to visit their homes. Many knew the name of one or more Garden contact they could call with questions, although few volunteers had taken advantage of this.

The group interviewer noted that Program volunteers also varied among "believer," "ready," and "willing" types. Those who met the profile of "believer" were the most enthusiastic about the Program, and reported having responded immediately to the Gardens' offer. The Program appeared to be a vital adjunct to their gardening hobby and they readily embraced all aspects of backyard composting, including separating food scraps in the kitchen and adding them to the bin, although some noted that the composting "requirements' were more rigid than those they had grown up with.

Persons who more closely resembled the "compost ready" or "willing" types were also enthusiastic about the Program, although less so. Many stated that they had assumed they would be composting leaves and outdoor organic waste only, and were hesitant about adding food to the bin, especially during the winter. These volunteers expressed some confusion about what items to compost and were unsure of what to do with compost once the bin was filled.

Nonvolunteers and Program Backlash

An unanticipated source of information about nonvolunteers came from the difficulty Grey Advertising had in trying to convince them to participate in focus groups. Grey writes:

> During the screening phase we uncovered a great deal of animosity among the vast majority of those who had been targeted for participation [in] this program but had little interest or desire in [sic] the composting program. These residents were very uncooperative and regardless of the amount of the incentive refused to participate in this research study. Consequently, [in November 1997] we conducted focus groups among [other] NYC residents who resided in a house with access to a backyard...It was very unusual that our recruiting efforts could not result in enticing any people who...chose not to participate...given the high incentive we eventually offered (upwards of $200). Additionally, recruiters made mention of the high animosity to their calls when they mentioned the 'composting program.' Although reassurance was given that this was only for market research, the word 'composting' seemed to elicit very negative reactions.

This unusual and strong resistance to Grey's normal recruitment practices suggests that residents had very negative reactions to the intense outreach effort in their neighborhood. For this reason, the focus groups conducted in November 1997 (approximately four months after the outreach had been conducted) only included volunteers and members of the general public with backyards from other sections of the City. Grey was finally able to recruit nonvolunteers for focus groups in March 1998 (eight months later) by rephrasing their telephone solicitation so as not to mention composting. Instead, nonvolunteers were asked to participate in research about environmental issues and leisure time. It should be noted, however, that the nonvolunteers recruited in March were specifically asked if they remembered being solicited to join the Backyard Composting Program. Only those who remembered were recruited for the focus groups. The March 1998 focus groups did not provide any additional information about residents' perceptions of "backlash," but did reinforce the findings of focus groups of City residents about the "compost unwilling" type.

When asked why they had not participated in the Program, the majority of nonvolunteers recruited for the group explained that because they did not like gardening or maintaining their yards, they could not see any benefits to their participation and were confused as to why they would be asked to participate. They stated that they felt that the Program was appropriate for those who enjoyed gardening and would need the compost, but that it was far-fetched to think that anyone would expend time and effort to compost if they could not use the end product. Many respondents expressed pride in their yards and homes, but felt that compost would do nothing to enhance their property.

A smaller number of nonvolunteers who reported moderately enjoying gardening and working in their backyards showed some interest in the Program after the benefits of composting had been discussed within the group. A number of these felt that protecting the environment and reducing the amount of waste going to landfills was something they would like to do, but many of these same persons were concerned about the time and effort involved, and were unsure what they would do with compost they did not need.

Implications for Outreach

Focus group discussions among volunteers, nonvolunteers, and the general public revealed several consistent trends that are relevant to the structuring of program outreach. The first is that a Backyard Composting Program will largely appeal only to those to whom it has clear benefits — namely those who enjoy gardening or caring for their yard. Such persons will be more familiar with the concept of composting to begin with, and will participate because they feel the Program will provide them with something that they need and can use. The research furthermore suggests that attempting to convince non-gardeners to join, either by selling them on the potential uses of compost or the environmental/civic benefits of the Program, will have little effect and, if carried out too aggressively, will cause negative backlash.

A number of items in the outreach letter appealed to those who had or would join the Program. These included discussions of neighborhood beautification, the free Botanical Gardens membership, and the subsidized bin. Mention of other environmental benefits of composting, especially for landfills, did not appear to be a critical factor in deciding to join and, when presented along with the DOS name, created an association with recycling and concern about making the Program mandatory, which only added to rejection of the Program.

Focus group members consistently pointed to several aspects of the letter that could be improved. Volunteers, nonvolunteers, and the general public who were less familiar with composting commented that the letter did not fully explain the benefits of composting, how it worked and could be used, and what would be expected from them. Nearly all expressed confusion over what the bin would look like and would have liked to have seen a picture. A number also mentioned that they did not understand that personal assistance would really be available.

Many nonvolunteers commented that they had not taken the time to read the letter since they considered it "junk mail." Nonvolunteers and those who were "compost unwilling" were also very vocal about the sense of intrusive government presence ("big brother" feeling) they experienced when they read the phrase "we haven't heard from you." Also, a dislike of telemarketing was expressed across the board by volunteers, nonvolunteers, and the general public. This all suggests that direct mail will reach those who have some interest in the Program, but that further attempts to contact residents will either be ignored or actively resented.

Quantitative Research

The insights provided in the focus group discussions were complemented by quantitative results obtained by telephone surveys. The results summarized below are derived from the Composting Study survey and the Wave 1 survey.

Comparisons Among Volunteers, Nonvolunteers, And The General Public

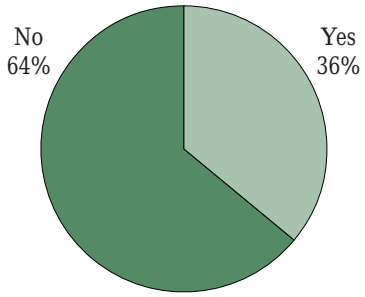
Backyard Access

Backyard access was a condition for volunteering for the Program, and for considering a test area resident a 'nonvolunteer' (since someone with no backyard would not be able to consider setting up a compost bin.) All of the volunteers and nonvolunteers interviewed for the Composting Survey, therefore, had backyard access. The Wave 1 Study revealed that over **one third** of all New York residences have access to a paved, grass, or other type of yard. Yards are most prevalent in Staten Island, where nearly 80% of homes have them, and are seen to a lesser extent in Queens (47%), Brooklyn (27%) and the Bronx (21%). In Manhattan, which was not included in the Backyard Pilot, yards are found in a mere 8% of households. (See Figures 9 and 10.)

Figure 9

Access to a sideyard or backyard

among sample of 750 NYC residents

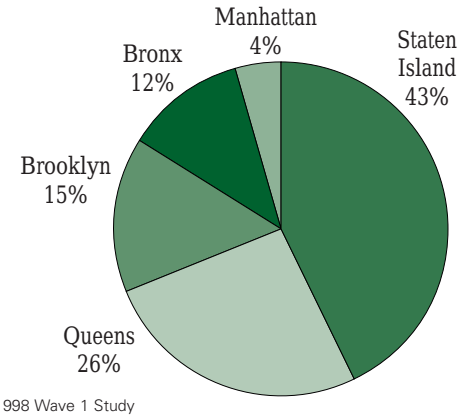


Source: 1998 Wave 1 Study

Figure 10

Access to a sideyard or backyard

among sample of 750 NYC residents



Source: 1998 Wave 1 Study

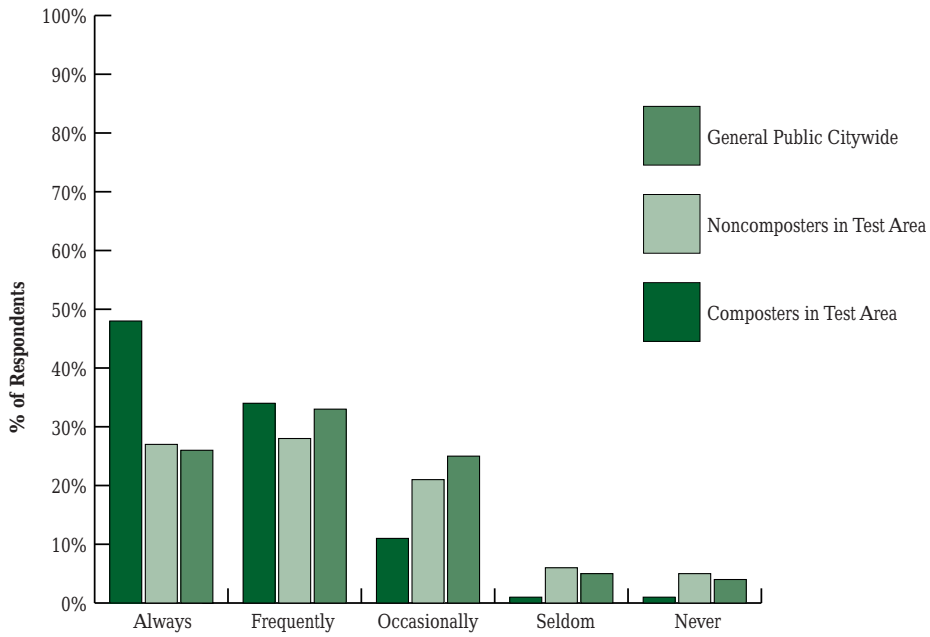
Yard Use

Figures 11 through 15 display findings regarding yard use. The comparison of results showed that volunteers are significantly more likely to use their yards than the general public or nonvolunteers. Eighty two percent (82%) of volunteers report "always" or "frequently" using their yard, as opposed to 59% of the general public, and 55% of nonvolunteers. The results showed that volunteers like to work in their yard and enjoy "gardening and growing plants and vegetables" significantly more than others. Nearly all volunteers (over 90%) like yard work and gardening a "great deal" or "somewhat." While the majority of nonvolunteers and City residents (around 60%) also reported enjoying these activities, a substantial number did not. Only 3% of volunteers stated that they disliked yard work, and none indicated distaste for gardening, as opposed to 14-16% for both activities among nonvolunteers and the general public. These findings were reinforced by responses to a separate question in which respondents were asked how much they agreed with the statement "I feel there are other things I would rather do than spend time working in my yard or gardening." Only 9% of volunteers completely agreed, as opposed to close to 30% for nonvolunteers and the general public.

Figure 11

Frequency of Yard Use

among a sample of 174 composters and 177 noncomposters in the test tracts, and 269 NYC residents Citywide

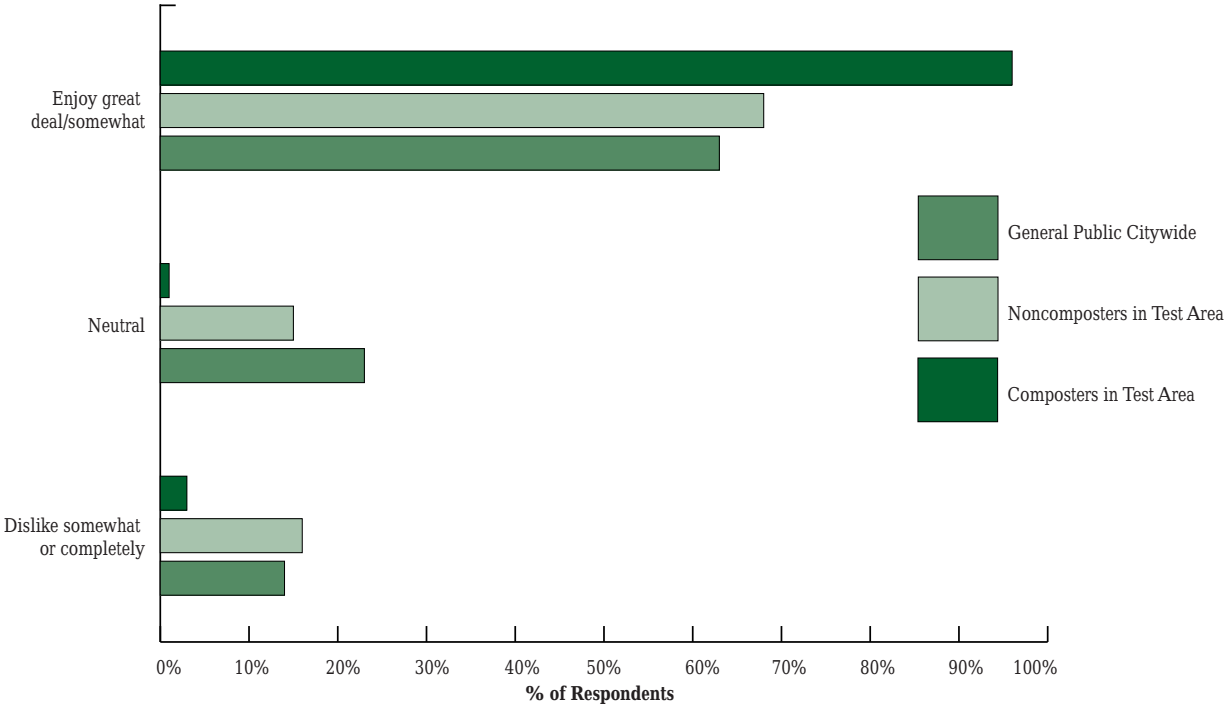


Source: 1998 Wave 1 and Composting Studies

Figure 12

Enjoyment of Working in Yard

among a sample of 174 composters and 177 noncomposters in the test tracts, and 269 NYC residents Citywide

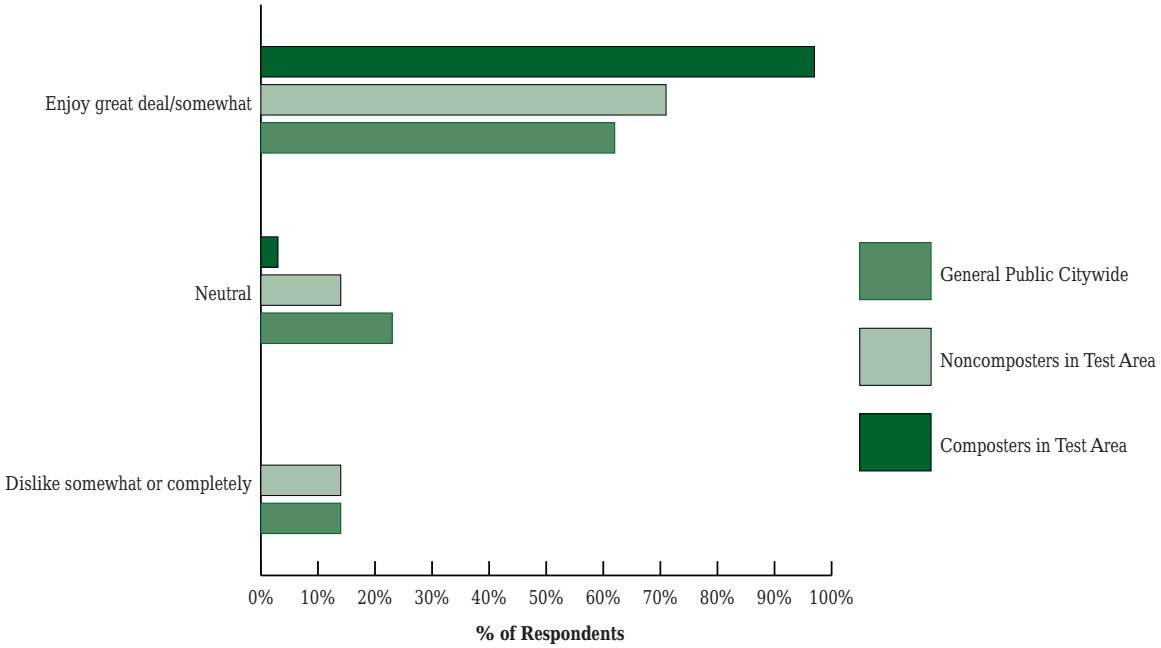


Source: 1998 Wave 1 and Composting Studies

Figure 13

Enjoyment of Gardening

among a sample of 174 composters and 177 noncomposters in the test tracts, and 269 NYC residents Citywide

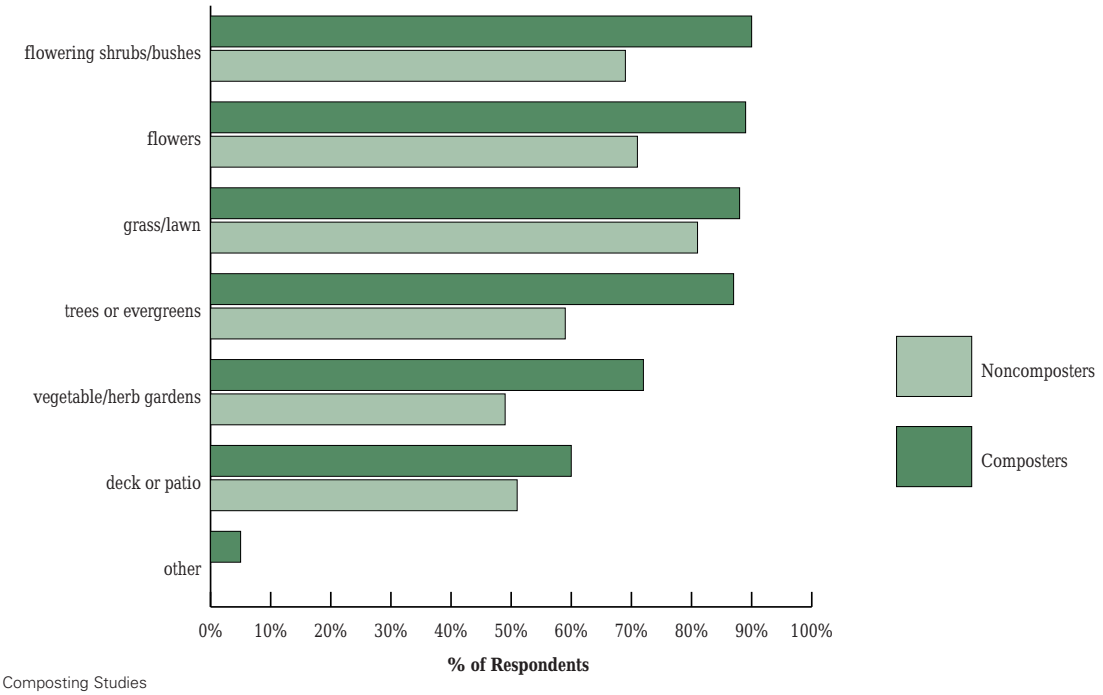


Source: 1998 Wave 1 and Composting Studies

Figure 14

Items in Backyard or Sideyard

among a sample of 174 composters and 177 noncomposters in the test tract

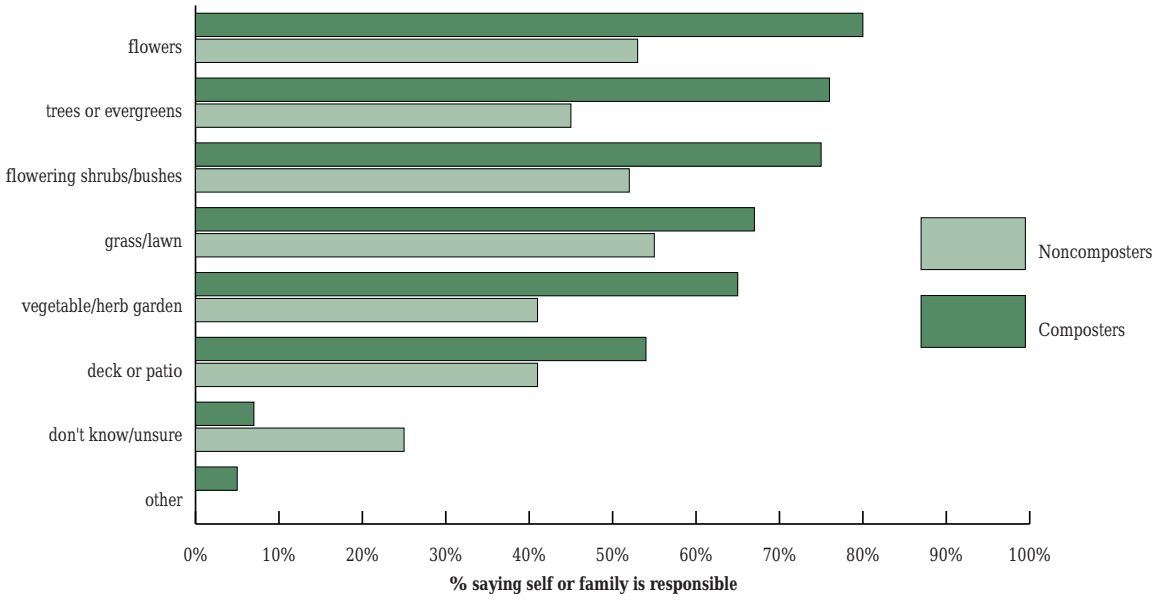


Source: 1998 Composting Studies

Figure 15

Responsibility for Outdoor Maintenance

among a sample of 174 composters and 177 noncomposters in the test tracts



Source: 1998 Composting Studies

The Composting Study also found that the majority of tract residents have grass, flowers, trees, and shrubs in their yards; however, volunteers are more likely to have these than nonvolunteers. Furthermore, nearly three quarters of volunteers have a vegetable or herb garden, as opposed to around one half of nonvolunteers. Volunteers are also more likely to personally care for their yards and plants than nonvolunteers, who turn more frequently to outside gardeners and landscapers. While roughly half of nonvolunteers handle these tasks themselves, many more volunteers take this responsibility, especially when it comes to tending flowers, trees, and the garden.

