# PART I. CURRENT WASTE DISPOSAL SYSTEMS AND THE EXISTING ENVIRONMENT.

## CHAPTER 1. NEW YORK CITY'S SOLID-WASTE-MANAGEMENT PROBLEM.

### 1.1 The Problem.

On January 2, 1990 (the first workday after New Year's), the 7.42 million residents and 1.47 million visitors and commuters in the City of New York produced a total of 87 million pounds of solid waste of all sorts. Although every resident of the City contributed his or her share and every business contributed its share to the total problem (and some also contributed to the solution), the ultimate responsibility for managing this problem is the municipal government's.

11,350 tons of that waste, generally called "municipal solid waste," or "MSW," were collected by the Department of Sanitation, which recycled 300 tons of paper, glass, and metal, incinerated 1,200 tons in three municipal incinerators, and landfilled 11,000 tons in one small landfill in southeastern Queens and one enormous landfill (the world's largest) in central Staten Island.[1]

14,000 tons of that waste, MSW generated by private businesses, were collected by private carters. They recycled an estimated 2,500 tons and sent most of the remainder to landfills outside the city.

8,700 tons of that waste were dredged up from the bottom of the rivers and harbor that surround this island city; most of this material was taken out to sea and dropped again to the bottom. An additional 100 tons of "harbor debris" or "floatables" were collected from the dismantling of aged piers or skimmed from the surface of the city's waters; most of this material was burned at sea in open barges.

8,300 tons of that waste were construction and demolition debris, some of which was processed in sorting/shredding/and grinding facilities for re-use as aggregate in new construction or for fill, and the remainder of which was sent to landfills out-of-state.

700 tons of that waste were the de-watered product of sewage flushed down toilets and sewers; this material was pumped into barges, hauled 106 miles out to sea, and dumped.

Finally, 200 tons of that waste, "red bag" medical waste generated in city hospitals and health-care facilities, were burned in on-site incinerators or collected and transported by specialized waste-carters to incinerators and landfills outside of the city.

The total direct cost to the City for collecting and disposing of the residential and institutional portion of this day's waste was about $1.8 million (not including the value of depleted landfill space); costs to private businesses for collecting and disposing of their wastes were probably about twice that.[2] The environmental costs were harder to measure, but they included the effluents spewed into the air and water from tens of facilities and thousands of vehicles, and the effects of noise, odor, and visual intrusions on the senses of the city's populace.

The greater problem, however, is that this status quo, this existing waste-management system, cannot continue, because the places where this waste was being put were either filling up or going out of existence. Changes in the system are inevitable.

The most dramatic lever of change may be the federal Ocean Dumping Ban Act of 1988, which mandates that the City's decades-old practice of disposing of sewage at sea stop as of 1992. A slower-creeping, and ultimately, perhaps, more insidious change is the result of the gradual accretion of material on the Staten Island swamp (now known as the Fresh Kills landfill) that Robert Moses began filling up in 1948. At the present rate of accumulation, the Fresh Kills landfill will rise to peaks of about 450 feet in the coming decades -- provided that the City is able to meet the regulatory requirements for environmental improvements to keep it open. The landfill in Queens closed in 1991. The out-of-state landfills that now accept a significant portion of the city's private-carter-collected wastes are likewise filling to capacity, while their availability for New York waste is threatened by proposed regulatory proscriptions against exporting waste.

Other legal and regulatory restrictions and mandates will further affect the management of the City's wastes. The City's mandatory recycling law (Local Law 19 of 1989) requires the City to recycle at least 25% of its wastes by 1994. The State Solid Waste Management Act of 1988, and the Department of Environmental Conservation's regulations pursuant to it (NYCRR Part 360-15), establish a target of 8-10% waste-prevention and 40% recycling by 1997, and, in order to minimize landfilling, specify that as much of the remainder as is feasible be processed in waste-to-energy facilities. Existing on-site medical-waste incinerators that cannot be upgraded to meet stringent new environmental standards will be forced to close after 1992. The U.S. Army Corps of Engineers is changing requirements for dredge-spoil disposal, and the U.S. Environmental Protection Agency has restricted the at-sea incineration of harbor debris.

Since effective management of the city's wastes is necessary for protecting public health and the environment, as well as for maintaining the passability of the city's streets, it is inevitable that new programs and facilities will be developed eventually. Just as inevitably, the cost of these new programs and facilities will be higher than are the costs of existing facilities. Since every dollar from the City's highly constrained budget that is spent on waste management is not available for such other crucial services as police protection or patient care, there is a compelling need for an integrated waste-management system that, balancing environmental impacts with the operational need for reliability and flexibility, minimizes these overall costs to the greatest extent possible.

In addition to establishing a hierarchy of waste-management techniques that is designed to minimize landfilling by maximizing, in order of priority, waste prevention, recycling, and waste-to-energy, the State Solid Waste Management Act (Chapter 70 of the Laws of 1988) requires each locality in the State (as a prerequisite to permitting any new waste-management facilities) to develop a long-term, comprehensive plan for managing its wastes. This document presents that plan for the City of New York, and evaluates the environmental, social, and economic impacts of this plan in comparison to the feasible alternatives to it.

## 1.2 How the Problem Developed.

### 1.2.1 The Growth of New York City.

In its first centuries, New York City's population expanded rapidly; in 1950, it reached a peak of 7.9 million people. From the founding of the City in 1625 to the present day, the major engine of population growth has been immigration from a wide range of foreign countries rather than the native birthrate or an increase in life expectancy. This means that the city has always had a diversity of ethnic stocks, a diversity that is increasing rather than decreasing over time. Preliminary results from the 1990 census show that one in every three New Yorkers is foreign-born, and that one in every nine immigrated within the past ten years.

The city's population is also diverse in terms of the range of income levels, and in terms of its variety of business and commercial enterprises. For all of these reasons, neighborhoods vary greatly in their demographic conditions and land-use characteristics.

Between 1950 and 1980, the city's official population count declined by some 800,000, then increased slightly to its present official Census Bureau count of 7.35 million people. (This number is disputed by the City, because other statistical information suggest that the actual figure is likely to be closer to 7.42 million. The waste-generation data developed by the Sanitation Department, for instance, suggest that the city's population is approximately 7.8 million people: since this number is calculated through an analysis of waste-generation rates, this is the figure that is used as a basis for this waste-management plan. In recognition of the discrepancy between the Census Bureau's count and statistical projections, the U.S. Commerce Department is reconsidering the figure for New York City that will be used as the official count.)[3] Projections of future population growth between now and 2010 range from 2.4 to 7.2 percent. For purposes of this plan, a growth rate of 0.23% percent a year (4.7% over the 20-year period) is assumed. (More detailed information about the past and projected demographic growth of the City is presented in "A Statistical Profile of New York City for Solid-Waste-Management Planning," in Appendix Volume 1.)

The City's physical and political boundaries have also expanded. From the time of first settlement, for example, the island of Manhattan increased by a third, due to the deposition of solid materials (much of it solid waste) around its periphery. A similar degree of expansion has taken place along the shoreline of the other boroughs. Politically, the City of New York first expanded up the spine of Manhattan, then into the South Bronx, and finally, in 1898, expanded to incorporate the rest of the Bronx and the formerly independent counties of Brooklyn, Queens, and Staten Island.

### 1.2.2 The Evolution of New York City's Waste Stream.

Increasing size brought increases in the amount of solid waste generated within the city. Solid waste also increased due to changes in packaging materials, in the types of commodities available, and in standards of living. Other changes -- in technology, in transportation systems, in health and environmental regulations (which, for example, eventually prevented the dumping of waste into the rivers to make new shoreline property and prohibited the unrestricted use of garbage as animal food), and in global markets (which affected recycling rates) -- also increased the volume of waste. Some forms of waste, however, decreased over time. Coal ash, once a significant proportion of the waste generated in the city, has all but been eliminated with the advent of oil, gas, and electric heat. Horse manure, a large component of the city's waste when horses provided the city's primary motive power, has likewise all but disappeared, as have the remains of the deceased horses that once pulled the city's carts and trolleys, and the other animal wastes that remained when all of the city's meat and milk marched in on the hoof.

Whole new "categories" of waste have come into existence as a result of changes in regulation and practice. Sewage sludge -- a material once simply flushed into the rivers to "disappear" or become embedded on the bottom to later become a component of dredge spoils[4] -- is the by-product of improvements in sewage-treatment facilities. Regulated medical waste is the product of legal definitions pursuant to legislation passed in 1987, 1988, and 1989. "Commercial waste" represents a classification created by Sanitation Department regulations that have evolved since 1916.

The systems for collecting these varied wastes have evolved as well. What began as an informal confederation of private cartmen carrying municipal wastes in return for governmental recognition of monopoly carting privileges gradually evolved into an organized collection force of municipal employees, although various combinations of public and private collection responsibilities were tried over the years.

## 1.3 How Wastes Have Been Disposed of Up to the Present.

### 1.3.1 Ocean Dumping of MSW.

From the earliest days of New York's settlement, solid wastes of all sorts usually were dumped into the water body closest at hand. When the practice of dumping refuse into the city's rivers was put to an end in the mid-19th century because of the deleterious effects on shipping, a barge-transport system was developed to move the wastes further out into New York Harbor. When this dumping began to create problems in the Upper Harbor, the barges were dispatched to the Lower Harbor, and gradually, through successive generations of regulations, further and further out to sea. But winds and tides still brought floating refuse onto the beaches of Long Island and New Jersey, generating opposition to ocean dumping that ultimately resulted in its being outlawed. The City's compliance with the law, however, was far from complete, since as late as 1934, when the State of New Jersey finally succeeded in getting the U.S. Supreme Court to enforce an order for New York to stop ocean dumping, a third of the City's refuse was being dropped into the sea. The City's history of ocean dumping left an important legacy: the system of barges and enclosed loading piers ("marine transfer stations") that the Sanitation Department continues to rely on today for transporting 85 percent of its collections to the Fresh Kills landfill in Staten Island.

