

A. INTRODUCTION**OVERVIEW**

This chapter analyzes the potential impacts of the proposed project on the City's infrastructure systems, specifically the landfill infrastructure at Fresh Kills Landfill. As defined by the *City Environmental Quality Review (CEQR) Technical Manual*, the City's "infrastructure" comprises the physical systems supporting its population, including water supply, wastewater treatment, and stormwater management. Other infrastructure elements, such as solid waste management, energy and transportation, are addressed separately under CEQR and are assessed in separate chapters of this environmental impact statement (EIS).

WATER DEMAND

With respect to water supply, according to the guidance of the CEQR Technical Manual, actions that could significantly impact City water supplies or local water pressure generally are analyzed in a detailed impact assessment. This would include large developments (e.g., those that use more than one million gallons per day) or actions taking place in locations that have weaknesses in the local water distribution system (i.e., an impact could occur by creating a large draw of water in a location where water pressure is low or near pressure boundaries).

As described in the *Fresh Kills Park Final Generic Environmental Impact Statement (FGEIS)*, while the New York City Department of Parks & Recreation (DPR) may need to extend water lines into the project site to serve the proposed facilities, the added water demands of the proposed Fresh Kills Park project are expected to be limited and is not expected to overburden the City's water supply system. The component of the water service relative to the management of the East Park roads is also very limited. In addition, it is anticipated that sustainability strategies will be implemented on the site to further reduce water demand. The proposed park roads would have little water demand. Thus, an additional analysis of water supply is not necessary in this SEIS.

WASTEWATER TREATMENT

While DPR may need to extend sanitary sewer lines into the project site to serve the proposed Fresh Kills Park facilities, there would be adequate wastewater treatment capacity at the Oakwood Beach and Port Richmond Water Pollution Control Plant (WPCP) to handle the increased sanitary flows from the proposed project. Thus, no significant adverse impacts would occur to the City's wastewater treatment facilities. The proposed park roads would create no demand for wastewater treatment. The proposed East Park roads would not generate any demands for wastewater treatment. Thus, an additional analysis of wastewater treatment is not necessary in this SEIS.

LANDFILL INFRASTRUCTURE

The proposed project would require the relocation or modification of landfill infrastructure in order to create the proposed road. Thus, an analysis of potential impacts on landfill infrastructure is appropriate in this SEIS. The purpose of this analysis is to determine whether the proposed East Park road system would significantly impact any of the New York City Department of Sanitation (DSNY) managed and the New York State Department of Environmental Conservation (DEC) regulated landfill environmental protection and monitoring systems of the Fresh Kills Landfill Final Closure Plan. This chapter presents conditions for four scenarios: (i) a No Build condition in 2011 (i.e., closure under the existing approved closure plan completed); (ii) modifying the final closure construction at Landfill Section 6/7 to provide a closed landfill cover and a road embankment completed by 2011; (iii) installation of the Yukon Avenue Connection road by 2016; and (iv) installation of the Forest Hill Road and Richmond Hill Road Connections by 2036.

This analysis does not include a discussion of the DSNY Plants 1 and 2 since they are located outside the project site. A full discussion of Plants 1 and 2 was presented in the Fresh Kills Park FGEIS (March 13, 2009).

STORMWATER MANAGEMENT

To avoid stormwater impacts from the proposed roads (such as impacts to DSNY infrastructure or receiving waters) existing stormwater basins may be modified and individual stormwater BMPs would be constructed by the project to provide adequate stormwater management for the proposed roads. Therefore, an analysis of stormwater management impacts is appropriate in this SEIS.

The *CEQR Technical Manual* states that a detailed analysis of stormwater management is warranted if a proposed project involves certain types of industrial activities or actions that would greatly increase the amount of paved area or areas that would be served by a separate storm system and that would involve construction activities, or construction of a new stormwater outfall. The proposed project would create additional impervious surfaces on the project site and would alter existing on-site stormwater management systems. Thus, an analysis of potential impacts on stormwater runoff is appropriate in this SEIS.

B. EXISTING CONDITIONS

FRESH KILLS LANDFILL STRUCTURES AND FACILITIES

OVERVIEW

In accordance with the requirements of the 1990 Consent Order between NYSDEC and the City of New York, which establishes the regulatory framework for the operation and closure of the landfill, various environmental protection features and systems have been designed for closure construction and have been approved by NYSDEC at Landfill Section 6/7. These systems are described in the NYSDEC-approved Landfill Final Closure Plan. In addition to the physical environmental protection systems, DSNY is also responsible for on-going operation, maintenance, monitoring, and reporting of data pertaining to each of these systems, as described in the site-wide Post-Closure Care, Maintenance, Monitoring and Operations (PCCMMO) Manual, which is a component of the Final Closure Plan.

The Final Closure Plan also includes an extensive internal roadway system to allow vehicular operations to move throughout much of the Fresh Kills Landfill site independent of the adjoining

public roads. Although the internal roadway system is not specifically an environmental protection feature, these roads provide a means of access for operation, maintenance and monitoring of the site features and are therefore a crucial component of the Final Closure Plan.

The Fresh Kills Park East Park Roads project is located both on and adjacent to the Landfill Section 6/7. In general, the environmental protection systems that are located within the project boundary include:

- Leachate Control System;
- Landfill Gas Control System;
- Landfill Cover and Stormwater Management System; and
- Environmental Monitoring Network (i.e., groundwater wells, gas migration wells, and surface water sampling locations)

A description of the general function, location, and components of each of the environmental protection systems is provided below.

INTRODUCTION

To support the final closure of Fresh Kills Landfill, there is an extensive infrastructure system that was installed and is managed and maintained by DSNY (see Figures 13-1 and 13-2). In addition to the final cover, this includes landfill gas and leachate collection and treatment systems, stormwater collection and control structures, bridges and landfill access roads. There are also Plants 1 and 2 and a significant stretch of bulkheaded waterfront where solid waste once arrived by barge when the landfill was operating. Currently there are about 113 DSNY employees at the site. These include about 87 employees from the Bureau of Waste Disposal, 4 from enforcement, and 22 in support services.

A description of the more critical components of the DSNY infrastructure at Fresh Kills Landfill is provided below, with a focus on Landfill Section 6/7. This includes a discussion of the landfill section final cover, the leachate control and treatment facilities, the landfill gas collection and treatment systems, and the stormwater management system.