Meal Preparation and Time at Home

One hypothesis investigated in the Composting Study was that volunteers and nonvolunteers differ in their food preparation and consumption habits. Such differences, if found, might inform composting program planning. Clearly, a family that eats out frequently will have less organic waste to compost. In addition, meats, cheeses and oils — which attract vermin and cause odors — are not suitable for home composting; thus many takeout, convenience, or pre-packaged foods, while they may contain vegetables, cannot not be composted in the backyard. By contrast, residents who use fresh, "from scratch" ingredients, should have more compostable waste generated through food preparation.

The Composting Study questioned volunteers and nonvolunteers about the percentage of meals they ate out, as well as their tendency to use take-out items, frozen produce, and convenience foods instead of preparing meals from scratch, using fresh ingredients. The analysis shows that while there were statistically significant differences between the two groups, suggesting that volunteers eat at home and use fresh ingredients slightly more often, these differences were very small. Overall, volunteers and nonvolunteers alike consume roughly three quarters of their meals at home and one quarter out. Of the meals prepared at home, around 70% are made with fresh produce, and around 70% are made from scratch, as opposed to roughly 30% from canned or frozen produce, and from convenience foods.

The Wave 1 and Composting Studies did reveal, however, that volunteers spend more time at home than average. When read the statement, "We do not spend that much time at home," 23% of volunteers, vs. 35% of nonvolunteers and 31% of the general public "completely" or "somewhat" agreed.

Civic and Environmental Concerns

Several survey questions were designed to test the hypothesis that volunteers — residents who voluntarily joined the Backyard Composting Program — take more pride in their homes, are more interested in community activities, and/or have more commitment to environmental causes. The data gathered, however, revealed few significant differences between volunteers and others for these characteristics. Roughly 60% of respondents agreed that "I think the way my yard looks is a reflection of me and my household," and around 30% stated that, "I usually volunteer my time for causes I believe in." Minor differences in percentages among volunteers, nonvolunteers, and the general public for these measures were not statistically significant. The only finding of significance was that nonvolunteers are slightly more likely to agree with the statement, "I already do everything I can to help the environment," (56%) than volunteers or the general public (43% and 46%, respectively).

The study also revealed no significant difference in opinion about the City's Recycling Program between volunteers and nonvolunteers. Both highly approve of it, with 95% rating it "extremely," "very," or "somewhat" positively. While an identically worded question was not posed to the general public in the Wave 1 study, the Composting Study results are loosely comparable to results in that study that found that 75% of New York City residents rate the Recycling Program as "excellent," "very good" or "good."

When interpreting the data on civic and environmental concerns, it should be noted that residents in the four tracts had already had their waste sampled twice by the time the survey was taken. Sampling involved a very visible DOS presence, with yellow bags of sampled refuse being prepared by Department staff and Sanitation vehicles moving from house to house for their collection. This may have exerted a positive or negative influence on the residents' attitudes towards recycling and their civic responsibilities.

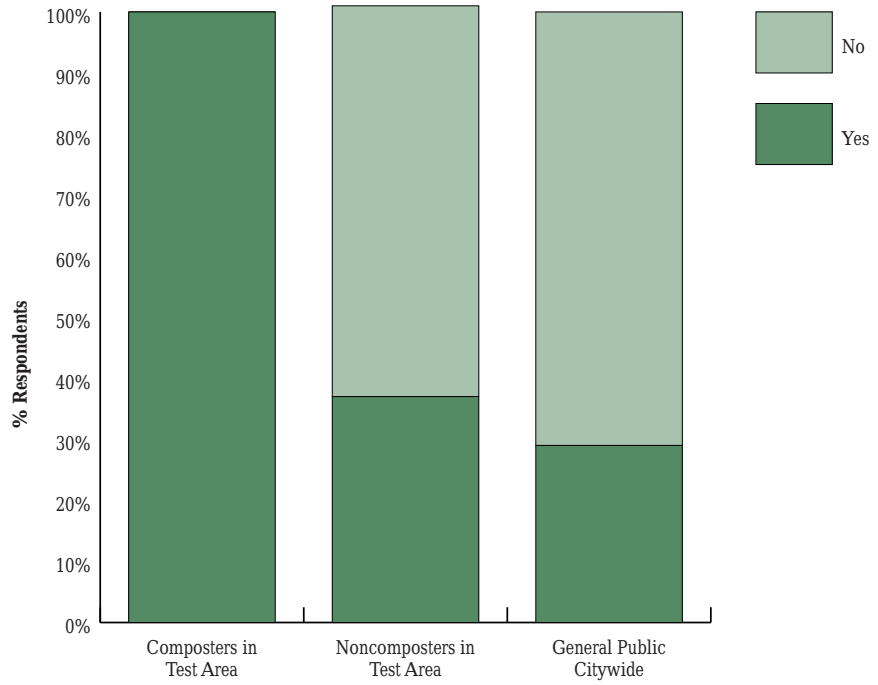
Compost Bin Experience

Not surprisingly, **100% of volunteers surveyed reported having seen or used a compost bin**. As shown in Figure 16, only 30% of New Yorkers with backyards, and 37% of nonvolunteers, reported such familiarity (presumably having had experience through some other means than the DOS Program).

Figure 16

Experience/Familiarity with Compost Bin

among a sample of 174 composters and 177 noncomposters in the test tracts, and 269 NYC residents Citywide



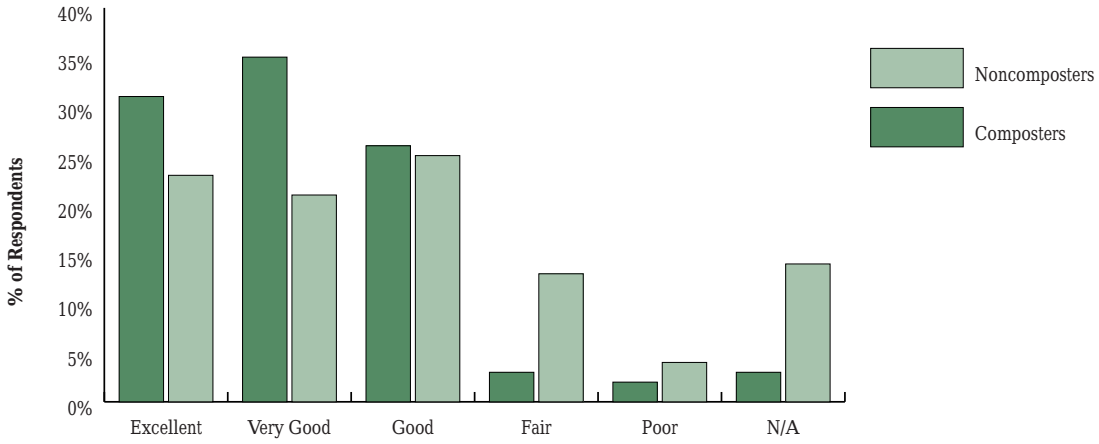
Source: 1998 Wave 1 and Composting Studies

The Composting Study also found that both volunteers and nonvolunteers who had composted on their own enjoyed the experience of using a bin, although volunteers more so. Ninety-two percent (92%) of them rated using a pile or bin as "excellent," "very good," or "good," as opposed to 68% of nonvolunteers, who were more likely to call their own experience "fair" (13% vs. 3%). Around 70% of respondents in both groups specified positive reasons for rating the Program as they did; these included protection of the environment, the usefulness of compost in gardening and soil enrichment, and general feelings that composting is a worthwhile, enjoyable, and convenient thing to do. The positive views did not differ significantly between the two groups. More volunteers than nonvolunteers, however, saw educational benefits to composting (13% vs. 4%), both for children and adults. (These results are displayed in Figures 17 through 20.)

Figure 17

Rating of Experience Using a Compost Bin or Pile

among composters and noncomposters who have used one

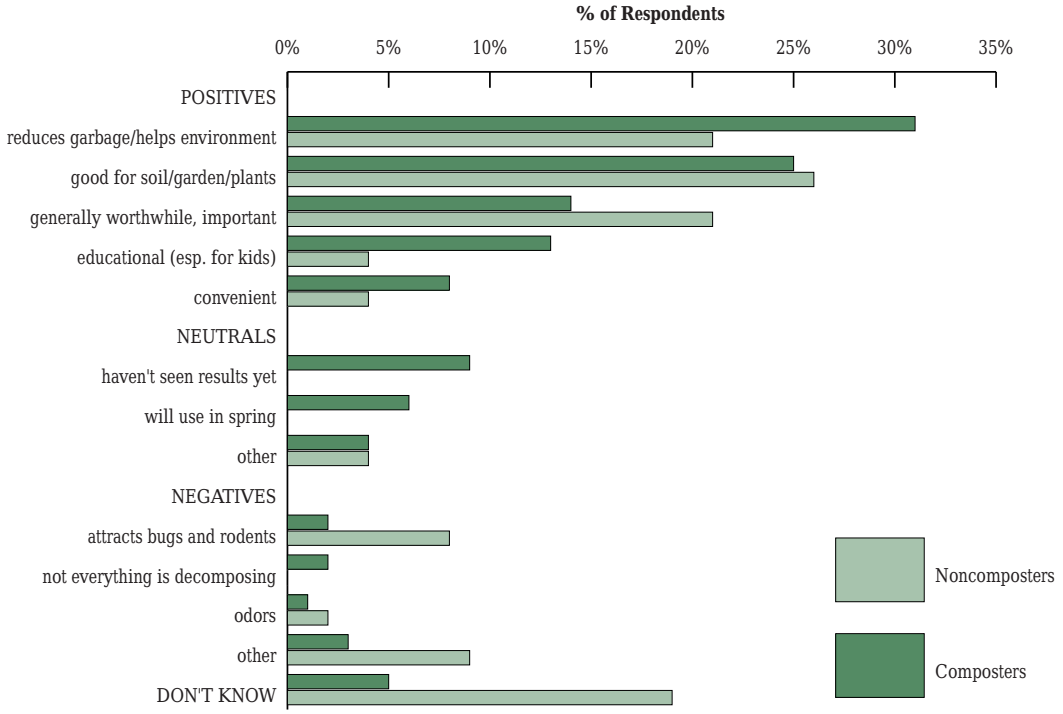


Source: 1998 Composting Study

Figure 18

Rating of Experience Using a Compost Bin or Pile

among composters and noncomposters who have used one

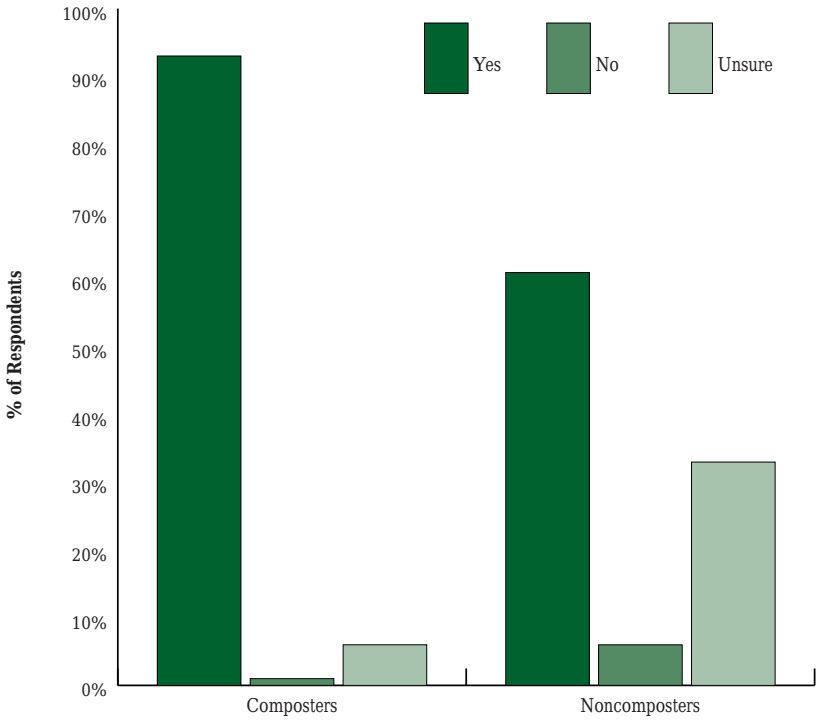


Source: 1998 Composting Study

Figure 19

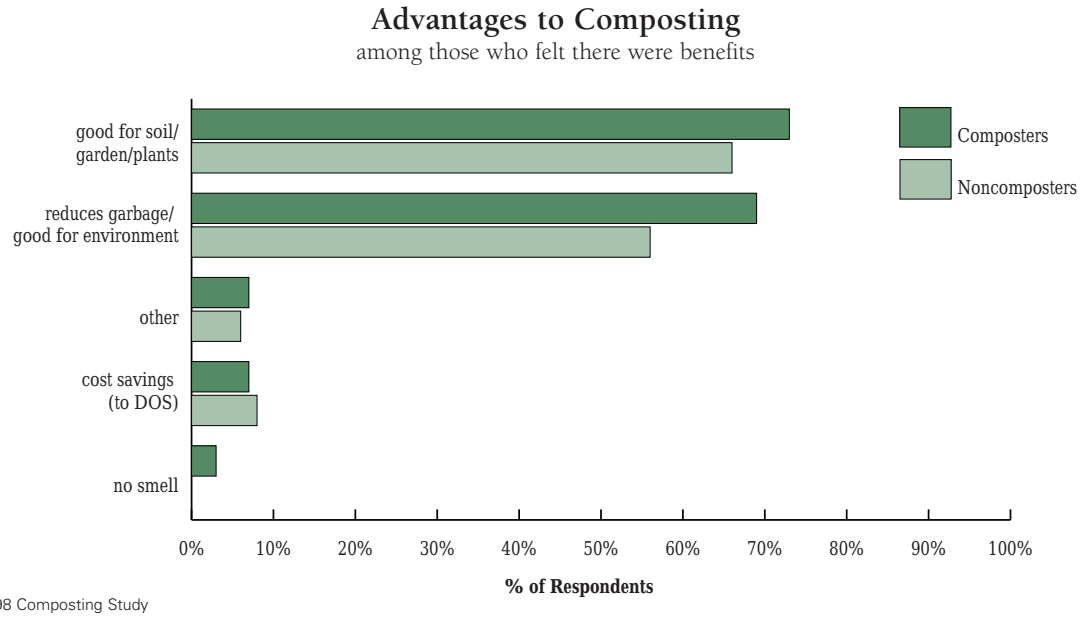
"Are there advantages or benefits to home composting?"

(among a sample of 174 composters and 177 noncomposters)



Source: 1998 Composting Survey

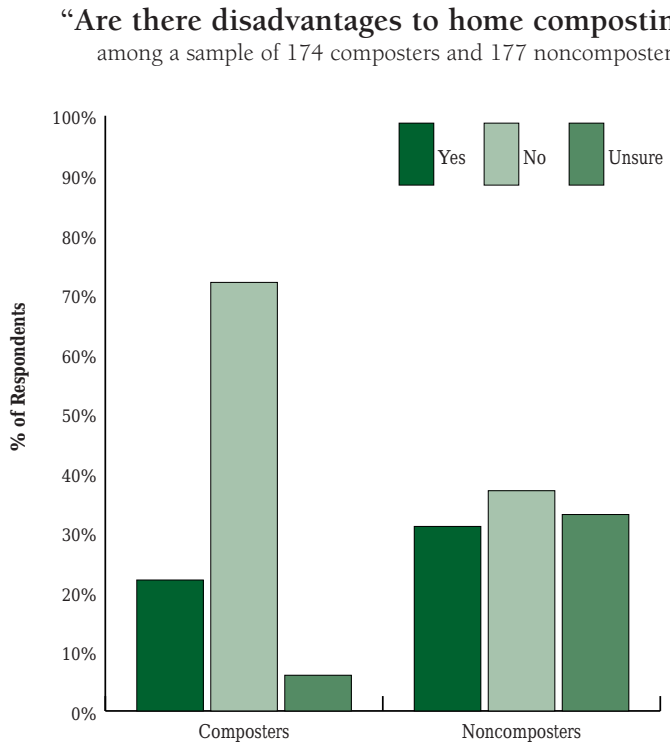
Figure 20



Source: 1998 Composting Study

Nonvolunteers, on the other hand, were significantly more likely to list negative reasons for rating the Program as they had. Seventeen percent (17%) of this group, as opposed to only 7% of volunteers, listed attracting bugs and rodents, odors, and the failure of all materials to decompose as justifications for a negative rating. Significantly more nonvolunteers than volunteers felt negatively about the Program, but could not list a specific reason (19% vs. 5%). Figures 21 and 22 summarize perceived disadvantages to composting.