### 1.3.2 Landfilling of MSW.

Through the mid-19th century, much of the waste that was dumped into water bodies became new "land," either by filling up ponds (such as the "Collect Pond" beneath what is the area now covered by the court-and-government-building complex in Lower Manhattan), or streams (such as "Canal" Street), or swamps (such as the salt meadows north of western Houston Street), or by jutting out into the rivers and bays, as the periphery of lower Manhattan has done. The problems thus created during the city's first centuries -- interference with navigation, destructive effects on marine life and fisheries, interference with natural waterways which exacerbated the disease-inducing effects of the city's primitive sewage-drainage system, not to mention the odors and aesthetic effects -- made landfilling an unpopular waste-management solution, and gradually created regulatory restrictions on where waste could be placed in landfills. As increased awareness of other environmental impacts developed, such as of the effects of landfill leachate on surface and groundwater and of the migration of landfill gas into surrounding subsoils and its escape into the air, regulatory requirements for landfills became increasingly stringent. The city's population growth, which spread residential developments toward the vacant regions at the city's periphery, further restricted the areas that could be used as landfills. Finally, lowland areas that had been used as landfills were either filled to grade (and then developed for other use) or otherwise reached the point where it was infeasible or impractical to extend their capacity.

A host of regulatory processes, including zoning and land-use restrictions, the City's Uniform Land-Use Review Procedure (ULURP), and the environmental review procedures pursuant to the State's Environmental Quality Review Act (SEQRA) and the City's Environmental Quality Review process (CEQR) further reduced the likelihood that new landfills could be developed within the city. Restrictions on the expansion of the Fresh Kills landfill have come about through consent orders and other agreements that preclude the use of "virgin" land around the perimeter of that facility. Thus, even without the additional new layers of regulatory requirements introduced by the State's NYCRR Part 360 revisions of 1988, which establish even-more stringent limitations on the areas in which a landfill may be sited, and which require the construction of liners, it is difficult to imagine a new landfill of any significant size within the boundaries of New York City.

The result of these trends is that the number of landfills within the limits of New York City has gradually contracted over time, from the dozens of landfills that once operated simultaneously throughout the city to the one landfill that remains today. Instead of having multiple, geographically dispersed facilities, which would minimize the distances that wastes would have to be transported, and provide operational flexibility and redundancy for this vital infrastructural system, the Sanitation Department is now, so to speak, forced to put most of its eggs in one basket. (A more detailed account of the city's former landfills is presented in Appendix Volume 4.2)

### 1.3.3 Incineration of MSW.

Specially designed incinerators for municipal solid wastes were first developed in 1874 in Leeds, England, the engineering outcome of a cholera epidemic. The first incinerator in this country was built in 1884 on Governor's Island. In 1904, the Department of Street-Cleaning built an incinerator that generated electricity to light the Williamsburg Bridge. In 1938, Mayor Fiorello LaGuardia built two incinerators equipped with turbine generators to produce significant quantities of electricity. Unfortunately, the Little Flower was never able to sell any of this electricity because the New York Edison company refused to buy it. His difficulty illustrates a major reason why New York -- like other cities in this country -- never joined other major metropolises (such as London, Paris, and Berlin) in developing incineration systems that could contribute to the disposal of solid wastes while at the same time producing hot water, steam, and electricity. Waste-to-energy incineration, without the ability to productively use the energy created, never really became a practical possibility in this country until a cardiganed Jimmy Carter declared the moral equivalent of war on the OPEC-induced energy crisis of the 1970's, and developed the legislation (the Public Utilities Regulatory Policy Act) that for the first time required utilities to purchase energy produced by alternative energy sources.

Without the possibility of energy revenues to offset capital and operating costs, incineration of municipal wastes was a costly waste-management alternative -- particularly in relation to landfilling, which, while new landfill capacity was available, could be done at a fraction of the cost of incineration, while producing land that could be used for public purposes such as park, road, bridge, and airport construction. Nonetheless, because of the environmental and public nuisances created by landfilling, for several decades in the middle of this century, about a third of the city's municipal solid wastes were incinerated. But in addition to their relatively high capital and operating costs, these incinerators posed other nuisances of their own. They produced soot and odors that made them unwelcome neighbors.

The last new municipal incinerators in the city were constructed under Robert Moses, who, as City Construction Coordinator bore ultimate responsibility for most of the City's infrastructural developments in the post-World-War II era. The last of these, the Southwest Brooklyn incinerator, opened in 1962. Since then, ten of the City's 13 Moses-era incinerators have been closed, largely due to the development of enormously more stringent federal, State, and City air-pollution-control regulations that made retrofitting them for continued operation a financially impractical proposition.

Many of the small-scale incinerators in the city's once-vast network of thousands of apartment-house incinerators have been closed due to their costs of operation and maintenance, and because of the significant cost of retrofitting them to comply with the more stringent City air-pollution regulations promulgated in the 1970's. Due to Local Law 39 of 1989, the remainder of these incinerators (according to Sanitation Department collection records, there were 731 residential buildings with on-site incinerators in 1991)[5] will be closed by the end of 1993.

### 1.3.4 Recycling of MSW.

In the City's early centuries, much of what could be re-used or recycled from the City's waste stream was collected and reclaimed by rag-and-bone men and other scavengers who rummaged through the streets, ashcans, barges and dumps. Much of what is today "food waste" was fed to animals. These practices, though producing a subsistence of sorts for many people and reducing the volumes of waste that had to be buried, dumped at sea, or burned, were not without perils. Meat, milk, and eggs produced from animals that digested refuse were often of poor quality, and commonly the source of disease. Rags retrieved from refuse often were contaminated with pathogens. Boiling bones and other garbage and offal to make a variety of products from soap and candles to nitroglycerine and fertilizers created putrid odors and noxious liquid effluents.

For these reasons, and more importantly, because demand for these products decreased while labor costs increased, recycling declined. New, harder-to-recycle synthetic materials also contributed to the decline of recycling, as did the lower costs of producing these new materials from virgin sources. An increase in New Yorkers' general standard of living, along with the increased manufacture of products that are difficult or relatively expensive to repair, further contributed to the collapse of recycling and re-use systems.

### 1.3.5 Composting of MSW.

Until the late 19th century, composting was often carried out in vacant lots, with straw and manure swept from stables and streets as the primary ingredients, to which were added kitchen and garden wastes. These materials, piled in a heap and turned over occasionally by pitchfork, produced a compost for kitchen gardens in the city and truck farms on Long Island. These primitive compost operations were invariably the source of odors and public complaints.

In addition to these straight-forward composting operations, there were a variety of manufacturing plants built between 1850 and 1920 in Brooklyn and Staten Island which boiled or steamed garbage, or subjected it to solvents, to produce fertilizer ingredients from organic wastes. These plants, too, were invariably the source of noxious odors and vociferous complaints. They went out of existence when technologies and markets changed, destroying the demand for the low-grade fertilizers and other materials they produced. The demand for this type of fertilizer ended with the development of modern fertilizers made from chemical and petroleum feedstocks.

### 1.3.6 Export of MSW.

Considerable quantities of New York City waste have been exported for hundreds of years. New York waste filled vast expanses of Long Island and New Jersey. Since the creation of the City's Department of Sanitation in 1934, no municipally collected waste has left the city, but waste collected from commercial businesses by private carters has continued to be exported in significant amounts. In the early 1980s, New Jersey greatly restricted the degree to which out-of-state wastes could be landfilled there. This increased the amount of waste that was brought by private carters to the City's Fresh Kills landfill and other disposal locations. In 1979, the City began to increase the cost for dumping waste. After a significant price increase in 1987, much less waste was delivered to Fresh Kills and other disposal sites than in the previous year; although some of this diverted waste may have been part of increased recycling efforts by private carters, most of it was undoubtedly shipped out of the city. In 1988, the Department more than doubled its "tip fee" at Fresh Kills, and thus drove away an additional several thousand tons a day. This spurred an increase in the number of private solid waste transfer stations within the city, and provided a significant incentive to additional recycling efforts; it also increased the amount of waste that is being shipped out of the city, mostly to landfills out-of-state.

A detailed discussion of recent export patterns is presented in Appendix Volume 2.

### 1.3.7 Sewage Sludge Disposal.

Since the 1930's, when sewage sludge began to be produced by the city's first sewage-treatment plants, sludge has been loaded into ocean-going vessels and dumped at sea. From 1938 to 1986, the site at which sludge was dumped was six miles from the coast; since 1986, the dumping location has been moved to a site 106 miles away. Because of beach wash-ups and the effects of ocean dumping on the marine environment, ocean dumping of sewage is banned after 1992 by federal law. New York City's efforts to comply with this law are being managed by the Department of Environmental Protection, the agency responsible for the City's water, sewer, and sewage-treatment system. An extensive discussion of these efforts is available in a recent series of planning documents and environmental impact statements prepared by that agency.

### 1.3.8 Regulated Medical Waste.

"Regulated medical waste" is that portion of the medical waste stream that is considered to pose a potential hazard to human health or the environment, and which is therefore subject to stricter regulation than are non-regulated medical waste or other municipal solid wastes. In New York State, regulated medical waste includes needles and other sharp instruments, cultures and stocks of infectious agents, human blood, human pathological waste, contaminated animal carcasses from medical research, laboratory wastes, dialysis wastes, and wastes from patients who have been isolated with highly communicable diseases. A detailed summary of regulatory definitions and requirements is presented in "Legislation and Regulations Governing Medical Waste in New York City," in Appendix Volume 8.

As part of this planning process, the Health and Hospitals Corporation, with the Department of Health, has prepared an evaluation of the medical-waste-management practices of the facilities in the HHC and DOH system, and a more cursory evaluation of the practices of private and voluntary medical-waste generators. The reports developed in this study are presented in Appendix 8.

Medical waste regulations are a relatively new phenomenon. They stem, in large part, from the fact that syringes, drug vials, i.v. tubing, and other medical wastes are immediately recognizable as such, and often engender an aesthetic revulsion that is heightened by a fear of the H.I.V. virus and hepatitis. The public perception of dangers due to medical waste was fanned in the summers of the late 1980's by a highly publicized series of beach washups. Despite these widespread public fears, a legitimate public health threat due to medical waste has never been substantiated. Threats to medical workers who come into contact with these wastes are much more common.