LANDFILL SECTION 6/7 FINAL COVER

Description of Cover Types at Fresh Kills Landfill

Final cover has been or will be placed over the solid waste in all the landfill sections for the purposes of minimizing water infiltration, reducing erosion, promoting positive surface water drainage, and providing a physical barrier between the solid waste below and the above-ground environment. Final cover is the regulatory terminology for the system of layers that are generally comprised of an impermeable liner, 2 to 2.5 feet of barrier protection material (a compacted, largely inorganic soil layer that creates a barrier above the liner), and a roughly 6-inch thick layer of growing medium. The five layers from the top to the bottom comprise the following.

- Top Layer (Vegetation/Roadways/Surface) - The top of the final cover is designed to direct runoff away from the landfill and control erosion of the cover. It typically consists of vegetative cover and a 6-inch-thick layer of planting soil but may also include asphalt or gravel road materials. The final cover vegetation includes warm season grasses. Annual rye grass is used initially to establish a cover crop to prevent erosion until the warm season grasses take hold.

Fresh Kills Park East Park Roads SEIS

- Barrier Protection Material - This layer is composed of a roughly 2-foot thick layer of soil. Its purpose is to protect the underlying hydraulic barrier layer from weather extremes that could cause cracking or heaving, to store excess water until plants uptake water or until the water drains from the cover, and to protect against burrowing animals.
- Drainage Layer - Made of either soil or a geosynthetic, this layer facilitates drainage of water that has infiltrated into the final cover, draining the overlying soils so as to minimize the saturation of the final cover.
- Hydraulic Barrier Layer - This layer consists of a geomembrane that prevents water from percolating into the underlying solid waste and creating leachate. It also functions to contain landfill gas.
- Gas Venting Layer - This layer typically consists of a geocomposite layer that allows landfill gas generated within the landfill to move toward landfill gas extraction wells or vents.

A summary of the various types of final covers used at Landfill Section 6/7 and across the site is provided in Table 13-1 and shown in Figure 13-3. At Landfill Section 6/7, the cover types include a geomembrane cap with a 2-foot thick layer of soil that acts as barrier protection material with a 6-inch layer of topsoil and seeding (Type I, II, IV, V, and VIII), crushed stone and/or gravel (Type VI and VII), or pavement (Type VIII).

Final Cover Landfill Section 6/7

Final cover installation for Section 6/7 is in progress (see the “Future Without the Proposed Project,” below). The existing and planned final cover consists of five types: Types IV, V, VI, VII, and VIII as defined by the Fresh Kills Final Cover Plan (DSNY 2001, see also Table 13-1).

Type IV final cover is being installed on slopes of between 15 and 33 percent. The Type IV final cover is comprised of (in descending order) a minimum of 6 inches of topsoil, a minimum of 24 inches of soil barrier protection material, a geocomposite drainage layer, a hydraulic barrier layer consisting of 40-mil thick textured linear low-density polyethylene (LLDPE) geomembrane and a geocomposite gas venting layer.

Type V final cover is being installed on slopes of between 4 and 15 percent. The Type V final cover is comprised of (in descending order) a minimum of 6 inches of topsoil, a minimum of 24 inches of soil barrier protection material, a drainage layer consisting of a geotextile fabric, a hydraulic barrier layer consisting of 40-mil thick textured LLDPE geomembrane and a geocomposite gas venting layer.

Type VI final cover will be used for finished asphalt roads. The Type VI final cover is comprised of (in descending order) a minimum of 4 inches of asphalt material, a minimum of 6 inches of crushed stone and gravel, a geotextile fabric barrier protection layer, a minimum 20-inch thick soil barrier protection layer as additional barrier protection material, a drainage layer consisting of geotextile fabric protection material, a hydraulic barrier layer consisting of 40-millimeter thick textured LLDPE geomembrane and a geocomposite gas venting net.

Type VII final cover will be used for finished gravel roads. The Type VII final cover is comprised of (in descending order) a minimum of 6 inches of gravel, a geotextile fabric barrier protection layer, a minimum 24 inches of soil barrier protection material, a geocomposite drainage layer, a hydraulic barrier layer consisting of 40-mil thick textured LLDPE geomembrane and a geocomposite gas venting net.

**Table 13-1
Summary of Final Cover Types**

Final Cover/Layer Information	Final Cover Type										
	I	II	IIIA	IIIB	IIIC	IV	V	VI	VII	VIII	IX
Locations Where Used	Sections 2/8, 3/4 10% - 33% slopes	Sections 2/8, 3/4 Slopes <= 10%	Section 1/9, Southeast perimeter slope north of Arden Ave. Section 3/4, Some perimeter slopes	Sections 2/8, 3/4 Some perimeter slopes	Section 1/9 Southeast perimeter slope south of Arden Ave.	Sections 1/9, 6/7 Slopes > 15%	Section 1/9, 6/7 Slopes <= 15%	Section 1/9, 6/7 Asphalt roads	Section 1/9, 6/7 Gravel roads	Section 1/9, 6/7 Perimeter road	Section 1/9 Northern and eastern perimeter of reclamation area
Top Layer	6" topsoil and seeding	6" topsoil and seeding	6" topsoil and seeding	6" topsoil and seeding	12" topsoil and soil barrier protection material	6" topsoil and seeding	6" topsoil and seeding	4" asphalt; 6" crushed stone and gravel	6" gravel	6" topsoil and seeding (shoulder) or Type 1 or 2 pavement (roadway)	Topsoil and seeding 60" alternative final cover (max. permeability of 1.0×10^{-5} cm/sec)
Barrier Protection Material (BPM)	24" barrier protection material	24" barrier protection material	18-24" soil barrier protection material	18" soil barrier protection material		24" soil barrier protection material	24" soil barrier protection material	Geotextile fabric protection layer 20" soil barrier protection layer	Geotextile fabric protection layer 24" soil barrier protection layer	24" soil barrier protection material	
Drainage Layer (DNL)	Geocomposite (HDPE drainage geonet with a non-woven geotextile on both sides)	-----	-----	-----	-----	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geotextile fabric protection layer	Geotextile fabric protection layer	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet		
Hydraulic Barrier Layer	40-mil textured HDPE geomembrane	40-mil smooth HDPE geomembrane	12" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	18" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	12" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	60-mil HDPE geomembrane	
Gas Venting Layer (GVL)	-----	-----	-----	-----	-----	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	-----	

Source: Fresh Kills Landfill Final Closure Plan, DSNY, June 2003.

