FRESH KILLS: LANDFILL TO LANDSCAPE

INTERNATIONAL DESIGN COMPETITION : 2001

ABOUT FRESH KILLS

Fresh Kills Landfill is located on the western shore of Staten Island. Approximately half the 2,200-acre landfill is composed of four mounds, or sections, identified as 1/9, 2/8, 3/4 and 6/7 which range in height from 90 feet to approximately 225 feet. These mounds are the result of more than 50 years of landfilling, primarily household waste. Two of the four mounds are fully capped and closed; the other two are being prepared for final capping and closure. Fresh Kills is a highly engineered site, with numerous systems put in place to protect public health and environmental safety. However, roughly half the site has never been filled with garbage or was filled more than twenty years ago. These flatter areas and open waterways host everything from landfill infrastructure and roadways to intact wetlands and wildlife habitats. The potential exists for these areas, and eventually, the mounds themselves, to support broader and more active uses. With effective preparation now, the city can, over time, transform this controversial site into an important asset for Staten Island, the city and the region.

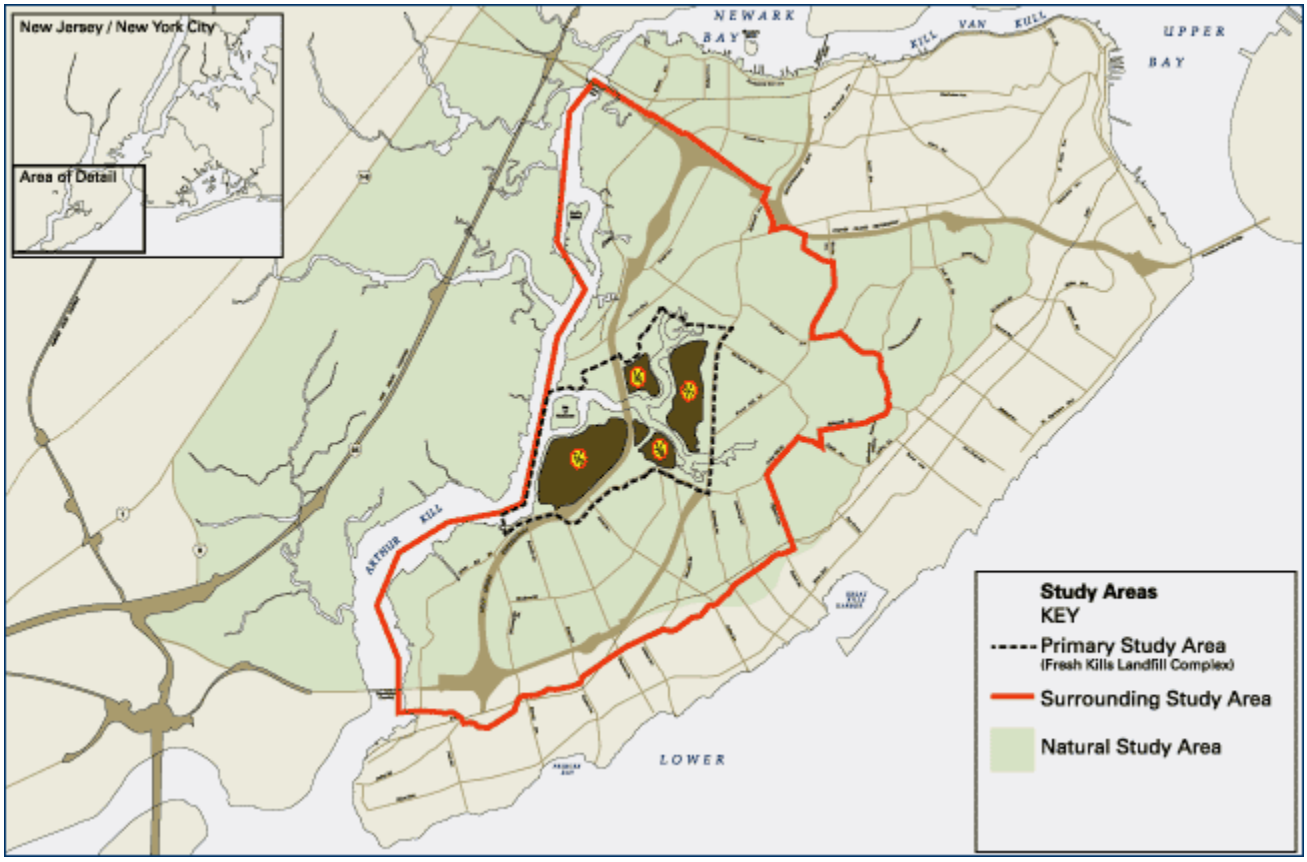
Before dumping began, Fresh Kills Landfill was much like the rest of northwest Staten Island. That is, most of the landfill was a salt or intertidal marsh. The topography was low-lying, with a subsoil of clay and soils of sand and silt. The remainder of the area was originally farmland, either actively farmed, or abandoned and in stages of succession.

Although Fresh Kills Landfill is not a wholly natural environment, the site has developed its own unique ecology. Today, even with four large landfill mounds on the site, forests, tidal wetlands, and freshwater wetlands still exist. One of the fundamentals of nature, adaptation, is demonstrated in the evolution of these natural features in an unnatural context.

Perhaps most representative of nature's ability to adjust to man's presence is the Isle of Meadows. Located at the mouth of the Fresh Kills Estuary, the Isle of Meadows was first harvested for its salt hay. The island then served as a repository for spoils from channel-dredging operations. Most importantly, it now serves as a source of ideal materials for herons constructing nests.

The potential value of this site is increased by the fact that the Fresh Kills Estuary lies on the Atlantic Flyway. The Flyway is a path used each spring and fall by many bird species as they migrate to the north and south. The Fresh Kills Estuary, designated by New York State as a Significant Coastal Fish and Wildlife Habitat, is one of the largest tidal wetland ecosystems in

the region.



Fresh Kills Reference

The Fresh Kills Site and its Context

Fresh Kills Landfill received its last barge of garbage on March 22, 2001, marking the beginning of a new era for the landfill. Whether seen as community blight, a majestic landscape or an engineering marvel, the landfill and its context, in all its varied aspects, must be fully understood by future planners and designers of the Fresh Kills site.

Fresh Kills Landfill Complex

The approximately 2200-acre Fresh Kills Landfill Complex is located in the central western portion of Staten Island. Approximately half of the landfill is composed of four mounds, or sections, identified as 1/9, 2/8, 3/4 and 6/7, which range in height from 90' to an anticipated 225'. These mounds are the result of more than fifty years of landfilling of primarily household waste. A system of tidally influenced creeks flow through the landfill and ultimately meet along the western boundary of the site at the Arthur Kill waterway.

Surrounding Study Area

The Surrounding Study Area is defined by census tracts that are adjacent to or near the Fresh Kills Landfill Complex. It extends from one to three miles north, east and south of the landfill, encompassing approximately one third of Staten Island. History and archeology; land use and zoning; neighborhoods; population; and traffic and transportation are discussed in the context of the surrounding study area.

Natural Study Area
The natural study area encompasses unique geological and natural systems important to the ecological functioning of the area and relevant to the Fresh Kills Landfill. This study area includes natural areas within a complex of residential, commercial and industrial areas. The area extends from Staten Island into New Jersey, based on an assessment of major topographical features, delineation of the Fresh Kills Watershed, and the presence of unique natural habitats relevant to the landfill. The boundary of the study area is aligned with major roads or highways.

Regional Context
The Fresh Kills Landfill is located in New York City, one of the world's global command posts. The city serves as the nation's and perhaps the world's cultural, communications, business service and financial capital as well as a premier tourist destination. With the presence of the United Nations headquarters, the city is often referred to as the capital of the world. It is also home to the world's most diverse population.

The city's five boroughs -- Staten Island, Brooklyn, Manhattan, Queens and the Bronx -- are at the heart of a 31-county region that spreads over portions of three states: New York, New Jersey and Connecticut. The city is famous for Manhattan's skyscrapers and high-density development yet most of the city, particularly outside of Manhattan, is developed with buildings of three or fewer stories.

Both the city and its region are dynamic. The city's official population grew by 9.4 percent between 1990 and 2000, exceeding eight million for the first time. During the last decade the city grew faster than the region which increased in population by 8.3 percent and now has over 21 million residents. Staten Island, with a 2000 population of 443,728 accounts for 5.5 percent of the city's populace. Its 17.1 percent increase in population between 1990 and 2000 makes Staten Island the fastest-growing county in New York State.

New York City is also the largest center of employment in the United States. Its exceptional concentrations of talent, finance, business, industry, media and culture have no rivals in this country and few abroad. In the second half of the 1990's, the city experienced its most rapid economic growth since data collection began in 1950 and, exclusive of the self-employed, employment now tops 3.7 million.

History & Archaeology

PALEO-INDIAN PERIOD (10,000BC TO 8000BC)
Most historical artifacts in Fresh Kills Landfill have either been buried or previously removed by treasure hunters. However, records from the early part of the twentieth century report that Native Americans inhabited the area of the Fresh Kills Landfill Complex and its surrounding environs starting in the Paleo-Indian period until approximately the 1670s. Vestiges of Native American settlements and campsites, such as shell middens and tools, have been discovered

in the Landfill Complex. The earliest artifact discovered, a Paleo-Indian fluted projectile point, was found close to the southernmost tip of Section 1/9. Such remains were also found in Charleston and Rossville.

ARCHAIC PERIOD (CA 8000-1000BC)

A major shift in settlement among Native Americans was noted during the Archaic Period. While hunting and gathering was still a part of everyday life, the prey shifted from large Pleistocene animals, which were becoming extinct, to small game, fish, shellfish and plants.

Vestiges of Native American settlements and campsites were discovered in the Landfill Complex including on Lake Island (the northern tip of 1/9) where Henry David Thoreau was known to have collected arrowheads. Burial sites, relics and oyster and clamshell middens have been found throughout the Landfill Complex and its surroundings. During this period a rise in sea level resulted in a consequent rise in the Staten Island water table and the creation of large swamps. Perhaps as a result, settlements became larger and more permanent.

WOODLAND PERIOD (CA 1000BC-1600AD)

During the Woodland Period, ceramic vessels were used, and by the middle Woodland Period plants were domesticated. By the late Woodland Period, while hunting-gathering and shellfish harvesting continued, horticulture became well established. The presence of many storage pits on Staten Island is indicative of large base camps or villages.

NATIVE AMERICAN CONTACT PERIOD (1600-1750AD)

In 1524 the first European, Giovanni da Verrazano, came to Staten Island. Eighty-five years later, Henry Hudson named the island Staten Eylandt, after the Dutch governing body, the States-General. This marks the beginning of the Native American Contact Period, when the settlement of New Amsterdam by the Dutch prompted trade with the Lenape Indians who occupied Staten Island. As a result, the Lenape acquired European-made tools, ornaments, and other material items.

The landscape of the island was altered little during its centuries of Indian occupation. When the Dutch ruled New Amsterdam, attempts at colonization began during the first half of the 17th century, though none succeeded. In 1639, David Piertsz, to whom title to the island had been granted, sent over a group of people to settle it. One observer chronicled the poor treatment of the Native Americans during this failed period of colonization: "such acts of tyranny were.... far from making friends with the inhabitants." Barlow, Elizabeth, The Forest and Wetlands of New York City, (Boston: Little Brown and Co., 1971): 94

Staten Island eventually became part of a popular stage coach route between New York City and Philadelphia, crossing the Arthur Kill by boat in the vicinity of Rossville and later at Travis. Under English rule, after 1664, European settlement of the island began in earnest. In 1670 the Lenage signed a treaty surrendering their possession of the island.

By 1683, the colony of New York was divided into ten counties. Staten Island, Shooter's Island and the Isle of Meadows became Richmond County. Land patents were granted in 80-acre units, many located along the coastline or inland waterways. By 1708 the entire island was separated into 166 farmshares with two manorial estates. Eventually, the British divided the island into four administrative precincts-North, South, West and Castleton.

The first real village in Staten Island, Richmondtown, became the county seat in 1729. Residents were primarily self-sufficient farmers and fishermen living in small settlements close to ferry landings, farms or commercial activities. The island's coastal and agricultural economy prospered owing to successful farming, fishing, shipping, piloting, maritime trading, flour and lumber milling and blacksmithing enterprises. This lifestyle endured until almost a hundred years later, when rapid development in the other boroughs triggered growth in Staten Island. During this period, Staten Island could attribute its distinct, cultural and linguistic mix to the strong French Huguenot presence, Dutch and English immigrants and a substantial minority of Africans, most of whom were slaves.

THE AMERICAN REVOLUTION (1776-1783)

From 1776 until 1783 Staten Island, like the surrounding mainland, was engulfed by the Revolution; Richmond County was under British occupation. Staten Island's location at the entrance to the New York Harbor was strategically valuable. After 1776 it became the primary ground for the landing and staging of British troops. The British Army cleared Staten Island's hilltops for strongholds and chopped down its forests for firewood.

With the patriot victory, farms that had been pillaged by the British returned to prosperity and Staten Islanders resumed their agrarian and maritime livelihoods. A second growth forest appeared on the hillsides, and the broad rolling plains became pastoral landscapes of fields and hedgerows. What would become the Landfill Complex was at this time mostly expansive salt hay marsh and, to a lesser extent, orchards and cultivated fields.