In attempting to comply with the new regulations governing the disposal of potentially dangerous medical wastes, hospitals and other medical institutions have incurred a three-fold increase in waste-disposal costs since 1989. The amount of wastes segregated for this type of special handling has also increased, increasing as well the degree to which this material is handled by medical workers, thereby increasing their risks. And the amount of medical wastes exported out of the state also has increased significantly. Contrary to common assumptions, the increase in medical waste quantities is not due to the increase in disposable protective gear, and although the use of certain disposable medical items has increased over time, these constitute only about five to seven percent of the medical waste generated in the city.

Medical waste, historically, has either been incinerated or landfilled. Most New York City hospitals at one time had their own incinerators. Many of these have been closed over the years due to the cost of complying with more stringent air-pollution-control regulations; of the several dozen still in existence, most will close in the early 1990s to avoid the retrofit requirements imposed by law. Some medical wastes ("black-bag," i.e., non-regulated wastes) have been and continue to be incinerated at the Department of Sanitation's facilities. As a result of local law, the Sanitation Department no longer accepts any "raw" (i.e., non-incinerated) medical waste for disposal at Fresh Kills; medical wastes that are not incinerated within the city are now shipped out of the state for landfilling or incineration elsewhere.

### 1.3.9 Dredge Spoils.

Because of the need to maintain channels for navigation, periodic dredging needs to be done to clean out the accumulations of sediment and other material that are washed into New York's rivers and harbor. This material has traditionally been dumped at sea under the supervision of the U.S. Army Corps of Engineers, which is responsible for maintaining the navigability of the nation's waterways. Since 1977, the Corps has required that dredged materials be tested and meet minimum standards for a variety of criteria (see Appendix Volume 4.2) in order to be disposed of at sea. Materials that do not meet these criteria must be disposed of "upland" through techniques that involve extensive control and mitigation measures. For materials dredged from New York Harbor, the current ocean disposal site is known as the "Mud Dump Site." However, this site is inappropriate for the disposal of contaminated spoils, and the Corps of Engineers has proposed that future disposal of contaminated dredge spoils take place in "borrow pits" (which were created in the Harbor-Lower Bay area by sand and gravel mining, or which will be created specifically for this purpose), where the material will be placed under controlled dumping conditions and then covered with a clay cap to minimize the leaching of pollutants into the marine environment.

The Sanitation Department has been de-watering dredge spoils from its facilities at an uplands site at the Fresh Kills landfill since 1987.

### 1.3.10 Construction and Demolition Debris Disposal.

Historically, most construction and demolition debris has been landfilled. Often, because this material contains little putrescible matter, it was considered desirable fill material, and was used on private property to level and fill in low-lying areas. Because construction-debris landfills were considered more beneficial, or less nuisance-causing, than MSW landfills, the Sanitation Department maintained separate landfills for most construction debris through the 1970's. After that, most construction debris that was delivered to Sanitation Department facilities has been used at the Fresh Kills landfill for constructing haul roads. The amount of this material received by the Sanitation Department has declined over the years, in part because of the increase in "tip fees" that have reduced the use of Fresh Kills for other types of commercial waste, and in part because construction debris is particularly suited for recycling and re-use.

A very small subset of construction waste is asbestos. Regulations promulgated during the 1980's resulted in a separate system for disposing of asbestos, which involves a manifest system, carters who are licensed to transport asbestos, double-bagging in yellow bags, and disposal in a separate, dedicated area of the Fresh Kills landfill under carefully controlled and monitored conditions.

### 1.3.11 Harbor Debris Disposal.

Most harbor debris is metal-encrusted, salt-fouled wood that is collected when sagging pier structures are dismantled. Until 1991, this material was burned at sea in open barges. Floatable debris skimmed from the harbor was either burned in these barges, or landfilled. The disposal of this material has been carried out through private contracts; due to the Water Resources Act of 1990 and the lack of ocean-burning permits, all current contracts require upland disposal or chipping for re-use.

## 1.4 Previous Planning Efforts.

### 1.4.1 Plans for Municipal Solid Waste.

Waste-management planning of one sort or another has gone on in New York City for a hundred years, with a new set of initiatives every decade or so as the failures to adequately implement prior plans -- and the awareness of an ever-more urgent impending shortfall in existing waste-disposal capacity -- have made apparent the need for a more pro-active course of action. In recent years, new regulatory requirements affecting various waste streams have also spurred more formal planning processes.

The first full-scale planning efforts took place in the 1870's and 1880's, and concentrated, as other planning efforts have done since, on evaluating technology options for waste disposal, and focussed particularly on newly emerging technologies. The technology options considered included equipment for ocean dumping, but incineration and "reduction" (i.e., grease-extraction from wet garbage) plants were considered preferable. However, the actual building of such facilities lagged more than a decade behind a plan which proposed them in the early 1880's. Shortly before the turn of the century, the Street-Cleaning Commissioner implemented a plan that not only incorporated reduction facilities on the disposal side, but also a source-separation system for the collection system. (Source-separated recyclables were further separated by hand-pickers and prepared for market at processing plants.) The source-separation system, however, soon collapsed. Thereafter, successive generations of planners focussed only on disposal facilities, rather than on any integrated concept of a collection, processing, and disposal system, much less one that involved any measures designed to reduce the amount of waste that was generated in the first place.

Shortly after the turn of the century, the Street-Cleaning Department experimented with pilot waste-to-energy plants as well as with ordinary incinerators. The plans developed pursuant to these generally successful pilots culminated, over the following decades, in a network of public and private incineration facilities, some of which produced steam and electricity, others of which did not. With the creation of the Department of Sanitation in 1934, the City's planning efforts primarily focussed on the siting and development of new incinerators. The incinerator-construction program came to a halt four years later, in 1938, due to a combination of factors: the inability of the City to sell energy produced from waste-to-energy facilities noted above, the relative cheapness of landfilling, the beginning of the reign of Parks Commissioner and highway-builder Robert Moses (who found in municipal solid waste a conveniently inexpensive raw material with which to make his parks and parkways), and the difficulties involved in obtaining sites.

For a period of ten years, the major "planning" battles fought out by City officials had only to do with the placement of new landfills throughout the city. In 1948, at Robert Moses' behest, the Board of Estimate approved a sweeping resolution endorsing a "comprehensive plan" for waste-management. The plan called for a major landfill at Fresh Kills, in Staten Island, which would serve as a bridge until the City could build sufficient incinerator capacity to eliminate the need for landfilling raw garbage. That even the Power Broker's plans for developing new incineration capacity were only partially implemented reflected his lack of interest relative to other construction priorities, the additional expense of incineration over landfilling, and most importantly, the difficulties of obtaining sites.

Site selection for incineration facilities became the principal planning preoccupation in the middle decades of the century. The first formal inventory of potential waste-to-energy sites was developed in 1977 by a joint Department of Sanitation/Department of Environmental Protection "Resource Recovery Task Force." This plan, the "Wegman Report," focussed only on incineration. It did not consider possibilities for waste prevention or recycling. Compost technologies were ruled out due to an assessment that markets were lacking. The 22 sites it proposed -- which were later memorialized in the 1980 State legislation that provided an exemption from "Wicks Law"[6] requirements for "full-service" waste-to-energy facilities developed on them -- were mostly sites that already had been used for Sanitation Department facilities.

This definition of a planning universe that was largely limited to sites already owned by the Sanitation Department raised to a more explicit level a time-worn Departmental practice: rather than procuring and developing sites on the basis of an evaluation of their inherent operational and environmental suitability, or designing "waste-sheds" to minimize transport distances, and siting and sizing facilities accordingly, the Department had become accustomed to avoiding the public controversies generally associated with obtaining new sites by clinging to locations that it already had. Most of these sites (due to the Department's former ocean-disposal and landfilling practices) were waterfront locations. In some regards, of course, this approach was useful, since areas that had been used for waste-disposal purposes in the past often were surrounded by relatively appropriate land-uses (though this was not always true in a dynamically expanding metropolis), and a constancy of location was not disruptive to existing collection and transport systems.

The proposed Brooklyn Navy Yard waste-to-energy facility site was nominated by the Wegman study, and formally proposed after a further analysis of sites prepared for the Sanitation Department by DSI, Inc. Based on a review of available properties, most of which were City-owned, the "Citywide Plan for Action" prepared by the Sanitation Department for the Board of Estimate in 1984 proposed sites for waste-to-energy facilities in each of the five boroughs. Although a target of 10-15% recycling was proposed, no specific recycling programs were examined, and waste-prevention and composting were not considered. The Sanitation Department began environmental impact statements for these four projects, but they were not completed before the State requirements for the current citywide plan were promulgated.

In 1985, the Sanitation Department began a series of pilot recycling programs designed to test the possibilities for recycling. These ad hoc pilots became the basis for Local Law 19, the mandatory recycling act that was enacted in 1989. The "plan" for future recycling activities called for in that legislation is part of the present comprehensive solid-waste-management plan.

### 1.4.2 Plans for Sludge.

In response to the Ocean Dumping Act of 1977, the US EPA developed regulations requiring the cessation of all ocean dumping of sludge by the end of 1981. In order to meet that deadline, the Department of Environmental Protection engaged Camp Dresser & McKee in 1977 to develop interim and long-term plans for "upland" sludge disposal. The 1978 Interim Plan proposed that sludge from the 12 existing water-pollution-control plants be transported by vessel to two pontoon-mounted dewatering facilities, and that the dewatered product be transported to three composting facilities. The compost was to be applied to underdeveloped parkland. Delays in implementing this plan led to a revised plan to do most of the dewatering and composting on Wards Island. The long-term plan called for continued composting of Staten Island's sludge at the Fresh Kills landfill (some of the compost was to be used as landfill cover), and incinerating the remaining sludge at three locations. Before the interim plan was implemented, the US District Court for the Southern District of New York ruled that the City should be allowed to continue ocean disposal under revised US EPA regulations, and further efforts to implement the plan were abandoned.

A more detailed discussion of this planning effort is presented in the New York City Sludge Management Plan, Task 1, August, 1990.