Type VIII final cover was installed around the perimeter of Section 6/7 and overlies the leachate cutoff wall, leachate collection drain and other associated components of the leachate collection and containment system. The Type VIII final cover is comprised of (in descending order) a minimum of 6 inches of topsoil or pavement, a minimum of 24 inches of soil barrier protection material, a hydraulic barrier layer consisting of 60-mil thick HDPE geomembrane and a minimum 6-inch thick HDPE geomembrane bedding layer.

LEACHATE CONTROL SYSTEM

Leachate is defined as a liquid solid waste, including any suspended components in the liquid that result from contact with or passage through solid waste. Leachate is created as percolating rainwater travels vertically through the solid waste layer and dissolves soluble substances in the solid waste layers into leachate. As described in detail below, the Consent Order agreement between DEC and DSNY establishes a number of environmental controls, management, treatment, and monitoring programs pertaining to leachate generated by Fresh Kills Landfill.

Geologic materials at Fresh Kills are represented by three distinct layers or units: refuse/fill, unconsolidated overburden, and unconsolidated bedrock. The refuse/fill layer consists of man-made deposits (i.e., the landfilled solid waste), which has been lain on top of natural soils. These refuse/fill materials range in thickness from several feet to ± 150 feet. Below this layer, the unconsolidated overburden is composed of natural soils lying between the refuse/fill layer and bedrock below. This overburden layer consists primarily of fine-grained silt and clay material.

In accordance with the requirements of the 1990 Consent Order, DSNY prepared management and modeling investigation and analyses with respect to leachate control at Fresh Kills Landfill. These reports, *Final Hydrological Report* (IT Corporation, July 25, 1993) and *Final Leachate Mitigation Report and Corrective Assessments Report* (IT Corporation, March 7, 1994), detail the activities and findings of these leachate mitigation investigations. As part of the development of a conceptual model of the site hydrology, analytical analyses of the rate of horizontal and vertical groundwater influx was performed in order to estimate the magnitude of leachate and groundwater discharge and the rate of groundwater infiltration into the landfill mounds. To understand this condition, models were developed projecting a volume of flow and solute transport in order to evaluate the effects of the landfill on local groundwater and surface waters, identify the potential vertical leachate migration pathways, and to develop corrective measures, as necessary. In addition to the modeling, groundwater sampling was also performed. Based on that modeling, (steady-state numerical model calibrated to 1993 existing conditions), it was conservatively estimated that the combined leachate generation at the site from all the landfill sections was 1.3 million gallons per day prior to implementation of any corrective measures. The calculated volume of leachate is a numerical model output and therefore should not be considered an exact number. Rather, the purpose of the modeling was to evaluate the potential for leachate migration away from the landfill unit, conduct a sensitivity analysis to determine potential leachate migration based on a variation of the geologic parameters and to develop a tool for the evaluation of various remedial alternatives during the leachate mitigation design process. The results of pre-corrective measure leachate generation models suggested that approximately 92 percent of the migration away from the landfills (1.2 million gallons per day) affected shallow groundwater and certain upstream surface waters. The remaining leachate volume, approximately 100,000 gallons per day, was estimated to migrate vertically downward, with the majority of the vertical migration (81,000 gallons per day) estimated to occur within the Section 1/9 area of the landfill. The relatively large proportion of predicted leachate migrating through the base of Landfill Section 1/9 may be attributable to the presence of high permeability

sand units that are in direct contact with the refuse along the western side and portions of the northern side of Section 1/9.

As a result of these modeling and monitoring analyses, a leachate control system was selected by the city and approved for installation at the Fresh Kills Landfill by DEC. The objectives of the corrective measures system are to minimize leachate impacts to local groundwater or surface waters. The corrective measures have been in place and operating at the Fresh Kills Site for more than ten years, and all monitoring data to date have demonstrated that the measures are meeting or exceeding the original objective and standards. Consequently, the leachate mounds within the landfill units are no longer directly monitored. To the extent that there may be limited vertical migration of leachate, these releases have been disclosed in annual monitoring submitted to DEC and the discharges deemed adequately addressed by the approved corrective measures. A description of the corrective measures, as well as the landfill cap system that helps to reduce leachate generation is provided below.

At Landfill Sections 1/9 and 6/7, this leachate control system is comprised of a cutoff wall and leachate collection drain with collection pump stations located around the perimeter of the two landfill sections (see Figure 13-4). Collected leachate from these systems is conveyed through header pipes and force mains to the Fresh Kills Landfill Leachate Treatment Plant (see the description below).

Leachate control measures at Fresh Kills, including the impermeable landfill covers (discussed above), cut-off walls, leachate recovery wells, and a leachate collection and conveyance system and treatment plant that minimize leachate volumes reaching local groundwater and surface waters in and around Fresh Kills. In addition, the mostly Pleistocene geological formation beneath the landfill forms part of an impermeable barrier between the landfill and deeper groundwater. The isolated areas that lack the Pleistocene geological layer are composed of sandy Cretaceous deposits.

As stated above, the components of the Fresh Kills leachate containment and collection system for each landfill section are designed based on the underlying substrate and modeling performed at the site. As shown in Figure 13-4, a vertical hydraulic barrier (or “cutoff wall”) and leachate collection drains have been installed around the perimeter of Landfill Section 6/7 along with associated leachate collection pump stations.

As described above, the final cover on top of the landfill sections also limits rainwater infiltration into the landfill refuse below, thereby reducing the volume of leachate. The cutoff walls are keyed into the underlying geological barriers and are constructed to restrict the horizontal in-flow of water from outside the landfill sections and into the leachate collection drain as well as to restrict the flow of leachate out from the landfill sections into the surrounding environment. As described above, the leachate collection drains are located completely around the perimeter of Landfill Sections 6/7 and 1/9 and are constructed of crushed stone and perforated pipe.

Leachate recovery wells connect leachate header pipes and force mains to the Fresh Kills Landfill Leachate Treatment Plant at the south edge of the Landfill Section 1/9. The Fresh Kills Landfill Leachate Treatment Plant has a design capacity of 1,050,000 gallons per day and contains the following major unit processes: influent holding, sequencing batch reactors for biological treatment, metals precipitation, gravity clarification, sand filtration, effluent pH adjustment, and discharge through diffuser outfall. Once leachate is treated, it is discharged into the Arthur Kill in compliance with permitted effluent levels. The residuals are transported off

site and properly disposed. Ongoing monitoring of treated leachate discharge from the plant to the Arthur Kill is performed to ensure that the environment is protected and in accordance with permit requirements (see also the discussion below). Pairs of hydraulic wells monitor groundwater elevations around the perimeter of the landfill and are inspected regularly to verify the effectiveness of these systems. The performance of the leachate management system is monitored and data relevant to the performance of the system is submitted to DEC on a regular basis.