FROM AGRICULTURE TO INDUSTRIALIZATION (19th Century)

Beginning in the early 1800s and for almost a century thereafter, Staten Island's chief industries were farming and oystering. Salt hay was the island's main cash crop. It was used for grazing and sold for cattle bedding and packing material.

Rapid growth in the other boroughs triggered more industrial growth in Staten Island. Records show public docks for schooners delivering goods and loading products from the tanneries, flour mills and farms of Richmondtown. Twisting estuarine creeks and rivulets fed Fresh Kills forming branches through the marsh. Both Richmond and Main Creeks were navigable for more than a mile. Sandy hummocks protruded out of the surrounding tide-inundated land. Cargo ships traveled up Fresh Kills Creek and Richmond Creek. These waters were also used for fishing, hunting and swimming.

With the advent of industrialization, several brick factories, which quarried the local clay, were built on the Landfill Complex south of Fresh Kills. Additionally, a waste disposal facility predominately used for animal rendering operated in the vicinity of the northern portion of section 1/9 (Lake Island).

THE CIVIL WAR

Until the 1850s Staten Island's cohesive identity and character as a county remained, despite growing population and "strong internal divisions between the Northeast and Southwest, immigrant and native, Republican and Democrat, metropolitan and rural resident" [Jackson, Kenneth, editor, The Encyclopeida of New York, Yale University Press, New Haven, Conn., 1995 page 1114]. Unity and growth were marked by the opening of a railroad between Clifton and Tottenville and the subsequent development of hamlets at the railroad depots, such as Eltingville, Annadale and Huguenot. Development slowed during the Civil War when Staten Island became a major military encampment and training ground.

COMPANY TOWNS AND FORMER SUMMER RETREATS

After the war, development and industrialization resumed and "company towns" were established to support the factories. To the south of Fresh Kills, the town of Kreischerville (known today as Charleston) was devoted to manufacturing fire bricks, gas retorts, drainpipes and other refractory ware made from clay mined in the vicinity of today's Clay Pit Ponds State Park Preserve. To the north of Fresh Kills, in the locale of today's Travis, the American Linoleum Company established the town of Linoleumville to support production of innovative linoleum as well as floor cloths, ground cork and linseed oil.

Despite increased industrialization, population still lagged in comparison to the other boroughs. In response, the state legislature formed an investigative committee, led by Frederick L. Olmsted, to determine the cause of slow growth. In 1871, the committee found poor ferry service, fear of malaria, and poor drainage contributing to a slow rate of development. In these years the island was notorious for its malarial infestation.

Previously established suburban villas and summer retreats relocated to Westchester and Long Island, ending an era in which Staten Island attracted residents of New York City in search of

summer homes. Olmsted proposed a drainage network of open-jointed pipes three or four feet below the ground surface, graded so that the water would flow in descending channels to outfalls near the shore. In addition, he suggested that "free spreading trees should be common" to provide shade necessary to guard against "wafted malaria". The ditching of these areas was implemented, but not until around 1888. Other recommendations by Olmsted's committee for a system of major roads and parks were mostly ignored by the State.

DEVELOPMENT AND CONSOLIDATION

Improvements to utilities and transport services, made by a developer, Erastus Wiman, spurred growth in the 1880s and 1890s. In 1880, rail and ferry services were consolidated, expanded, and unified. Wiman sought to establish suburbs, estates, heavy industry, popular resorts, and mass entertainment.

In 1894, Staten Islanders, although wary of overwhelming growth, voted 4 out of 5 for consolidation with the City of New York. Town governments were disbanded and George Cromwell was elected Borough President.

STATEN ISLAND OBSERVED

William T. Davis left one of the larger legacies in Staten Island. His work, including "Days Afield On Staten Island," documented Staten Island at this time. At the end of the nineteenth century, when Davis recorded his observations, the Staten Island shore was dotted with shell heaps and mounds of Indian artifacts, forests were populated with oaks and chestnuts and salt marshes dominated the western shores of the island.

This was the Staten Island that also charmed Henry David Thoreau as a young man. In a letter to his family soon after his arrival, Thoreau wrote, "The whole island is like a garden and affords very fine scenery."

EARLY TWENTIETH CENTURY

Before the turn of the nineteenth century, an influx of immigrant groups had begun to settle in older shoreline villages and manufacturing areas. They were predominantly Italians, Hungarians, Poles, Slavs, Scandinavians, and African Americans. The 1880 census tallied Staten Islanders living on farms and in villages. A concentration of business activity developed in St. George and in 1898, the county seat was moved there. Construction of Borough Hall began in 1904. By 1921 all government facilities, except for the county jail, were in St. George. Tentative plans for a subway link between Brooklyn and Staten Island triggered increased real estate speculation.

By 1922, approximately two-thirds of Staten Islanders lived in the northern and eastern portions of the island. Although the island still hosted a small but thriving agriculture and horticulture industry increased activity in the Port of New York and New Jersey fostered increased industrialization of the shorelines of the Arthur Kill and the Kill van Kull.

Commercial access to Staten Island greatly improved by 1931 after the opening of the Goethals and Bayonne Bridges and the Outerbridge Crossing provided, for the first time, vehicular links between the island and the mainland of New Jersey. However, growth remained slow in the midst of the Depression. Plans for the subway link were abandoned and tax defaults returned thousands of acres of land to the city. During the Second World War, industry was boosted temporarily.

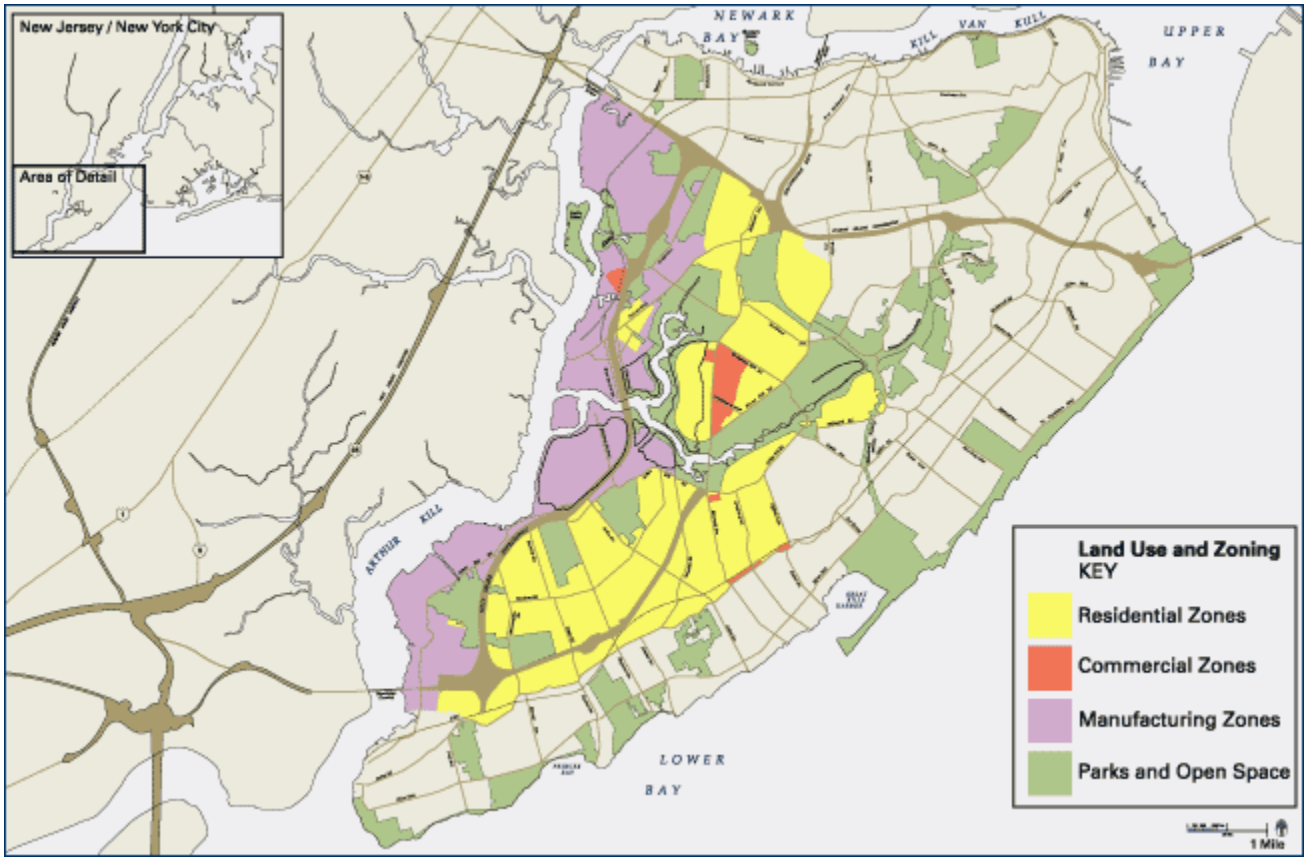
FROM 1948 TO PRESENT

After the Second World War, population began to grow slowly. However, the central western shoreline of Staten Island remained rural. This would become the site for Fresh Kills Landfill, occupying nearly 3,000 acres. It started receiving waste in 1948 and this program was greatly accelerated in 1951.

For Staten Island, the opening on November 21, 1964 of the Verrazano Narrows Bridge was the most significant part of Robert Moses' plans for increasing limited access roads and bridges in the region. This new connection to Brooklyn, Staten Island's first and only arterial link to

another New York City borough, had a profound effect on its growth and development. From that date on, Staten Island became one of the fastest growing counties in the state. It retained its suburban character, even with a rapid population increase, partly as a result of several actions to preserve open space enacted by the city during this period (e.g. adoption of special zoning districts and creation of the Staten Island Greenbelt).

The 2000 census counted 443,728 residents of Staten Island, still the state's fastest growing county and the city's least densely populated borough.



Land Use & Zoning

Since the 1960s, the area surrounding Fresh Kills has become increasingly suburbanized. This character is strikingly different from that of most other parts of New York City.

Future growth is anticipated to occur primarily in the southern portion of the study (surrounding) area, where there are still large tracts of vacant land. Over 1,200 residential units, 18 acres of industrial use including a private waste transfer station, and over 40 acres of commercial development are currently in the planning stages for the area.

RESIDENTIAL ZONES

About one-quarter of the land area in the study (surrounding) area is comprised of residential one- and two-family detached and semi-detached houses with most buildings no more than two stories in height. Residential zoning in the area is predominately lower density, allowing single-and two-family residences, attached and detached, garden apartments, row houses and a broad range of community facilities.

Only one small area found in New Springville is zoned for medium-density residential use. Housing in this area consists of three-story, walk-up and elevator multiple dwellings. The

maximum building height is 40 feet.

Approximately nine percent of the land in the surrounding area consists of public facilities and institutions. The largest is the College of Staten Island in the northeast portion of the study area.

COMMERCIAL ZONES

Only a small proportion of the land area in the surrounding area, three percent, is used for retail and office use, ranging from small neighborhood shopping area, to a large regional shopping facility - the Staten Island Mall.

MANUFACTURING ZONES

Close to a quarter of the study (surrounding) area is used for manufacturing, industry, utilities and transportation, most of which is concentrated in the west. Almost 15% of the total is the Fresh Kills Landfill Complex. Other uses in this category include the closed Brookfield Landfill, Port Mobil oil storage, the NRG Power Plant (formerly Con Edison) and a paper recycling plant.

The Arthur Kill is heavily trafficked by vessels serving bulk oil storage facilities along both shores. On the New Jersey shore, there are a number of industrial uses, including chemical plants, oil refineries, and storage facilities, many of which are water-dependent. Collectively, the two shores house the largest concentration of oil storage facilities in the harbor.

PARKS AND OPEN SPACE

Another one-quarter of the land area is dedicated to parks and open space. This does not include creeks in the surrounding area, or vacant properties, many of which are natural in character. The surrounding area enjoys an exceptionally high ratio of preserved open space to population, 37 acres per 1,000 persons as compared with the citywide median of 1.5 acres per thousand, or even the island's high open space ratio of over 15 acres per 1,000. The character of the open space is predominately natural.

Sports facilities, such as ballfields, courts and playgrounds, are unevenly distributed and lacking in several neighborhoods. The largest park with sports facilities is Willowbrook Park in the northern portion of the surrounding area.

A large portion of the 2,500-acre Staten Island Greenbelt is a dominant part of the open space network in the study area. The Greenbelt encompasses both private and public land, including wetlands, woodlands, stream corridors and ponds. It borders Fresh Kills Landfill on the north and east, forming almost a complete circle. It extends from the highlands beyond the northeast portion of the study area through La Tourette Park and Golf course south to the landfill. The Greenbelt also contains the lowlands of the William T. Davis Wildlife Refuge in the west and Willowbrook Park in the north.

Other large tracts of ecologically rich land in the surrounding areas include Clay Pit Pond State Park Preserve, characterized by pine barrens and bogs; Bloomingdale and Arden Woods, characterized by freshwater wetlands and forests; and the Staten Island Corporate Park, characterized by swamp forests. Additionally the study area has two golf courses, South Shore Golf Course and La Tourette Park and Golf Course.

SPECIAL DISTRICTS

To further guide development of Staten Island's natural areas, the City has designated three different special purpose zoning districts which tailor underlying zoning regulations to maximize preservation of unique natural features. These districts form a corridor through Staten Island. Special districts are established through zoning text and zoning map amendments, which involve approval by the City Planning Commission and the City Council.