### 1.4.3 Plans for Regulated Medical Waste.

There have never before been any Citywide or HHC-wide plans for the disposal of regulated medical waste. Individual facilities have developed and, in some cases implemented, plans for on-site incineration and/or autoclave capacity. The Greater New York Hospital Association has developed a series of proposals: one called for a regional medical waste incinerator, another for on-site disinfection and use of Sanitation-Department incinerators. Implementation of either proposal will depend on whether member hospitals of the Association contract for disposal services, and on the implementation of the relevant components of the present waste-management plan. The Bronx-Lebanon Hospital Center is developing a medical-waste incinerator in the South Bronx that is sized to handle a significant portion of the regulated medical wastes generated in New York City.

### 1.4.4 Plans for Harbor Debris.

With the cessation of ocean-burning, all harbor debris must be disposed of upland. After reviewing the options available for disposal of the large pieces of wood that constitute most harbor debris, the US EPA issued an Environmental Impact Statement in 1990 which suggests that this material be taken to a facility that is capable of shredding it so that it can be burned in a land-based incinerator.

### 1.4.5 Plans for Dredge Spoils.

The US Army Corps of Engineers began evaluating alternative means for the disposal of dredged material in the New York region in 1977. In December, 1989, the Corps issued a summary report on its analyses. It found a number of options feasible for clean sediments, including, in some cases, various forms of upland disposal, and various forms of ocean disposal. For less-clean material, the report recommends "permanent placement in existing, subaqueous borrow pits accompanied by appropriate capping to prevent the escape of pollutants to the water column or to the biota."[7] According to the Corps' analysis, landfill cover and containment islands remain other alternatives likely to prove feasible in the near future.

### 1.4.6 Construction and Demolition Wastes.

For the most part, construction and demolition debris is generated and handled by the private sector. As for other types of private-carter waste, individual companies have developed or planned the development of specific private facilities, but no comprehensive planning as such for a significant portion of this waste stream has thus far taken place. (The State Department of Environmental Conservation is in the process of reviewing the management of this waste-stream, with a view toward formulating broad-based recommendations to facilitate recycling and improved disposal practices.)

## 1.5 Structure and Content of This Comprehensive Solid-Waste-Management Planning Effort.

The current planning process is designed to meet the objectives of the State solid-waste-management plan, which establishes a hierarchy of waste-management techniques with prevention as the most-preferred management modality, followed in order by recycling, waste-to-energy processing, and landfilling. Consistent with State and City environmental-quality-review mandates to minimize the environmental, economic, and social costs of alternative options, this plan seeks to develop an integrated waste-management system that achieves this objective to the greatest extent practicable.

The elements of this plan have been assembled in the following way:

Because the responsibility for managing the various waste-streams is shared by a number of City agencies, the first step in organizing the development of this planning process was to create, by Mayoral Executive Directive, an Interagency Planning Committee on Solid Waste Management. This committee consists of the agencies directly responsible for managing particular types of wastes -- the Departments of Environmental Protection, Health, Sanitation, and the Economic Development and Health and Hospitals Corporations -- along with other agencies that contribute to their management: the Departments of City Planning, Consumer Affairs, Cultural Affairs, General Services, Parks and Recreation, the Office of Management and Budget and the Mayor's Office of Operations, the Mayor's Office of Construction, and the Law Department. The Interagency Committee reports to the Deputy Mayor for Planning and Development.

Because it is the agency responsible for managing the greatest proportion of the city's wastes, the Committee designated the Department of Sanitation to take the lead in this planning process. A team of consultants was assembled to provide technical assistance in the preparation of this generic environmental impact statement/comprehensive solid-waste-management plan. A separate consultant team was selected by the

Health and Hospitals Corporation to prepare portions of the plan related to the management of medical wastes. Portions of the plan related to the management of sewage sludge were prepared by consultants already working with the Department of Environmental Protection on its sludge-management program.

Basic data were developed on the generation, composition, and current management of each of the six waste-streams. Technology evaluations were conducted for the various potential collection and processing options; these evaluations included an assessment of the generic environmental and cost impacts of the various options, as well as of their engineering feasibility. Analyses of related issues, such as current and future waste-export patterns and potentials, procurement and financing options, and economic and demographic projections, were also developed.

These basic data "building blocks" were then assembled in the form of alternative integrated waste-management scenarios, which were analyzed through a software system, "New York City WastePlan," that was created for this purpose. WastePlan performed calculations to predict comparative costs, as well as the other quantitative factors (e.g., numbers of truck shifts, miles travelled, tons handled) that would be needed to perform environmental analyses of the relative impacts of alternative waste-management systems. (See Chapter 15 for further details on this process, and Appendix Volume 7 for documentation of the various alternative scenarios that were constructed and evaluated.)

These alternative, iterative scenarios were evaluated in an ongoing way in terms of both costs and environmental impacts. This Environmental Impact Statement, in documenting this process, shows how the plan itself was developed, as well as disclosing the impacts of the range of feasible alternatives.

The proposed plan consists of three basic elements:

First, this plan proposes an integrated system of prevention programs, collection systems, and processing and disposal facilities for implementation in the near-term, and presents siting criteria and other environmental information to guide successive steps in implementing these programs and facilities. Each major facility proposed will be the subject of a site-specific supplemental environmental impact statement. ~~For the mid- and long-term, this 20-year plan presents a basic decision tree that reflects the basic program decisions that must be made in the future.~~

**This is a 10-year plan, which includes studies of a number of possible alternative waste-management systems over a 20-year period.**

Second, the plan identifies monitoring programs and systems that will guide the choices to be made at each of the branches in this future decision tree.

Third, the plan identifies research-and-development pilot-scale projects that will enable the City to test the variables and potential options of greatest significance, in order to develop the data that will be required to make future decisions in as informed a manner as possible.

The present volume, the main volume of the GEIS, presents the plan, its environmental impacts, and a comprehensive overview of the planning process. Because of the scale of this planning enterprise, however, it functions somewhat as an "executive summary" would for a smaller-scale project. (There is also an Executive Summary for this GEIS.) It is based on the work of a team of some dozen technical consultants (engineers, environmental scientists, planners, economists, analysts, and a public-health specialist) who analyzed waste composition, waste-management technologies, and environmental impacts. Their work is presented in 15 volumes of technical appendices, which are referred to throughout this document. The contents of the appendices are:

<u>Appendix Volume 1.1</u>: <u>Waste Stream Data</u>

- 1-A. A Statistical Profile of New York City
- 1-B. Construction and Demolition Waste
- 1-C. Harbor Debris
- 1-D. Sewage Sludge

<u>Appendix Volume 1.2</u>: <u>Waste Stream Data</u>

- 1-E. Waste Composition Study Executive Summary
- 1-F. Waste Composition Study Overview
- 1-G Residential Waste
- 1-H. Institutional Waste
- 1-I. Commercial Waste
- 1-J. Laboratory Refuse Analysis
- 1-K. Compaction Testing

<u>Appendix Volume 2</u>: <u>Planning Issues</u>

- 2-A. Waste Export Study
- 2-B. Legal Constraints on Out-of-City Waste Export
- 2-C. Transportation Systems
- 2-D. Implementation Issues

<u>Appendix Volume 3.1</u>: <u>Markets for Recyclables</u>

3-A. Recyclables Market Assessment
3-B. Corrugated Cardboard
3-C. Ferrous
3-D. Non-Ferrous
3-E. Glass
3-F. Newspaper

<u>Appendix Volume 3.2</u>: <u>Markets for Recyclables</u>

3-G. Magazines
3-H. Mixed Paper
3-I. Plastics
3-J. Stone Aggregate
3-K. Wood

<u>Appendix Volume 4.1</u>: <u>Waste-Management Components</u>

4-A. Waste Prevention
- 4-A.1 Analysis and Strategy
- 4-A.2 Backyard Composting

4-B. Recycling
- 4-B.1 Overview
- 4-B.2 Collection Alternatives
- 4-B.3 Processing Systems

4-C. MSW Composting
- 4-C.1 Source-Separation Composting
- 4-C.2 MSW Composting Technologies
- 4-C.3 Food Waste Composting
- 4-C.4 Yard Waste Composting
- 4-C.5 Compost Markets
- 4-C.6 Anaerobic Digestion

<u>Appendix Volume 4.2</u>: <u>Waste Management Components</u>

4-D. Collection Alternatives
4-E. Waste-to-Energy Technologies
4-F. Landfilling Technologies
4-G. Household Hazardous Waste
4-H. Sewage Sludge
- 4-H.1 In-Sink Waste Disposals
- 4-H.2 Sludge Collection
- 4-H.3 Sludge Composting
- 4-H.4 Co-Composting

4-I. Construction and Demolition Waste
4-J. Harbor Debris
4-K. Dredge Spoils
4-L. Existing Collection and Transfer

4-M. Existing Incinerators
4-N. Existing Landfills
4-O. Baseline Analysis of Collection/ Processing/Disposal System

<u>Appendix Volume 5</u>: <u>Reference Facilities</u>

5-A. Facility Descriptions
5-B. Air Emissions
5-C. Noise
5-D. Odor
5-E. Traffic
5-F. Water
5-G. Siting Requirements
5-H. Costs

<u>Appendix Volume 6</u>: <u>Environmental Data</u>

6-A. Air Quality
  6-A.1 Existing Conditions
  6-A.2 Existing Facility Emissions
  6-A.3 Prototypical Facility Modelling
6-B. Water Quality
  6-B.1 Existing Conditions
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  6-B.3 Facility Siting Implications
6-C. Traffic
6-D. Noise
6-E. Odor
6-F. Energy
6-G. Assessment of Potential Health Impacts at a Hypothetical Waste-to-Energy Facility Near the Hunts Point Food Distribution Center

<u>Appendix Volume 7.1</u>: <u>Scenario Analysis Results</u>

7-A. NYC WastePlan Modelling
  7-A.1 Overview
  7-A.2 Waste Stream Characteristics
  7-A.3 Final-Stage Scenarios
  7-A.4 Initial-Phase Scenarios
  7-A.5 Near-Term Implementation Plan Analysis
  7-A.6 Reference Documents
  7-A.7 NYC WastePlan Model Description

<u>Appendix 7.2</u>: <u>Scenario Analysis Results</u>

7-B. Air-Quality (Stationary Sources)
7-C. Air-Quality (Mobile Sources)
7-D. Water Quality

7-E. Traffic
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7-G. Socioeconomic Impacts
7-H. Public Health Assessment

Appendix Volume 8: Medical Waste Management Plan

Executive Summary.
Vol 1. The Medical Waste Plan
Vol 2. Literature Review
Survey of Associations and Environmental Groups
Review of Laws and Regulations
Vol 3. Municipal Medical Waste Generators
Waste Characterization
Current Waste Management Systems
Vol 4. Non-Municipal Medical Waste Generators
Waste Characterization
Current Waste Management Systems
Vol 5. Identification and Evaluation of Waste Management Techniques and Disposal Options

Appendix Volume 9: Public Participation

9-A. Public Participation Summary
9-B. Public Comments During the Plan-Development Process
9-C. Responses to Public Comments Received During the Plan-Development Period

Appendix Volume 10.1: Comments on the Plan/Draft GEIS

Appendix Volume 10.2: Responses to Comments

## Endnotes

1. All tonnages for January 2, 1990, are averages based on a 302-working-day year. The sum of the tons landfilled, burned, and recycled totaled more than tons collected because private haulers and other city agencies hauled directly to both the landfills and incinerators.