In summary, the Fresh Kills Landfill leachate control system is designed to contain, collect, and treat leachate before it reaches local groundwater or surface waters. Moreover, groundwater and surface water monitoring programs are also used to measure the performance of the system and to ensure that any possible impacts to the environment due to leachate releases are identified, and appropriately mitigated, in order to minimize any negative impacts to the environment.

LANDFILL GAS MANAGEMENT SYSTEM

Introduction

Municipal solid waste landfills contain buried wastes that produce gaseous compounds through biological and chemical decomposition. The primary components of landfill gas are methane and carbon dioxide with trace amounts of non-methane organic compounds including some highly odorous contaminants. In order to avoid significant impacts to the environment from air emissions at the landfill, Fresh Kills Landfill has an active gas collection system that collects these gaseous compounds. The gas management process includes a mechanical blower to pull in landfill gases (i.e., the blower creates negative pressure, a vacuum) via collection pipes and vertical gas extraction wells. The system was designed to have a collection efficiency of 90 percent or greater. Gaseous emissions not captured by the collection system (i.e., 10 percent or less) are considered fugitive emissions when released to the atmosphere from the landfill. The pathways for these fugitive emissions may include escape through the landfill cover, underground soil gas migration, and the passive vents at the landfill surface if negative pressure in the collection system is not fully attained.

At Fresh Kills Landfill, the collected gases are either sent to a gas recovery plant for re-use as pipeline natural gas after pre-treatment or directed to a flaring station. The primary objectives of the system are to control odors and prevent adverse impacts on air quality. The methane content of landfill gas (usually about 50 percent) is the reason it can be flared or used as fuel. As with any combustion source, carbon dioxide, a greenhouse gas, is emitted as a by-product of burning the methane. Methane, however, is also a greenhouse gas and is considered to be at least 20 times more potent a greenhouse gas than carbon dioxide. Therefore, any release of carbon dioxide into the atmosphere from methane combustion would be a minimized impact when compared with the release of methane generated by the landfill, if there were no flaring or gas recovery reuse systems were in place. Current operations at the landfill rely mostly on landfill gas recovery and re-use as pipeline natural gas. This re-use displaces the need for natural gas from other utility sources that would otherwise have been burned by local customers, providing an overall net benefit to air quality and providing a positive effect with regards to greenhouse gas reductions.¹

¹ On September 9, 2008, DEC issued the *Draft Guide for Assessing Energy Use and Greenhouse Gas Emissions in Environmental Impact Statements*. This report addresses a range of issues that are currently under consideration with respect to greenhouse gas emissions, global climate changes, and their effects

As described above, Fresh Kills Landfill incorporates such measures, including gas collection, flaring, and reuse for energy production. Also proposed with the Fresh Kills Park project (see the discussion below), is a final vegetative cover program that further reduces the impacts of greenhouse gases. A more detailed description of the gas control systems at Fresh Kills Landfill follows.

Without gas collections and controls, landfill gas would migrate vertically and horizontally away from the landfill within unsaturated soil layers. The landfill gas migration management system at Fresh Kills is, as stated above, composed of engineered controls for collection supported by gas migration monitoring around the waste cells and buffer areas. The Fresh Kills landfill gas emissions management system is generally composed of an active landfill gas collection system, a landfill gas recovery and flaring system, and a passive venting system. Landfill gas collected at the site is processed through one of two methods in order to comply with regulatory requirements for emissions reduction:

- Recovery and purification of the gas for use as fuel; or
- Flaring, which involves combustion of landfill gas at high temperatures for thermal destruction of both methane and non-methane organic compounds, which otherwise could be harmful to human health.

During normal operating conditions, the active collection, flaring, and gas recovery systems are operated and the passive vents remain closed. Over time, once methane gas production has diminished at the landfill, and after active gas collection is no longer required, the passive vents may be opened. If the quantity of landfill gas exceeds the capacity of the landfill gas recovery plant or if the plant is decommissioned in the future as gas production declines, then collected landfill gas is expected to be managed at the flare stations. A description of each of the components of the landfill gas management system follows:

Active Landfill Gas Collection System

- Landfill gas extraction wells—these wells collect landfill gas under vacuum pressure. Located at a spacing of approximately one per acre of the landfill sections (see Figure 13-5), these wells extend vertically downward to approximately the saturated zone of the refuse.

on sea level rise. The report does not set a threshold for the determination of impacts under CEQR/SEQR, but does begin to establish a framework for the evaluation of greenhouse gas emissions from large projects. Among the large projects cited as examples in the report are power-generating facilities, projects that generate millions of vehicle miles traveled or consume a substantial amount of energy, and landfills. The six main greenhouse gases of concern are carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), hydroflourocarbons (HFCs), perflouracarbons (PFCs), and sulfur hexafluoride (SF₆). Of these, CO₂ accounts for an estimated 88 percent of the greenhouse emissions in New York State, of which the majority (approximately 88 percent) come from fuel combustion. Other sources include distribution of energy, refrigerant substitutes, management of municipal waste and wastewater and agricultural activities (which generate methane and N₂O, natural gas leakage, and other sources).

The report recognizes that there are discrete actions that can be taken to reduce methane emissions from landfills. Among them are recovery of organics from the waste stream, enhanced landfill gas collection and flaring and re-use of landfill gas for energy production. The report states that each of these measures would have a positive impact on total greenhouse gas emissions in New York State with respect to landfill emissions (see also Chapter 18, “Air Quality”).

- Landfill gas header pipes—a network of non-perforated, lateral pipes which generally lay atop the hydraulic barrier layer of the cover system, these pipes transmit gas collected in the wells toward flare stations or the landfill gas recovery plant.
- Condensate tanks—located at each of the four landfill sections, these tanks collect liquid that condenses from the landfill gas. The liquid is subsequently pumped out by trucks. At Landfill Section 6/7 condensate is drained to both collection tanks (southern side of the site) and into the leachate collection system (northern side of the site).