Special South Richmond Development District (SSRDD) The entire southern portion of the study area, from a line formed west to east by Fresh Kills Creek, Richmond Creek, Arthur Kill Road, Richmondtown Road, Clarke Avenue and Willowbrook Parkway to the southern tip of the island, is located in the Special South Richmond Development District (SSRDD). This

includes the southern portion of the Fresh Kills Landfill.

The SSRDD was adopted in 1975 to guide development of predominately vacant land. The special district maintains the densities of the underlying zones and ensures that new development is compatible with existing communities.

To maintain the existing community character, the district mandates tree preservation and planting requirements, controls changes in the topography, and limits the height of buildings. Additionally it restricts construction within over 100 acres of vacant land within the study area mapped as Designated Open Space.

Special Natural Area District (SNAD) Adopted in 1976, this district's purpose is to preserve unique natural characteristics, such as aquatic, biologic, geologic, and topographic features having ecological and conservation values, by reviewing all new developments and site alterations on primarily vacant land. Natural features are protected by limiting modifications in topography, by preserving tree, plant and marine life, and natural watercourses, and by requiring cluster development to maximize preservation of natural features.

Special Natural Area Districts have been mapped over the northern portion of the landfill and the Greenbelt and a small district in the northeastern part of Staten Island.

Hillsides Preservation District Although this district is not within the study area, it is part of a continuous corridor that is formed by the Special Districts. The purpose of this district is to preserve hilly terrain and unique natural features of Staten Island by reducing hillside erosion, landslides and excessive stormwater runoff. The primary concept for regulating development under this special district is the slope coverage approach: as the development site becomes steeper, the permitted building coverage decreases. Conservation of vegetation and tree preservation are also part of these regulations

Population

With 5.5 percent of the city's population, Staten Island remains one of the least densely populated areas of New York City, but it is growing rapidly. It grew by 64,751 people in the 1990s, reaching a total of 443,728 persons. This represents a growth rate of 17.1 percent between 1990 and 2000, higher than any other county in New York State. While increasingly diverse, the population remains predominantly white and native-born.

The population in the Study (surrounding) area continued to rise according to preliminary 2000 census data; almost 20,000 additional persons were counted, a change of almost 21 percent (see table below).

	1980	1990	% Change,	2000	% Change,

			1980-1990		1990-2000
Surrounding (Study) Area	76,745	99,289	29.4	119,115	20.7
Staten Island	352,121	378,977	7.6	443,728	17.1
New York City	7,071,639	7,322,564	3.3	8,008,278	9.4

Traffic & Transportation

Staten Island is accessible by ferry and four bridges. The famous Staten Island Ferry provides a link for pedestrians and vehicles between lower Manhattan and St. George at the northern-most point on the island. The Verrazano Narrows Bridge connects Staten Island, via the Staten Island Expressway (I-278), with the Borough of Brooklyn; the Bayonne Bridge provides access to Bayonne, New Jersey to the north via the Dr. Martin Luther King Jr. Expressway (Rte. 440, the Willowbrook Expressway); the Goethals Bridge provides access to Elizabeth, New Jersey by way of the Staten Island Expressway (I-278) at the island's northeast corner; and the Outerbridge Crossing connects with Amboy, New Jersey at the southern end of the island by way of the West Shore Expressway (Rte. 440).

ROADS

Regional access to the landfill (from New Jersey and other New York City boroughs) is provided by the island's three limited access highways: the Staten Island Expressway (I-278), the West Shore Expressway (Route 440) and the Dr. Martin Luther King Jr. Expressway (Rte. 440, Willowbrook Expressway). Important arterial roadways in the surrounding area include the Korean War Veteran's Memorial Highway (Richmond Parkway), Victory Boulevard, Arden Avenue, Arthur Kill Road and Richmond Avenue.

Fresh Kills Landfill is accessible from the West Shore Expressway at the Victory Boulevard exit, by way of the West Service Road. Vehicles can exit the landfill just south of the Victory Boulevard exit by the East Service Road (Glen Street). Muldoon Avenue also provides ingress and egress from the landfill by way of the southbound West Shore Expressway West Service Road just south of the Muldoon Avenue exit. (Although the West Shore Expressway bisects the site, allowing the public to pass "through" its landscape, it is not publicly accessible.)

Brief descriptions of existing access roadways follow.

Staten Island Expressway (I-278) an east-west limited access highway across northern Staten Island from the Goethals Bridge to the Verrazano Bridge, connecting Staten Island to New Jersey and Brooklyn.

West Shore Expressway (Route 440) a north-south limited access highway along the west shore of the island, connecting the Staten Island Expressway to southern Staten Island and to New Jersey, via the Outerbridge Crossing.

Dr. Martin Luther King Jr. Expressway (Willowbrook Expressway, Rte. 440) a north-south, limited access highway between the Staten Island Expressway and the Bayonne Bridge to New Jersey.

West Service Road an incomplete, southbound roadway along the west side of the West Shore Expressway. Access to Fresh Kills is available from this roadway at the intersection of the West Service Road and Wild Avenue.

Glen Street a local, one-way northbound roadway, which east of Route 440 becomes the East Service Road. A landfill exit is located at the intersection of Glen Street and Wild Avenue.

Muldoon Avenue a two-lane roadway providing direct access to section 1/9 of the landfill from the West Service Road. A designated exit ramp for Muldoon Avenue traffic is provided from the southbound West Shore Expressway. The road originates at the West Service Road, just west of the West Shore Expressway and terminates in the north near Fresh Kills Creek. There is an additional closed portion of Muldoon Avenue between the West Shore Expressway and Arthur Kill Road.

Victory Boulevard a major arterial in the northern portion of Staten Island, extending from St. George to Travis and the landfill. In the vicinity of the landfill it becomes a two-lane roadway with access to the West Shore Expressway.

Arthur Kill Road a major two-way, two lane roadway in southern Staten Island, bordering the southern boundary of Fresh Kills Landfill.

Richmond Avenue one of the few major north-south roads on Staten Island, extending through highly developed residential and commercial (including the Staten Island Mall) areas. In the vicinity of Fresh Kills, it is generally a six-lane roadway with signalized intersections at frequent intervals.

Arden Avenue a local, two-way, two-lane road extending east from the landfill through residential neighborhoods in southern Staten Island.

Korean War Veterans Memorial Parkway (Richmond Parkway) a limited access highway linking the Outerbridge Crossing to the West Shore Expressway and Richmond Avenue just south of the Staten Island Mall.

CRITICAL TRAFFIC INTERSECTIONS

The following intersections may have bearing on plans for the end use of the Fresh Kills Landfill Complex.

Victory Boulevard and West Service Road a signalized intersection, providing direct access to Fresh Kills Landfill via West Service Road and Wild Avenue, that acts as a regular passageway for trucks and other vehicles in and out of the Landfill.

Victory Boulevard and Glen Street a signalized intersection that provides access to the landfill at the West Service Road, coming from the northbound West Shore Expressway.

West Service Road and Wild Avenue a major ingress and egress to Fresh Kills for trucks, heavy equipment and other large vehicles.

Ramp at West Shore Expressway (southbound) (Rte. 440) and Muldoon Avenue an unsignalized intersection providing access to and from the landfill. Traffic enters the landfill at Muldoon from the southbound off ramp of the West Shore Expressway. Traffic leaving the landfill via Muldoon must travel south on the West Service Road to Arthur Kill Road.

West Service Road and Arden Avenue an unsignalized intersection providing access to northbound 440 via Arthur Kill Road.

Arden Avenue and Arthur Kill Road an irregularly configured and signalized intersection. Three eastbound lanes on Arden Avenue narrow to two lanes east of the intersection. Arthur Kill Road has two lanes northbound and southbound.

Richmond Avenue and Platinum Avenue Richmond Avenue has six lanes on the southbound side, two lanes reserved for left turn movement on to Platinum Avenue. On the northbound side, there are four lanes, one of which is reserved for right turn movement. Platinum Avenue has two-way local traffic to and from the Staten Island Mall.

BUS SERVICE

New York City Transit Authority's bus network on Staten Island includes 22 local transit buses and 21 express routes. All express buses operate on weekdays and a limited number run on the weekends.

There are three types of bus routes on Staten Island:

- **St. George Feeder Routes** extend to all parts of the island from the St. George Ferry Terminal.
- **Cross Island Routes** are part of a grid system, providing internal links within the island.
- **Interborough Routes** are longer distance, interborough feeders to link to various destinations in Brooklyn and Manhattan.

The following local routes travel to or near the landfill: S62, S42, S74, S56, S44, S94, S91, S61.

RAPID TRANSIT SERVICE

The Staten Island Rapid Transit system (SIRT) extends 14.3 miles between the St. George Ferry Terminal and Tottenville at the southern end of the island. There are 22 stations, with an average distance of .68 miles between them. Forty-four cars provide service 24 hours a day, seven days a week.

The best route to Fresh Kills Landfill via the SIRT is to stop at the Annadale or Eltingville stations, transferring to the following local buses:

- **S55** - Huguenot via Annadale Rd
- **S59** - Port Richmond - Tottenville
- **S79** - SI Mall - Bay Ridge

WATERBORNE ACCESS

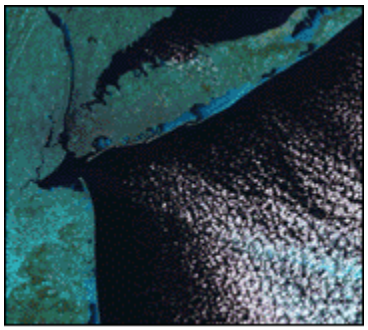
The Staten Island Ferry carries over 19 million passengers annually. On a typical weekday it transports approximately 65,000 people, primarily commuters to and from Manhattan. The ferry is also a major tourist attraction which operates 24 hours a day, 365 days of the year. The Fresh Kills Landfill is accessible from the Ferry Terminal by car, rapid transit or bus.

Fresh Kills Landfill can be reached directly by water from surrounding New York and New Jersey areas via the Arthur Kill, although waterborne service or public access are not available at present. Prior to closure, residential garbage was transferred by barge from one of nine Marine Transfer Stations to the landfill. Over one hundred barges entered Fresh Kills Creek daily and unloaded at one of two unloading facilities.

The Arthur Kill joins the Kill Van Kull and Upper Bay to the north and Lower New York Bay and the Atlantic Ocean to the south. Oil storage facilities and tidal wetlands characterize the New York and New Jersey shores. Collectively the shores house the largest oil storage facilities in the harbor. Thus many of the vessels on these waterways are oil tankers, which have little room to maneuver within the narrow confines of the Arthur Kill.

GREENWAYS

New York City is planning and developing a system of greenways for non-motorized commuting and recreational needs. Several greenways are being considered or developed in the areas surrounding the landfill. These include more than 10 miles of paths, some already existing, which will traverse the 2,500-acre Greenbelt and proposed network of routes along the south and west shores of Staten Island.



22 January 2000

Climate

Predominant meteorological conditions at the Fresh Kills Landfill are dictated by regional weather patterns, its geographic location and its topography. The weather in New York City is controlled by the jet stream causing the confluence of warm, moist air from the tropics and cold, dry air from polar regions. This can create extreme variations in humidity and temperature between summer (can be above 100° F/37.8° C) and winter (can be below 0° F/-17.8° C), although the average temperatures are 38° F/3.3° C and 70° F/21.1° C respectively.

The landfill's proximity to several rivers and to the Atlantic Ocean causes wind speeds to be higher than those in many landlocked areas. Average annual precipitation is approximately 44.12 inches/1122.6 millimeters spread evenly throughout the year. Slightly higher amounts fall during the spring months, and lower amounts during the winter months. Prevailing winds are from the northeast from November to April and from the southwest from May to October. The average wind speed measured at Central Park is 9.4 miles/15 kilometers per hour. The strongest winds are generally in March and the least windy months are July and August.

Fresh Kills Landfill is located on the west central coast of Staten Island along the Arthur Kill. It currently contains four large landfill mounds with a decidedly artificial appearance. It also contains marshland, and land that has never been filled or was filled more than twenty years ago.

The region's prevailing weather conditions are altered at the landfill because of the topography of the mounds. The steep slopes cause changes in air movements and, depending on their location, act as wind breakers, creating protected pockets, windy tunnels and changing solar exposure. Landfill areas exposed to high levels of sun and/or wind are thus subjected to harsher conditions. These conditions create opportunities and constraints for potential end use and vegetative cover.

Top images: Data available from U.S. Geological Survey, EROS Data Center, Sioux Falls, SD

GEOLOGY & TOPOGRAPHY

The geological history of any land includes such underlying rock structure and geologic processes as glaciation. These processes directly influence soil composition, the foundation for a functional, healthy community. The effects of glaciation on soil composition have a great influence on habitats in the study area.

The terminal moraine of the most recent glacier--the Wisconsin glacier--sits in Staten Island, creating three zones of differing geology: north of the terminal moraine, the terminal moraine itself and south of the terminal moraine. The area south of the terminal moraine is relatively unaffected by glaciation.

Most of the Fresh Kills Landfill sits in an ancient glacial lakebed. By l948 the lakebed had evolved into an intertidal marsh with winding streams, similar to the marshlands found today in northwest Staten Island.

Soil

The foundation beneath Fresh Kills Landfill includes unconsolidated overburden deposits and bedrock. The overburden deposits consist of peat, silt and clay, and sand and gravel of varying textures and ages. The bedrock formations-deep beneath the overburden-are composed of a variety of crystalline rock types. The most recent deposit of peat is typically several feet thick and directly below the refuse, often mixed with layers of silt and clay. The silt and clay--or Pleistocene deposits--lie directly beneath the peat.