Figure 21

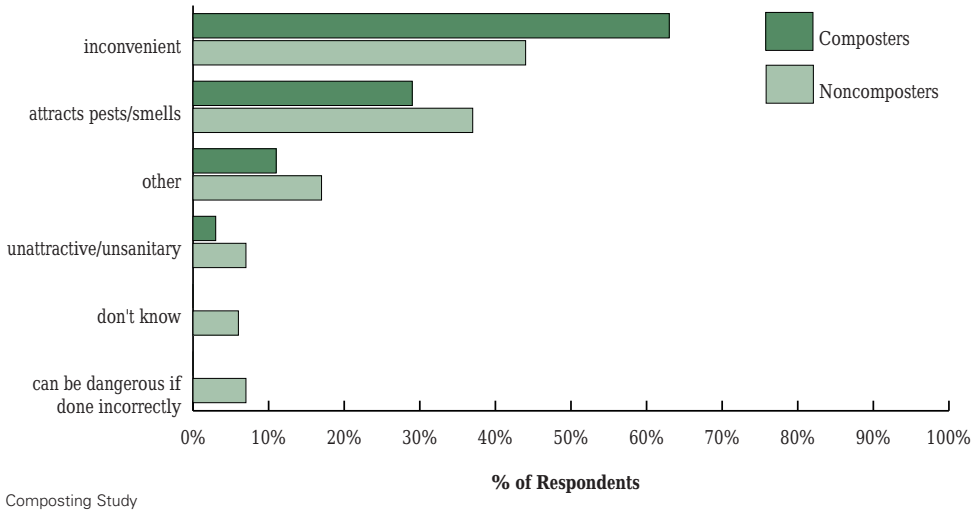


Source: 1998 Composting Survey

Figure 22

Disadvantages to Composting

among those who felt there were disadvantages



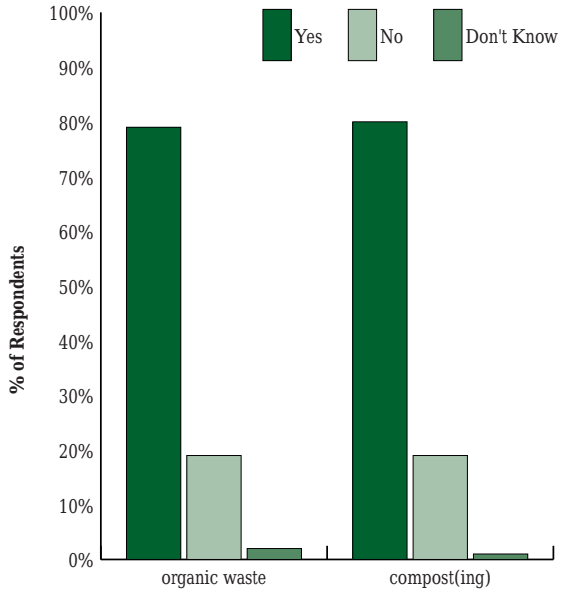
Source: 1998 Composting Study

Nonvolunteers were asked a separate set of questions designed to assess their understanding and opinion of composting, from the point of view of someone who did not participate in the Backyard Composting Program. Results showed that nonvolunteers have a relatively high awareness of the terms "organic waste" and "compost(ing)" — around 80%, although, as reported above, far fewer had ever had experience with a compost bin or pile, either directly or through another household member. Furthermore, of the minority that had ever used a bin or pile, only 34% reported still maintaining it (see Figures 23 through 27). *The disparity between familiarity with the term "composting" and lack of experience with the activity suggests that "not composting" was a clear choice that nonvolunteers made, and was not a consequence of ignorance.*

Figure 23

Awareness of Terms

among a sample of 177 noncomposters

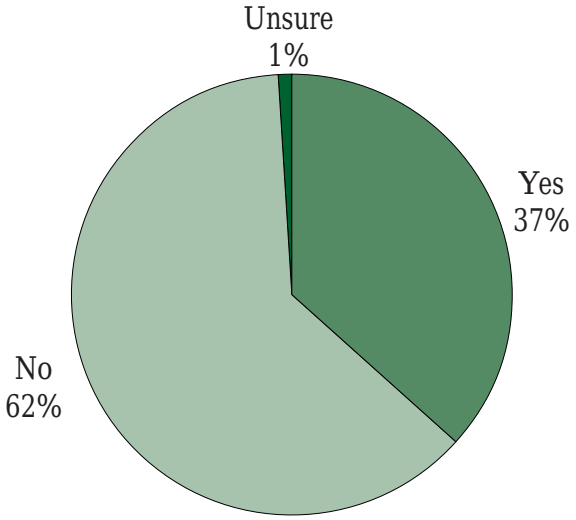


Source: 1998 Composting Study

Figure 24

"Have you or a member of your household ever seen or used a compost bin?"

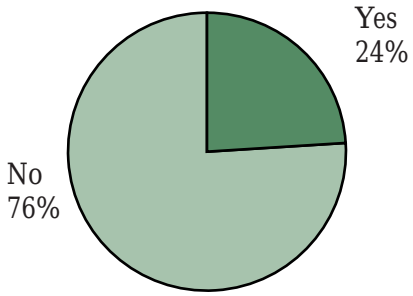
among a sample of 177 noncomposters



Source: 1998 Composting Study

Figure 25

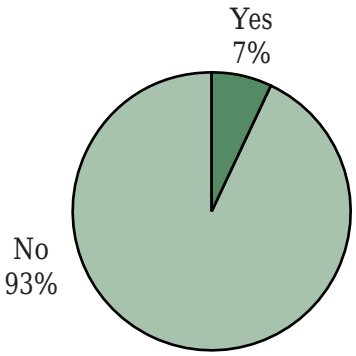
"Have you/another household member ever personally set up/used a compost bin or pile?"
(among noncomposters)



Source: 1998 Composting Study

Figure 26

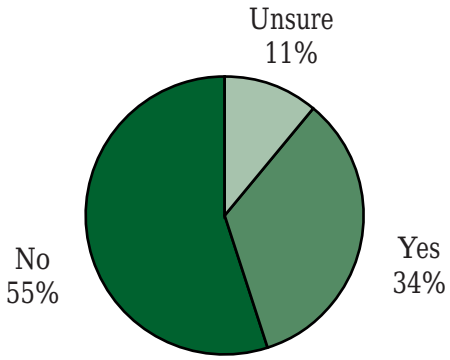
"Have you/another household member ever HELPED someone use a compost bin or pile?"
(among noncomposters who have never personally used one)



Source: 1998 Composting Study

Figure 27

"Do you still maintain your compost bin or pile?"
(among noncomposters who have used one)



Source: 1998 Composting Study

Demographics

The remainder of the questions administered to volunteers, nonvolunteers, and members of the general public measured and compared basic demographic characteristics — including housing type and status, household size, ethnicity, country of origin, time in New York City residence, marital status, gender, age, income, and education level. This exercise revealed some significant differences among the three groups. Before detailing these differences, however, it should be pointed out that for practical and unavoidable reasons, the tracts selected for the Pilot were not demographically representative of the City's population as a whole. The US Census data presented in Table 7, above, clearly shows this.

As shown in Table 22, Volunteers are significantly more likely to live in single-family homes than in two-family homes, multifamily dwellings, or other housing types. Nearly all own, rather than rent, their homes, as compared to close to 70% of the general public. Volunteers have slightly smaller household sizes than do the general public (3.02 vs. 3.34 persons). Consistent with these status indicators is the finding that volunteers make $20,000 more per year, on average, than other City residents with yards.

Table 22

Demographic Comparisons

Composters in the Test Area vs. Non-Composters in the Test Area and General Public

	Composters in test area		*Noncomposters in test area*		*General Public with yards, citywide*
Housing Type					
single family	82%	▲	76%	▲	53%
two family	17%		20%		29%
three family	0%		2%		4%
apartment building	0%	▼	2%	▼	12%
other	1%		0%		2%
Occupancy Status					
own	94%	▲	78%	▲	68%
rent	5%	▼	21%	▼	32%
Marital Status					
married	74%	▲	64%	▲	51%
single	13%	▼	15%	▼	31%
divorced/separated/widowed	7%		19%		15%
Ethnicity					
Caucasian	86%	▲	77%	▲	60%
African American	5%	▼	15%		20%
Indian/Pakistani	1%		2%		1%
Latino/Hispanic	2%	▼	2%	▼	10%
Asian	1%		2%		3%
Other/Refused	5%		2%		6%
Birthplace					
US	91%	▲	82%	▲	74%
Outside US	9%	▼	16%	▼	26%
Length of Time in NYC					
born a resident	67%	▲	50%		45%
over 20 years	22%		38%	▲	27%
10-20 years	6%		8%		17%
9 years or less	5%		4%		11%
Gender					
Male	45%		42%		36%
Female	55%		58%		64%
Household Size					
mean # of people	3.02	▼	2.83	▼	3.34
Income					
mean for household, annual	$66,300	▲	$53,200	▲	$48,600
Age					
mean age	49.2	▲	52.1	▲	42.8
Education					
some high school	1%	▼	9%		10%
high school graduate	20%	▼	29%		29%
some college	24%		24%		25%
college graduate	29%	▲	23%		22%
post-college graduate	26%		12%		12%

▲ significantly higher than the General Public sample, at 95% level

▼ significantly lower than the General Public sample, at 95% level

Table 22, continued

Demographic Comparisons

Composters vs. Non-Composters Only

	Composters in test area		*Noncomposters in test area*	
Borough				
Bronx	17%		25%	↑
Staten Island	64%	↑	35%	
Queens	6%		16%	↑
Brooklyn	13%		24%	
Age of Household Members				
under 5	7%		4%	
ages 5-17	19%		17%	
ages 18-24	9%		9%	
ages 25-34	17%	↑	11%	
ages 35-39	19%		23%	
ages 40-59	12%		9%	
ages 60-64	7%		8%	
65 and older	9%		16%	↑
Employment Status				
full time	40%		45%	
part time	11%		6%	
full time student	22%		19%	
not employed	12%		8%	
retired	14%		22%	
Living Environment History				
always lived in a city	63%		63%	
lived in a suburbs	28%		31%	
lived in rural environment	10%		11%	

↑ significantly higher, at 95% level

↕ significantly lower, at 95% level

Source: 1998 Recycling Study and 1998 Composting Study, Grey Advertising

While one fourth of New Yorkers with backyards are foreign-born, only 9% of volunteers are. Nearly 70% of volunteers were born in New York City, significantly more than the 45% among the general public. Far fewer volunteers than other City residents have not completed high school (1% vs. 10%), and more have college or graduate degrees.

Volunteers are, on average, older than the general public members by about seven years. More volunteers (three fourths) are married, compared to the half with this status among other City residents. Gender differences among volunteers and the general public, however, were not found to be significant. Caucasians outnumber any other ethnic group by a wide margin among volunteers (86%), but represent only 60% of the general public sampled.

Overall, nonvolunteers living in the test tracts fall somewhere between volunteers and the general public in terms of housing type and ownership, household size, marital status, ethnicity, country of origin, time in New York City, and income. They are not significantly different from the general public in terms of education, however. In addition, they tend to be the oldest of the three survey groups, with a median age of 52.

Volunteers' Experience With The Program

Survey questions targeted at volunteers were meant to gather information about the experience of participating in the Backyard Composting Program, including the outreach and recruitment, bin use, and opinions about the practice of backyard composting.

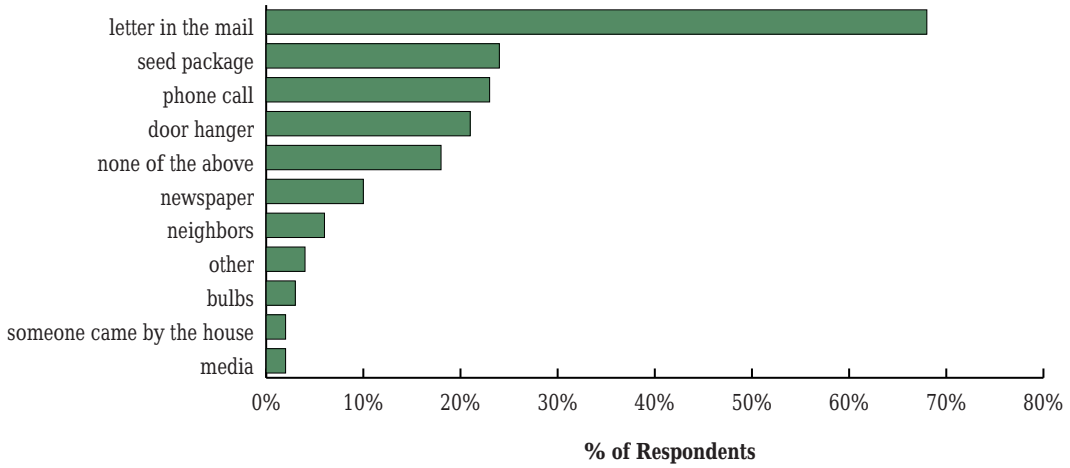
Why Volunteers Joined the Program

As shown in Figure 28, the majority of volunteers learned of the Program through direct mail, although fair numbers cited the doorknob hanger or phone call as their means of contact. In addition, the seed packet, which was included in the mailing and on the door hangers, was remembered by around one quarter of those surveyed.

Figure 28

"How did you learn about the backyard composting program?"

(among a sample of 174 composters)



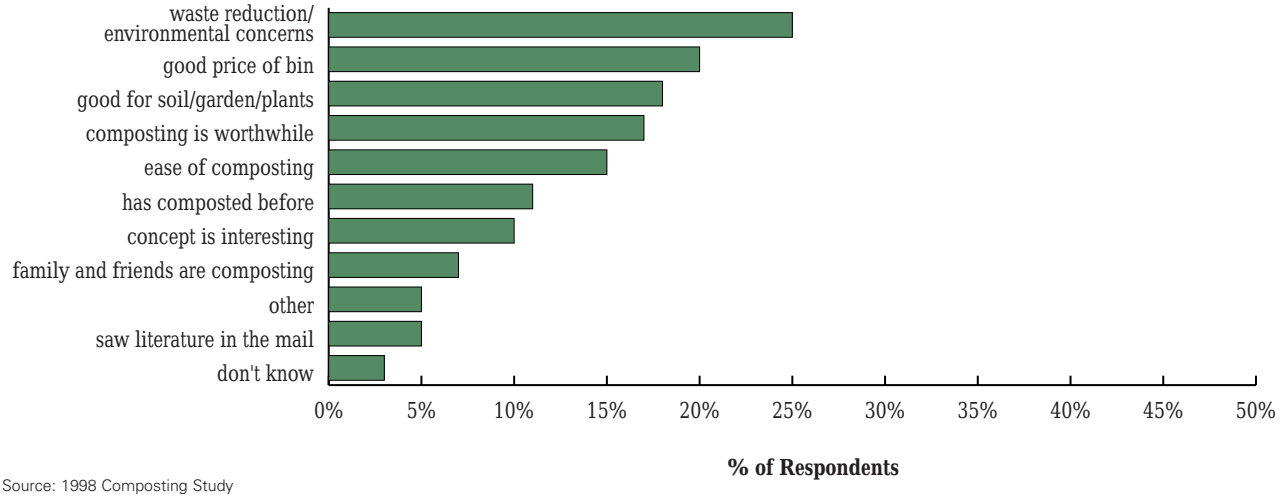
Source: 1998 Composting Study

Volunteers also listed a number of factors that motivated them to join the Program. The results show that while reducing landfills, environmental concerns, and a general feeling that composting is a worthy activity did play a role in the residents' decision to compost, the subsidized bin price, gardening benefits, and ease of composting also contributed significantly. (See Figure 29.)

Figure 29

Factors in Deciding to Join the Backyard Composting Program

among a sample of 174 composters



Source: 1998 Composting Study

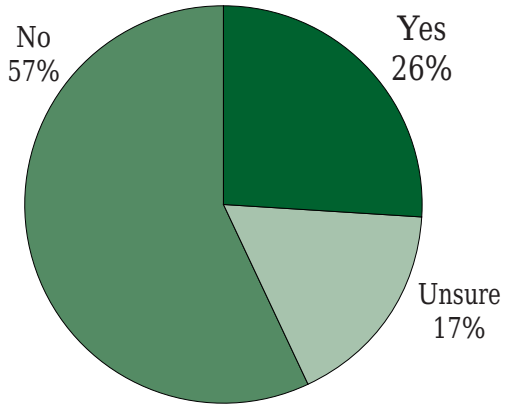
Making the Program Mandatory

Figure 30 shows that despite their strong approval of the Program, the majority of volunteers did not think it should be made mandatory for all households who have backyard space. While most considered backyard composting to be the best method for organic waste recycling (preferring it to in-sink disposal units by 8 to 1, as shown in Figure 31), only one quarter believed that it should be required under the law.

Figure 30

"Should a composting program be made mandatory (for residents of houses with yard space)?"

among a sample of 174 composters

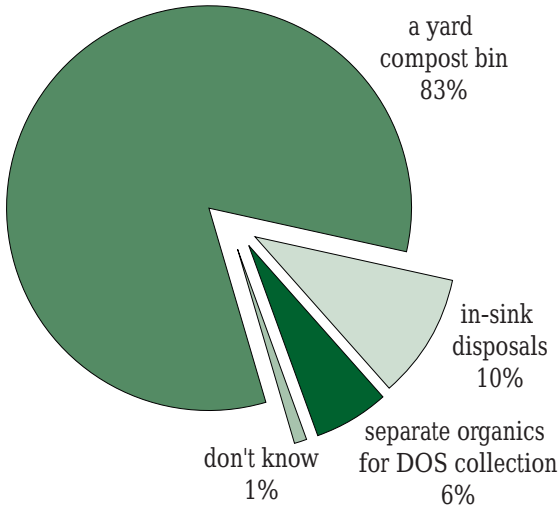


Source: 1998 Composting Study

Figure 31

Preferred Organic Waste Disposal Method

among a sample of 174 composters

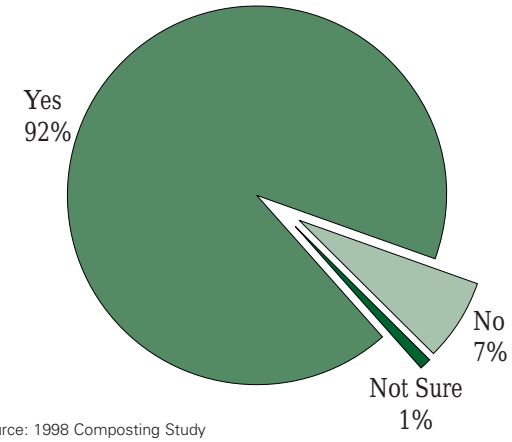


Source: 1998 Composting Study

Figure 32

Percent of Composters still using bin received from Botanical Garden

as of March 1998, 9 months after receipt



Source: 1998 Composting Study

Program Interest and Rating

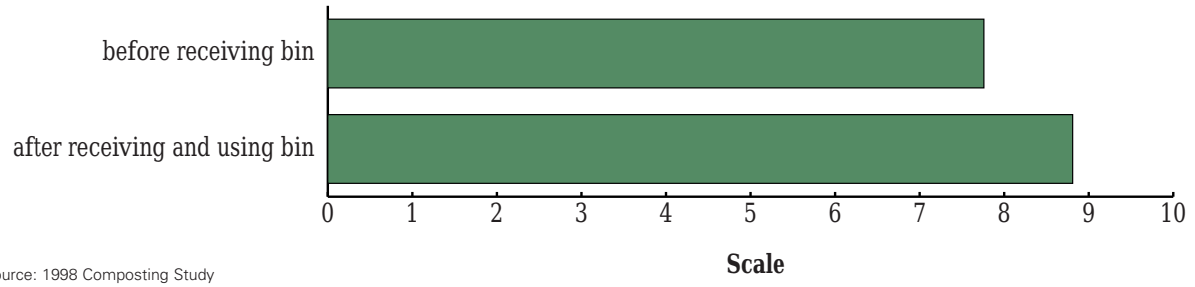
Indicators of Program interest and rating are summarized in Figures 32 through 37. **An important finding was that in March of 1998 the overwhelming majority of volunteers surveyed (92%) reported still using the bin they received in June 1997.** It should be noted that this rate, measured nine months after bin distribution, was what volunteers reported, but was not directly confirmed by Botanical Gardens staff through field visits.