Landfill Gas Recovery Plant and Flaring Stations

- Landfill gas blowers—provide the necessary vacuum to draw landfill gas from the extraction wellfield and convey it to the flare stations, from which it may be conveyed to the landfill gas recovery plant.
- Landfill gas transmission mains—a system of transmission pipes has been constructed to convey landfill gas from the flare stations at Landfill Sections 2/8, 3/4, and 6/7 to the landfill gas recovery plant. (Landfill gas from Landfill Section 1/9 goes directly to the landfill gas recovery plant.) If the landfill gas recovery plant shuts down, transmission lines will take the landfill gas from the landfill section to one of the flares.
- Flare stations—located on half-acre sites at the north, east, and south mounds. There are 3 flare stations that serve as a back-up safety system for combusting landfill gas in the event that the landfill gas recovery facility is not operating. Landfill gas flare stations are located on Landfill Sections 3/4 and 6/7, and north of 2/8. The flares are connected to the vast network of landfill gas collection pipes.
- Landfill gas recovery plant—this highly efficient facility is located in the northeast portion of Landfill Section 1/9. It is designed to manage landfill gas from all landfill sections and to process the landfill gas for reuse.

Passive Landfill Gas Venting System

- Sections 1/9 and 6/7: Geocomposite landfill gas venting net layer provides for passive venting of landfill gas through the final cover, installed at a spacing of about one per acre (see Figure 13-6).
- Sections 2/8 and 3/4: Landfill gas ducts—consist of stone-filled trenches cut into the refuse to facilitate movement of landfill gas to the vents; and passive vents—provide for passive venting of landfill gas through the final cover.

Engineered Controls

- Perimeter landfill gas Interceptor Venting System—independent of the landfill gas extraction network, these vents are located around the perimeter of the landfill, serving as a safety measure to prevent landfill gas from migrating underground off-site. They are trenches filled with coarse stones extending from the surface down to low-permeability soils or the seasonal low groundwater table; and
- Utility Seals—used as a barrier to landfill gas migration in underground utility conduits.

Migration Monitoring System

- Landfill gas migration monitoring wells—62 landfill gas migration monitoring wells are distributed along the landfill perimeter and placed outside the venting trenches;
- Methane Sensors—89 methane sensors are distributed throughout the site in 35 buildings.

LANDFILL SERVICE ROADS AND BRIDGES

Landfill Section 6/7 has an extensive internal landfill service road system that allows DSNY vehicular access across much of the site independently of the adjoining public roads. Off-site, the existing DSNY entrance providing access to and from Fresh Kills is Muldoon Avenue west of the West Shore Expressway. There is also a gated entry into Fresh Kills from the West Shore Expressway service road leading south from Victory Boulevard, which provides ingress to DSNY's Staten Island Solid Waste Transfer Station, Composting Facility, and the Crushing and Screening Facility (also off-site). Egress is provided by a northbound service road on the east side of the expressway, which leads to the service road leading to Wild Avenue in the Travis area and continues to Victory Boulevard. An entrance ramp north of Victory Boulevard connects to the West Shore Expressway northbound mainline. The northbound exit to Victory Boulevard provides an exit for vehicles now performing final closure at Landfill Section 6/7 as well as Waste Transfer Station vehicles. Additional service gates are located within the site. These are normally closed and kept locked. Active access and exit points are gated and guarded. Chain-link fences (10 feet high) surround all the landfill sections, preventing access by vehicles or the public at other locations. There is an internal network of landfill haul and service roads that includes passages under the north and south end spans of the West Shore Expressway bridges over Fresh Kills Creek, and two haul bridges: one over Main Creek and the other over Richmond Creek (see Figure 1-3 in Chapter 1, "Project Description").

Vehicle speed within the site is controlled by signs posted along the DSNY service access roads. These roads are regularly inspected and maintained by DSNY.

POST-CLOSURE MONITORING AND MAINTENANCE OPERATIONS MANUAL¹

Regulatory Requirements

In accordance with the requirements of the State of New York including 6 NYCRR Part 360 and the Order of Consent between DEC and DSNY, a Post-Closure Monitoring and Maintenance Operations Manual (the Manual) was prepared for Fresh Kills Landfill to provide all information necessary to effectively monitor and maintain Fresh Kills for the entire post-closure period. Under the requirements of the Post-Closure Manual, the City is required to perform a variety of measures to ensure that closure and post-closure monitoring and maintenance of the landfill occur in compliance with 6 NYCRR Part 360. Elements of the Manual include the following:

- A description of the environmental control system monitoring program with the sampling locations and methodologies, recordkeeping and reporting requirements for all environmental monitoring activities;
- A description of types, location and frequency of all facility maintenance activities including maintaining the integrity and effectiveness of any final cover, making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, maintaining the appropriate vegetative growth; preventing runoff from eroding or otherwise damaging the final cover; maintaining the leachate collection system; maintaining the landfill gas control and monitoring systems; and recordkeeping and reporting requirements.

¹ The source for the information provided below is the *Fresh Kills Landfill Post Closure Monitoring and Maintenance Operations Manual*, prepared by Roy F. Weston of New York, Inc. for DSNY, December 3, 2002. This is a summary description. A more detailed description of the Manual is provided in the Fresh Kills Park FGEIS ([March 2009](#)).

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- A description of personnel requirements including minimum qualifications, staffing, contact information, and equipment needs;
- A description of contingency plans that are necessary for responses to conditions that include, but are not limited to, major erosion, significant differential settlement, and fire; and a summary of any corrective measures that may be performed;
- Financial assurance that the City will remain in compliance with these obligations; and
- A description of the planned uses of the property during the post-closure period.

DSNY FACILITIES ADJACENT TO THE PROJECT SITE

DSNY operates a number of essential solid waste and sanitation management facilities at Fresh Kills that support ongoing solid waste management services and operations for the Borough of Staten Island. As depicted in Figures 1-3 and 1-6, these include the Staten Island Waste Transfer Station as well as two local Sanitation District facilities that are located adjacent to, but outside, the boundaries of the proposed park. The DSNY District 2 garage is adjacent to the project site, off Richmond Avenue near Richmond Hill Road, and serves DSNY's Staten Island Sanitation District 2.