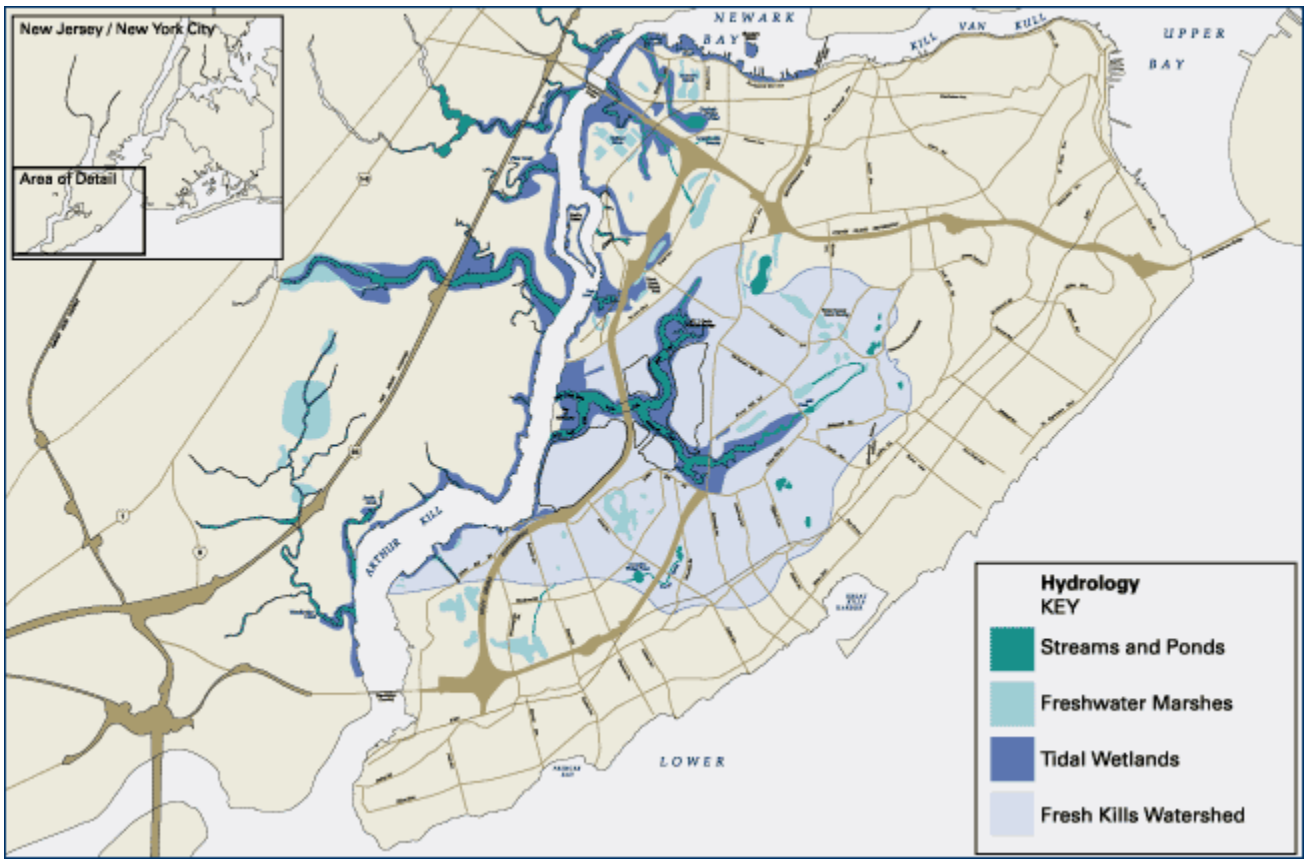
Certain isolated pockets of the landfill lack a Pleistocene layer. Instead, the pockets have sandy Cretaceous deposits, which originate from ancient rivers and lakes. The Pleistocene deposits serve an important function at Fresh Kills Landfill by forming a relatively impermeable

layer between the refuse and the water table below.

FRESHKILLS AND ITS ENVIRONS
Northwest Staten Island and Eastern New Jersey
Formation of wetlands in this region began 8,000 to 10,000 years ago when the last glacial advance began to melt and retreat northward. The terminal moraine of the glacier created a large inland lake, Glacial Lake Hackensack, which persisted for several thousand years on the western shore of Staten Island and the eastern shore of New Jersey. Now the Arthur Kill bisects this low, flat expanse. Water is constantly available because there is minimal percolation through a clay subsoil and a soil composed of sand and silt.

Central Staten Island
Central Staten Island is characterized by three ridgelines and the terminal moraine of the most recent glaciation. The topography is hilly, rugged, irregular, dotted with ice block ponds, glacial erratics, wetlands and bogs. Soils are dry on hilltops and moist along streams and ponds. In the Lowlands region of the Greenbelt, a steep ravine of glacial moraine marks the boundary of the southernmost extent of the terminal moraine.

Southern Staten Island and Southeast New Jersey
Just beyond the reach of the Wisconsin glacier lies a region influenced by the Atlantic Coastal Plain. The topography is low-lying; soils are acidic, consist of compacted clay and are thus waterlogged.



HYDROLOGY

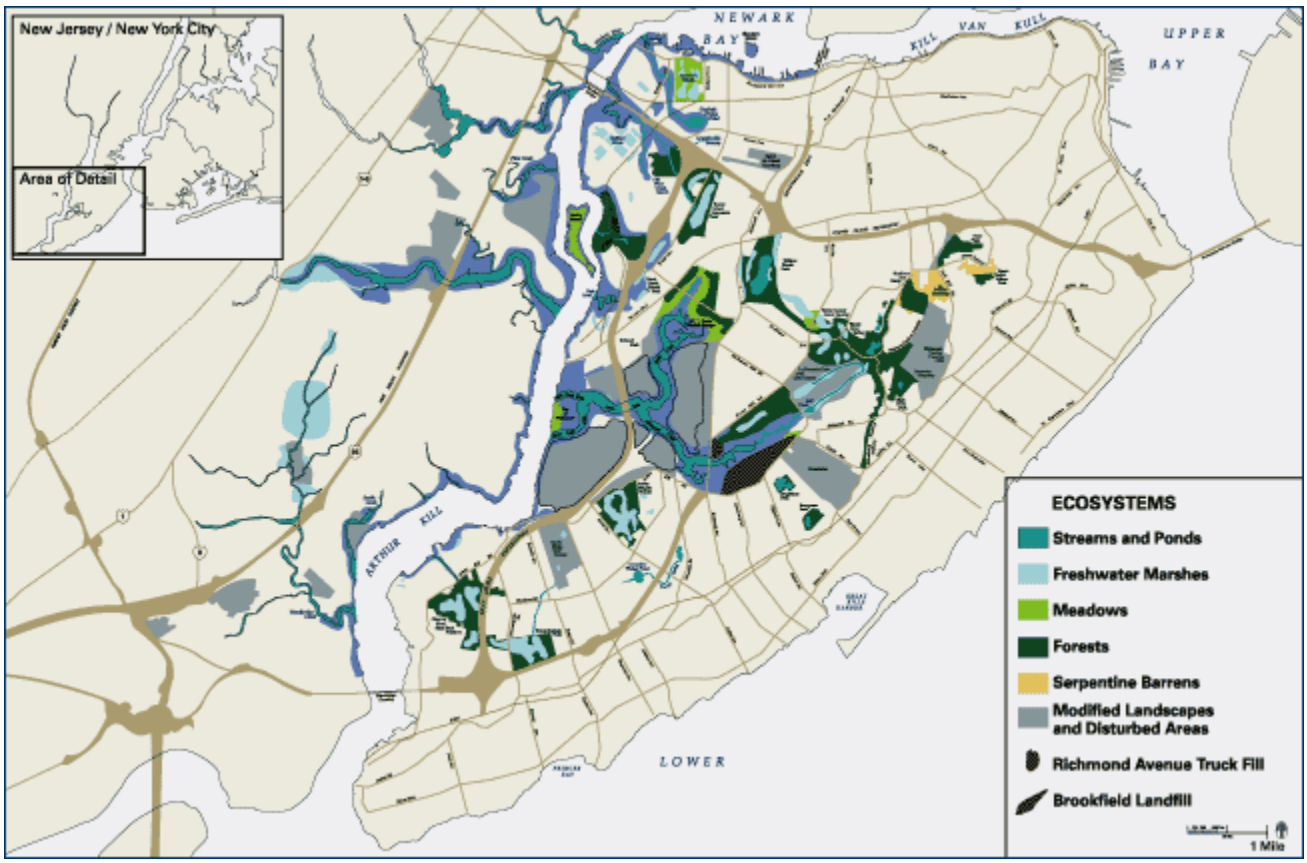
A network of waterways interweave in the Natural Systems Study Area. The major water resources serving the Natural Systems Study Area are the New York Harbor and the Hudson

River. The tidal cycles of the Atlantic and fresh water from tributaries in local watersheds are primary influences on surface water hydrodynamics. Tidal exchange between the New York Harbor and the Atlantic Ocean provides a flushing of the Harbor.

Fresh Kills Watershed
This is the key watershed in the study area, encompassing 8,336 acres, draining water from most of the study area to the Arthur Kill. The Fresh Kills Main Creek links inner Staten Island with the Arthur Kill. This Creek is tidally influenced and splits near its mouth. To the north of the Isle of Meadows, the creek is called the Little Fresh Kills and to the south it is the Great Fresh Kills. Further inland, Fresh Kills has two major tributary streams- Richmond Creek and Main Creek.

Arthur Kill Watershed
In New Jersey, most of the Arthur Kill watershed has been developed for industrial, commercial and residential uses, but more than 8,000 acres of parkland exist, mostly along river corridors. The Rahway River is the largest tributary and the Elizabeth River, the Woodbridge River, Morses, Piles and Smith Creeks are lesser tributaries to the Arthur Kill.

Aquatic Systems
Aquatic systems host marine species in water bodies and in the intertidal zone. Marine species such as flounder are found in the ocean, while estuarine species like Menhaden tolerate changes in salinity and can inhabit salt marshes. Anadramous fish such as herring spend most of their lives in the ocean, though they spawn in fresh water. Fiddler crab, ribbed mussels, and marsh snails are bottom dwellers living in the intertidal zone and are essential to the food chain. The intertidal mudflat community is home to worms, shellfish, snails, sponges, and jellyfish. The subtidal and low intertidal zones are dominated by segmented and bristled worms.



Ecosystems

Natural Systems Study Area

The Department of City Planning has defined an area around Fresh Kills for the study of natural systems, such as geology, soils, hydrology and plant and wildlife habitats. This study area includes natural areas within a complex of residential, commercial and industrial zones. The area extends from Staten Island into New Jersey.

An assessment of major topographical features and a delineation of the Fresh Kills Watershed, further refined by unique natural habitats relevant to the landfill, established the study area boundary. Finally, it was aligned with major roads or highways.

TIDAL WETLANDS

A salt marsh is divided into three zones: low salt marsh, high salt marsh and salt scrub. This community provides an important function: filtering pollutants from water, aerating the soil for underground microorganisms and providing flood control.

Low Salt Marsh

These communities lie in sheltered areas of the seacoast, extending from mean high tide to mean sea level. The area is regularly flooded and monospecific stands of saltmarsh cordgrass are present. The grass, along with marine algae, forms mats of surface sediment. Wildlife species present include belted kingfisher and vole. Low salt marshes occur along the coast of the Arthur Kill, Mariner's Marsh, Saw Mill Creek Marsh, Fresh Kills Main Creek, Little Fresh Kills and Richmond Creeks, at Goethal's Bridge Pond, Bridge Creek, the Rahway River, Morses and Piles Creeks.

High Salt Marsh

The high salt marsh is located in protected areas of the seacoast extending from mean high tide to the limit of spring tides. The community looks like a mosaic of patches dominated by marsh grasses. Wildlife like tree swallow and clapper rail frequent these communities. High salt marshes are at Saw Mill Creek Marsh, Mariner's Marsh, Goethal's Bridge Pond, Bridge Creek, Arlington Marsh, Old Place Creek, along the lower reach of the Rahway River and Piles Creek.

Salt Scrub

Salt scrubs lie between the salt marsh and upland vegetation. Storms cause periodic disturbances resulting in die back of indigenous scrubs. The marsh wren is a common bird in this community. This system is found in Saw Mill Creek Marsh, Mariner's Marsh, Goethal's Bridge Pond and along Bridge Creek. In New Jersey, salt scrubs are found competing with giant reeds along the Woodbridge River.

FRESHWATER MARSHES

PALUSTRINE WETLANDS

Palustrine wetlands associated with the Fresh Kills Estuary and areas of lower elevations are limited, and exist along upper fringes of the tidal marsh communities. They can be found in small areas of Saw Mill Creek and Goethal's Bridge Pond. There are three habitat types classified as palustrine wetlands: freshwater marshes, swamps and bogs. All are flooded for extended periods of time, limiting oxygen available to the root zone. Marshes are flooded year-round and, like bogs, they differ from swamps due to the absence of trees. Swamps and bogs are flooded most during the spring and early summer. Bogs have soils and water with a low pH, limiting natural decomposition and causing an accumulation of organic matter. Palustrine wetlands are common in Bloomingdale Park, Arden Heights Woods and Clay Pit Pond Park Preserve, Graniteville, Corporate Park and the W.T. Davis Wildlife Refuge. In New Jersey, they are in the distant reaches of Woodbridge Creek and the southeastern portion of the study area. The Greenbelt's Great Swamp contains freshwater wetlands in uplands, with its mature canopy of trees. One of the few intact bogs in the study area is near the Staten Island Teleport, in the Staten Island Corporate Park.