Another indicator of program enthusiasm was the survey finding that using the bin caused a small increase in an already strong interest in composting among Program volunteers as a result of joining the Program (from close to 8 to close to 9 on a scale of 10). These positive results were reinforced by the finding that 95% of those surveyed would be likely to recommend the Program to family or friends, as shown in Figure 34.

Figure 33

Level of Interest in Participating in the Backyard Composting Program

on scale of 1 to 10, among sample of 174 composters

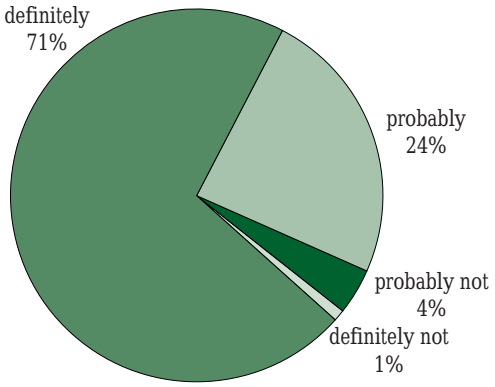


Source: 1998 Composting Study

Figure 34

Likelihood of Recommending Compost Program to Family and Friends

among a sample of 174 composters

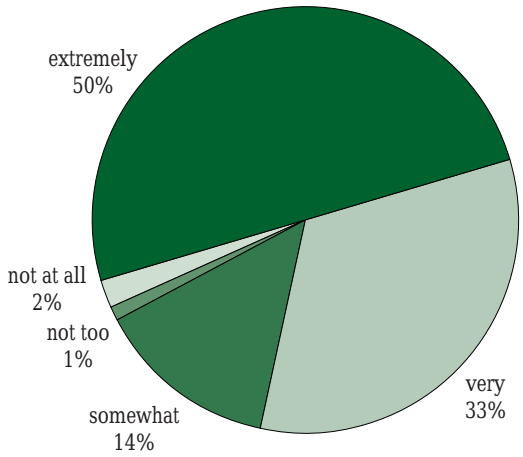


Source: 1998 Composting Study

Figure 35

Rating of Helpfulness of Botanical Gardens Personnel

among a sample of 174 composters

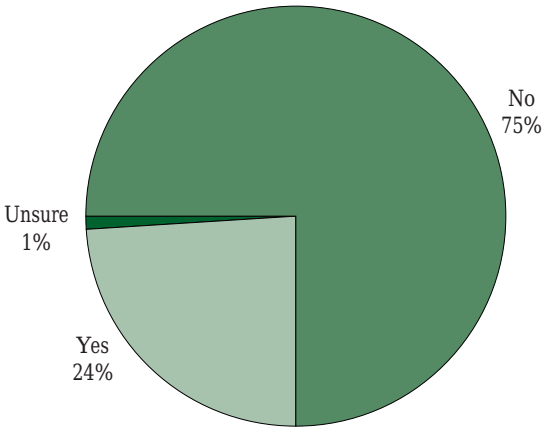


Source: 1998 Composting Study

Figure 36

"Should Anything Be Changed About the Backyard Composting Program?"

among a sample of 174 composters



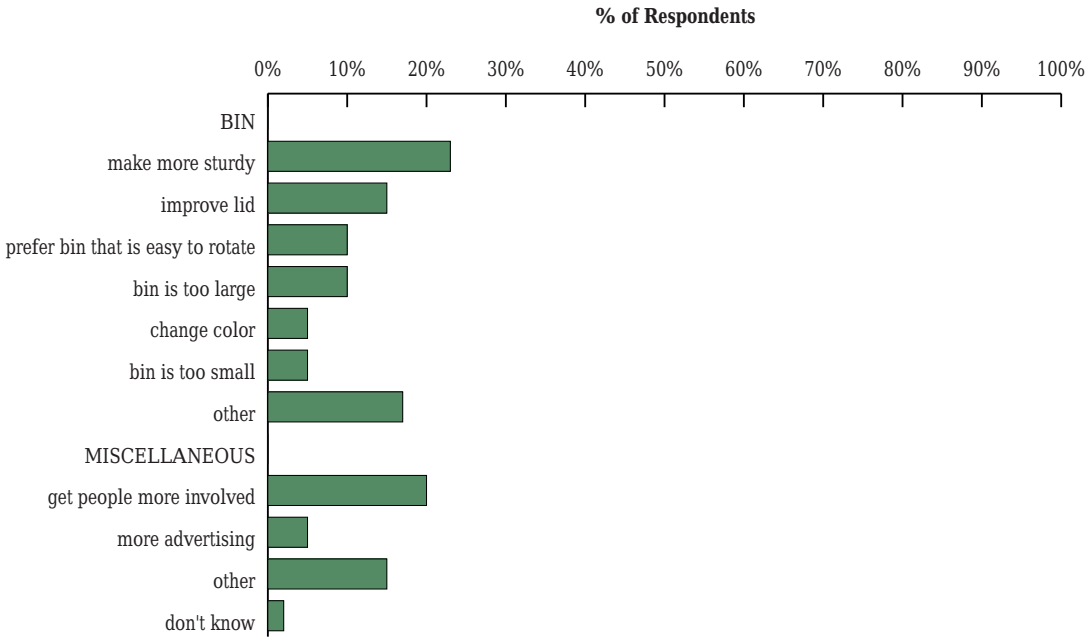
Source: 1998 Composting Study

Figure 35 shows that most Program volunteers rated Botanical Gardens' staff as extremely or very helpful (83%), and Figure 36 shows that similar percentages felt that the Program was good enough not to need changes or improvements. Of the roughly one fourth who did suggest changes, over 60% suggested modifications of the bin — in terms of improving its lid, making it more sturdy, changing its size or color, or other adjustments. Other suggestions included recruiting more volunteers and increasing Program-related advertising, as shown in Figure 37.

Figure 37

Suggested Changes to the Backyard Composting Program

among a sample of 174 composters



Source: 1998 Composting Study

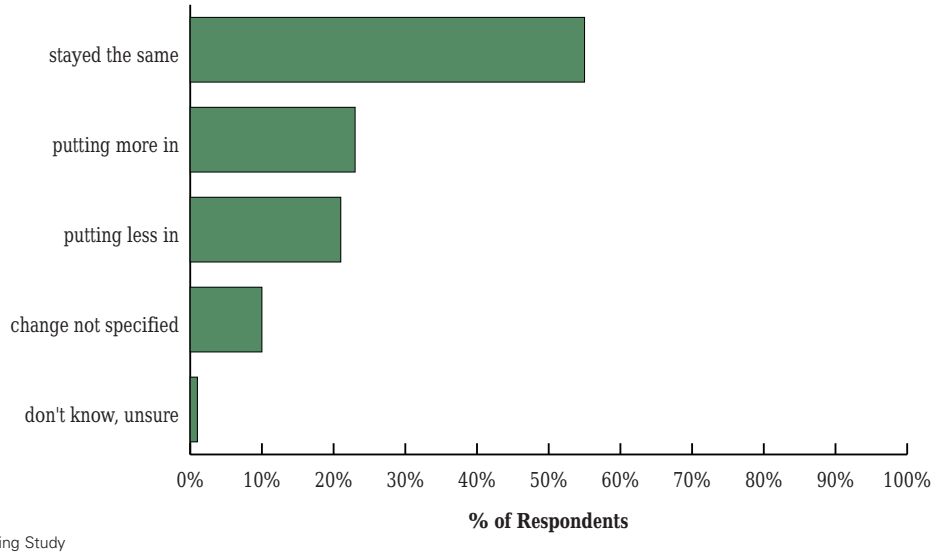
What was Composted

Figures 38 and 39 show that most volunteers (55%) reported placing consistent volumes of organic waste in the bins after they had joined the Program, although some had increased or decreased these amounts as time passed (around 20% for each group). The range of items reported composted by residents shows very little incorrect usage of the bin (only 4% reported composting meat or chicken), and high rates of composting yard waste and vegetable matter. Leaves (composted by 84% of residents), rather than paper (by 13%), appeared to be the carbon source of choice.

Figure 38

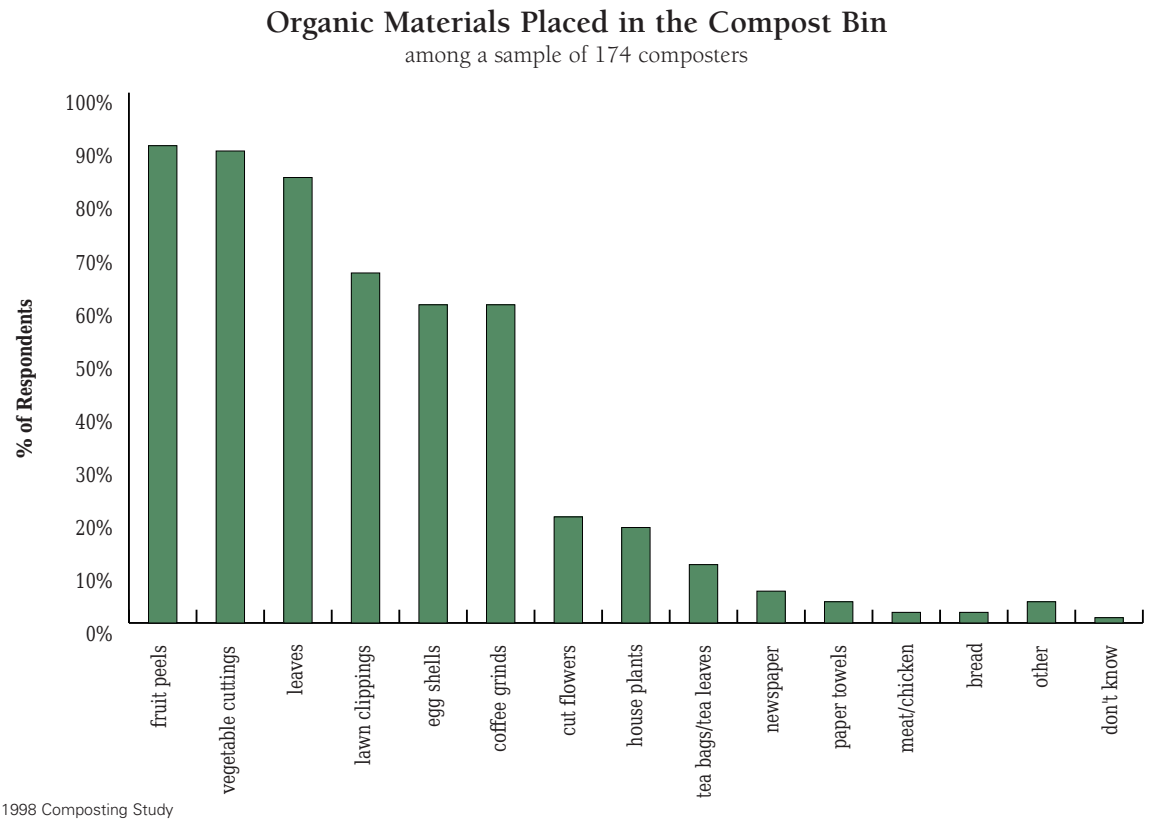
Estimate of change in amount of organic waste put in compost bin, over time

among a sample of 174 composters, over 9 months



Source: 1998 Composting Study

Figure 39



Source: 1998 Composting Study

Conclusions and Implications

Backyards in New York City

Neither the US Census, the New York City Department of City Planning, nor the New York City Department of Housing Preservation and Development collects data on backyard access among City residents. The first major finding of this market research, therefore, was that **one third** of New York City's households have access to a sideyard or backyard. This percentage is consistent with the preliminary market research carried out by Grey Advertising, and would suggest that considerable opportunity exists, in theory at least, for backyard composting as a DOS-sponsored program.

The Volunteer Profile

The research also suggested that persons who volunteer for composting programs differ in several ways from those who choose not to. An understanding of these differences may aid the Department in targeting outreach materials to appeal to those who will be likely to join a program, or to try to change conceptions of those who are reticent. Clearly, stressing compost's benefits for yardwork and gardening will be crucial in promoting program participation, since the data show that likely volunteers will enjoy these activities more than average, and the focus groups indicate that potential volunteers or nonvolunteers will base their decision about whether to join on the benefits of compost to their own garden. Concentrating on the environmental, civic, or community-building advantages of composting, on the other hand, may not result in increased program participation rates.

Nonvolunteers

Another major finding of the study is that many characteristics of nonvolunteers (who live exclusively in the test areas) do not significantly differ from members of the general public with backyards who reside throughout the City. This is especially true for yard and gardening behaviors, as well as familiarity with the compost bin. The fact that nonvolunteers resemble the general public suggests that, within the test areas, residents did not divide themselves into two extreme camps (those who love gardening and those who can't stand it), but rather that **nonvolunteers are in a sense "normal," and volunteers are unusual.** This will be important to know when planning outreach to maximize recruitment of the composting type of person, or to improve participation among average citizens.

The one exception to this may be that nonvolunteers, when surveyed, have a higher propensity to feel that they already do all they can to protect the environment; on this measure alone, volunteers more closely resemble the general public than do nonvolunteers. This may or may not be related to the resentment of composting and recycling that was suggested by Grey's difficulty in recruiting volunteers for focus groups. However, the implications of these trends would need further study to meaningfully inform program planning.

Demographic Differences

As discussed above, nonvolunteers and the general public did **not** resemble each other in terms of demographic characteristics. Instead, if one imagines volunteers to be at one extreme of a socioeconomic continuum and the general public in the middle of this scale, then nonvolunteers more closely resemble volunteers. This is clearly because volunteers and nonvolunteers live in the same neighborhoods, which are in areas of the city where incomes and education levels are higher, single-family homes are owned at a greater rate, families are smaller and headed by married couples, residents are native to New York, and people are mostly Caucasian.

The fact that the "suburban" type neighborhoods selected for this study have certain demographic characteristics does not mean, however, that outreach will be targeted at persons with similar characteristics. Gardening interest seems to be the most salient predictor of program participation across the board, and outreach should be targeted at people who enjoy gardening and working in their yards.

The Backyard Composting Program

Finally, this study served as a crucial component in evaluating how the Backyard Composting Program was carried out in the test areas. It showed that the Program, as it was designed, worked very well in terms of providing education and support to volunteers and contributing to their feeling that they were improving their gardens, the environment, and the waste situation in New York City. Some thought should be given to providing a choice of bin styles, since modifications of its size, color, and configuration represented the bulk of Program improvements suggested by participants.

Furthermore, while modifications to the direct mail letter should be made along the lines that the focus groups suggested (emphasizing neighborhood beautification, explaining program details and benefits more clearly, including a photo of a compost bin, and eliminating mention of DOS), the letter appears to be the most effective means of reaching those who will decide to compost. Door hangers and unsolicited phone calls reminding residents to respond should not be included in future outreach efforts, as they appear to engender backlash.

CHAPTER VII. COST-BENEFIT ANALYSIS

The preceding chapters have shown that backyard composting is not likely to substantially reduce the weight or volume of waste going to export. Nevertheless, a comparison of the costs and benefits of backyard composting is still useful for future program planning, given the Department's continued support of Botanical Gardens backyard composting programs as part of its ongoing public education and outreach efforts.

DETERMINING PROGRAM COSTS

The Pilot Program

As discussed in Chapter III, Program outreach for the Backyard Composting Program was multi-faceted and intense, involving direct mail, telemarketing, and door-to-door canvassing. The materials distributed by mail and in-person included letters, response cards, door hangers, and complimentary packets of seeds. Each resident who purchased a bin was visited by one or more Botanical Gardens' staff for home installation of the bin and on-site education, and some solicited ongoing telephone assistance after that point. Considerable time was also devoted to program planning, both by staff at the Department and the Botanical Gardens. Each of these activities involved labor and materials costs. In addition, there was the direct cost to the Department of Sanitation for subsidizing the bins themselves. Finally, the eventual disposal of the compost bin, after it had gone through its life cycle, also bore a cost. All of these factors went into the calculation of total costs for the Backyard Composting Pilot Program.

It should be noted that the calculation of actual outreach program costs should not and did not include the following: (1) costs associated with the waste composition study, (2) costs of the market research, or any other evaluation component of the Pilot; and (3) additional costs coming from exploratory and/or start-up activities; since none of these would be duplicated in future programs.

Alternative Bin Distribution Activities

As backyard composting continues to be promoted by the Department through the Gardens and staff gain expertise, planning time is expected to go down. Furthermore, the feedback gained from the market research component of the study suggests that future outreach should be simplified, eliminating telemarketing and door hangers. Additional bin distribution efforts are already underway throughout the Bronx, Brooklyn, Queens, and Staten Island that incorporate these ideas. At the same time, the Botanical Gardens are also taking a different approach to bin distribution, combining bin sales with compost givebacks (free distribution of leaf compost from the City's leaf composting sites) at one-time public events. Such events are most likely to attract gardeners, which the market research indicates are the segment of the population most interested in composting. In addition, because these events do not include home visits or extensive outreach, they entail lower planning, publicity, and supply costs. Bins are furthermore often sold directly by manufacturers at wholesale prices, eliminating the need for subsidy by the Department of Sanitation.