2. Commercial waste-disposal costs to NYC businesses are estimated by the Department of Consumer Affairs to be on the order of $1 billion per year (NYC Department of Consumer Affairs, "DCA's New Trade Waste Rate: A Narrative," 1991, p.1); the Sanitation Department's costs for collection were $331 million in fiscal year 1990, and processing and disposal costs were $223 million; these figures are divided by 302 collection days per year.

3. New York Times, 6-14-91.

4. This practice continued as recently as 1986 for most of the West Side of Manhattan.

5. Martin Oestreicher to Benjamin Miller, 12-16-92; the DEP reported 2,300 certified incinerators in 1989.

6. The Wicks Law requires all public-sector construction in New York State to have separate contractors for general contracting, plumbing, electricity, and heating/ventilation/air conditioning (HVAC).

7. US Army Corps of Engineers, NY District, "Managing Dredged Materials," 12-89, p. 99.

# CHAPTER 2. THE EXISTING ENVIRONMENT AND PROJECTED CHANGES.

## 2.1 The Planning Unit.

The City of New York is 315 square miles in size, and contains 6,375 miles of streets. Except for pick-ups and deliveries, trucks must travel on designated truck routes. Rail lines also serve all five boroughs; rail access is particularly available to certain of the manufacturing districts in the South Bronx, Queens, Brooklyn, and northern and western Staten Island. Much of the City's shorefront is accessible to marine transportation systems, and much of it is zoned for manufacturing or commercial uses that could include certain types of waste-management facilities. The Hudson and East Rivers, Long Island Sound, and the New York Harbor separate the boroughs from each other and from neighboring jurisdictions to the west, north, and east. The major truck-accessible river and harbor crossings that link these areas are the George Washington, Triborough, Whitestone, Throgs Neck, and Verrazano Bridges, and the Battery, Holland, Lincoln, and Midtown Tunnels.

Most of the city's supplies of fresh food and produce enter the city by truck, and are distributed through the Hunt's Point Market, and by the meat markets on Manhattan's west side.

Most New Yorkers live in multi-family buildings, and more people rent their living quarters than own them. One in five households moves every year, although the vacancy rate for rental apartments is one of the lowest in the country (2.5 percent). 30 percent of the households in the city are in Brooklyn, 26 percent in Queens, 25 percent in Manhattan, 15 percent in the Bronx, and four percent in Staten Island. In 1987, nearly five percent of all renter-occupied housing units (166,400 units) were in public housing. The condition of rental units overall improved significantly in the years between 1984 and 1987, with a substantial decline in the proportion defined as dilapidated (two percent of all occupied rental units in 1987).[1]

Some waste-relevant features that make New York relatively unique even among other major cities are the relatively low percentage of citizens who own automobiles (26 percent), the rarity of backyards (New Yorkers therefore generate much less leaf-and-yard waste than do other North Americans), and the fact that New York is the only place in the country where in-sink garbage disposals are illegal (in almost all locations).

Along with Philadelphia, New York is one of the few cities in this country to have a district steam distribution system, a legacy of the late 19th century. The fuel used for space heating and electricity generation is primarily oil, supplemented, in descending order, by natural gas, and Canadian and upstate hydropower. Virtually no coal is used in New York City.

## 2.2 Statistical Profile of New York City, Current and Projected.

Appendix 1-A, "A Statistical Profile of New York City," provides an extensive discussion of present and projected demographic and economic conditions in New York. Its major findings are summarized below.

The size of New York City's population is not known with certainty. The 1990 Census count is 7.35 million, but the City of New York believes that the figure is closer to 7.7 million. It is easier to estimate the number of non-resident workers and visitors who are in the city on any given day: it is 1.47 million. The metropolis attracts daily commuters from an area with a radius of roughly 80 miles, from neighboring New Jersey, Connecticut, Long Island, and upstate New York. It attracts visitors from all over the United States to do business and to participate in its unequalled artistic and cultural life. With its three major airports (and its harbor), the city is the country's major gateway for foreign visitors and emigrants, and attracts 5.1 million foreign visitors every year to sample its unique attractions.

Manhattan was the most populous borough at the beginning of the century, but since 1930 Brooklyn has had the largest population. Queens has been the second-most-populous borough since 1960, while the Bronx is fourth, and Staten Island, the fastest-growing borough, is fifth.

More than one in five New Yorkers are employed in finance and business-service concerns. Fewer than one in ten New Yorkers are employed in manufacturing industries.[2] Textiles and printing are the two major manufacturing industries (employing 3.1 and 2.6 percent of the working population respectively); other manufacturing industries account for only 10.8 percent of New York City's employment. There is very little heavy industry in the City. This represents a significant shift over the course of the last half-century, due largely to the high cost of land, which has largely eliminated industries that cannot operate efficiently in multi-story buildings (as printing and apparel firms can).[3]

Because of the downturn in the city's economy at the beginning of this decade, many development projects that have been proposed within the past ten years are on hold, or have been dropped from consideration. Of 40 major projects proposed for Manhattan, only a handful -- including a significantly downsized proposal for Riverside South on the Upper West Side, the proposed four-tower Times Square Center, and two federal buildings near Foley Square -- still appear likely to be built.[4]

### 2.2.1 Population and Projected Population Change.

At the most fundamental level, waste generation is a function of population and of economic activity. In order to project future rates of waste generation, and in order to extrapolate present rates for the entire city from the samples that have been measured, it is necessary to establish a relationship between the amounts of waste generated and the "activity units" that generate them. The sample units selected for the different waste-generating sectors must be easy to measure and must match categories used for published data and forecasts. In the case of residential populations, for example, waste generation corresponds most directly to the number of households (rather than to the number of individual residents of the city). Depending on the specific sector, commercial and institutional waste generation corresponds most directly to the number of employees, the square feet of space, or the volume of annual sales; for the most part, employment has been used as the "activity unit" for projecting the amount of waste that will be generated by these sectors.

In order to develop demographic, economic, and waste-generation forecasts for this plan, national, regional, and New York City-specific data and forecasts have been used. National data were used to establish national trends, such as declining population growth and household size, increases in the number of women in the work force, and the general shift from industrial to service employment. Regional developments were assessed in order to provide a context for New York City's situation, such as the shifts of population within the region over time. An analysis of New York City-specific data was essential for understanding the effects of population density and income levels, and other factors that set New York apart from broader trends.

#### 2.2.1.1 Population Past and Present.

Until 1950, the city's population grew at a declining rate. From 1950 to 1970, it was relatively constant. Between 1970 and 1980, there was a substantial population decline (of up to one percent a year), which was partially reversed during the 1980's (in 1988, the rate of increase was just under half a percent).

The average household size in New York City has typically been smaller than in the rest of the nation. As elsewhere in the country, it has generally declined since 1960, although it has increased somewhat over the past seven years as a result of the influx of immigrants.

Average household income in New York City has grown somewhat less since World War II than in the nation as a whole. New

York's per-capita income has historically been higher than the national average, since the cost of living in the city is much higher than the national average. In recent decades, the relative discrepancy between high- and low-income groups has increased.

The size of the national labor force in the postwar period grew more quickly than the population because of the number of women who joined it. In New York City, however, both the percentage of people employed and the overall size of the labor force declined between 1960 and 1985, despite a significant increase in the percentage of female workers.

### 2.2.1.2 Population Forecasts.

While there is considerable uncertainty associated with the available forecast data, modest demographic and economic growth over current baseline levels is most likely. The rate of population growth for the period from 1990 to 2010 is estimated to be about five percent. Most forecasts assume a more rapid rate of growth in the near-term years, and a reduction in the growth rate after 2000. Of the available forecasts, that developed by the Regional Plan Association for population and employment has been chosen as most appropriate for use in this plan.[5] In order to deal with the inevitable uncertainty that pertains to the use of forecast data, an analysis of the potential effects of the full range of forecasts was performed (see Appendix Volume 7.1) to determine the significance these variations could have for waste-management decision-making.

#### 2.2.1.2.1 Residential Population Forecasts.

Table 2.2.2-1 summarizes the population forecasts by borough and density category for the years 1990, 1995, 2000, 2005, and 2010.

The residential population of New York City is projected to grow by 4.7 percent over the planning period. Staten Island is projected to have the largest increase in population, followed by Brooklyn, Bronx, Queens, and Manhattan. The number of persons per household in each borough is assumed to be constant over the twenty-year planning period.

The residential waste stream is projected to grow 0.4 percent per year, or a total of 9 percent between the years 1990-2010. The number of households in New York City is expected to increase, while the number of persons per household is projected to remain constant. The amount of waste generated per household is projected to remain relatively constant until the year 1995, and then increase by 0.2 percent per year until the year 2010.