MEADOWS

In upland areas, a combination of meadows, young forests and mature forests are now found. These locations were clear-cut and slowly underwent succession. Succession begins as a meadow dominated by annuals and biennials. Later, small woody plants invade the herbaceous plant community and create a forest. Meadows decrease in occurrence as young forests take their place. Presently, there are meadows in La Tourette Park, Willowbrook Park and in Edison, New Jersey. As they become rare, so do the birds that frequent them, such as the Eastern meadowlark. Other wildlife, such as the red bat and the Eastern cottontail are typical in meadows.

FORESTS

Sandy Hummocks

Sandy Hummocks are dry "islands" rising six to seven feet from the salt marsh. Plants in sandy hummocks include trees, scrubs and salt marsh grasses. These plants survive drought and little soil in part because clayey soil limits a regular supply of water. Wildlife here prefers dry, sandy dunes for nesting.

Upland Forests

One of the ecologically significant plant associations in uplands is the Oak association, signifying a mid-age to mature forest. Such a forest is a stopping area for migrant birds every spring and fall, and provides food for birds typical of suburban environments. Small mammals such as opossum are in upland forests and white-tailed deer are reportedly repopulating in these areas. Upland forests are scattered around the study area, with greatest concentrations in the Greenbelt and along Woodbridge Creek.

Pine Barrens

Pine barrens have a canopy of pitch pine and oaks, and an understory of scrubs. This community is still found in central and southern New Jersey and in the Clay Pit Pond Park Preserve.

Pitch Pine Forest

A subhabitat of the pine barrens is the pitch pine forest. In these forests, the canopy, dominated by pitch pine, stands above a scrub and herb layer. This community exists in Clay Pit Ponds Park Preserve and in some areas of La Tourette Park. The extent of these communities is defined by firesheds.

SERPENTINE BARRENS

This is a grass savanna community on shallow soils over outcrops of serpentine bedrock. A marked change in vegetation makes serpentine barrens easy to identify. Trees frequently appear dwarfed due to low amounts of topsoil and nutrients. The only place where serpentine barrens can be found in New York State is in the upland areas of northeastern Staten Island.

MODIFIED LANDSCAPES AND DISTURBED AREAS

This category does not refer to habitat, but to greenspaces that are less diverse. As long as these greenspaces are not developed with buildings or roads and have limited human and domesticated animal occupancy, they can provide corridors for wildlife and plant species to cross, linking richer habitats. Examples include golf courses, cemeteries, landfills and areas in a state of disturbance, often with many exotic species. These occur throughout the study area.

RICHMOND AVENUE TRUCKFILL

Richmond Avenue Truckfill islocated east of Fresh Kills on the north shore of Richmond Creek. Although invasive species dominate the site, such natives as groundsel tree have been successful.

BROOKFIELD LANDFILL

Currently, plans are being finalized for the end-use of Brookfield landfill. Despite the barrier formed by Richmond Avenue, important links between Fresh Kills Landfill and Brookfield Landfill have the potential to be enhanced. The strong connection between the two sites is formed primarily by Richmond Creek, which meanders down to the Fresh Kills from Brookfield, originating to the east at La Tourette Park.

Landfilling Overview

Landfilling History of Fresh Kills

Fresh Kills Landfill was established in 1948. In a 1951 report to the Mayor, the New York City Parks Commissioner Robert Moses states that Fresh Kills Landfill represents "not merely a means of disposing of the city's refuse in an efficient, sanitary and unobjectionable manner pending the building of incinerators. We believe that it represents the greatest single opportunity for community planning in this City."

A Model Landfill

Shortly after filling began, a reporter saw the operation as "creating two thousand acres of useful land on what was once swamp and creek." When the landfilling was complete, which was anticipated to occur in eight to twelve years, Moses envisioned a large residential community within a park belt to the east of the West Shore Expressway and industrial use to the west. The original footprint of the Landfill Complex was approximately 2,900 acres and included Richmond Avenue Truckfill, Brookfield Avenue Landfill, the Isle of Meadows and portions of William T. Davis Wildlife Refuge.

When Fresh Kills Landfill first opened it was considered an advanced waste disposal facility and a model for other landfills around the nation. The landfill was perceived by Moses to be an engineering project. The city's Sanitary Codes of the day contained the following provisions:

- minimizing the size of an open face at any given time
- placing clean daily cover over the working face at the end of each day
- constructing a 24" thick final cover
- preventing waste material from entering open water

Concern Grows as Fresh Kills Grows

By 1951, the landfill was receiving approximately 6,000,000 cubic yards of refuse, household ashes and incinerator residue annually, compacting down to 2,500,000 cubic yards of fill. At this time, landfilling occurred in areas throughout the complex.

Since the 1970s landfilling has occurred in the distinct footprints of four sections amounting to approximately 1100 acres: Sections 1/9, 2/8, 3/4 and 6/7. By 1980 the size of the entire landfill Complex had decreased to approximately 2200 acres with the surrender of former landfill properties east of Richmond Avenue.

The landfill's acceptance of garbage peaked at 29,000 tons a day in 1986-87. As Staten Island became increasingly urbanized, experiencing rapid growth, concerns increased over the limited buffer between the landfill and neighboring communities. The landfill has been a reality for

many Staten Island residents for a lifetime.

Closing Fresh Kills
In May of 1996 Mayor Giuliani and Governor Pataki announced that the landfill would close to further receipt of solid waste by December 31, 2001. The final shipment of household garbage actually occured on March 22, 2001.

Landfill Operations

What has occurred on the landfill, and will continue to occur after the landfill closes, is a dynamic interplay of activities and engineered components working together to make the landfill safe and stable. This is one of the most critical things to comprehend as plans are made to guide its future evolution.

Landfill Dynamics
A solid waste landfill can be conceptualized as a biochemical reactor, with solid waste and water as major inputs, and landfill gas and leachate as the principal outputs. A number of systems are put into place to control the release of gases and leachate and to keep the landfill mass stable.

Compression
Once placed in the landfill, solid waste goes through several processes that reduce its volume and cause the landfill to settle. These processes can be categorized into primary and secondary compression.

Primary compression of waste occurs when waste is first placed on the landfill and is compacted under its own weight, the weight of the cover material or that of the compacting vehicles. This compression occurs relatively rapidly, most of it having occurred by the time closure construction is complete.

Secondary compression is caused by the occurrence of two processes in addition to primary compression: biological decay of waste and chemical interactions including corrosion and oxidation. These processes, which begin before the garbage leaves the curb, continue for a minimum of 30 years post-closure.

Breakdown of Organic Material
Biologic breakdown of organic material in the solid waste occurs in a series of steps, moving from aerobic to anaerobic microbial activity. Throughout the process of decomposition, organic material is broken down into smaller components be coming available for different microorganisms to break it down further.

When all of the oxygen is depleted, anaerobic microorganisms known as methanogens begin to convert the organic material into methane or natural gas and carbon dioxide. This, combined with a small percentage of non-methane organic compounds including hazardous air pollutants and water, forms landfill gas (LFG). LFG, if not controlled, may either migrate

underground or be emitted into the atmosphere. Gas migration underground could build up pressure and cause an explosion if allowed to increase to sufficient concentrations in an enclosed area. Uncontrolled emissions of LFG into the atmosphere can cause air pollution; methane and carbon dioxide are greenhouse gases and therefore could contribute to global warming. In addition, escaped methane can kill cover vegetation thus causing erosion.

Leachate Creation
Leachate is created as water moves downward through the garbage and particles dissolve and suspend in the water. An important part of landfill management is the removal of pollutants in the leachate before they reenter the environment. Once the final cover is placed on the landfill, the quantity of leachate produced diminishes considerably since water no longer infiltrates the landfill.

Landfill Settlement
Over time, the solid waste mass becomes more dense. Materials break down and water is pushed out from the pores between particles, causing the landfill to subside. The volume of the garbage mass is also diminished as gas and leachate are removed from the landfill. This process will cause overall or total settlement, as well as settlement in isolated areas (differential settlement) of the landfill.

Anticipated total settlement of the landfill is roughly estimated to decrease the height of the mounds by 10 to 15 percent over time. Approximately half of this settlement will occur in the first five to ten years after the final waste has been placed, further settlement will continue at a decreasing rate for at least another twenty years. Engineering of the landfill would not be so complex if settlement were uniform; however, differential settlement will occur because the character and depth of the refuse is not uniform.

Anticipation of how the landfill will settle relates to the overall safety of the landfill including the integrity of the final cover, protection of environmental control systems and the potential of future construction. An understanding of this process will ultimately play a part in decisions on the type and location of activities sited and the phasing of the master plan.

Landfill Systems

A number of systems have been put into place at the landfill to protect public health and the environment including those to manage gas and leachate. These systems maintain stability, control erosion and promote safety.

FINAL GRADING

Before the final cover can be placed, final grading must be completed. An intermediate cover material, sometimes called the cover foundation level or sub-base, is graded and compacted

to the appropriate angles. Before the final cover is placed on the landfill, grades (slopes) may need to be adjusted to meet the minimum and maximum required grades (4% to 33%) set by the Department of Environmental Conservation (DEC) to maintain stability and promote proper drainage. Benches or terraces, which provide stability, are built into the design of the landfill.

FINAL COVER

The final cover placed over the solid waste is constructed in phases. The essential design goals are to provide for hydraulic performance, slope stability and long-term integrity or durability of the landfill.This is achieved by minimizing surface water infiltration (thus leachate generation), preventing erosion, promoting proper surface water drainage, and separating the refuse layer from the environment to protect public health. It also captures and prevents the emission of air polluting gases. The final cover is made of a series of layers, each with distinct functions, which are described below.

Hydraulic Barrier

The Hydraulic Barrier or Low Permeability Layer is placed on the sub-base material. This is the most crucial component of final cover. It prevents water from entering the waste directly by stopping the flow of water and indirectly by promoting storage or drainage of water in the above layers. This layer also prevents the upward flow of gas into the atmosphere except in controlled places. It is made of low permeable and/or plastic material.

Drainage Layer

The next layer, the Drainage Layer, is needed in some portions of the final cover. This layer reduces the pressure of water on the barrier layer and increases friction, thus reducing the risk of sliding. It drains the overlying protection layer, increasing water storage capacity and reducing the risk of over-saturating the cover soils above.

Soil Barrier Protection Layer

The Soil Barrier Protection Layer follows the Drainage Layer. It protects the hydraulic barrier from the extremes of weather that could cause the underlying layers to crack or heave. This layer stores excess water until it is either used by overlying plants or drained off. This layer is composed of soil and has a minimum thickness of 24 inches.

Topsoil Layer

The Topsoil or Planting Soil Layer above this must have a minimum thickness of six inches. It is specified to be fertile. The soil used is a sandy loam, selected for its potential to prevent soil erosion and to provide a good growing medium for the **Vegetation Layer**. The primary objective of the vegetation layer is to protect the integrity of the Final Cover through erosion control. A network of plant roots hold onto the soil, providing stability. Vegetation also facilitates the movement of water back into the atmosphere through evapotranspiration, dissipates the energy of rainfall on the surface, and decreases the effect of wind on soil further preventing erosion of soil particles. Without adequate vegetative cover, sheet erosion and rills can form on the surface. This can eventually lead to the formation of gullies. Left unabated, soil from the layers below can become exposed and clog systems with excess soils.

Landscape

Landscape plans are designed to provide stability, minimize long-term maintenance, and to preserve the integrity of the final cover. Therefore the planting program includes a

combination of perennial native grasses and rapidly germinating annual grasses that quickly stabilize the soil.

LANDFILL GAS SYSTEMS

Landfill Gas (LFG) is the product of decomposing waste. It consists largely of methane, carbon dioxide and a small percentage of water and non-methane organic compounds (NMOCs). The Landfill Gas System collects and controls gas emissions through a system of wells and prevents subsurface migration of gas off site. If not controlled, gas can build up pressure to an explosive level and/or cause harmful air pollutants to be emitted into the atmosphere.

Active Recovery System / Landfill Gas(LFG) Emissions Control

An active recovery system collects the LFG to prevent its emission into the atmosphere. Once collected, it is either flared off (burned) or processed to pipeline quality. The active recovery system collects gas by using LFG extraction wells under vacuum pressure. This system moves the gas through a network of pipes. The pipes increase in size as they move toward the perimeter of the landfill, reaching flare stations or the gas recovery plant. The Department of Sanitation (DOS) has been recovering gas from a portion of Section 1/9 since 1982 and processing it. Currently, a system of flares operates to burn off the portion of the gas that is not recovered from sections 3/4, 2/8 and 6/7. The LFG recovery plant and related systems, when complete, are estimated to be able to provide enough fuel for the cooking and heating needs of close to 25,000 homes.

The active system consists of LFG extraction wells placed at approximately every acre. A pipe extends down through the depth of the refuse or to groundwater table, if higher. Beyond roughly the first 20 feet below the surface, the well pipe is perforated. The well and the geomembrane are sealed with a geomembrane boot closed by stainless steel and neoprene (synthetic rubber) bands. Above the topsoil, the well is attached to flexible tubing connecting to a network of non-perforated lateral header pipes, lying on top of the geomembrane or clay lining. Water in the LFG condenses and the condensate is collected in tanks and subsequently pumped out by truck.