DETERMINING PROGRAM BENEFITS

There are many potential benefits of backyard composting. Because it diverts organic material — a major source of leachate contamination — from landfills, and to a lesser extent fights erosion and resulting runoff where compost is applied, backyard composting can have direct environmental benefits. Furthermore, the increased ecological awareness that comes with this practice is of benefit to society as a whole, as well as to the Department in particular, because of potential increase in attention to waste and recycling compliance. In addition, there are direct benefits to composters in terms of avoided costs for purchase of peat moss or other soil amendments, and the neighborhood benefits that come when residents use extra compost to beautify street trees, traffic triangles, community gardens, and other public greenery.

Although these benefits are valid and important, they will not be weighed against direct program costs for this analysis. There are several reasons for this. First, most of the environmental and neighborhood benefits that come from composting are extremely difficult to quantify. These benefits, furthermore, would largely accrue to entities other than the Department of Sanitation, which does not have jurisdiction over wastewater treatment, community beautification, or the landfills that will be used when the City moves to export. Finally, the avoided costs for soil amendments to residents are private benefits, and as such should not be counted in making decisions about public funding. In order to develop the most realistic understanding of the costs and benefits of backyard composting to the Department, the boundaries of this analysis will therefore be defined to include only expenditures directly affecting the Department's budget.

Benefits relevant for consideration by the Department of Sanitation are avoided collection, transfer, and disposal costs; as well as costs for leachate treatment at Fresh Kills. Leachate treatment costs will not be considered in this analysis because of the minute effect that diversion of two years worth of backyard composting (at levels established by this study, or even at double or triple those levels) would have on the total contamination potential of the landfill. Current and future costs for collection and disposal, on the other hand, are substantial and can be directly attributed to the avoided tons that would be composted, on a per ton basis. As discussed in the Department's **1998 Comprehensive** *Solid Waste Management Plan Modification* refuse collection, transfer, and disposal costs for every ton of material have been projected as follows:

Table 23

Actual and Projected Avoided Collection and Disposal Costs, per ton in 1997 dollars

	FY 1997 Actual	FY 1998*	FY 1999 Projected	FY 2000 Projected	FY 2001 Projected	FY 2002 Projected
Costs per Ton in 1997 dollars	$77	$77	$122	$122	$124	$139

Source: 1998 Comprehensive Solid Waste Management Plan Draft Modification, Table 4-2

** Estimate for FY 1998 was not included in Table 4-2, so the FY 97 actual cost has been substituted for the purpose of this analysis.*

The Plan discusses the increase in per ton collection, transfer, and disposal costs, stating that:

> The total cost of waste transfer, transport, and disposal is...for Fiscal Year '97 based on the City's actual reported costs...the incremental cost of export is the change in the total costs of waste transfer, transport and disposal operations, as depicted each year...for FY '98 through FY '02, that are caused by addition of the export program.[22]

It should be noted that these estimates were developed to analyze financial benefits of large scale paper, metal, glass, and plastic recycling and leaf composting diversion operations which, in total, are projected to divert nearly 1 million of the 3.6 million tons of curbside and containerized residential waste from export annually by 2002 (see Table 20 in Chapter V). The economies of scale for collection and transfer of such large amounts would never apply in the case of backyard composting. This is because trash collection routes comprise approximately 650 households in neighborhoods of the housing densities to be featured in this Pilot, and backyard composting by some or all of these homes could not make a sizeable enough reduction in total tonnage to eliminate a truck route. Truck route designations are based on considerations such as traffic patterns, exclusion of mechanized collection sites or commercial waste, historical collection patterns, and labor agreements, and cannot be extended or contracted in response to minor fluctuations in tonnages set out for collection. *The effect of simply decreasing trash tonnage by 2.5 pounds per household per week among some of the households on a route would simply not be substantial enough to alter these designations.* This can be demonstrated with a simple calculation. Assuming the participation rate of 9.4% and per volunteer household per week reduction of 2.5 pounds that was found in the Pilot (which calculates out to .24 pounds or .0001175 tons for all households in the tracts, on average), roughly 85,106 stops would be needed in order to realize a reduction of 10 tons, the amount a Sanitation truck normally collects. This would be impossible to achieve even if the normal collection routes were doubled, tripled, or quadrupled.

As shown in Table 23, the Department's *1998 Comprehensive Solid Waste Management Plan Draft Modification* combines collection costs with those for transfer and disposal. Because this data is the best the Department has to date on future cost of waste management, avoided collection costs will be included in the calculation of benefits. Since collection costs are substantial, benefits presented should be considered an upward boundary.

COST CALCULATION

Calculation of program costs is shown in Table 24. Three different approaches to bin distribution have been analyzed. The first corresponds to the intense, heavy outreach that was conducted during the actual Backyard Composting Pilot Program, minus initial planning costs. The second is a simplified outreach program that eliminates telemarketing, door-to-door canvassing, and pares down what is mailed to residents. The third is a bin sale event that is publicized among area residents through direct mail, and also via newspaper advertisement and article.

The cost of the eventual disposal of the compost bin after its lifespan is over is calculated as well. When empty, a bin weighs approximately 15 pounds, or .0075 tons. With future collection and disposal costs ranging from $77 to $139 or more per ton (as will be detailed below), disposal costs come to roughly $1 per discarded bin.

All cost estimates, except those for disposal, were developed from information on actual costs incurred by the four Botanical Gardens during the Pilot and in subsequent events. Although salaries and benefits for Botanical Gardens staff vary, this labor has been valued at $26.00 or $21.00 per hour for full-time employees, and $5.50 per hour for temporary part-time staff. $26.00 per hour has been used to quantify labor of Bureau of Waste Prevention, Reuse and Recycling analysts.

Table 24

Fixed and Variable Program Costs, under Three Alternative Bin Distribution Scenarios

		#1 Pilot-Style (Heavy) Outreach		#2 Simplified Outreach		#3 One Day Event (Unsubsidized Bin Sale)			
FIXED PROGRAM COSTS	**unit costs**	**units**	**total cost**	**units**	**total cost**		**unit costs**	**units**	**total cost**
PRINTING						**PUBLICITY**			
letters	$0.01 *per piece*	2346	$ 23.46	2346	$ 23.46	mass mailings	$0.15 *per piece*	2000	$300.00
response cards	$0.05 *per piece*	2346	$ 117.30	---	---	posters	$2.00 *per piece*	50	$100.00
brochures	$0.05 *per piece*	2346	$ 117.30	2346	$ 117.30	advertising	$50.00 *per ad*	1	$50.00
door hangers	$0.24 *per piece*	2346	$ 563.04	---	---	newspaper articles	$0.00 *per article*	0	$0.00
seeds	$0.60 *per piece*	2346	$1,407.60	---	---	banner	$100 *per banner*	1	$100.00
COPYING									
DOS tipsheet	$0.05 *per piece*	2346	$ 117.30	---	---				
MAILINGS									
large envelope	$0.03 *per piece*	2346	$ 70.38	2346	$ 70.38				
return envelope	$0.03 *per piece*	2346	$ 70.38	---	---				
priority postage	$2.90 *per piece*	2346	$ 6,803.40	2346	$ 6,803.40				
return postage	$0.50 *per piece*	38	$ 19.00	---	---				
LABOR (IN HOURS)									
Gardens Staff									
TELEPHONE						*Gardens Staff*			
telemarketing	$16.00 *per hour*	125	$ 2,000.00	---	---	event planning	$26.00 *per hour*	50	$1,300.00
follow up assistance	$21.00 *per hour*	31	$ 651.00	31	$ 651.00	event staffing	$26.00 *per hour*	14	$364.00
						event support	$5.50 *per hour*	14	$77.00
PROGRAM PLANNING									
staff 1	$26.00 *per hour*	44	$ 1,144.00	30	$ 780.00				
staff 2	$21.00 *per hour*	72	$ 1,512.00	50	$ 1,050.00				
OTHER									
envelope stuffing	$16.00 *per hour*	175	$ 2,800.00	175	$ 2,800.00				
Bureau Staff						*Bureau Staff*			
program planning	$26.00 *per hour*	72	$ 1,872.00	50	$ 1,300.00	event planning	$26.00 *per hour*	25	$650.00
TOTAL			**$19,288.16**		**$13,598.23**				**$2,941.00**
VARIABLE COSTS, PER BIN SOLD									
wholesale bin	$38.00					wholesale bin	$ 38.00		
retail bin	($10.00)					retail bin	($ 38.00)		
bin cost to DOS	$28.00 *per bin*	1	$ 28.00	1	$ 28.00	bin cost to DOS	$ 0.00 *per bin*	1	$ 0.00
bucket cost to DOS	$ 2.00 *per bucket*	1	$ 2.00			eventual disposal of bin	$ 0.96 *per bin*	1	$ 0.96
home visit, staff 1	$26.00 *per hour*	1	$ 26.00						
support staff for home visit	$16.00 *per hour*	2	$ 32.00						
avg. van roundtrip for setup	$ 0.25 *per mile*	8.4	$ 2.10						
eventual disposal of bin	$ 0.96 *per bin*	1	$ 0.96	1	$ 0.96				
TOTAL			**$ 91.06**		**$ 28.96**				**$ 0.96**

Costs estimates were derived from actual costs incurred by the Botanical Gardens for Backyard Composting Pilot Project outreach activities and subsequent bin distribution efforts.

The outreach scenarios are calculated based on 2,346 potential Program participants contacted. This corresponds to the actual number contacted in the Backyard Pilot recruitment effort. The bin sale scenarios are calculated based on a mailing to 2,000 local residents, plus additional print media and poster publicity.

Costs associated with the research effort, and one-time startup costs were not included in any of these calculations.

Staff wages do not include fringe benefits.

These scenarios are meant to serve as examples of how costs vary, but are not intended to project actual Program costs in the future.

Calculating Per Bin Costs

Table 25 quantifies Program costs, *per bin*. This is calculated by dividing fixed program costs by number of bins sold, and then adding the costs associated with selling each bin. This means that the cost calculations are extremely sensitive to the number of bins purchased. In the case of the two "outreach" (#1 and #2) approaches examined, the number of purchasers would be determined by the program participation rate, which was observed at 9.4% in the Pilot study. In the case of the bin sale event (#3), the number of purchasers would simply be determined by sales that day (which ranged from under ten to over 200 in the Gardens' 1998 events, with most under 100.)

Table 25

Program Costs, Per Bin

SUMMARY OF COSTS FOR EACH OUTREACH METHOD		#1 Pilot-Style (Heavy) Outreach	#2 Simplified Outreach	#3 One Day Event (Unsubsidized Bin Sale)
FIXED PROGRAM COSTS		$19,288.16	$13,598.00	$2,941.00
VARIABLE COSTS, PER BIN SOLD		$91.00	$29.00	$0.96
*NUMBER OF BUYERS TARGETED**		2,346	2,346	*N/A*
	number of actual buyers	TOTAL COSTS PER BIN SOLD **		
outreach with 9.4% participation rate (measured in the pilot)	221	$ 178.34	$ 90.49	*N/A*
outreach with 20% participation rate (optimistic)	469	$ 132.19	$ 57.95	*N/A*
with 100 bins sold per event	100	*N/A*	*N/A*	$ 30.37
with 200 bins sold per event (optimistic)	200	*N/A*	*N/A*	$ 15.67

* Calculations for the costs of the outreach scenarios are calculated based on 2,346 potential Program participants contacted. This corresponds to the actual number in the Backyard Pilot recruitment effort. Calculations for the bin sale event are based on the fact that the number of purchasers targeted is indeterminate. It includes a mailing to 2,000 local residents, plus additional print media and poster publicity.

** Costs per bin = (fixed program cost/number of bins sold) + variable program costs per bin

Table 25 shows costs for two levels of participation. For each outreach approach, the measured 9.4% participation rate is tested along with a more optimistic 20% rate. For the bin sale approach, costs with 100 and 200 purchasers are evaluated. It should be kept in mind that the bin distribution approaches analyzed are only several examples of many possible ways in which bins can be distributed. If program elements or number of bins sold different vary, per bin costs will vary. However, since it is not possible to test every cost scenario, the calculation is limited to these alternate approaches.

Calculating Present Value of Benefits

All expenses related to outreach, bin purchase, and other program activities were incurred in "year zero" of the Program, i.e. FY 1997. On the other hand, benefits — in terms of avoided collection, transfer, and disposal — extend over a period of years into the future. In order to compare costs and benefits accurately, all benefits have been calculated in 1997 dollars and further discounted by 2% real economic growth. This calculation is presented in Table 26.

Table 26

Costs to the Department of Sanitation for Collection, Transfer and Disposal of Refuse

	in 1997 dollars (from SWMP)		in 1997 dollars discounted for 2% real growth	
Fiscal Year	*per ton*		*per ton*	*per pound*
1998	$77.00		$75.49	$0.04
1999	$122.00		$117.26	$0.06
2000	$122.00		$114.96	$0.06
2001	$124.00		$114.56	$0.06
2002	$139.00		$125.90	$0.06
		Total for 5 years	**$548.17**	**$0.27**
		Mean per year	$109.63	$0.05

Collection, transport, and disposals costs per ton (in 1997 dollars) are known from research carried out by the Department, published in the 1998 Comprehensive Solid Waste Management Plan Draft Modification.

These costs have been discounted by 2% real economic growth so that Program costs can be compared to future benefits.

Dividing costs per ton by 2,000 yields costs per pound.

The lifespan of the Program has been set at five years, meaning that this analysis assumes that a compost bin purchaser will keep actively and consistently composting for five years at the rates measured in the waste composition study. While the published lifespan of a commercial compost bin may be ten years or longer, the Department has chosen five years as a benchmark because individuals may use bins for shorter or longer periods.

Weighing Costs and Benefits

As discussed above, bin distribution may be achieved through outreach (heavy or simplified) or one-day bin sales. Since the number of bin purchasers will vary, it makes sense to evaluate alternative outreach approaches at both a measured (9.4%) and an optimistic (20%) participation rate; and a bin sale approach with 100 and 200 purchasers. Furthermore, the amount composted, which was measured at 2.5 pounds per household per week in the Pilot, may also vary. For the purposes of this analysis, it is useful to consider an additional "optimistic" estimate of 5 pounds per household per week as well. This results in twelve alternative scenarios, only one of which (the Pilot-style or "heavy" outreach, with 9.4% participation and a composting rate of 2.5 pounds per household per week) was actually examined in the Pilot study:

Table 27

Evaluation Scenarios

Pilot-style (heavy) outreach, 9.4% participation, 2.5 lbs per week	Heavy outreach, 20% participation, 2.5 lbs per week	Simplified outreach, 9.4% participation, 2.5 lbs. per week	Simplified outreach, 20% participation, 2.5 lbs. per week	Bin sale, 100 purchasers, 2.5 lbs. per week	Bin sale, 200 purchasers, 2.5 lbs. per week
Heavy outreach, 9.4% participation, 5 lbs per week	Heavy outreach, 20% participation, 5 lbs per week	Simplified outreach, 9.4% participation, 5 lbs. per week	Simplified outreach, 20% participation, 5 lbs. per week	Bin sale, 100 purchasers, 5 lbs. per week	Bin sale, 200 purchasers, 5 lbs. per week

The shaded option was actually observed in the Pilot; all other scenarios are hypothetical.

Table 28 calculates the costs and benefits of these twelve scenarios, on both a per bin and per ton basis. Costs per bin are simply Program costs divided by number of bins sold; benefits per bin are avoided collection, transfer, and disposal costs that result from one bin composting continuously for five years. Costs per ton reflect the Program costs that would have to be incurred to divert one ton of waste, while benefits are avoided costs of processing one ton.

Table 28

Comparison of Backyard Composting Program Benefits and Costs

PER BIN SOLD

BENEFITS (DISPOSAL SAVINGS) — **COSTS**

composting at these rates yields increasing benefits, in terms of avoided disposal, each year, for every bin used.

	Composting Level		Pilot-Style (Heavy) Outreach (Option #1)		Simplified Outreach (Option #2)		Bin Sale (Option #3)	
In Fiscal Year...	At a rate of 2.5 lbs/week	At a rate of 5 lbs/week	With 9.4% participation (measured)	With 20% participation (optimistic)	With 9.4% participation (measured)	With 20% participation (optimistic)	With 100 bins sold	With 200 bins sold
1997			$178.34	$132.19	$90.49	$57.95	$30.37	$15.67
1998	$4.91	$9.81						
1999	$7.62	$15.24						
2000	$7.47	$14.95						
2001	$7.45	$14.89						
2002	$8.18	$16.37						
Total for 5 years	**$35.63**	**$71.26**	**$178.34**	**$132.19**	**$90.49**	**$57.95**	**$30.37**	**$15.67**

Costs depend very much on how many people participate, and how expensive the out reach is.

these are the costs and benefits, per bin, that are cost effective

PER TON COMPOSTED

BENEFITS (DISPOSAL SAVINGS) — **COSTS**

Export Costs, per ton, are projected to be ...		Composting Level	Pilot-Style (Heavy) Outreach (Option #1) With 9.4% participation (measured)	Pilot-Style (Heavy) Outreach (Option #1) With 20% participation (optimistic)	Simplified Outreach (Option #2) With 9.4% participation (measured)	Simplified Outreach (Option #2) With 20% participation (optimistic)	Bin Sale (Option #3) With 100 bins sold	Bin Sale (Option #3) With 200 bins sold
		At a rate of 2.5 lbs/week	$548.73	$406.73	$278.43	**$178.32**	**$93.45**	**$48.20**
		At a rate of 5 lbs/week	$274.36	$203.36	$139.22	**$89.16**	**$46.72**	**$24.10**
1998	$75.49							
1999	$117.26							
2000	$114.96							
2001	$114.56							
2002	$125.90							
Total for 5 years	$548.17							
Mean cost to process one ton	**$109.63**							

Now we compare the savings we would gain from NOT exporting one ton, with the cost of distributing enough compost bins to prevent one ton of waste, assuming FIVE YEARS of continuous bin use. The costs will again depend on how expensive the distribution is.

Averaged out over five years

NOTES

Comparison of costs and benefits can be made in two ways: per bin, or per ton:

For per bin calculations, the dollar benefits, in terms of avoided collection, transfer, and disposal costs, of a bin composting 2.5 lbs (as measured in the Pilot), or 5 lbs (an optimistic scenario) for five years can be weighed against the one-time costs of bin distribution under alternative scenarios.

For per ton calculation, the costs associated with distributing enough bins to compost one ton of refuse, under alternative scenarios, are weighed against the benefits of avoiding one ton of collection, transport, and disposal.