**Table 2.2.2-1: Population Forecasts by Borough and Density.***

| | 1990 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|
| **Bronx** | | | | | |
| High Density | 776,000 | 787,000 | 794,000 | 802,000 | 810,000 |
| Medium Density | 44,000 | 45,000 | 45,000 | 46,000 | 46,000 |
| Low Density | 271,000 | 275,000 | 278,000 | 280,000 | 283,000 |
| **Brooklyn** | | | | | |
| High Density | 1,024,000 | 1,053,000 | 1,063,000 | 1,072,000 | 1,082,000 |
| Medium Density | 217,000 | 223,000 | 225,000 | 227,000 | 229,000 |
| Low Density | 1,103,000 | 1,134,000 | 1,144,000 | 1,154,000 | 1,165,000 |
| **Manhattan** | | | | | |
| High Density | 1,536,000 | 1,550,000 | 1,560,000 | 1,570,000 | 1,581,000 |
| Medium Density | 32,000 | 32,000 | 33,000 | 33,000 | 33,000 |
| Low Density | 41,000 | 41,000 | 42,000 | 42,000 | 42,000 |
| **Queens** | | | | | |
| High Density | 597,000 | 610,000 | 613,000 | 616,000 | 620,000 |
| Medium Density | 164,000 | 167,000 | 168,00 | 169,000 | 170,000 |
| Low Density | 1,173,000 | 1,197,000 | 1,204,000 | 1,210,000 | 1,217,000 |
| **Staten Island** | | | | | |
| High Density | 17,000 | 18,000 | 18,000 | 19,000 | 19,000 |
| Medium Density | 21,000 | 22,000 | 22,000 | 23,000 | 23,000 |
| Low Density | 361,000 | 375,000 | 384,000 | 394,000 | 404,000 |
| **TOTAL** | 7,377,000 | 7,529,000 | 7,594,000 | 7,659,000 | 7,725,000 |

*High Density = Residents of buildings of more than four units and five or more stories.
Medium Density = Residents of buildings of more than four units but under five stories.
Low Density = 1-4-family buildings.

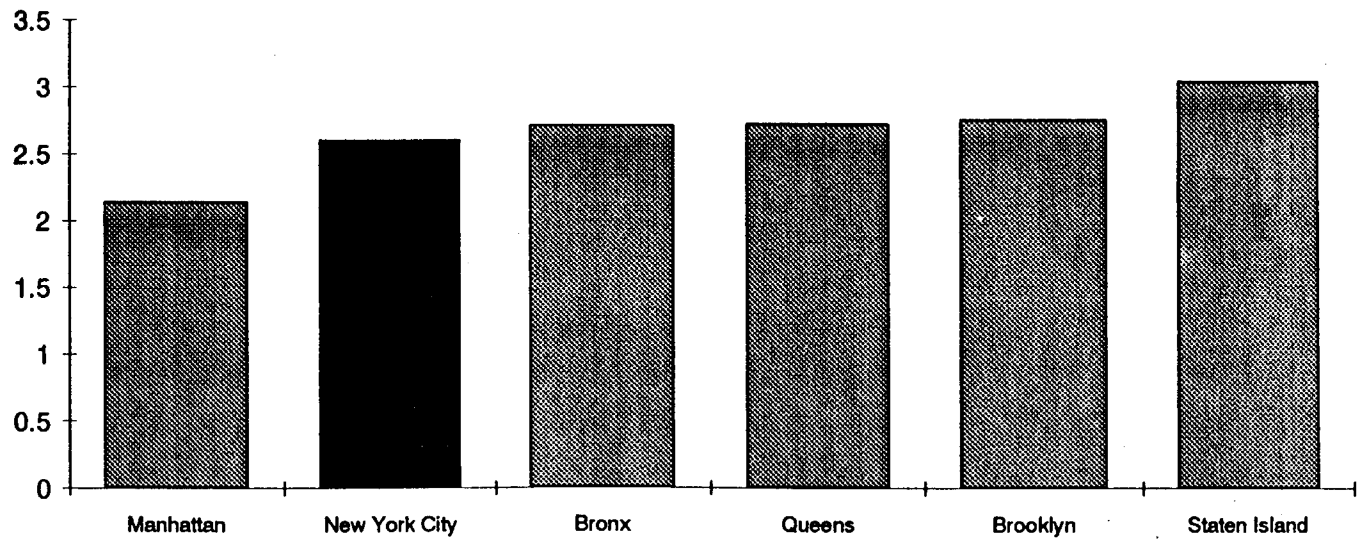


**Figure 2.2.2-1: Persons per Household in the Five Boroughs of New York City**

2.2.1.2.2 **Commercial, Industrial, and Institutional Forecasts.**

Employment in New York City is expected to grow by 12 percent over the plan period. The dramatic shift from manufacturing to service industries is expected to continue.

The commercial, industrial, and institutional waste streams are projected to grow by 1.04 percent per year from 1990 to 2010.

2.2.1.2.3 **Forecasts of Non-MSW Waste Streams.**

The largest other waste stream is dredge spoils. It is projected to remain constant over the planning period.

Construction and demolition debris, the next-largest non-MSW waste stream, is also predicted, based on projections of the number of construction employees, to remain virtually constant over the planning period.

The amount of sewage sludge generated is a function of the number of New York City residents and of the number of workers and visitors in the City. The total amount of sewage sludge generated in the City is predicted to increase only modestly, by about six percent over the planning period.

On the basis of projections of the number of hospital beds in the city (which are projected to increase by nearly 2 percent per year), medical waste generation is expected to increase by half by 2010.[6] (This projection does not take into account the effects of prevention measures such as those proposed in this plan.)

The amount of harbor debris that will be generated in the city is expected to decrease significantly over the planning period, as the Corps of Engineers' Harbor Drift Prevention Program removes pier-debris material from the New York-New Jersey shoreline. The amount of waste material that currently enters the harbor through combined-sewer runoff is also projected to decline due to the development of holding capacity that will largely prevent storm-water run-off from being discharged through combined-sewer overflows.

## 2.3 Waste-Stream Analyses.

### 2.3.1 Municipal Solid Waste.

#### 2.3.1.1 Residential MSW.

To determine the composition of New York City's residential waste stream, as well as the amounts of waste that are generated by individual households, the Department of Sanitation conducted a four-season waste-sorting study in 1989-90. So that the results of these sample sorts could be extrapolated to the entire city (as well as to be able to use this information in the design of its waste-management programs), 20 sample collection routes were developed to reflect nine demographic strata: high-, low-, and medium-density, and high-, low-, and medium-income groups.[7] Trucks that collected waste from these nine sample routes dumped their loads on the floor of an enclosed building, and from these loads, 200-300-pound samples were taken (over the course of the year) and hand-sorted into 46 material categories, ranging (alphabetically) from aluminum to yard waste.

New York City's waste stream varies most dramatically from national averages in its organic fraction. Nationally, yard wastes account for about 16 percent of the residential waste stream; in New York City, for obvious reasons having to do with density, the figure is under five percent. Kitchen wastes are 12 percent of New York's wastes, while nationally the figure is closer to seven percent; most of this difference is probably attributable to the fact that in-sink garbage grinders are not allowed in most parts of the city. (An evaluation of the relative advantages and disadvantages of in-sink garbage grinders is presented in Chapter 7, and in more detail in Appendix 4-H.1.)

The differences in waste composition between various parts of the city appear to be primarily due to population density; the effects of income levels are less clear-cut. Differences in the amount of waste generated also varied most directly with density: in general, people who live in apartment buildings generate less waste than do people who live in single-family homes (32 pounds per household per week in high-density areas versus 57 pounds per household per week in low-density areas.) (A detailed description of this sampling program and its results is presented in Appendix Volume 1.2.)

To extrapolate the sample findings to the city as a whole, the 59 Community Districts were weighted by the number of households in each density strata, and the total amount of waste collected was divided by the number of households at the various generation and composition rates. This extrapolation provides a profile of how much waste of each type is generated in each area of the city.

Forecasts for future generation rates were developed on a material-specific basis, using industry projections for the production of specific materials. These growth rates were then applied to the demographic forecasts for the different income and density strata, in proportion to the percentage of these materials in the waste-stream, to develop an overall rate for the future generation of residential waste.[8]

The conclusion of this analysis is that residential waste in New York City is expected to grow by about half a percent per year from 1990 to 2010. (The range of potential growth is from .23 percent to .89 percent per year from 1990 to 2010.) About three-quarters of this growth is expected to be due to growth in the number of households, while one quarter is expected from increases in the amount of waste generated per household.

#### 2.3.1.2 Institutional MSW.

Wastes from 14 different types of institutions were sampled. These institutions, ranging from correctional facilities to transportation hubs, represent about 80 percent of New York City's total institutional sector Further details are presented in Appendix Volume 1.2.

The "activity units" used were: inmates (for correctional facilities); square feet (for government offices); beds (for municipal, non-profit, psychiatric, and teaching hospitals and nursing homes); students (for private and public elementary schools, high schools, and colleges); and tons (for transportation hubs).

Employment projections were used to forecast changes in most of these institutional sectors (extrapolating from number of employees to the original activity units); cohort population projections were used to forecast changes in schools, colleges, and correctional facilities. Overall, the institutional waste-stream is projected to increase by about a fifth over the 20-year planning period. The range of projections is minus (-)1.2 percent to plus (+)4.4 percent per year from 1990 to 2010.

#### 2.3.1.3 Commercial Waste.

Based on an analysis of data on the number of employees, the amount of square footage, and volumes of annual sales for New York City businesses,[9] the commercial sector was divided into nine representative categories. With the cooperation of a number of private carting firms, sample routes were devised to collect wastes from a statistically representative segment of each category. All of the wastes generated by these establishments over a one-week period were collected, weighed, and sorted. Then, using number of employees as the common activity unit, these factors were extrapolated to produce citywide generation and composition figures. As for most of the segments of the institutional sector, the Regional Plan Association's employment projections were used as the basis for forecasting changes in commercial waste generation over the plan period. Overall, commercial waste generation is projected to increase by about 25 percent between 1990 and 2010 (about 1 percent a year). The range of growth is from minus (-)1.6 percent to plus (+)3 percent per year from 1990 to 2010.