From the lateral pipes, the gas travels to the gas recovery plant or to the flare stations, which are located on half-acre sites at sections 3/4, 2/8 and 6/7 within the interior of Fresh Kills Landfill (gas from section 1/9 goes directly to the LFG recovery plant). Each flare station consists of two flares, which combust the landfill gas at a temperature between 1600°-2000°F. Gas emissions and NMOCs and other hazardous air pollutants are reduced by almost 100%. LFG and its odor are prevented from entering the atmosphere. A gas transmission main, begun in 1999, will link all of the sections to the gas recovery facility located northeast and adjacent to Section 1/9. The installation of the transmission main is in anticipation of expansion of the gas recovery facilities to handle the LFG from all of the landfill sections. When the gas is recovered for reuse, the flares will be used as a safety back-up measure in the event the recovery system is down. In the future, when little or no gas is generated and the active extraction system is no longer productive, the remaining methane will either be returned to the flares or vented passively into the atmosphere through the previously fitted vents.

Landfill Gas Migration Control

Independent of the active gas extraction network, as a safety measure to ensure that no gas migrates off site, a passive venting system is in place around the perimeter of the landfill. Passive vents keyed to low permeable soils or below the seasonal low groundwater table form an effective barrier to stop the movement of gas off-site. This system can be seen on the surface as a channel of coarse stones mounded up around the perimeter. Additionally the subsurface cut-off walls for the leachate further prevent migration of gas off-site. Monitors are

placed outside the trench to ensure that gas has not migrated off-site. In addition, utility trenches have been sealed to eliminate potential off-site routes for the gas.

LEACHATE SYSTEM

Leachate is created as water comes in contact with garbage. The goal of the leachate management system is to contain, collect and treat leachate before it reaches adjacent surface waters and groundwater, or damages the final cover. This is achieved by minimizing the amount of water that comes in contact with refuse and treating the leachate that is created. As the final cover is placed on the landfill, the production of leachate will diminish; however, water remaining in the landfill will cause the continued production of leachate. Storm water management systems are also designed to prevent the production of leachate by removing water as quickly as possible from the landfill face.

An integral part of the leachate control system at Fresh Kills Landfill is the fine silt and clay Pleistocene layer beneath the landfill that forms a relatively impermeable barrier between refuse and the groundwater table below. The leachate that gravitates through the refuse mass downward and outward to the perimeter must be collected before escaping from the landfill. Perimeter collection drains are located outside the footprint of each section. The drains are placed two feet below groundwater level (anywhere from 8 to 39 feet below the surface). This positioning of the drains establishes higher pressure on the outside of the drain so water and any escaped leachate is pushed inward toward the landfill. The drains are connected to trenches that are connected to collection wells and pumps.

Leachate is pumped from the collection pumping wells to a pump station via a force main, then conveyed to the Fresh Kills Landfill Leachate Treatment Plant (FKLLTP) at the southern tip of section 1/9. The leachate is treated to remove pollutants before being discharged into the Arthur Kill. It is monitored to ensure that the effluent levels are not above acceptable levels. The plant has a permitted treatment capacity of 1,000,000 GPD.

Additionally, cut-off walls keyed to low permeable soils extend around the entire perimeter of sections 1/9 and 6/7, approximately 20 feet out from the perimeter drains. This further prevents the movement of leachate from Fresh Kills Landfill to the surrounding water by maintaining a higher outside water level and therefore pressure. It also decreases the amount of surface water that enters the leachate collection system and thereby maximizes the efficiency of the leachate collection system.

STORM WATER MANAGEMENT SYSTEM

The storm water management system is designed to collect, convey and discharge storm water from the surface of the landfill as quickly as possible. The control of storm water is necessary to prevent erosion of the final cover, decrease potential seepage into the barrier protection layer, and control storm water run-off from the landfill.

The slopes of the landfill are designed and graded to provide positive surface water drainage after the settlement of the waste has occurred. In the event of inadequate drainage, ponding could occur, increasing the possibility of leakage through the hydraulic barrier. The soil barrier layer and vegetation also serves to divert surface water away from the hydraulic barrier.

Water not removed by evapotranspiration is collected in swales (drainage channels). Swales are uphill of all roadways to divert storm water run-off. Storm water flow is conveyed from the side slopes to chutes. The chutes run perpendicular to the contours. They are either open channels lined with stones or enclosed drainage pipes. They distribute the storm water into a perimeter conveyance system located at the toe of the landfill whereupon it moves into the storm water control basins.

Storm water control basins or retention basins, located outside the limit of solid waste, are designed to control water that can rapidly accumulate during a storm, by holding the water in

the basin so it can be slowly released into adjacent waterways. Any sediment in the runoff will also settle to the bottom before the water is discharged. To facilitate controlled drainage of as much landfill area as possible, and to locate and size the basins, the landfill sections are divided into sub-shed areas.

LANDFILL SYSTEMS POST-CLOSURE

After the landfill closing, it is anticipated that it will be a minimum of thirty years before decomposition of the garbage is complete, associated gas production and settlement cease, and leachate is drained from the site. While these processes are occurring, there will be a continuing need for regular maintenance, monitoring and evaluation of the site and systems that have been put into place, primarily the Final Cover, LFG and Leachate Systems. It is essential that access to these systems be preserved during this time to inspect, maintain and repair them.

Regulations

A variety of federal, state and local laws and regulations govern present and future use of the Fresh Kills Landfill. The overall goals of these regulations are to protect and preserve public health and the environment. To do so, it is essential that the integrity of the landfill and its systems be maintained. In addition to monitoring the landfill, regulations govern the city's land uses, the quality of its air and water, and its coastal resources. In some instances, administration and enforcement of federal requirements are delegated to state or local authorities. Similarly, state requirements may be delegated to local governments. Actions requiring review by a regulatory agency typically require a public review process as well.

Solid Waste Management
The city's Department of Sanitation is currently working with the State to ensure environmentally sound closure of the landfill sections that need to be capped and to prepare for the Department's long-term operational responsibility (a minimum of 30 years post-closure) for on-site environmental monitoring and control systems.

The New York State Department of Environmental Conservation (DEC), Division of Solid Waste regulates landfill closure and post-closure operations under 6 NYCRR Part 360, Solid Waste Management Facilities, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York. The regulations for landfill closure and post-closure (Section 360-2.15) address issues related to control of landfill gas, leachate, final cover, vectors (potential carriers of disease or infection), post-closure operations, maintenance and monitoring, as well as planned uses of the property during the post-closure period.

Air Quality
The federal Clean Air Act of 1970, regulates air emissions from area, stationary and mobile sources. This comprehensive law authorizes the U.S. Environmental Protection Agency (EPA)

to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. It also directs the states to develop state implementation plans (SIPs) applicable to appropriate industrial sources in the state. The law was further amended in 1990 to address problems such as acid rain, ground-level ozone, stratospheric ozone depletion and airborne toxins.

Water Quality
The Clean Water Act and the Safe Drinking Water Act, authorize EPA to set federal water quality standards. While the EPA retains oversight responsibilities, many permitting, administrative and enforcement aspects of the law are delegated to the states. In New York, DEC is responsible for upholding the federal standards.

Wetlands
New York State Department of Environmental Conservation is responsible for management and protection of natural resources and environmental quality, and regulates activities that may have a negative impact on wetlands under the Divisions of Marine Resources (Tidal Wetlands) and Fish and Wildlife (Fresh Water Wetlands). Activities such as draining, filling or building structures within a wetland or its adjacent buffer area may be undertaken only if DEC has granted a permit.

The US Army Corps of Engineers (ACOE) is responsible for the protection and management of the nation's waterways and wetlands. Like DEC, ACOE is empowered to review and issue permits for activities in tidal or freshwater wetlands and navigable waters. These activities include dredging, filling, bulkheading and placement of structures in water. In reviewing projects, ACOE consults with other federal agencies including the US Fish and Wildlife Service, the Coast Guard and the US EPA.

Protection of Coastal Resources
Fresh Kills Landfill is within New York City's Coastal Zone. The federal Coastal Zone Management Act is designed to encourage and assist states in preparing and implementing management programs to "preserve, protect, develop and, where possible, to restore or enhance the resources of the nation's coastal zone."

The New York State Department of State Coastal Management Program contains 44 coastal policies and provides for local implementation of the city's Waterfront Revitalization Program (WRP). The local WRP establishes the city's policies for development and use of the waterfront and provides the framework for evaluating discretionary actions in the coastal zone. The guiding principle of the WRP is to maximize the benefits derived from economic development, environmental preservation and public use of the waterfront, while minimizing the conflicts among these objectives. The program is designed to coordinate activities and decisions affecting the coast when there are overlapping jurisdictions or multiple discretionary actions. When a proposed project is located within the coastal zone and requires a local, state or federal discretionary action, a determination of the project's consistency with the policies and intent of the WRP must be made before the project can move forward.

Future development occurring at Fresh Kills Landfill may require ACOE and DEC permits. To receive permits from either agency, a proposed project must be consistent with the Coastal Zone Management Program and the city's WRP. Local agencies, including the Department of Parks and Recreation, the Economic Development Corporation, the Department of Buildings, the Department of Health and the Department of Environmental Protection have roles in the development of NYC's waterfront and protection of its water quality. Coordination among these agencies and resolution of policy conflicts is part of the coordination role of the WRP consistency review.

The city's waterfront planning goals are contained in ten policies dealing with:

residential and commercial redevelopment
water-dependent and industrial uses

commercial and recreational boating
coastal ecological systems
water quality
flooding and erosion
solid waste and hazardous substances
public access
scenic resources
historical and cultural resources

Fresh Kills is both a state-designated Significant Coastal Fish and Wildlife Habitat and it is within the Northwest Staten Island Special Natural Waterfront Area (SNWA), one of the three designated SNWAs in the city's WRP. Under the city's WRP, consistency reviews of actions at Fresh Kills would therefore give greater weight to policies furthering protection of its coastal ecological systems, waterways, and component habitats.

LAND USE

SEQRA / CEQR

In 1975, New York State enacted the State Environmental Quality Review Act (SEQRA). The basic purpose of SEQRA is to incorporate environmental factors into existing planning, review and decision-making processes of state, regional and local government agencies at the earliest possible time. To accomplish this goal, SEQRA requires that all agencies determine whether the actions they directly undertake, fund or approve may have a significant impact on the environment, and, if it is determined that the action may have a significant adverse impact, prepare or request an environmental impact statement.

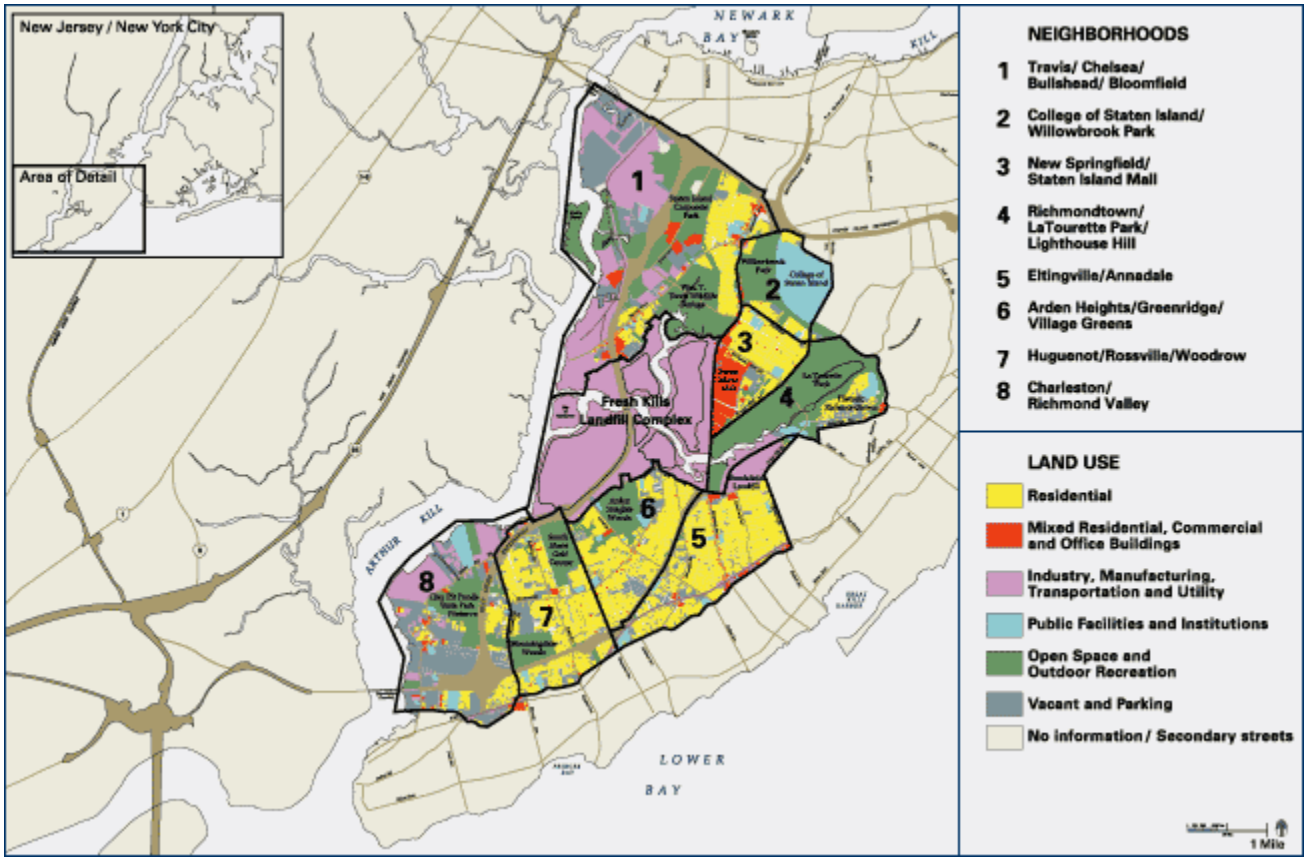
DEC has extensive regulations to guide the SEQRA review process, permitting local governments to promulgate their own rules, provided they are no less protective of the environment than the state rules. The City of New York has exercised this prerogative by promulgating its own procedures known as City Environmental Quality Review (CEQR) which requires city agencies to review proposed discretionary actions to identify and address any adverse effects those actions may have on the environment.