Calculations:

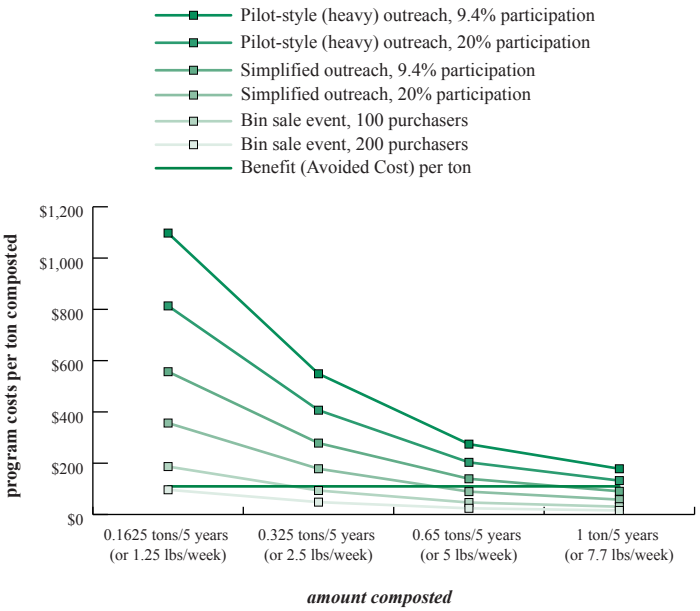
2.5 pounds per week = 130 pounds per year = .065 tons per year = .325 tons per five years
5 pounds per week = 260 pounds per year = .13 tons per year = .65 tons per five years

Yearly benefits per bin = (avoided collection, transfer, and disposal costs per pound x 2.5 pounds or 5 pounds)
Program costs per bin = (fixed program cost/number of bins sold) + variable program costs per bin
Yearly benefits per ton = avoided collection, transfer, and disposal costs per ton
Program costs per ton = (program costs per bin)/tons composted for five years at 2.5 pounds per week (.325)
or (program costs per bin)/tons composted for five years at 5 pounds per week (.65)

Table 28 allows the reader to weigh the benefits of backyard composting against program costs under the program scenarios described above. Figure 40 presents this same information graphically, in terms of "per ton composted."

Figure 40

Costs and Benefits of Backyard Composting per ton, assuming 5 continuous years of composting



Source: BWPRR calculations based on Waste-Tech results and Botanical Gardens cost information

This exercise shows that backyard composting programs can be cost effective in New York City, but only when program costs are low and participation is maximized. For example, if we assume a composting rate of 2.5 pounds per week, benefits begin to outweigh costs only under the "bin sale" scenario. If double the composting rate is tested (for an optimistic projection of 5 pounds per week), the "Simplified Outreach" with 20% participation also becomes cost effective, but costs still exceed benefits for the remaining outreach approaches. The 2.5 pounds per week is based on actual program experience, but measured only once after one year of household composting. The benefit measures calculated here assume continued participation at the same level. If households reduce the amount of composting, or drop out altogether, costs per ton composted would rise, so that the range of cost-effective programs would narrow. Moreover, as explained above, the benefit measure is an upward bound because it includes some unlikely-to-be-achieved savings from reduced collection costs.

CHAPTER IX. CONCLUSION

As New York's reliance on Fresh Kills Landfill comes to a close, it is imperative that the residents, government, and organizations of this City continue to work towards continuing and increasing waste prevention, reuse, and recycling. The Department of Sanitation is committed to exploring innovative methods to reduce the tonnage of municipal solid waste that will have to be exported, but is equally committed to realistic evaluation of the effectiveness (in terms of tons and dollars) of any idea. Because backyard composting targets a fraction of the waste stream that has not as yet been addressed in other DOS programs, and because it has relatively low start-up costs and beneficial end product, the Department has given it serious consideration.

The results of this Pilot have shown that backyard composting appeals to a very small segment of the residents of New York who have backyard access (who are, in turn, a minority themselves). The waste composition study has furthermore demonstrated that while the amount of residents' waste that ends up in the compost bin may seem considerable at the individual household level, even under the most optimistic scenarios of enhanced participation and increased composting activity this reduction will not measurably impact the millions of tons going to export each year, nor will it have an impact on Sanitation truck routes.

It is important to note that indirect effects of the Program, in terms of increased recycling and changes in the generation rates of some other waste components, even among nonvolunteers, were measured in this pilot. It is very probable that the intense effort that went into publicizing this program by mail, phone, and in-person, possibly enhanced by the obvious presence of DOS staff and vehicles during the special waste collection weeks, contributed to an atmosphere that caused an increase in recycling compliance. It is also possible that this presence affected other waste stream components. However, neither intense bombardment of citizens with outreach materials, nor visible and unusual waste collection mobilizations, are activities that can or should be implemented as City policy. The increased recycling compliance that was found should instead serve to remind us of the importance of public education and enforcement as ongoing Department activities.

Despite the results of the Pilot that indicate that backyard composting has no substantial implications for reducing waste going to export, the Department is enthusiastic about encouraging it through its ongoing relationship with the City's four Botanical Gardens. This is because of its benefits to heighten public awareness about waste management. Combining backyard bin programs with leaf compost givebacks, leave-it-on the lawn campaigns, and general recycling education will strengthen collective thinking about where waste goes and alternatives to landfilling. Current joint projects between the Department's Bureau of Waste Prevention, Reuse and Recycling and the City's four Botanical Gardens include compost give-back events, compost and lawn care workshops, outreach to civic groups and community gardens, establishing a Master Composter program, landscaper education, and teacher training workshops. As future outreach is refined, participation rates will continue to be tracked, with the goal of recruiting more volunteers. Important as well will be keeping residents interested and actively composting once they have been sold bins.

Furthermore, the Backyard Composting Pilot research highlights the importance of the Department's other compost programs — such as the current leaf collection, NYCHA, Rikers Island, and Christmas tree programs — in managing New York City's organic waste on a larger scale than could be achieved with backyard bins. This research also points to the need to look into future policies to address more of the City's organic waste stream, such as expanded collection of yard waste, mixed waste composting, and/or expanded in-vessel composting in institutions.

The Department invites comments and questions on the Backyard Composting Pilot Program, and looks forward to continuing to promote composting, waste prevention, reuse, and recycling throughout New York City in years to come.

ENDNOTES/SOURCES

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APPENDIX I

METHODOLOGY FOR THE WASTE COMPOSITION STUDY

CALCULATING THE PARTICIPATION RATE

The participation rate was calculated as the number of households who purchased compost bins out of all –"qualifying" households in the tracts. For the purpose of rate calculation, "qualifying" homes were defined as occupied single or two unit dwellings, as per in 1990 U.S. Census data. The true indicator of qualification — and that used for program outreach — was access to a backyard. However, information on backyard access is not collected by the Census Bureau, nor by the New York City Department of City Planning, Housing Preservation and Development, nor by any other governmental agency. While a house-by-house count of homes with backyards was carried out during the outreach phase by Botanical Gardens' staff, the Department decided to use Census data for occupied single or two unit dwellings as the count of qualifying households. This is because it would be necessary to use published, reproducible data — as opposed to that collected by hand — to apply participation rate estimates to other Census tracts in the City, should future studies be warranted.

Because the U.S. Census data did not exclude occupied single- and two-family houses without backyards, it is possible that the estimate of "qualifying households" may have miscounted the number of potential volunteer households. However, when staff conducted a house-by-house inspection of homes in the tracts, its manual count of houses with backyards corresponded quite well to Census counts of dwellings with one and two units, as shown below:

Table A-1

Qualifying Households

Tract	Households with Backyards (hand counted by DOS/Gardens staff)	Number of Qualifying Occupied Housing Units (U.S. Census)
Bronx	429	432
Brooklyn	439	526
Queens	344	384
Staten Island	973	1004

SAMPLE SIZES

Table 18 in Chapter V summarizes the number of households in each test census tract, the participation rates that were achieved in each, and the number of samples used in the analysis. In total, 120 nonvolunteer households (to achieve an adequate sample size of 30 in each of the four test tracts) were selected for sampling at baseline. After Program outreach, 221 households out of a potential 2,346 qualifying households volunteered for participation, yielding a participation rate of 9.4%.

All volunteer households were selected for follow-up sampling, in addition to the baseline group. When sorts of both groups were conducted, however, samples whose waste suggested commercial, construction, demolition, or other unusual activity were excluded as unrepresentative, and in the end data for only 116 of the nonvolunteers and 185 of the volunteers were used in the analysis. In addition, 30 samples were identified and 23 analyzed for a tract in Little Neck, Queens (where the program was not being promoted) to be used as a seasonal control.

EXPERIMENTAL DESIGN

The experimental design of this study followed a pre-test/post-test format, in that a baseline measurement was taken before program implementation, followed up by two post-program assessments, and experimental and comparison groups were selected. It should be noted that the volunteer (experimental) and nonvolunteer (comparison) groups were not measured separately at baseline. Instead, an initial group of tract residents (30 from each of the four test tracts) was selected at random as a sample of the population of qualifying households as a whole. The great majority of these households (110 out of the 120) did not end up volunteering for the program; these became the nonvolunteer group in the follow-up studies. Volunteers, on the other hand, self-selected themselves after baseline. The result was that out of the 221 in the tracts who joined the program, only 10 were from the original 120 sampled; the balance were households in test tracts who were not assessed at baseline, but who nevertheless joined the program.

THE USE OF THE BASELINE

In its final report to the Department, Waste-Tech wrote:

> It is important to understand that the purpose of the Baseline Waste Characterization was to establish the average waste generation rate and composition for the targeted tracts [as a whole], not for households that would (or would not) later volunteer for participation in the Pilot. The household participation rates for each tract could not be known [before program implementation] without interviewing the Study population and possibly influencing their waste generation and segregation practices. Thus, it was important to collect the baseline samples before publicly announcing the program or soliciting volunteers. This precluded the possibility of collecting samples from households in proportion to their interest in participating in the Pilot. However, a comparison of the baseline composition for the two groups does not enter into the analysis necessary to establish the Program's effectiveness. That is because the comparison is between the average waste generation rate and composition for the Study population before and after the Pilot's implementation, not for individual households.[1]

Waste-Tech advised the Department that because implementation of the Program would likely have effects on nonvolunteer households that would affect waste generation, impacts should be measured for the tract population as a whole, rather than simply among volunteers, to understand the Program's effect on diversion. Waste-Tech noted that, "households which would later volunteer for Program participation had an equal chance to be sampled [in the Baseline] as those which did not choose to participate. Therefore, it may be inferred that the average data for sampled households for each targeted tract represent the larger population"[2]

As to comparisons between volunteer and nonvolunteer waste composition changes, Waste-Tech wrote:

> It should be noted that differences in the average Post Implementation waste generation rates and composition between Volunteers and Non Volunteers may be influenced by differences between two groups which may have existed before the Program's implementation...[but] the Baseline sample contained too few households that later became Volunteers to determine whether a statistically significant difference may have existed between the two groups.[3]

For the comparison of volunteers and nonvolunteers, it would have been preferable to have sampled a large group of "future volunteers" at baseline, so as to be able to track their changes in waste composition separately from nonvolunteers. As explained above, this would have been impossible logistically, and would have conflicted with the primary goal of the study — to sample the tract population as a whole. The Department therefore decided to accept Waste-Tech's recommendation to make the assumption that the baseline waste characterization — although it reflected a sample that would turn out to be nearly completely nonvolunteer households (110 out of 120) — could serve a benchmark against which to measure *both* volunteer *and* nonvolunteer waste composition changes. The comparison of volunteers and nonvolunteers after the Program had been implemented consequently assumed that the two had similar waste generation rates and composition during the baseline sampling period. Although this assumption could not be tested, it should be noted that a calculation of waste composition among the 10 "future volunteers" in the baseline group — while not statistically significant due to small sample size — did not suggest that their waste composition differed from that of the other 110 "future nonvolunteers."

THE SEASONAL CONTROL TRACT

Data from a census tract in Little Neck, Queens was used to control for seasonal and other extra-program factors that might have been generally occurring in suburban areas with backyards and single family homes. All calculations of change were adjusted by subtracting change measured in the Little Neck tract from overall change. A discussion of the efficacy of the Little Neck tract as a statistical control was discussed in Chapter V.

ROUTING AND COLLECTION

Thirty households were randomly selected for baseline sampling from address lists for each of the census tracts. Addresses were located on maps of each tract, and collection routes designed so as to make most efficient use of traffic flow. In follow-up periods, volunteer household addresses were added to these routes. All routes were supplied to the Department of Sanitation's Bureau of Cleaning and Collection one week prior to each sampling period.

Samples were collected in June 1997, October 1997 and June 1998 according to the calendars shown in Table A-2.

Table A-2

Collection Timetable

Backyard Composting Pilot Waste Assessments

B = Marine Park, Brooklyn
Q = St. Albans, Queens
X = Morris Park, Bronx
L = Little Neck, Queens
S = West Brighton, Staten Island

June 1997

	sun	mon	tues	wed	thurs	fri	sat
	1	2	3	4	5	6	7
Baseline Sampling Period	8	9	**10**	**11**	12	**13**	**14**
TRACTS AND STREAMS COLLECTED			trash & recycling: B,Q,X. trash only: L	trash and recycling: S		trash only: B,Q,X. trash & recycling: L	trash only: S
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					

October 1997

	sun	mon	tues	wed	thurs	fri	sat
				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
First Follow-Up Sampling Period	26	27	**28**	**29**	30	**31**	November 1
TRACTS AND STREAMS COLLECTED			trash & recycling: B,Q,X. trash only: L	trash and recycling: S		trash only: B,Q,X. trash & recycling: L	trash only: S

note: between October 1997 and June 1998, the B and S tracts moved to weekly recycling.
To collect comparable samples to the biweekly recycling tracts (X,Q and L),
recycling for B and S was consequently collected over a two week period in June 1998.

June 1998

	sun	mon	tues	wed	thurs	fri	sat
		1	2	3	4	5	6
First Follow-Up Sampling Week	7	8	**9**	**10**	11	**12**	**13**
TRACTS AND STREAMS COLLECTED			trash & recycling: B,Q,X. trash only: L	trash and recycling: S		trash only: B,Q,X. trash & recycling: L	trash only: S
	14	15	**16**	**17**	18	19	20
TRACTS AND STREAMS COLLECTED			recycling only: B	recycling only: S			
Second Sampling Week (to gather ancillary data)	21	22	**23**	**24**	25	**26**	**27**
TRACTS AND STREAMS COLLECTED			trash & recycling: B,Q,X. trash only: L	trash and recycling: S		trash only: B,Q,X. trash & recycling: L	trash only: S
	28	29	**30**	**July 1**			
TRACTS AND STREAMS COLLECTED			recycling only: B	recycling only: S			

Starting at 5:00 AM on each collection day, Department staff, following each tract's collection route, bagged trash and recycling left out for collection in special yellow bags. Each sample was tagged with a random numerical identifier that corresponded to a household address. Master lists linking identifiers to addresses were placed in safekeeping with a Department manager not conducting the analysis, to preserve the anonymity of the households. After samples were bagged, they were collected by Sanitation workers and placed in a special non-compacting Bureau of Cleaning and Collection truck that preceded normal collection trucks on the designated pickup days for that week. All samples were taken to an indoor sort site in Williamsburg, Brooklyn for analysis.

WEIGHING AND SORTING

The quantities and composition of waste generated by the sampled households were determined through hand sorting and weighing each household's sample separately. Collected recyclables were weighed but not sorted. Upon receipt at the sort site, the total sample weight for each household's waste and recyclables was recorded and the contents examined. Samples suggesting commercial activity, construction, or remodeling were discarded as unrepresentative of household waste. Each sample was then sorted into two groups of primary sort components.

The component categories are defined as follows:

Table A-3

Waste Component Categories

Waste Component	Definition
Recycling	source separated for collection by DOS
Yard waste	bagged grass, leaves, prunings, dirt, etc.
Bulk	nonrecyclable small bulk items commingled with other trash
Food	animal and vegetable products, beverages, and soiled napkins and paper towels
Lost Recyclable	metal, paper, and recyclable glass and plastic improperly discarded in and commingled with trash
Other	all remaining materials, including hygiene products; nonrecyclable glass and plastic; and other residue

All table scraps, trimmings, packaged food and beverages, fruits and vegetables, and pet foods were characterized as "food". Paper towels commingled or soiled with food were categorized as "food" because they are also compostable. The contents of food and beverage containers were emptied into the food category. The emptied containers were characterized as lost recyclables, as were all other metal, glass, paper and plastic items that met the DOS recycling criteria but were not separated by the household for separate collection. Some bundled newspapers and magazines were commingled with the waste and thus categorized as lost recyclables. In the end, items classified as "other" were comprised of 50% fine, organic residuals; 20% paper; 20% plastic, and 10% personal hygiene products.

The weights for the primary sort components were recorded separately for each sampled household. The food, lost recyclables, and other materials were accumulated and kept segregated by census tracts. For the baseline characterization only, these then underwent a secondary sort, in aggregate, among the following categories:

food soiled paper, all food items, and residual

lost recyclables recyclable paper, plastic, metal/glass, and residual

miscellaneous non-recyclable plastic, paper, and metal; feminine hygiene/diaper products; and residual

Paper in the lost recyclables was further categorized in a tertiary sort as: old corrugated cardboard; paper/chip board; newspapers/magazines; and mixed paper. It should be stressed that because of time and budgetary limitations, only the primary sort components were sorted by household. Thus only those data reflect the variability among individual households. For this reason, the comparison between baseline and post-implementation waste characterizations includes only primary sort components.

Weights of each primary, secondary, and tertiary sort components were taken, and data were recorded and entered into a database.

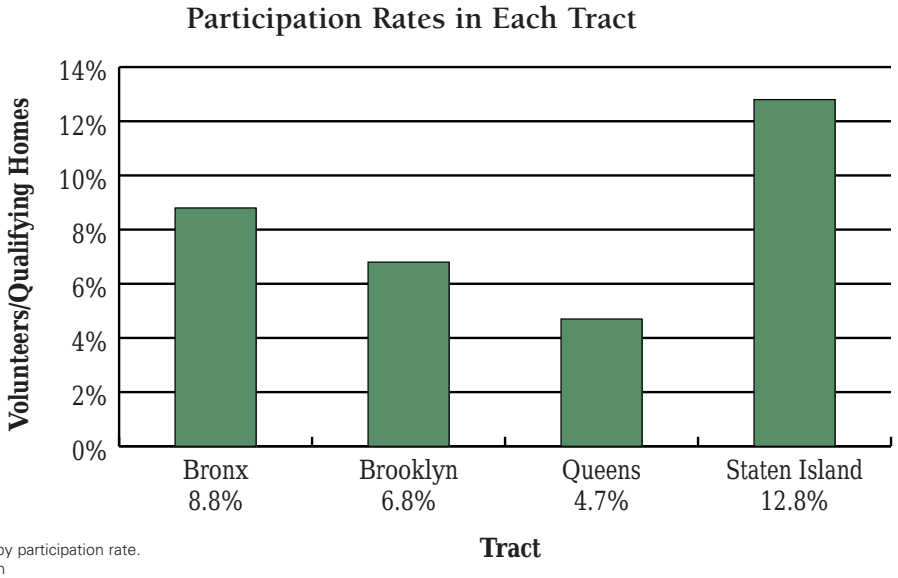
DATA ANALYSIS

Waste samples were collected on the two normal collection days for each tract during a one week sampling period. However, the collected recyclables represent a two week generation period. The recyclables generation rates were therefore standardized to a one week period. Waste and recyclable component weight data was used to calculate **average generation rates**, expressed in pounds per household per week, and **average percent composition**, calculated on a per household basis from average generation rates. Confidence intervals at the 95% level are presented for each average, meaning that were the study to be repeated 100 times for a similar population, in 95 of those cases the true average would fall between the upper and lower intervals. The change from baseline for the October 1997 and June 1998 periods was calculated as the difference between the average baseline generation rate and the adjusted post-implementation samples.