STORMWATER

INTRODUCTION

Stormwater management is an essential component of Fresh Kills Landfill, and stormwater management infrastructure is therefore located throughout the project site. The system at Fresh Kills has been designed to detain all site-generated stormwater runoff on the site and to facilitate the removal of suspended sediments and any adhered pollutants prior to any discharges to local waterbodies. It is designed to prevent erosion of the top layer of the final cover, thereby preventing damage to the underlying hydraulic barrier layer and thus minimizing infiltration and leachate generation. This system was installed by DSNY in accordance with a DEC-approved stormwater management and pollution control plan and has a State Pollution Discharge Elimination (SPDES) permit. In addition to the stormwater management system, erosion and sediment control practices across the site, but particularly on the landfill sections, greatly reduce the potential for water quality impacts from the landfill on the surface waters flowing through Fresh Kills (see the discussion above). Figure 13-7 provides a map of the existing stormwater system at Fresh Kills Landfill.

The final cover and grading of the landfill sections is carefully engineered to ensure positive drainage and to direct storm flow. With the Fresh Kills stormwater management system, the stormwater runoff that develops on the landfill sections is directed into stabilized swales on the top plateau and sideslopes. These systems convey the water to downchutes, pipes, and rip-rap lined swales, which in turn convey the runoff to the stormwater basins. The stormwater basins reduce the rate of stormwater discharge from the site and allow sediment to settle out before the stormwater is released to local waters. Specific components used in the construction of the drainage systems vary for each landfill section. For example, Sections 2/8 and 3/4 employ underground downchute pipes to convey stormwater from swales to stormwater basins while Sections 1/9 and 6/7 will use gabion downchutes and drop-inlet boxes (see Figure 13-8).

Grading of the individual landfill sections is carefully engineered to ensure positive drainage and to direct storm flow. Under the Fresh Kills stormwater management system, the high-velocity stormwater runoff that develops on the landfill sections is directed into stabilized swales on the top plateau and on sideslopes. These systems convey the water to downchutes, pipes, and rip-rap

lined swales, which in turn convey the runoff to the stormwater basins. The stormwater basins reduce the rate of stormwater discharge from the site and allow sediment to settle out before the stormwater is released to local waters.

In summary, site drainage and runoff at Fresh Kills is controlled through vegetative cover, grading, and stormwater collection and control systems. To that end, final cover (described above) plays an important role in stabilizing and protecting the soil from erosion during rainfall events.

Landfill Section 6/7 Details

The existing stormwater drainage system for Fresh Kills Landfill Section 6/7 is located throughout the project area with the purpose of managing the quantity of the stormwater runoff and controlling sediment discharge from the site. The stormwater drainage system serves three primary functions. First, the final cover grading provides positive drainage for surface runoff to minimize infiltration into the final cover. Second, the drainage system collects and conveys all landfill generated stormwater runoff to existing stormwater management basins. Finally, sediments contained within stormwater runoff are reduced through settling that occurs within stormwater management basins prior to discharge into the adjacent waterways.

In accordance with the New York State Part 360 landfill design regulation, final cover slopes are a maximum 33 percent and minimum 4 percent. The vegetated final cover slopes direct runoff in a sheet flow or shallow concentrated flow to grass or rip-rap lined swales. A series of 54 swales, six chutes, and seven drop inlets are used to direct the flow towards six stormwater management basins (A, B1, B2, C1, C2, and R) that handle runoff from Landfill Section 6/7. The swales are identified by a two part designation code, which consists of an alphanumeric prefix that identifies the stormwater management basin to which the flow will ultimately be directed followed by a sequential serial number. The existing swales are trapezoidal in shape, bottom widths range from 4 to 10 feet, depths range from 2.5 to 3.5 ft deep. Longitudinally, the channel slopes range from 1 to 11 percent, the predominate lining is a grass and turf reinforcement mat combination; 4 of the 54 channels are designed with riprap lining. Table 13-2, obtained from conforming construction working drawings which are based on the Final Cover Report, presents a summary of the landfill Section 6/7 swale designations, lining type and defining geometric dimensions (see also “Typical Swale Construction” following Table 13-2).

Geometrically, the swales are designed to pass the peak flow at the 100-year design storm with one foot of freeboard assuming fully vegetated conditions. Lining materials are selected based on resistance to erosion at the 25-year design storm assuming bare slope conditions.

The majority of the swales drain into stepped channels lined with riprap-filled gabion baskets (commonly referred to as stepped downchutes), which in turn discharge into open, gabion-walled drop inlet structures that direct flows into existing culverts that drain to the existing stormwater management basins.

Table 13-3 summarizes the 100-year design discharge rates entering each existing basin, as presented in the conforming design documents based on the Final Cover Report.

In the future without the proposed project, it is assumed that the Landfill Section 6/7 stormwater collection would not change from the flow estimates summarized in Table 13-3.

Table 13-2

Summary of Final Closure Stormwater Swales

Swale Designation	Swale Lining	A (ft.)	B (ft.)	C (ft.)	Swale Designation	Swale Lining	A (ft.)	B (ft.)	C (ft.)
A-1	Grass	5	3	4/15	C-26	Grass	4	2.5	4
A-2	Grass	4	3	15	C-27	Grass	4	3	15
A-3	*	*	*	*	C-28	Grass	6	3	4
A-4	*	*	*	*	C-29	Grass	6	3	4
A-5	Grass	6	3	4	C-30	Grass	4	3	15
A-6	Grass	4	3	15	C-31	Grass	4	3	4
A-7	Grass	4	3	4	C-32	Grass	4	3	4
B1-8	Grass	6	3	15	C-33	Grass	6	3	15
B1-9	Grass	6	3	4	C-34	Grass	6	3	4
B1-10	Grass	6	3	4	C-35	Grass	4	3	4
B1-11	Grass	4	2.5	15	C-36	Grass	4	3	15
B1-12	Grass	4	3	15	C-37	Grass	4	3	4
B2-13	Grass	6	3	15	C-38	Grass	8	3	4
B2-14	Grass	4	3	4	C-39	Grass	4	3	15
B2-15	Grass	8	3	4	C-40	Grass	4	3	4
B2-16	Grass	4	2.5	4	C-440A	Grass	4	3	4
B2-17	Grass	4	2.5	4	C-41	Grass	6	3	4
B2-18	Grass	4	3	4	C-42	Grass	8	3	4
B2-18A	Grass	4	3	15	C-43	Grass	10	3	4
B2-19	Grass	4	3	4	C-44	Grass	4	3	4
B2-19A	Grass	4	3	15	C-45	Grass	4	3	15
B2-20	Grass	4	2.5	4	C-46	Rip-Rap	10	3	15
R-21	Grass	6	3	4	C-47	*	*	*	*
R-22	Grass	4	3	4	C-48	Grass	8	3	15
R-23	Grass	4	3	15	C-49	Grass	8	3.5	4
R-24	Grass	4	3	15	C-50	Rip-Rap	10	3.5	15
R-25	Grass	8	3	15/4	C-51	Rip-Rap	8	3.5	4
					C-52	Rip-Rap	10	3.5	4
					GZA-1	Grass	4	3	15

Note: * denotes swales not used.