ULURP

Selected land use proposals for the end use of Fresh Kills Landfill may be subject to the New York City Charter mandated Uniform Land Use Review Procedure (ULURP). Actions that require ULURP generally are related to the use, development or improvement of real property. This includes, but is not limited, to changes to the City Map; designation or changes of zoning districts, including conversion from one land use to another; selection of sites for capital projects; disposition or acquisition of property by the city; and granting of revocable consents, requests for proposals for franchises and major concessions.

ULURP reflects the increasing involvement of the city's community boards in the development of the city and a substantial increase in community participation in many aspects of government. Each of the city's 59 community districts is represented by a community board with up to fifty members who live or work within the district. Each community board has the responsibility for advising the City Planning Commission on "any matter relating to the development or welfare of its district."

ULURP's rules consist of (1) guidelines, minimum standards and procedural requirements for the community boards, Borough Presidents, borough boards and the City Planning Commission in the exercise of their duties; (2) standards for certification of applications and (3) time periods for review of applications.



The Neighborhoods

Fresh Kills Landfill, with its grassy landfill mounds, wetlands, and above ground infrastructure, has a strong connection to adjacent neighborhoods. Descriptions of these nearby neighborhoods, organized within eight subareas, follow.

The perimeter of the Fresh Kills Landfill is shaped by the narrow Arthur Kill and the industrial New Jersey waterfront to its west, Arthur Kill Road to the south, Richmond Avenue to the east, Travis Avenue is to the north and Victory Boulevard to the northwest. Fresh Kills is inaccessible to the general public even though the West Shore Expressway bisects the complex, allowing motorists to move directly "through" its landscape. The public's visual perception of the site remains one largely shaped by external observation from limited access highways, slower-moving local roads and parts of the neighborhoods bordering the site. These views, looking from the outside in, are often quite compelling and will remain significant after the closed landfill is redeveloped and, eventually, open and accessible to the public.

Subareas:
Within the Surrounding Area there are eight subareas, each of which includes several neighborhoods. Neighborhoods to the north and northeast of Fresh Kills Landfill and Arthur Kill Road include Bullshead/ Bloomfield/ Travis/Chelsea; College of Staten Island/Willowbrook Park; New Springville/Staten Island Mall; and La Tourette Park / Richmondtown /Lighthouse Hill. Neighborhoods to the south of Fresh Kills Landfill and Arthur Kill Road include Charleston/Richmond Valley; Huguenot/ Rossville/ Woodrow; Arden Heights /Greenridge / Village Greens; and Annadale /Eltingville. All of the subareas have experienced population growth between1990 and 2000, generally speaking more rapidly in those to the south than those to the north.

TRAVIS / CHELSEA / BULLSHEAD / BLOOMFIELD

Northern subarea, Community District 2
Total Population: 15,112 (1990 Census); 16,844 (2000 Census), 12 percent increase

At close to 3000 acres, this subarea covers almost a quarter of the Study Area. Extensive interconnected tidal wetlands with lush green fields of salt hay are characteristic of the landscape. Before filling, this landscape extended through the Fresh Kills Landfill Complex.

Records indicate a large population of Native Americans lived in the area before Europeans established small villages prior to the Revolutionary War. Known today as Travis, Bloomfield, Bullshead and Chelsea, these villages typically featured a church, tavern and small shops surrounded by pastures, and an occasional dock onto a creek. The New Blazing Star Ferry and Inn, an important stage coach stop between Manhattan and Philadelphia, was established at the foot of Victory Boulevard before the war and was the site of a battle between the British and Americans in August of 1777.

Through the mid-19th century settlers were generally fishermen, oystermen, or farmers of salt hay and other crops. The Asbury Methodist Church (c.1849, replacing an earlier structure) now the Son-Rise Charismatic Interfaith Church is notable for its historic status and for the grave of Ichabod Crane whose name was used by Washington Irving in *The Legend of Sleepy Hollow*. Summer residences were built in the area in the late 19th century, including the home of the grandfather and father of Theodore Roosevelt, sited where William T. Davis Wildlife Refuge stands today.

Industry developed after the Civil War. In 1873, the first linoleum factory in the nation, the American Linoleum Company, was established. At its peak, over 700 people were employed and the factory and related facilities, including workers' housing, covered over 300 acres. The former Con Edison Plant occupies the factory site. Known as Linoleumville, the town retained this name until after the factory closed during the depression; then it became Travis.

After World War II, the industry, this subarea intensified with the acquisition of property for the Fresh Kill Landfill in 1948. Bulk oil facilities, served by pipeline and barge, were developed along the Arthur Kill, and junkyards were established upland. Despite industrial growth, the area maintained an agricultural base with its truck farms into the 1960s.

Partially due to its wetlands and industry, this subarea is sparsely populated and ecologically rich. Roughly 35 percent of the area consists of open space and outdoor recreation; industry and utilities use about 25 percent of the land and an additional 23 percent is vacant. Less than 20 percent is occupied by residential, institutional and commercial uses. Most of the undeveloped land is natural but not pristine. There are three designated New York State Significant Coastal Fish and Wildlife Habitats in the subarea and the area is also referred to as the Harbor Herons wetlands ecosystem which the Audubon Society identifies as the "single most important waterbird rookery complex in New York State."

Large natural parks in the subarea, also described in Ecosystems, include: Prall's Island, an 88-acre preserve; the 112-acre Saw Mill Creek Marsh Park which includes Merrel's Creek and marshes to the north; Neck Creek Marsh, a 60-acre park; and the 226-acre Staten Island Corporate Park. The Greenbelt's 260-acre William T. Davis Wildlife Refuge borders the Landfill Complex to the north. It supports diverse wildlife habitat and an aquifer that supplied water to the area before the city's upstate reservoir system was established. A trail runs through a portion of the Refuge. The adjacent Greenbelt Native Plant Center is owned by the city and used to propagate native plant species for park and restoration projects. Additionally, the Department of Environmental Conservation (DEC) owns 58 acres on Old Place Creek set aside for open space protection.

Habitat-rich areas coexist with industrial uses in places like Gulfport Marsh where extensive bulk oil storage facilities and an electrical substation abut significant freshwater wetlands. The Travis Branch of the Staten Island Railroad extends from the upper end of the subarea to the former Con Edison Plant (the NRG Plant). Industrial, manufacturing, utility and transportation

uses are concentrated in Chelsea, the central western portion of the subarea which is zoned manufacturing to allow heavy industry. Industrial uses include petroleum storage facilities ("tank farms") located in the northwest. Recently all of the tanks of the GATX Petroleum Storage Company in Gulfport Marsh have been demolished. Further south, several building contractors as well as sand and gravel facilities are located along the waterfront. The most visible landmark in the area, aside from Fresh Kills Landfill, is the stack of the former Con Edison Plant (now the NRG Plant) which rises 500 feet on the shore just north of the Landfill Complex.

Active public recreational resources are limited to the 8.5-acre Schmul Park which includes a playground, courts and ballfields, and several non-city facilities such as the Emil Borg Memorial Field, the Amateur Softball Association Field, the Mid-Island Little League and Babe Ruth Field.

Residential areas constitute only 12 percent of total land area. Residents are concentrated in Bullshead and to a lesser extent Travis.

The subarea's major commercial concentration is located in the Staten Island Corporate Park (SIIP). In 1961, a 777-acre Staten Island Industrial Park was proposed for the north central portion of this subarea straddling the West Shore Expressway. Due to limited roads and other infrastructure many years passed before development began. In the intervening years, abundant wetlands within the SIIP began to be protected by environmental regulations and much of this land was transferred to the Parks Department including portions of Sawmill Creek Marsh Park and the 226-acre SIIP Park. The remaining portion of the original assemblage, now the SI Corporate Park, contains the major office center of this subarea including the high technology communications center, Teleport, to the southeast of the complex, and over 700,000 square feet of office space.

Several retail uses are found in the subarea including Showplace Center adjacent to Fresh Kills Landfill which contains a fourteen screen movie theater, stores, and restaurants. Older local retail is located along Victory Boulevard in Travis.

The major institutional uses in the subarea are elementary schools located in Travis and Bullshead (PS 26 and PS 60) and Moore Catholic High School located in the northern portion of the subarea.

COLLEGE OF STATEN ISLAND / WILLOWBROOK PARK

Northern subarea, Community District 2
Total Population: 3,311(1990 Census); 3652 (2000 Census); 10 percent increase

During the Revolution, American soldiers secretly met and hid in this subarea; it was connected to Fresh Kills by the Willow Brook, which ran through it. Farms were established and portions of the marsh as well as the brook were later filled to form Willowbrook Park, part of the Staten Island Greenbelt.

Sixty percent of the land in the subarea is used for public facilities and institutions. In 1938, New York State Department of Mental Health purchased 375 acres for use as a mental health facility; it remained in operation until the 1970s. In 1989, the City University acquired 204 acres of the property for the College of Staten Island, which opened in 1993. The campus is the largest in the City University system. It has two and four year and Masters Degree programs. In the late 1990s it enrolled 12,500 full and part-time students and employed 370 full-time faculty members.

The next largest land use in the subarea, approximately 25 percent, is open space, concentrated in the 164-acre Willowbrook Park, off Victory Boulevard and Forest Hill Road. Four and a half miles of trails meander through what was once the proposed right-of-way for Willowbrook Parkway and is now part of the Greenbelt. One trail passes a lake with a fishing

area, a boathouse and carousel. Future plans for the park call for multi-purpose trails linking it to the rest of the Greenbelt through La Tourette Park and along Richmond Avenue.

Willowbrook Park is also a regional facility for active recreation. There is one regulation turf baseball field, four turf softball fields, one turf football / soccer field, six hard surface tennis courts, a picnic area, archery range and horseshoe court.

Although residential development is sparse in the subarea, roughly 14 percent of total land area, it has steadily grown since the 1980s. The limited amount of commercial use is concentrated on Richmond Avenue.

NEW SPRINGVILLE / STATEN ISLAND MALL

Northern subarea, Community District 2
Total Population: 16,034 (1990 Census); 18,665 (2000 Census); 12 percent increase

Historically farms dominated this subarea. A clapboard farmhouse (c.1810, expansion 1840) located on Richmond Hill Road at the Decker Farm museum is typical of 19th century structures in the area. Truck farms were active into the early 1960s.

Today, the heavily trafficked Richmond Avenue separates the Fresh Kills Landfill Complex from the Staten Island Mall. The road and mall dominate the eastern boundary of the landfill. It is the major commercial thoroughfare connecting the southern portion of the study area to the north. This major retail center comprises over 30 percent of land use in the subarea. The mall contains 622,000 square feet of retail space in approximately 180 stores, and a significant amount of large-scale retail is adjacent to the Mall.

This subarea is the most densely developed in the Surrounding Area. Not only does it contain the retail center, over half the subarea is residential. Unlike the rest of the Surrounding Area, where the housing is mostly one- and two-family homes, a portion of New Springville has multi-family elevator buildings, generally four to five stories.

Two schools are located in the subarea -- IS 72 Rocco Laurie Intermediate School and PS 69 Daniel Thompson Elementary School. The Board of Education plans to build an elementary school (PS 58) for 900 students on two and half acres of a 17-acre city-owned site immediately east of the Mall. It is expected to open in September 2003. Plans for the remainder of the site are not final, but could include another school.

RICHMONDTOWN / LA TOURETTE PARK / LIGHTHOUSE HILL

Northern subarea, Community District 2
Total Population: 1,674 (1990 Census); 1771 (2000 Census); 6 percent increase

Located centrally in Staten Island, this subarea is the least densely developed in the study area; it contains La Tourette Park and Golf Course, Historic Richmondtown and the low density neighborhood of Lighthouse Hill.

Heaps of oyster shells, in all likelihood originating from Fresh Kills Creek west of Richmondtown, indicate an early Native American settlement estimated to be about 10,000 years old. Under the British Crown land patent of 1685, Europeans began to arrive in Richmondtown during the late 17th century. It became the county seat in 1729, centered around the intersection of Arthur Kill Road (officially laid out in 1709) and Richmond Road (officially laid out in 1728). By the Revolution, Richmondtown had a jail, courthouse, assorted shops, poorhouse, churches, gristmill and private homes. Richmondtown today has been preserved as a living museum where visitors can see three centuries of Staten Island history.

The original forest that grew in this vicinity was virtually cleared by the end of the Revolution,

accelerated by British troops cutting down trees for firewood, and replaced with large farms. Level land was used for grain crops and steeper land for orchards and sheep grazing; salt hay was used as winter-feed. Today one of these farms is the 511-acre La Tourette Park and Golf Course.

Between 1760 and 1927 a tidal grist mill, whose remnants can still be found, operated on the shores of Richmond Creek. After processing, grain was shipped down Richmond Creek to the Arthur Kill.