WEIGHTING

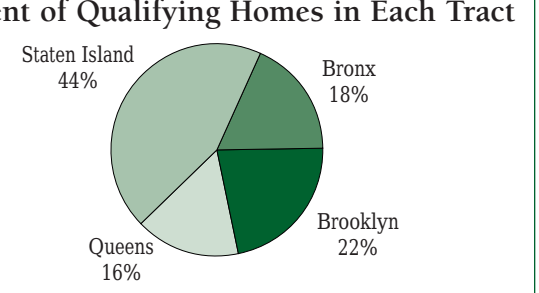
As described throughout this Report, the four test census tracts vary in population, number of qualifying households, and participation rates. Because an even number of households from each tract (30) were selected for baseline assessment, and because the ratio of volunteers to nonvolunteers identified for sampling (221 to 120) did not correspond to the ratio of volunteers to nonvolunteers in the tract population (221 to 2,125), the data were weighted by the percentage of qualifying households and participation rate in each tract. Figures A-1 through A-4 show graphically how participation rate and qualifying households vary, and how weighting recast the data.

Figure A-1



This is the basis for weighting by participation rate.
Source: 1998 Waste-Study Tech

Figure A-2

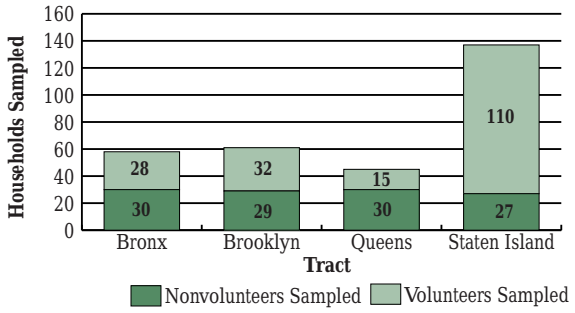


This is the basis for weighting by number of households.
Source: 1998 Waste-Study Tech

Figure A-3

Samples Used in the Statistical Analysis

Unweighted by Participation Rate or Number of Qualifying Households

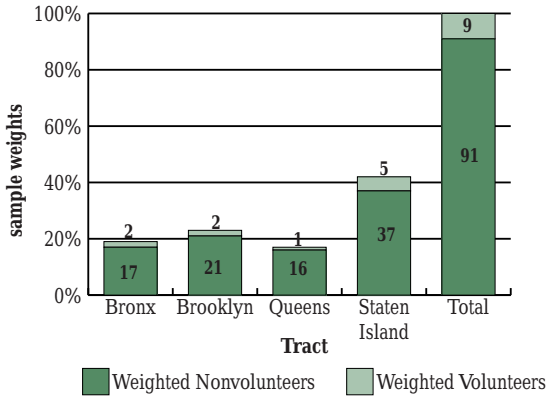


Source: 1998 Waste-Study Tech

Figure A-4

Samples Used in the Statistical Analysis

Weighted by Participation Rate and Number of Qualifying Households in Each Tract



Source: 1998 Waste-Study Tech

ADDITIONAL DATA COLLECTION AND ANALYSIS

A second week's worth of data was collected in June of 1998, to be used not in the calculation of waste composition change, but to investigate the nature of household and week-to-week variability in waste and recycling, and to construct correlation analyses among waste components. This analysis revealed that while there was considerable variability in waste generation from week to week at the household level, using a single week's sample did not compromise the statistical significance of the estimation between the average waste compositions of households as a group. This confirmed that the approach used in the study — to compare data one week in June 1997 to one week in October 1997 and one week in June 1998 — was appropriate.

In addition, the statistical correlation tests indicated that households tend to have consistently high or low recycling and refuse generation rates from one week to the next. These correlations indicate that households with a large amount of one type of waste tend to have large amounts of other types of waste.

ADDITIONAL INFORMATION ON METHODOLOGY

For an exhaustive and detailed description of the statistical and analytical methodology used by Waste-Tech, the reader is encouraged to consult their report, entitled *Second Seasonal Waste Characterization and Post-Implementation Report.*

APPENDIX II

EXHIBITS

Exhibit 1

JUDITH D. ZUK
President

July 1997

Dear Brooklyn Neighbor:

Please accept this packet of seeds, compliments of the Brooklyn Botanic Garden. They are our way of inviting you and your neighbors to take part in an exciting program that will help your garden, your neighborhood, and our city grow into a greener and more beautiful place.

Did you know that you could be creating a rich, nutritious compost — excellent for gardens, lawns, street trees, and even potted plants — right in your back or front yard, with materials you have at home? Most people think of composting as something that can only be done on a farm or in the suburbs. But with the right equipment and experience, anyone with access to even the smallest outdoor space can make good compost, without causing odors or attracting pests.

The Brooklyn Botanic Garden is offering everyone in your neighborhood the chance to buy a sturdy compost bin, which normally retails for over $60, for the very reduced cost of $10. If you choose to purchase a bin, you will be assisted personally by our composting staff in setting it up and learning how to use it properly. And as an added incentive, we are offering all participants a free one-year membership to the Brooklyn Botanic Garden. By receiving our mailings and visiting our grounds, you will begin to realize how much your own gardens, however large or small, can benefit from compost. And if you have private landscapers taking care of your yard, we can let them know how they can join in this effort.

This pilot composting program is being sponsored with the assistance of the New York City Department of Sanitation. Both the Department and the Garden are studying strategies for waste reduction, such as home composting, which could play an especially important role now that the City's last landfill is scheduled to close permanently in the year 2001.

Over the next few weeks, our composting staff will be calling you to discuss this program in greater detail. In the meantime, you can indicate your interest in this project by filling out and mailing the enclosed card at your earliest convenience, or calling our Compost Hotline at (718) 622-4433, ext 246. We look forward to working with you to create a greener New York City.

Sincerely,

Judith D Zuk

Judith D. Zuk
President

PS If you don't have access to a garden or yard, the seeds we've sent can be grown in a planter or flower pot...and if you happen to live in an apartment and are interested in composting, don't hesitate to let us know. There are ways for all New Yorkers to make and use compost!

1000 WASHINGTON AVENUE
BROOKLYN, N.Y. 11225-1099
TELEPHONE (718) 622-4433
EXT. 311
FAX (718) 857-2430

Reduce/Reuse/Recycle

Bureau of Waste Prevention, Reuse and Recycling
NYC Department of Sanitation

COMPOSTING

Nature's Way of Recycling

Organic materials are things that were once alive. Leaves, twigs and grass clippings are organic. So are vegetable cuttings, fruit peels, eggshells, and coffee grounds.

The average New York City household throws away two pounds of organic waste each day. This adds up to a million tons per year, most of which is disposed of in the City's only remaining landfill, Fresh Kills Landfill in Staten Island. When we bury organic waste, we not only lose precious landfill space, we also discard a valuable resource that can help beautify our gardens, lawns, street trees and parks. This is because most organic materials can easily be made into compost.

Compost is a dark, crumbly material that looks and feels like potting soil. It forms naturally when organic materials decompose. Compost improves soil texture and provides nutrients for healthy plant growth.

Composting is a natural process taking place everywhere around us. When a leaf falls to the ground, it is eaten and digested by microorganisms such as bacteria and fungi, and by larger creatures, such as beetles and earthworms. Compost is what these organisms leave behind. It becomes part of the soil, where its nutrients are absorbed by plant roots.

What Are the Benefits of Using Compost?

Compost aids soil structure, increasing moisture retention in sandy soils and breaking up clay in heavy soils. It helps to improve drainage and reduces erosion. It provides nutrients and releases them gradually. Compost also helps make most soils more workable for yearly replanting and easy weeding. Compost is teeming with life and encourages a healthy balance of organisms in the soil, helping to prevent damage by pests and diseases.

If you have ever bought and used peat moss, wood chips, manure, or top soil then you already know how to use compost. Mix compost into flower and vegetable beds; blend it with potting soil to revitalize indoor plants; or spread it on your lawn as a fertilizer. Use coarser compost as a mulch around trees and shrubs.

Where to Use Compost

- Flower beds
- Street-tree pits
- Vegetable gardens
- Lawns
- Trees and shrubs
- Houseplants

Printed on recycled paper, of course.

Making Compost at Home

You can make your own compost with food scraps from the kitchen and leaves from the yard.

The Six Simple Steps for Home Composting

1. Set up a bin. For this pilot program, compost bins will be available through your borough's botanical garden. The compost bins normally retail for $60; however, as part of this pilot, the price of the bins have been reduced to $10. You can also make your own from chicken wire, old pallets, or scrap lumber—garden staff will show you how.

2. Add organic material. Many materials from your kitchen and yard, such as vegetable cuttings, fruit peels and leaves, can be put in your bin to compost. Our composting staff can provide you with more details on which organic materials to include.

3. Mix the pile. Stir or turn your pile and add coarse materials such as twigs and leaves to improve air circulation. This allows the microorganisms to breathe and prevents odors.

4. Control moisture. Your pile should be as damp as a wrung-out sponge. If it seems dry, add water. If it is too wet, add dry materials such as leaves or shredded paper.

5. Wait. It will take three months to one year for your organic materials to become compost.

6. Use your compost. When your compost resembles potting soil, it is finished. You can then use it for all your planting needs, indoors and out.

You can indicate your interest in learning more about composting by returning the enclosed postcard or by giving us a call. A member of the composting staff will deliver a bin, help set it up and explain how to use it properly.

The New York Botanical Garden
Bronx Green-Up Compost Project
(718) 817-8543

Queens Botanical Garden
Queens Greening Compost Project
(718) 539-5296

Brooklyn Botanic Garden
Brooklyn GreenBridge
Urban Composting Project
(718) 622-4433 extension 246

Staten Island Botanical Garden
Staten Island Compost Project
(718) 273-0629

Exhibit 3


☐ YES, I AM INTERESTED IN LEARNING MORE ABOUT HOME COMPOSTING. PLEASE CALL ME WITH MORE INFORMATION.
NAME: _____
TELEPHONE NO: _____
BEST TIME TO CALL: _____

Exhibit 4

Rear

COMPOST

is a dark, crumbly material that looks and feels like potting soil. It forms naturally when organic materials decompose. Compost can be made with things you already have at home, such as food scraps from the kitchen and leaves from the yard.
The nutrients in compost are extremely important for healthy plant growth, and home composting helps reduce the amount of waste going to the landfill.

Where to use COMPOST
•Flower Beds
•Vegetable Gardens
•Trees and Shrubs
•Lawns
•Houseplants
•Street-trees

Call our COMPOST HOTLINE to find out more!

☐ yes

I'm interested in the Composting Program.
Please call me with more information.

Name.....

Telephone.....

Best time to call.....

Front

we've been waiting to hear from you...

If you have access to a yard, don't miss the opportunity to join the Composting Program. Many of your neighbors have already received compost bins and started composting.
Just send us the attached card or call our Compost Hotline number to find out more.

COMPOST HOTLINE: 718-539-5296

Queens Botanical Garden

Queens Greening Compost Project
Queens Botanical Garden
43-50 Main Street
Flushing, NY 11355

Exhibit 5

BACKYARD COMPOSTING PILOT PROGRAM TELEPHONE SOLICITATION SCRIPT

The following is the script that was used by Botanical Gardens staff in the summer of 1997 to solicit participation in the Backyard Composting Pilot Program, by telephone. Phone numbers of neighborhood residents were obtained through the reverse directory, and each household with a backyard in test tract areas was called twice.

Staff: Yes, good evening, this is (Staff's first name) calling from Garden X. Is (Resident name) there, please?

Resident Not At Home

Resident: Resident is not at home/available

Staff: Could you tell me when (Mr./Ms./Mrs. Resident name) might be available for me to talk to him/her?

Resident: Time/Date given — Doesn't know

Staff: I'll call him/her at that time/date — I'll try again another time. Thank you very much.
Thank you very much.

Resident Answers the Phone

Resident: This is (Name)

Staff: Hi (Name), I promise to be brief. Recently we mailed you a letter about home composting along with some seeds. Have you had time to look over the information or plant the seeds?

Resident: Yes. (Scenario 1). No (Scenario 2).

Scenario 1

Resident: Yes, I read the letter

Staff: Great! After reading the letter, are you ready to start composting at home?

or

Resident: Yes, I planted the seeds.

Staff: Great! So are you ready to start composting at home?

Scenario 2

Resident: No.

Staff: The letter gives information about a home composting program sponsored by the Garden. Can I take a couple of minutes to share with you how it works?

Resident: Sure. Or No, this is not a good time (Scenario 3)

Staff: Thanks.

The composting program, being sponsored in (Neighborhood) lets you make your own fertilizer that's natural and organic — using things you already have in your home. To get started, all you need is a composting bin. As part of this Pilot Program, the Garden is offering composting bins, which normally cost $60, for just $10. And someone from the Garden will deliver the bin and show you how easy it is to use.

Scenario 3

Resident: No.

Staff: Is there a better time to call?

Resident: Yes, time/date. — No.

Staff: I'll call you then. Thank you. — May I ask why you're not interested?

Scenario 4

Resident: Home composting? What's that?

Staff: That's a good question. Home composting is simply a way the Garden is trying to encourage people to recycle organic material such as food scraps from the kitchen and leaves from the yard at home. Compost is a natural soil conditioner. The nutrients in compost are extremely important for healthy plant growth, and home composting helps reduce the amount of organic material that we send to the landfill. Home composting is easy and we can help you set up a compost bin and show you how to use it.

Exhibit 6

New York City Backyard Composting Tips

Goes in—

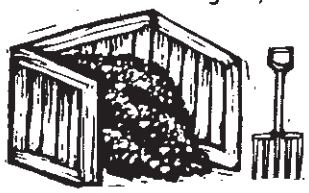
You can put these materials in your backyard bin or pile:

Fruit and vegetable scraps
Coffee grounds and filters
Tea bags
Breads and grains
Crushed egg shells
Food-soiled paper towels and napkins
Leaves
Grass clippings
Garden plants and trimmings
Weeds
Old potting soil
Woodchips, small twigs and sawdust
Wood ashes

Stays out—

Don't add these materials to your compost:

Meat or fish scraps
Dairy products
Fats, oils or grease
Dog and cat waste
Invasive weeds
Diseased plants
Charcoal ashes
Non-compostable materials such as plastics, metals, glass, etc.



Please call our compost hotlines with any questions

Brooklyn Botanic Garden
Brooklyn GreenBridge
Urban Composting Project
(718) 622-4433 ext. 246

Queens Botanical Garden
Queens Greening Compost Project
(718) 539-5296

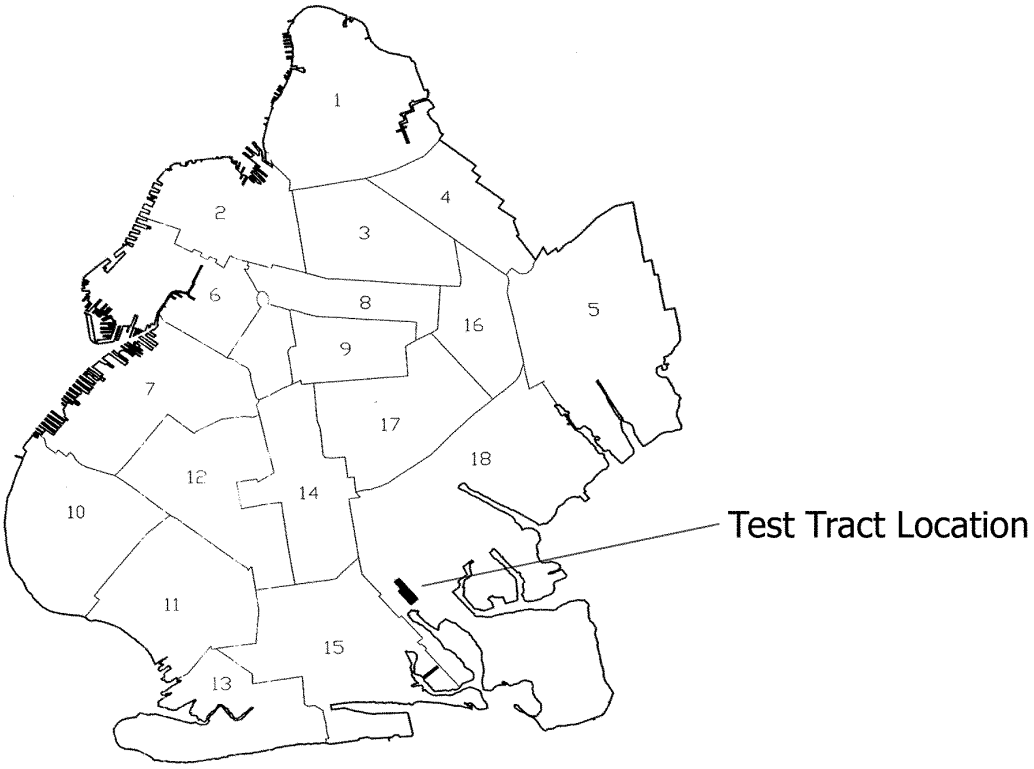
New York Botanical Garden
Bronx Green-Up Compost Project
(718) 817-8543