Typical Swale Construction

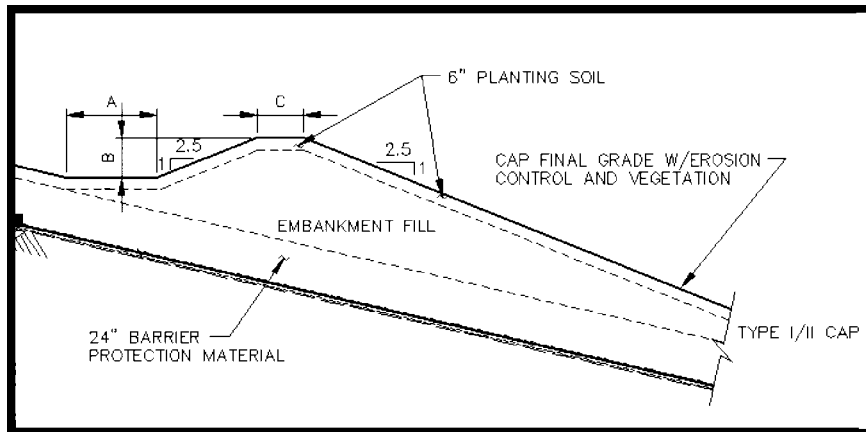


Table 13-3

Existing Stormwater Control Basin Inflow Discharge Rates and Drainage Areas

Basin	Discharge Rate	Drainage Area
A	172 cfs	46.13 ac.
B1	128 cfs	33.93 ac.
B2	90 cfs	31.66 ac.
C	426 cfs	111.40 ac.
R	72 cfs	19.77 ac.

Notes:

(1) Existing stormwater control basin inflow discharge rates and drainage areas from “*Engineering Report Final Cover at Fresh Kills Landfill Section 6/7, Staten Island, New York, Contract Number CT8272006004094, Volume 1: Text and Appendices A Through E*”, prepared by GZA GeoEnvironmental of New York, January 10, 2007.

(2) Analysis is based on the 100-year, 24 hour storm event with a precipitation total of 7.5 inches. Stormwater runoff conditions were analyzed using the Win TR-55 computer program, developed by the Natural Resources Conservation Service (NRCS) and Flowmaster Model Version 3.43 dated 1991 developed by Haestad Methods.

FIREWATER AND OVERHEAD ELECTRIC SUPPLY

At the east side of the Yukon Avenue corridor an existing 8-inch fire fighting water supply line and overhead electric supply line enter the landfill site. The fire fighting water main extends into the site and over the top of Landfill Section 6/7 and terminates in a fire hydrant located at the Section 6/7 ground flare. The overhead electric line provides power to the landfill Section 6/7 ground flare, and appurtenant systems necessary to operate the landfill gas system. Without the proposed project, the existing fire fighting water main and overhead electric supply would remain unchanged.

C. THE FUTURE WITHOUT THE PROPOSED PROJECT

2011 ANALYSIS

INTRODUCTION

By 2011, in the future without the proposed project, closure of Landfill Section 6/7 is assumed to proceed under the approved plan. A summary of conditions in 2011 is presented below.

LANDFILL INFRASTRUCTURE

Closure of Landfill Section 6/7 is underway in accordance with a DEC-approved design. This closure will continue in the future without construction of the proposed East Park roads. The permitted final closure design for the Landfill Section 6/7 is provided in the report entitled “*Fresh Kills Landfill, Section 6/7. Final Cover Design Report*,” January 2001 by Malcolm Pirnie, Inc. Without the proposed project, DSNY would continue on-going closure construction at Landfill Section 6/7 in accordance with that “Final Cover Report.” Following completion of the closure construction, DSNY would continue to operate, maintain and monitor the environmental protection systems in accordance with the approved Final Closure Plan.

A phasing plan for the final closure of Landfill Section 6/7 as approved is shown on Figure 13-9. That plan includes four phases of closure construction, each covering about 60-80 acres, being

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implemented in a counterclockwise direction around Landfill Section 6/7. Final landfill closure construction was intended to be completed by 2010 at Landfill Section 6/7. It is expected to take nearly 1,000,000 cubic yards of soil to construct the final cover at Landfill Section 6/7 overall. As part of that final cover construction, the vegetation and drainage systems will also be installed. As of January 2009, Phase 1 and Phase 2 closure construction activities were completed.

While the closure construction would be completed and the monitoring and maintenance program for Fresh Kills Landfill underway in the future without the proposed East Park Roads project, there would be no public roads provided in East Park. In the future without the proposed park, DSNY would continue use of all needed facilities currently on site for at least 30 years.

STORMWATER

In the future without the proposed project, by 2011, the final cover and grading and stormwater management systems are assumed to be installed in accordance with the approved final closure plan. No other changes in the Landfill Section 6/7 stormwater collection system are expected by 2011.

2016 ANALYSIS

LANDFILL INFRASTRUCTURE

In the future without the proposed project, there would not be any changes in Landfill Section 6/7 infrastructure conditions by 2016. All closure construction would be completed and the monitoring and maintenance program for Fresh Kills Landfill would be in effect. DSNY would continue use of all needed facilities currently on site for at least 30 years. In the future without the proposed East Park Roads project, there would be no public roads provided in East Park.

STORMWATER

In the future without the proposed project through 2016, the Landfill Section 6/7 stormwater collection system would be monitored and maintained, but not modified.

2036 ANALYSIS

LANDFILL INFRASTRUCTURE

In the future without the proposed project, there would not be any changes in landfill infrastructure conditions between 2017 and 2036. All closure construction would be completed and the monitoring and maintenance program for Fresh Kills Landfill would be in effect. DSNY would continue use of all needed facilities currently on site for at least 30 years. In the future without the proposed East Park Roads project, there would be no public roads provided in East Park.

STORMWATER

In the future without the proposed project through 2036, the Landfill Section 6/7 stormwater collection system would be monitored and maintained, but not modified.