### 2.3.2 Construction and Demolition Waste.

Construction and demolition waste is defined by State regulations (6NYCRR Part 360) as "uncontaminated solid waste resulting from the construction, remodeling, repair, and demolition of structures and roads." It typically includes concrete, rock, dirt, drywall, asphalt, brick, wood, and metal. Using national and New York City-specific data, quantities of construction and demolition waste were estimated on the basis of overall population, the number of persons employed in construction trades, the percentage of construction and demolition waste in the overall waste stream, the number of construction and demolition permits issued, and the permitted capacity of the private transfer stations that are licensed to handle construction and demolition waste. The most useful indicators of construction and demolition waste quantities were determined to be the number of construction employees in New York City and national per-capita generation rates. Composition estimates were developed on the basis of published national data. An analysis of the current and projected quantity and composition of construction and demolition waste is presented in Appendix Volume 1.1.

### 2.3.3 Regulated Medical Wastes.

Concern over the management of medical wastes has increased drmatically in recent years for several reasons. One is the increase in the incidence and public awareness of highly infectious organisms such as the human immunodeficiency virus ("HIV" or "AIDS") and the hepatitis B virus. Another is the highly publicized series of "beach wash-ups" that have occurred when litter and other wastes have washed up on beaches. A third reason is the rapidly increasing cost of managing these wastes in compliance with more stringent regulatory requirements.

These requirements now define certain medical wastes that are potentially hazardous or infectious as "regulated medical waste," which must be collected and disposed of in a way that minimizes public health risks. (A detailed discussion of the regulations pertaining to the management of medical wastes is presented in Appendix Volume 8.) These specially regulated medical wastes must be placed in rigid, sealed containers in distinctive red bags so that they can be readily distinguished from non-regulated ("black-bag") wastes.

Medical facilities in New York City are required to keep records that show how much regulated medical waste was generated, the disposal destination, and the cost incurred. Generators of over 50 pounds of regulated medical waste a month must also keep "cradle-to-grave" "tracking" forms that identify the licensed firm that transported the waste. These reports must be submitted annually to the New York State Department of Environmental Conservation (with copies sent to the Department of Sanitation, and, for generators of over 50 pounds of regulated medical waste a month, to the US EPA). In addition, under Local Law 75 of 1989, all generators of regulated medical waste are required to file with the Department of Sanitation a solid-waste-removal plan that sets forth planned disposal arrangements. Generators of over 50 pounds a month must file annual updates of this plan.

Regulated medical waste in New York State must be disposed of in a facility permitted to process regulated medical waste either by incineration, by another form of sterilization or disinfection in combination with grinding, by discharge to a sewerage system (in the case of certain liquid wastes), or by another method approved in writing by the Commissioner of the Department of Health.

Whenever non-regulated medical wastes are mixed with regulated medical wastes, the entire mixture must be treated as regulated waste. Because there are significant penalties for a generator who improperly disposes of medical waste, and because of the complex logistics and handling requirements associated with properly segregating regulated from non-regulated medical wastes, waste generators often err on the safe side by being overly inclusive in terms of the waste that is "entrained" in the red-bag stream. This results in significantly higher waste-disposal costs than would otherwise be necessary, since the amount of wastes placed in red bags is often twice as great as the amount that technically would be defined as regulated medical waste. (At the same time, according to the medical-waste sorting study conducted for purposes of this plan, a significant amount of waste that <u>should</u> be processed as regulated medical waste often finds its way into "black" bags. This analysis is documented in Appendix Volume 8.) This points to a very fundamental problem in the medical-waste system. That problem should be a central focus of planning efforts for the future management of medical wastes.

Most medical waste is generated either in acute-care hospitals (which account for about two-thirds of the medical waste transported off-site for disposal) or in long-term-care facilities (which generate nearly one-third of the medical waste transported off-site.) All other types of facilities together, including DOH clinics, correctional facility clinics, Emergency

Medical Service operations, HHC Neighborhood Family Care Centers, and all other non-municipal medical-waste generators produce the rest of this waste. Representative waste samples were weighed and sorted at each of the 16 acute-care hospitals in the HHC system. Estimates of waste generation and composition from hospitals not in the City's system were made on the basis of prior sampling studies conducted at six hospitals and on walk-through visits and interviews to update these earlier findings, on a mailed survey of 47 hospitals (supplemented, in some cases, with follow-up interviews), and on reviews of purchasing records.

Of the 950 tons of medical waste generated in the city every day, about a quarter are regulated medical waste, and three-quarters are non-regulated medical waste.[10] Hospitals produce most of the regulated medical waste; the ratio of regulated to non-regulated medical waste in hospitals is 1:3, while for long-term-care facilities it is 1:25.

A detailed discussion of the medical-waste quantity and composition study is presented in Appendix Volume 8.

### 2.3.4 Sludge.

The Department of Environmental Protection developed current sludge-generation estimates for each water-pollution-control-plant drainage area based on historical data on the average flow into each plant, on the biological oxygen demand and total suspended solids in those flows, and on the efficiency of those plants in removing these pollutants. These total generation figures were used to develop per-capita generation rates that incorporated the contributions of both residential and working populations. (For purposes of this calculation, it was assumed that commuters deposit 40 percent of their daily defecations in city toilets.) Sludge generated by industrial facilities was also included in the development of overall generation rates.

New York City sludge-generation rates are lower than those in most other major cities. There are a number of factors that may explain this phenomenon. One of these is that in-sink food-waste grinders are prohibited in most of the city. Another is that there are relatively few industrial generators, such as breweries, paper mills, or food-processing plants, that generate large quantities of biological oxygen demand or suspended solids. A third is that the city's combined sewer overflows prevent some solids from being captured as sludge, because they release untreated sewage from street run-off and sanitary wastes directly into the rivers and harbor when heavy rains overload the sewer system.

In addition to "sludge" -- the organic material in waste water -- the solids that remain after sewage is treated also consist of grit, scum, and screenings. "Grit" is the sand, gravel, and other mineral matter that is washed off streets into sewers. "Scum" is the greasy stuff that floats to the top of wastewater during treatment at a water-pollution-control plant. Screens in the in-flow pipes to a sewage treatment plant trap large objects, typically pieces of wood and plastic, that would damage the plant's equipment; these materials are called "screenings."

Almost 200,000 tons of digested sewage sludge were produced in New York City in 1990. Based on projections of population growth and changes in employment, that figure is expected to creep upward to 211,000 tons in 2010. Reductions in the amount of water used due to water-conservation efforts will not affect the amount of sewage generated; improvements in the Combined Sewer Overflow system, by reducing the amount of street dirt that is flushed into surface waters during storms, may slightly increase the amount of sewage sludge produced.

Depending on its sources, sludge may contain a variety of heavy metals and other pollutants of concern from an environmental and public-health perspective. The City's Industrial Pre-Treatment Program, in which likely generators of large pollutant quantities are identified and measures taken to reduce the levels of pollutants that they discharge, has significantly reduced loadings of cadmium, chromium, and nickel, but at certain treatment plants cadmium levels are still too high to meet the State's regulatory requirements for land application. The copper level in New York City sewage also exceeds the DEC limits for land application; these relatively high levels are due to the corrosive nature of the city's water, and the predominance of copper or copper-alloy piping and fixtures in most plumbing systems. The City has proposed a corrosion-control program to reduce leaching of copper and zinc.

A detailed discussion of present and projected sludge quantities and composition is presented in Appendix Volume 1.1.

### 2.3.5 Harbor Debris.

Harbor debris consists of two major types of material: wooden debris produced by the collapse or dismantling of piers, and floatable pieces of municipal solid waste, most of which reach the harbor through combined sewer overflows following storms. While the Fresh Kills landfill and the marine transfer stations that feed it at one time made some contribution to waterborne MSW (albeit a much less significant one), current operational controls at these facilities have virtually eliminated this problem. Recreational boating, commercial vessels, illegal dumping, dredging, and beach littering are insignificant in terms of generating harbor debris.

Most of the 36,000 tons of harbor debris collected annually from New York Harbor are from the demolition of shoreline piers. Only about 3,000 tons are "drift," the floating material that is pulled out of the water. Most of this material is likewise wood from decayed piers; the remaining 500 tons are primarily street litter, much of which is plastic, which enters the harbor through combined sewer overflows. The US Corps of Engineers collects this floating material with boats equipped with nets.

The wood that makes up 90 to 95 percent of pier debris contains significant quantities of preservatives such as creosote, pentachlorophenol, fluoro-chrome arsenic phenol, or chromated copper arsenate; traces of zinc, chromium, lead, and copper are the residue of these compounds. Most of the remaining pier debris is metal; tires (which are fastened to piers as shock absorbers to protect hulls) comprise about one percent of the total.

The "drift" or floatable portion of the harbor debris was the subject of a Department of Environmental Protection sampling program, which analyzed both generation rates and composition. 85-90 percent of it is wood from piers. Of the remainder, largely items that have been flushed into the harbor from CSOs, 80 percent are plastics (20 percent of which is "styrofoam" [polystyrene foam]). "Medical waste" comprises about 0.3 percent. "Sanitary" wastes (condoms, panty liners, plastic tampon applicators) comprise about four percent of these items. The bulk of this material, along with other typical street litter (candy wrappers, cigarette butts, bottle caps) comes from streets on both the New York and New Jersey sides of the harbor.

Since the bulk of the harbor-debris waste stream is produced by the demolition of aging piers (many of which are not being replaced), annual quantities of this material are projected to decrease as the current pier-removal programs are completed. The amount of floatable material that is collected, however, is expected to double as the Department of Environmental Protection starts a collection program to supplement the Corps of Engineers' activities. This increase in the percentage of the harbor debris that is collected will be somewhat offset by a slight decrease (projected at 50 to 100 tons a year) in the amount of harbor debris that is created, due to the DEP's planned CSO abatement program.

A detailed discussion of present and projected harbor debris quantities and composition is presented in Appendix Volume 1.1.

### 2.3.6 Dredge Spoils.

Nearly eight million cubic yards of material (about 2.6 million tons) are dredged from New York City's waterways every year. Most of it is dredged by the Corps of Engineers. The Port Authority of New York/New Jersey is the second-largest producer of dredge spoils, dredging 600,000 yards a year. Other dredging within the City limits produces 300,000 yards (about four percent of the harbor-wide total), more than half of which is done by municipal agencies. (The Sanitation Department, the largest municipal generator of dredge spoils, dredges about 87,000 cubic yards a year to maintain its marine operations.) The remaining material (366,000 cubic yards) is dredged from harbor locations outside the boundaries of New York City.