The La Tourette family built a Greek Revival mansion in early 19th century that is used today as the clubhouse for the golf course. It is one of the few early 19th century brick country houses of this scale remaining in New York City.

Completion of the Erie Canal in 1825 was an economic boon to New York Harbor, but it ended an era of grain processing for local mills, which could not compete with grain from the north and west. Agriculture then changed to perishable fruits, vegetables and dairy products to serve the needs of the city. The decline of the area was compounded by the completion of the Staten Island Railroad in 1860. Courthouse Station was about a mile away from Richmondtown, thus inconvenient to reach the town or connect to the stagecoach.

Richmondtown continued to be an important center of Staten Island government until 1898 when the city was unified and the county courthouse moved to St. George. In 1917, sand-mining operations covered extensive areas of La Tourette. Richmond Creek was used to barge the cargo to the Arthur Kill. In 1928 La Tourette Farm was sold to the city for use as a park and golf course.

Today almost 80 percent of this subarea is parks, including La Tourette Park and Golf Course, part of the Greenbelt, and portions of Historic Richmondtown, owned by New York City and run by the Staten Island Historical Society. Approximately 7.1 miles of Greenbelt trails and three miles of bridle paths run through the park and neighboring streets.

La Tourette Park is ecologically diverse. Steep slopes in the northeast portion of the park, near Heyerdahl Hill (elev. 241') are at the very southern tip of the open serpentine barrens. From the hilltop, one has views of Fresh Kills. The 18-hole golf course with its 40-tee driving range lies to the west. The southern portion of the park is characterized by steep slopes running adjacent to Richmond Creek. To the southwest, La Tourette Park and Golf Course contains meadows and bluffs. Both tidal and freshwater habitats are found in the park as well as heavily wooded areas. The subarea is also part of the Richmond Creek Bluebelt in the vicinity of Richmond Creek.

Fresh Kills Landfill originally extended east of Richmond Avenue when it was established in 1948. However, Robert Moses, then the City Construction Coordinator and Parks Commissioner, wanted to protect "features of historic and scenic interest which should be preserved, as far as practicable, in conditions which have prevailed for more than two and a half centuries." He wanted the "broad sweep of meadows and waterways seen from the north [to] remain unbroken." Moses envisioned a "park belt" from Fresh Kills reaching up to Richmondtown, which he saw as a potential tourist attraction rivaling Colonial Williamsburg in Virginia. Historic Richmondtown was established in 1958. Annual visitorship today is 51,980.

The 55-acre Richmond Avenue Truckfill adjacent to Richmond Avenue was once part of the Fresh Kills Landfill Complex and is now part of La Tourette Park. Like much of Fresh Kills, it was rich in wetlands; from 1948 until its closure in the 1960s, it was used as a construction debris disposal site. Currently a model airplane field and one ballfield are located on the site.

Residential use, only eight percent of total land use in the subarea, is concentrated in Lighthouse Hill. It is the lowest density residential district in the study area. There are limited local retail uses along Richmond Road.

In addition to historic Richmondtown itself, this area has several unique structures and cultural

facilities. A lighthouse, built in 1912, is perched on Edinboro Road between Windsor and Rugby Avenues on the 220-foot high Lighthouse Hill. This is the Ambrose Channel Range Light and can be seen for miles out to sea. On Manor Court, west of Lighthouse Avenue, is the 1959 prefabricated Crimson Beach House, the only house designed by Frank Lloyd Wright in New York City. The Jacques Marchais Center for Tibetan Art, designed to resemble a Tibetan monastery building, houses the largest collection of Tibetan art outside of Tibet.

Another institution, the Eger Health Care Center, occupies a 15-acre site in the southeast corner of the subarea. It is a residential health care facility with 378 beds offering full nursing care and a full range of recreational and educational programs. The only school in the subarea is the Yeshiva Rabbi Jacob Joseph for Boys with about 200 students from pre-kindergarten to 8th grade.

ELTINGVILLE / ANNADALE

Southern subarea, Community District 3
Total Population: 24,828 (1990 Census); 28,190 (2000 Census); 14 percent increase

The Eltingville/Annadale subarea, southeast of Fresh Kills Landfill, is primarily residential and contains the closed Brookfield Landfill. The Staten Island Rapid Transit (SIRT) to the south connects the subarea to St. George but forms a nearly impenetrable barrier to the Amboy Road commercial area.

Annadale and Eltingville were among the villages that grew up around the rail line after its opening in 1860. With the completion of the Verrazano Narrows Bridge a century later, growth increased dramatically. Located within the Special South Richmond Development District (SSRDD), this subarea is close to 70 percent residential, mostly one- and two-family homes.

Commercial uses, occupying a little less than five percent of the land area, are clustered along Richmond Avenue at Arthur Kill Road and at Amboy Road, as well as Annadale Station.

Institutional uses consist mainly of schools and churches. There are five elementary schools in the subarea. The three public schools are PS 32, PS 42 and PS 36, each enrolling more than 1,000 students. The private parochial schools are Our Lady Star-Sea School, with an enrollment of just under 1,000, and Eltingville Lutheran School, with under 300 pupils.

The small amount of mapped parkland in the subarea is mostly in the 3.36-acre Genesee Park. Most of the subarea's vacant land is either associated with Designated Open Space, part of the SSRDD, or the Sweetbrook Watershed part of the Staten Island Bluebelt, under the jurisdiction of the Department of Environmental Protection (DEP).

Brookfield Landfill

Originally the Fresh Kills Landfill Complex extended east of Richmond Avenue to include the now closed 272-acre Brookfield Landfill as well as the Richmond Avenue Truckfill. This portion of the landfill was known as Section 10/11. It is bounded to the south and east by Arthur Kill Road and to the north by Richmond Creek. Like Fresh Kills, the land was low and high salt marsh before landfilling occurred between 1966 and 1980. Rising 45 feet above mean sea level, approximately 132 of the 272 acres received roughly 5.1 million cubic yards of mostly municipal solid waste. Additionally, a small amount of construction material was deposited here. Industrial and hazardous waste dumping may also have occurred at this site.

In 1980 the Department of Sanitation covered 38 acres in the eastern portion of the landfill. Passive vertical gas vents were installed and the area was regraded with 24 inches of clay and topsoil and seeded. The city's Department of Environmental Protection is currently implementing a remediation program in accordance with a 1992 order of consent. Preliminary plans include replacing the final cover and establishing native plant species. Approximately 25 to 30 acres in the western portion of the site have been designated for active recreation facilities. Although construction of recreational facilities and an education center is not funded

under the closure plan, preliminary site preparation work, such as building up the soil for facilities will be done. The closure plan also calls for an education center and trails to be built through the newly restored landscape.

Brookfield is separated from Fresh Kills Landfill by the heavily trafficked Richmond Avenue. The only direct link between the two facilities is via Richmond Creek under Richmond Avenue. Other city facilities at Brookfield include a centralized wastewater collection system, a wastewater pump station, and some storm sewer outfalls.

ARDEN HEIGHTS / GREENRIDGE / VILLAGE GREENS

Southern subarea, Community District 3
Total Population: 20,535 (1990 Census); 24,996 (2000 Census); 22 percent increase

Evidence of Native American settlements are found in this subarea within the Lemon Creek / Sandy Brook Watershed and Greenridge, once called Marshland, was settled by the Huguenots in the colonial period. The area contained fields, woods and wetlands similar to Fresh Kills Landfill Complex. Houses built before the Civil War still exist and early buildings from Greenridge are now in Historic Richmondtown.

Today, the subarea is entirely within the SSRDD and almost 60 percent of the land is devoted to residential use. The age of the housing stock varies, but much of it was built since the 1960s. Village Greens, a large planned unit development built on a 165-acre site in the early 1970s, is considered to be among the most thoughtfully planned developments built on Staten Island during this time. Its success has been attributed largely to zoning regulations encouraging cluster development and preserved open space.

Nearly one-quarter of the land in the subarea is open space. Arden Heights Woods, a 183-acre wildlife sanctuary, was mapped as Designated Open Space (DOS) in 1975 and was subsequently mapped as city parkland. Nearly 10 acres of land adjacent to the park are mapped DOS. A portion of the Sweetbrook Bluebelt, spanning more than 20 acres, is located in the southwest portion of the subarea.

Two public schools are in the subarea: PS 4, Maurice Wallen School, and IS 75, E. Bernstein Intermediate School.

HUGUENOT / ROSSVILLE / WOODROW

Southern subarea, Community District 3
Total Population: 15,095 (1990 Census); 18,894 (2000 Census); 25 percent increase

Native American sites have been identified in this subarea, including a large base camp from the late Archaic to Late Woodland period west of Sandy Brook. Much of what is now Woodrow was sparsely settled with an economy based on agriculture. One of the oldest cemeteries in Staten Island, the Sleight Family /Blazing Star Cemetery, active from 1750 to 1850, is located in Rossville. From the pre-Revolutionary days until the mid-19th century, Rossville, as well as Tottenville, were important ferry crossings between New York and Philadelphia. Rossville was developed around the old Blazing Star Ferry in the early 19th century. When Victory Boulevard was built across Richmond County, it improved connections to the western parts of the island and to the competing New Blazing Star Ferry in Travis, which had steamboat and stagecoach connections to Philadelphia. By the 19th century, Rossville was a thriving farm community and the village grew around it. In 1860 the construction of the railroad from Clifton to Tottenville bypassed Rossville, which caused the town's decline until the West Shore Expressway was completed in 1970.

Two landmarked churches are located in the subarea. The Memorial Church of the Huguenots was designed in 1924 by Ernest Flagg in the style of vernacular Norman architecture of northwestern France and England. It is built from Serpentine quarried from Staten Island. The

First Methodist church, a landmark Greek Revival church built in 1842, is still on its original site.

The community of Sandy Ground straddles this subarea and the Charleston / Richmond Valley subarea. Established in the 1830s, it was the first free black community in New York State. It was settled by African American oystermen from Maryland, New Jersey, Delaware, and Virginia coming north to Staten Island for greater freedom and flourishing oyster beds. Though only the cemetery and a few buildings remain, as a result of brush fires in the 1960s, the area is listed as a National Historic Site.

One- and two-family homes constitute almost half the land use in the subarea. A cluster of multi-family walk-up buildings is in the northwest section of the subarea, in the vicinity of the West Shore Expressway and Arthur Kill Road. Part of the SSRDD, this area has experienced rapid growth in population and development since the 1980s.

Almost a third of the subarea is open space, most of which is mapped parkland. The 18-hole, 175-acre South Shore Golf Course on the south side of the West Shore Expressway is a par 72 concession golf course with a putting green and clubhouse. The 139-acre Bloomingdale Woods Park spans this subarea and the Charleston/Richmond Valley subarea at Richmond Parkway. There are no other public recreational facilities in the subarea. This subarea contains the headwaters of Sandy Brook and associated land, which combined with Lemon Creek to the south, is one of the Staten Island's Bluebelts. In addition, a portion of the vacant land remains natural as Designated Open Space.

There is a limited amount of commercial use in the subarea, and one new 930-seat public elementary school, PS 56.

CHARLESTON / RICHMOND VALLEY

Southern subarea, Community District 3
Total Population: 2,699 (1990 Census); 6103 (2000 Census); 126 percent increase

Through the 19th century, upland areas of the Charleston / Richmond Valley subarea were settled by the Dutch, English and French farmers while the waters and shoreline of the Arthur Kill were used for fishing and shipbuilding. Oystering was the most profitable industry in the area until the oyster beds became polluted circa 1900.

In 1854, Balthazar Kreischer, a Bavarian immigrant, opened a factory to manufacture bricks and terra cotta ornamentation using the abundant clay in the area (some of the clay pits are visible in the 250-acre Clay Pit Ponds State Park). By the 1890s, more than 300 workers (mostly German and Irish immigrants) had settled the company town of Kreischerville. After the factory closed in 1927 the neighborhood became known as Charleston. There are still several structures associated with Kreischer Brick Works in the area. Balthazar Kreischer built a house on Arthur Kill Road overlooking the factory and two houses for his sons. The Charles Kreishcher house (c. 1888) is the only remaining house built in the Stick Style and has since been landmarked. The Westfield Township School No. 7, made of Kreischer Bricks, was built for the factory children around the same time. A row of landmarked wood Kreischer workers houses still remains, with Kreischer Brick sidewalks. Other brickworks were established near and within the Fresh Kills Landfill Complex. Just south of Rossville at Smoking Point, industrial plants such as the White Lead Company and the International Ultramarine Works (1884-1963) made pigments from the local clay.

Regional connections improved when roads were paved and Hylan Boulevard was constructed in the early 1900s. The Outerbridge Crossing, built in 1928, created access to New Jersey, which furthered the growth of the area. With the opening of the Verrazano Narrows Bridge and the completion of the West Shore Expressway, growth increased more rapidly. However, the Expressway separated upland parts of Charleston and Richmond Valley from the waterfront.

Manufacturing, industry, utility, transportation, and commercial uses account for approximately 20 percent of the land use in this subarea. Port Mobil, an oil storage facility, is the dominant industrial use in the subarea. The smaller Witte Marine Salvage company (ships' graveyard) has operated since the 1930s. Salvaged ships of all types are scattered on land and in the water offering passersby an historical survey of vessels that once plied the harbor's waters.

Close to 40 percent of the land is vacant, most of it zoned for industrial or commercial use. Development is now occurring in the subarea and other projects have been proposed, including new commercial development and expansion of existing manufacturing uses.