Staten Island Botanical Garden
Staten Island Compost Project
(718) 273-0629

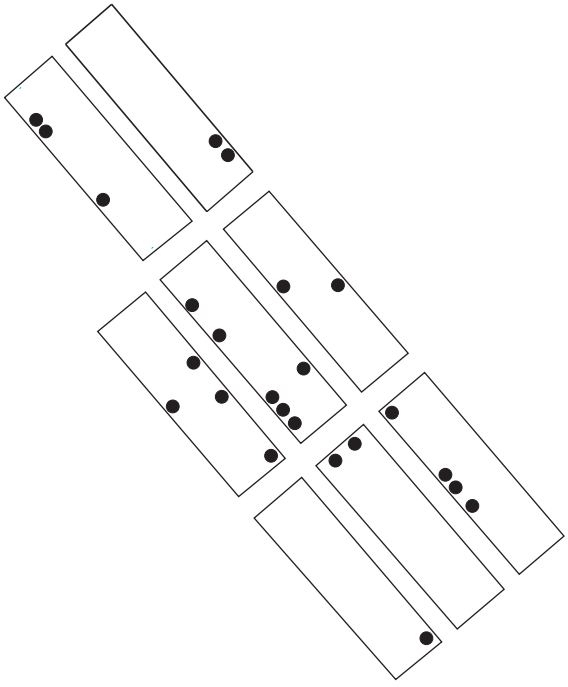
APPENDIX III

MAPS

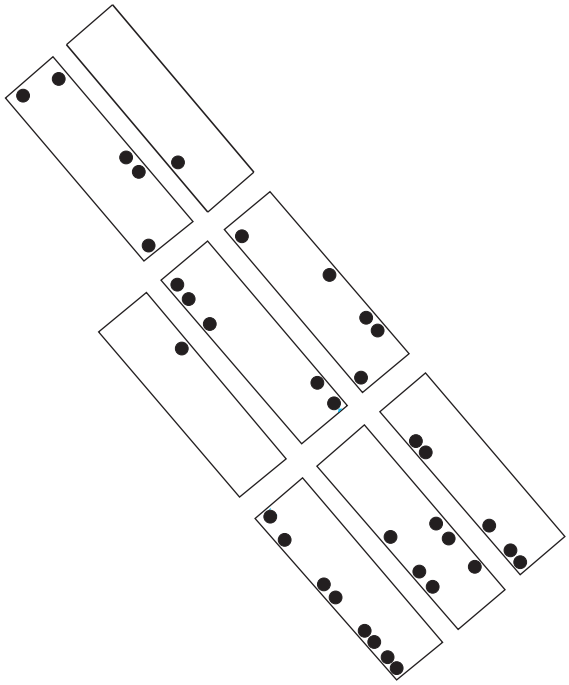
BROOKLYN
Marine Park, Census Tract 658



Households Sampled



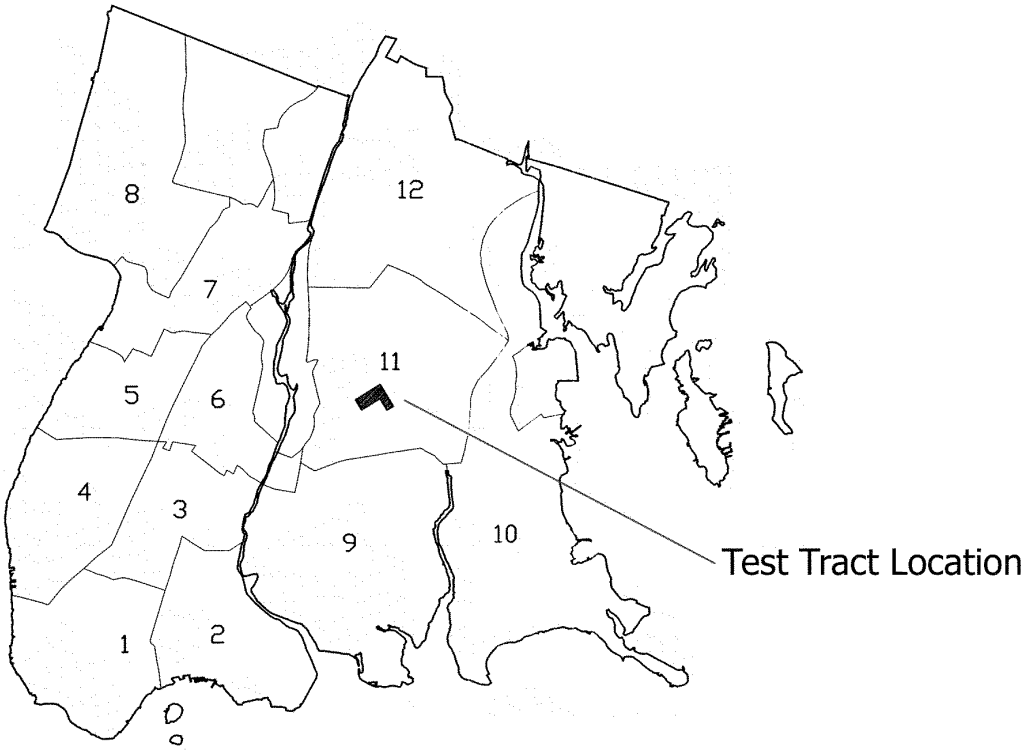
Baseline Households -
Random Sample



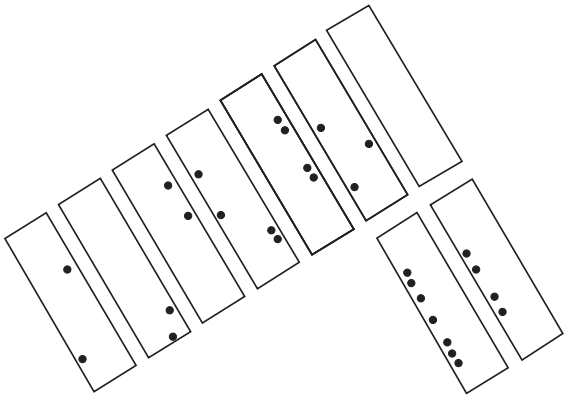
Composting Volunteer Households -
Follow-Up Sample

MAP 1

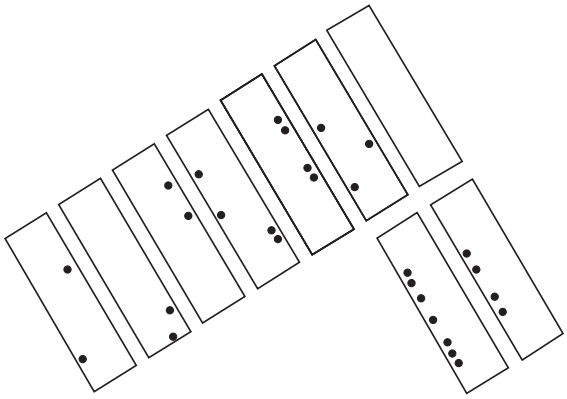
BRONX
Morris Park, Census Tract 250



Households Sampled



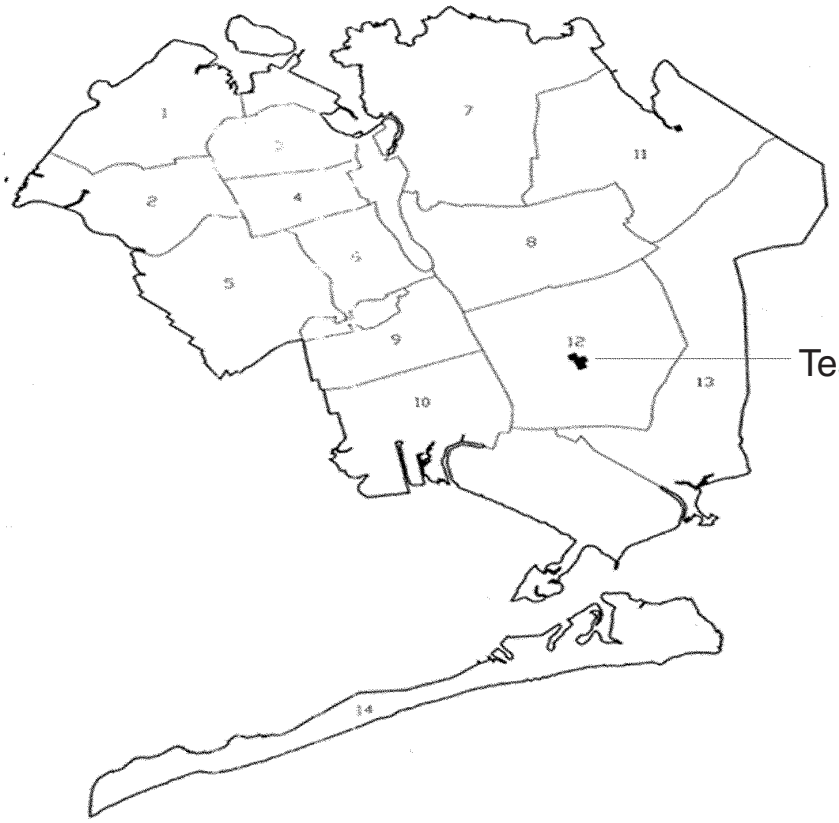
Baseline Households -
Random Sample



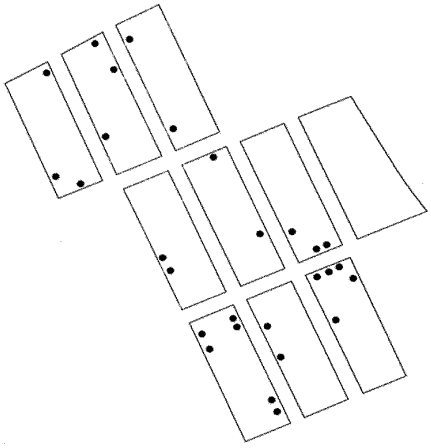
Composting Volunteer Households -
Follow-Up Sample

MAP 2

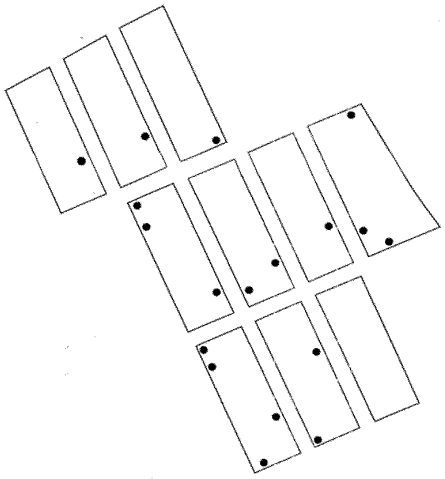
QUEENS
St. Albans, Census Tract 280



Households Sampled



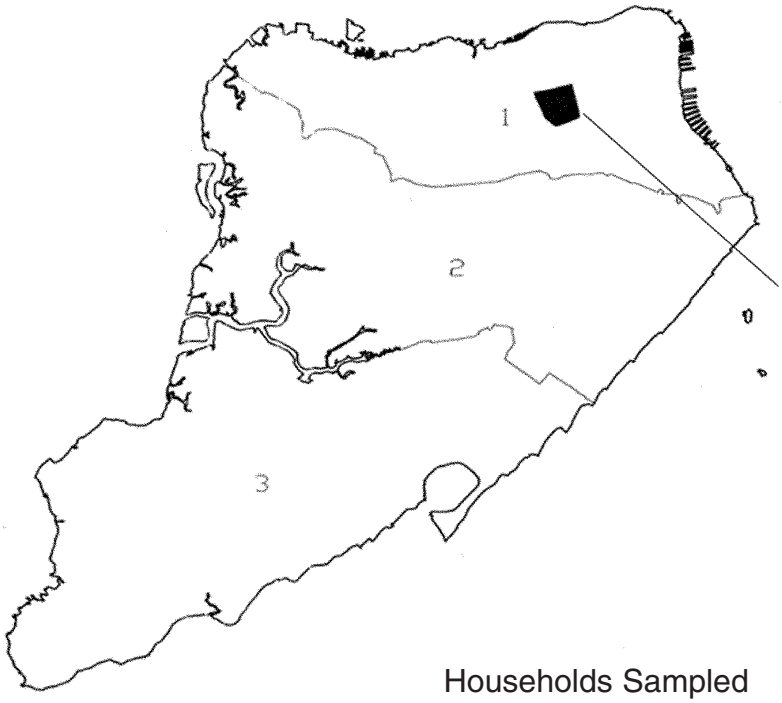
Baseline Households -
Random Sample



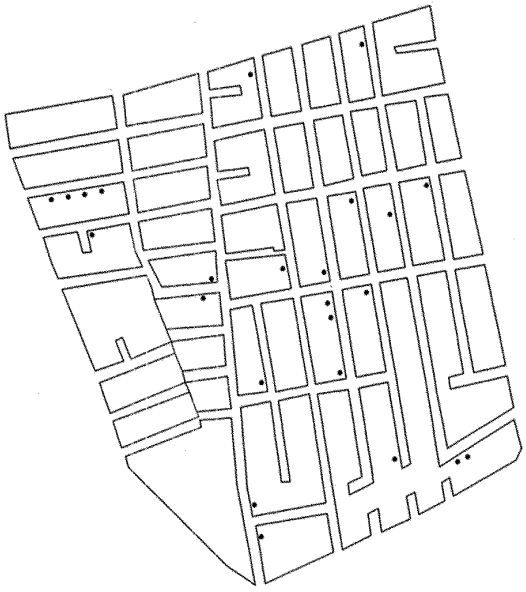
Composting Volunteer Households -
Follow-Up Sample

MAP 3

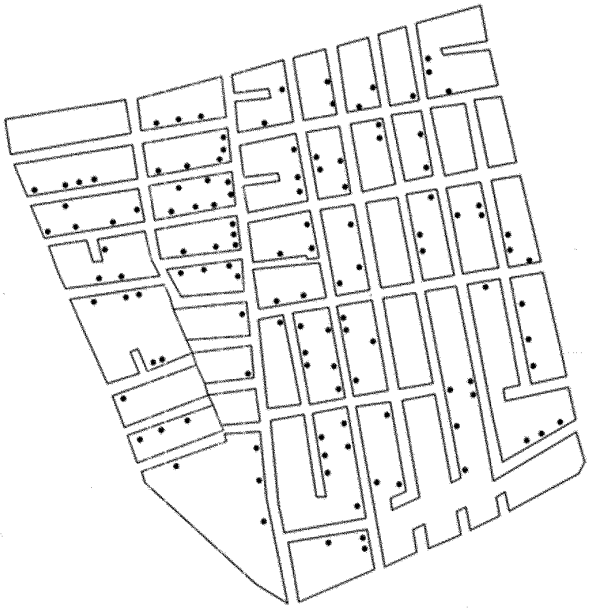
STATEN ISLAND
West Brighton, Census Tract 121



Households Sampled



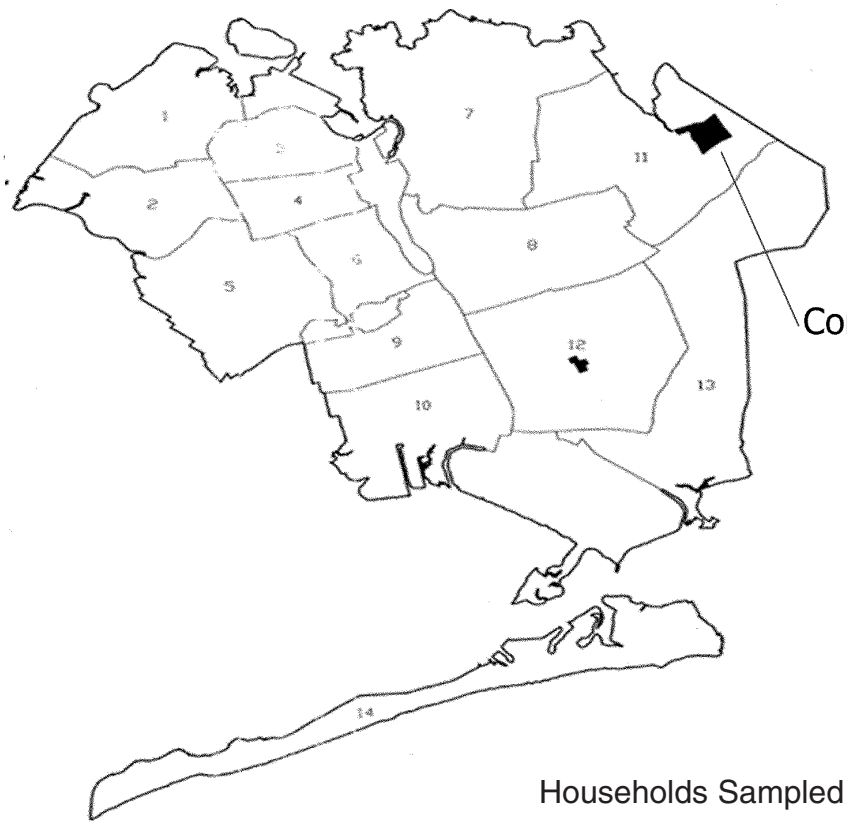
Baseline Households -
Random Sample



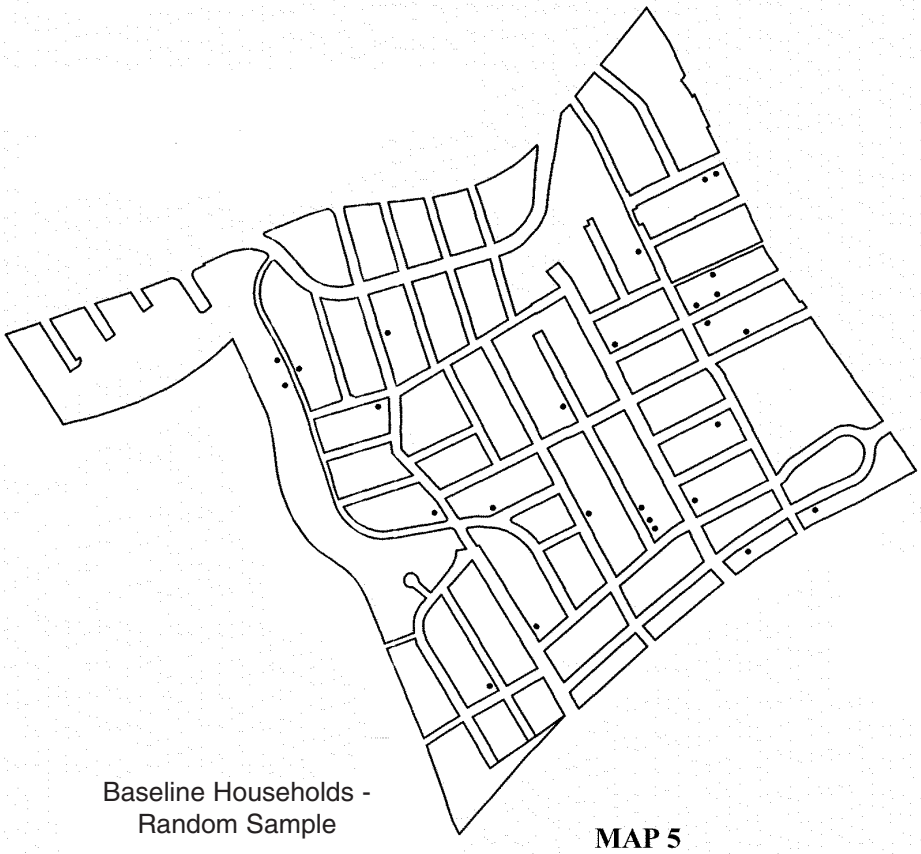
Composting Volunteer Households -
Follow-Up Sample

MAP 4

QUEENS
Little Neck, Census Tract 1507.1



Households Sampled



Baseline Households -
Random Sample

MAP 5

APPENDIX IV

PHOTOS

1. Sanitation staff bag curbside waste of households designated for sampling

2. A Sanitation staffer labels a collection bag with a code number

3. A Sanitation vehicle following the collection route

4. Sample bags are loaded into a special collection truck

5. Sample bags are opened at the waste sort site

6. Waste is sorted into component categories

7. Weights of each category, for each sample, are recorded

8. The sort operation

9. St. Albans, Queens volunteers with composting information

10. Morris Park, Bronx volunteer using the Earth-Machine™ compost unit

11. Botanical Gardens staff instructs Marine Park, Brooklyn volunteer on use of Garden Gourmet™ compost unit

12. A Brooklyn volunteer turning her compost