These data are derived primarily from the Corps of Engineers' tracking system, which requires quantity information from all dredging-permit holders who intend to dispose of dredged material at the Corps' Mud Dump Site. The small proportion of dredge spoils that is disposed of at upland sites must be quantified in applications for dredging permits, but this information, based on pre-dredging estimates, is less precise. These data sources were supplemented by historical data and interviews with generators of dredge spoils.

Generation rates vary considerably from year to year; over the past decade they have been somewhat lower than they were during the decade before. Generation rates are probably due more to the political and socioeconomic forces that support dredging activity than they are to the rate of sediment accumulation, and since the rate of sediment accumulation is presumably relatively constant, fluctuations in dredging activity are likely to be cyclical. To promote national commercial and security interests, the federal government has authorized the Corps of Engineers to perform most of the maintenance dredging in the Harbor, but recent efforts to control federal spending have shifted some funding responsibility to state and local government; this may slow the rate of dredging in the coming decades. Nonetheless, for purposes of this plan, projections of future dredge spoil volumes are based on annual averages over the past decade, and are assumed to be relatively constant.

The composition of the sediment varies significantly from location to location, but overall, New York Harbor sediments have among the highest metal concentrations in the country. Most dredging activity is "maintenance dredging," that is, dredging done simply to maintain sufficient draftage in existing channels. It produces spoils that consist mainly of sands, silts, and fine-grained clay. The ocean-approach channels dredged by the Corps of Engineers produce primarily sands, while the channels and berthage within the harbor area (where most of the City of New York's dredging activity takes place) are predominantly silts that contain a high concentration of organic matter. Sediment quality should improve in the coming years due to such factors as the improved operational controls for the Sanitation Department's barge system, which has reduced the amount of debris falling into the water, and the City's efforts to enforce illegal-dumping ordinances.

The most significant sources of pollutant loadings are municipal wastewater and surface run-off. The City's industrial pre-treatment program has significantly reduced the concentrations of pollutants flowing to wastewater treatment plants; this reduction has presumably reduced the concentrations of pollutants in CSO discharges as well. The City's plans to minimize CSO discharges by building CSO storage facilities, collection conduits, and swirl concentrators, would reduce sediment loadings by approximately 10,000 cubic yards a year, as well as improving water quality.

An analysis of dredge samples is a pre-requisite for a dredging permit from the Corps of Engineers. 95% of the material dredged in New York Harbor meets the Corps' standards for ocean disposal, which means that the Corps has determined that contamination levels are not significant enough to cause adverse environmental impacts. The remaining five percent is considered to be either acutely toxic to marine biota, or to cause unacceptable rates of bioaccumulation.

A detailed discussion of present and projected dredge spoils quantities and composition is presented in Appendix Volume 4.2.

## 2.4 Air Resources, Current and Projected.

Unlike many major metropolises (Los Angeles and Denver spring to mind, and further away, Mexico City, London, and Tokyo), New York City has been blessed with splendid meteorological resources. Winds and weather systems sweeping across the continent push pollutants out to sea, while ocean breezes moderate the effects of heat and cold.

Most of the land area of the city is covered with buildings, many of which are relatively high. This "rough" urban surface creates a turbulent wind pattern which affects the way pollutants are dispersed; unlike flat "rural" terrain, where the wind tends to move horizontally, winds are deflected up and down, thus creating somewhat higher pollutant concentrations under certain conditions than would otherwise be the case. Another feature of local geography that can affect the dispersion of pollutants is known as the "sea-breeze effect." When there are relatively dramatic differences between sea and land temperatures (as, for example, on hot spring days, when the land heats more quickly than the ocean does), a circular wind pattern can arise between sea and shore beneath the upper "boundary" layer; this can have the effect of keeping pollutants from ground-level or short-stack sources entrained in circulating air currents.

Depending on the height of the source from which air pollutants are released, two other features that can affect site-specific pollutant concentrations are building heights and terrain heights. New York has the highest concentration of high-rise buildings in the world: people breathing air from open windows or ventilation in-takes atop these buildings may be exposed to higher pollutant concentrations from elevated pollutant sources than would people on the ground. New York's terrain is relatively gentle (a feature modestly increased by prior generations' shaving and leveling), and much of it is near sea level, but each borough has areas with elevated terrain, the most dramatic of which is the 490-foot Todt Hill in Staten Island.

Federal regulations (the National Ambient Air Quality Standards) establish "permissible" levels for six air pollutants, carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, inhalable particulate matter, and lead, which are collectively referred to as "the criteria pollutants." In addition, New York State has ambient standards for total suspended particulates, settleable particulates, hydrocarbons, fluorides, beryllium, and hydrogen sulfide. Levels of these pollutants are monitored to determine whether the city's air quality is "in compliance" with these standards. If a region is found to be "in non-attainment of standards" for a particular pollutant, it must submit to the State DEC and the US EPA for their approval a plan (known as a "State Implementation Plan," or "SIP") for reducing concentrations of that pollutant. In addition, any new facility which is considered to be a major source of that pollutant must use the most stringent pollution-controls available for that pollutant, no matter what the cost.

Along with much of the Northeast, the entire City has been determined to be "in non-attainment" for ozone, a compound that is formed by photochemical reactions from nitrogen oxides and hydrocarbons. Most of the city also exceeds the standard for carbon monoxide, although carbon monoxide concentrations have decreased over the past few years as a result of vehicle inspection and maintenance programs and emission controls (catalytic converters). The city is in compliance with the other four federally regulated air pollutants, sulfur dioxide, nitrogen dioxide, total suspended particulates, and lead. There has been an overall decrease of sulfur dioxide levels due to a reduction in the sulfur content of heating oil and to the reduced consumption of coal. Lead levels have continued to decrease also, primarily due to the prohibition of lead additives in gasoline. Levels of nitrogen dioxide, an effluent from industries and electrical utilities, have increased since 1981. Total suspended and inhalable particulate levels, which are largely due to incomplete combustion of fuel from factories, power plants, cars, and construction activity, have shown some variation, but have remained fairly constant.

A detailed discussion of air-quality conditions in New York City is presented in Appendix Volume 6.

## 2.5 Water Resources, Current and Projected.

The New York City Department of Environmental Protection routinely samples the waters of New York Harbor during the summer months at more than 50 locations. Analyses are conducted weekly for dissolved oxygen, biochemical oxygen demand, and coliform bacteria. Analyses are performed once a season on a wider range of pollutants, including nitrogen, phosphorous, and various toxic metals and compounds. Certain reaches of the harbor and estuary system exceed standards for certain heavy metals, pesticides, and industrial chemicals.

A detailed discussion of water-quality conditions in the New York Harbor and estuarine region is presented in Appendix Volume 6.

## 2.6 Transportation Systems, Current and Projected.

The existing rail-freight network in New York City is complex and inefficient; boxcars are often shunted between a number of carriers, and rail cars often wait up to three days at different classification yards. Expanded rail-freight transport opportunities exist via Conrail, the Long Island Railroad (LIRR), and the Staten Island Railroad Corporation, and, in the Brooklyn waterfront area, the South Brooklyn Railway, the Bush Terminal Railroad, the 55th Street Rail Yard, and the New York Cross Harbor Railroad.

Conrail has active rail freight service through Brooklyn, Queens, Manhattan, the Bronx, and New Jersey. While many of the Conrail lines have been abandoned, many of those that remain have excess capacity. Conrail connects with Interstate Bi-modal, which floats solid waste by barge across the Harbor into New Jersey, the LIRR in Queens, the Staten Island Railway, the Cross

Harbor Railway, and the South Brooklyn Railway. The LIRR has underutilized or inactive rail freight lines that run from Manhattan through Brooklyn, Queens, Nassau and Suffolk Counties. The Staten Island Railroad has underutilized or inactive freight lines that run through Staten Island and to New Jersey.

Rail transport provides some economies of scale at distances beyond about 400 miles. There are, however, three major problems associated with rail transport at the present time in this region. First, there are an insufficient number of transfer stations located adjacent to rail spurs. Second, except for barging across the Hudson, New York City does not have a direct rail connection to the west: rail traffic must go to Albany before crossing the Hudson River, which can cause a delay of up to three days. Finally, few landfill sites have rail spurs, which necessitates costly trans-shipments from rail car to truck for the final shipment to the landfill site. The result is that only five percent of New York's commercial waste is moved by rail.

While none of New York City's waste is currently exported by water, marine transport could be a cost-effective way to move large quantities of waste over long distances if an acceptable destination port with convenient access to a disposal facility could be found.

A detailed discussion of transportation conditions relevant to future waste-management systems is presented in Appendix Volume 2.

## Endnotes

1. Stegman, Michael A., Housing and Vacancy Report: New York City 1987.

2. Statistical Profile, Appendix B, Table 25.

3. Statistical Profile, p.2-46.

4. David W. Dunlap, New York Times, 3-4-91:B4.

5. Statistical Profile, Executive Summary, p.3.

6. This projection is presented in Appendix 1-A in Appendix Volume 1.1.

7. The strata were defined as follows:
   High Density = Residents of buildings with more than four units and five or more stories.
   Medium Density = Residents of buildings with more than four units but under five stories.
   Low Density = Residents of one-to-four-family buildings.
   The income levels were created on the basis of 1980 census data, by dropping the top and lower 10 percent, and dividing the remaining 80 percent equally (approximately 26.6 percent per category).
   Census tracts were defined as low, medium, or high income on the median 1980 incomes of their residents; census tracts were similarly weighted on a density basis.
   See Appendix Volumes 1.1 and 1.2 for more detailed explanations.

8. See Statistical Profile, Appendix Volume 1.1.

9. These data were from the U.S. Bureau of Labor Statistics, for 1989.

10. On the basis of a 365-day year, there are 788 tons per day of medical waste in the City; the number in the test, 950 tons per day, is on the basis of a 302-collection-day year, which is how daily MSW waste quantities are presented. Of these 950 tons, about 75 are black-bag waste generated by so-called "small-quantity generators," which enters the ordinary commercial or municipal waste stream, and is not separately handled as "medical waste."