D. THE FUTURE WITH THE PROPOSED PROJECT

INTRODUCTION

Provided below is an impact assessment for the proposed project and its three analysis conditions: (1) with the Final Cover Design Report, Addendum 1 implemented (2011); (2) with the proposed Yukon Avenue Connection; and (3) with the completion of the proposed East Park Road system under an option selected from those available (2036 analysis year). Given that it is expected that the proposed project would require the modification of landfill infrastructure in all three of these scenarios, this analysis begins with a description of impact avoidance measures that would be employed in order to avoid significant impacts to these systems (significant impacts being defined as the permanent or extended loss of landfill infrastructure operations or the temporary losses in service that could result in significant adverse environmental impacts).

LANDFILL INFRASTRUCTURE IMPACT AVOIDANCE MEASURES¹

INTRODUCTION

The Fresh Kills Park project is a multi-year, multi-phase project (some 30 years of implementation) with a critical need to avoid or minimize impacts to landfill infrastructure as well as other sensitive features of the site, including wetlands. In addition, as the project moves forward, the design requirements and the regulatory approvals are likely to evolve. In all cases, DPR is committed to avoiding and minimizing impacts of the project and, to that end, has developed an extensive array of conceptual impact avoidance and mitigation measures that are presented in Chapter 23 of this SEIS, "Impact Avoidance and Mitigation Measures." Fresh Kills Landfill is subject to post-closure care monitoring and maintenance requirements but the proposed project would provide the public with access to the Fresh Kills site, thereby creating potential access to the landfill management systems. Furthermore, park development (particularly the proposed roads) may introduce new loadings and demands on subsurface landfill infrastructure. Therefore, the following measures are presented as preliminary conceptual measures that could be taken to avoid impacts to landfill systems and thereby avoid conflicts with post-closure care and maintenance or impacts to public health and the environment. These measures are aimed at avoiding impacts that would result from the public access that would be created within East Park with the 2016 and 2036 road phases. The measures presented below would not apply to the 2011 condition where only the modified final cover design is implemented, but no additional public access is provided. In addition, the measures presented below would be subject to further refinement and design review by DSNY and DEC as more detailed design is developed for the proposed park roads.

LEACHATE MANAGEMENT SYSTEM

- Install locks at leachate collection well vaults, leachate collection well valve chambers, and associated electronic control panels. These measures are intended to protect against public entry into confined spaces, where potentially unsafe conditions may exist, and to protect the public from potential electrical hazards.

¹ These measures are also described in detail in Chapter 23, "Impact Avoidance Measures and Mitigation."

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- Install security fences, locked gates (as necessary) and appropriate warning signs around leachate collection well vaults, valve chambers, and associated electronic control panels. These measures are intended to act as a deterrent against public interference with leachate management system features. The design of additional fencing and locks, if appropriate, at the leachate management system features will require that they do not conflict with ongoing post-closure care maintenance and operation program procedures.
- Install locking manhole covers at manholes located along the leachate transmission forcemain route.
- Install perimeter security fencing around the Landfill Section 6/7 leachate transmission forcemain pump stations (for example). The design of fencing around these leachate management system features would require that it does not conflict with ongoing post-closure care maintenance and operation program procedures.
- Prevent malicious activities or vandalism to leachate management system infrastructure through site security.
- Deploy park managers and security personnel to deter malicious acts or vandalism. DPR on-site personnel would also receive training regarding identification of landfill infrastructure and would be provided with emergency contact information for responsible landfill personnel.

LANDFILL GAS MANAGEMENT

- Develop road and park designs with DSNY and DPR coordination to avoid conflicts with the landfill gas management system features. Measures include selection of road alignments that avoid flare locations, use of living fences (e.g., thorn bushes), or landscaping that discourages public access on or along the landfill gas interceptor vent trenches. The design would take into consideration any added post-closure care maintenance and monitoring activities that occur at the various landfill gas management system features.
- Install permeable gas venting layers (e.g., gravel layers) across interceptor venting trenches where park development features would cover the interceptor vent trenches.
- Post signage to inform the public of hazards associated with landfill gas.
- Maintain seals on landfill gas vents to prevent escape of landfill gas into the atmosphere. Unsealing of the gas vents would not be allowed without modification of the existing Title V and Part 360 landfill gas permits, which would involve review and approval by DEC.
- Install security fencing and lock gates around landfill gas flare pads.
- Install locking manhole lock covers on manholes associated with the landfill gas transmission main.
- Authorize DPR staff and security personnel to deter malicious acts of vandalism of landfill to gas management system features. The groundskeepers and security personnel would receive training to identify landfill infrastructure and would be provided with emergency contact information for responsible landfill personnel.

STORMWATER MANAGEMENT

The development of the proposed East Park roads would involve grading and landscaping/enhancement. Park roads would be constructed according to final designs developed for each capital project and in accordance with the overall design approaches presented in Chapter 1,

“Project Description.” These roads would alter some runoff patterns and increase impervious surface cover. The greatest change in the proposed hydrology at the site would be the introduction of impervious surfaces with the proposed park roads which would add 2,600 linear feet (about ½ mile) of two-lane roads by 2016 (the Yukon Avenue Connection) with the potential for up to 9,410 linear feet (about 1.8 miles) of park road by 2036 (this park road may be two lanes or four lanes wide) and this would depend upon the selected design option.

To avoid stormwater impacts from increases in impervious surfaces and to protect receiving waters, individual stormwater best management practices (BMPs) would be used to enhance proposed park road design to provide water quality treatment and quantity management. The overall objectives of the proposed stormwater management system are to:

- Collect and handle all project-generated site runoff without off-site or downstream impacts.
- Maximize pervious surfaces and minimize the introduction of new impervious surfaces, reusing existing structured surfaces where feasible;
- Provide natural conveyance and management systems for stormwater to the extent possible, but consistent with landfill design regulations (e.g., created runoff swales, pocket wetlands, vegetated treatment swales, planter boxes) and minimize the use of hard infrastructure (e.g., inlets and pipes), particularly for handling runoff from roads and parking areas;
- Minimize impacts to natural stormwater management features at the site such as freshwater and tidal wetlands to minimize any potential impacts to local water quality; and
- Utilize the existing DSNY stormwater basins, to the extent feasible, without adversely impacting the DSNY stormwater management system—if modifications are necessary, they would be designed in accordance with DSNY and DEC specifications.

Since the proposed project is located directly along the coastal waterways of Richmond and Main Creeks, it is not expected that the proposed project would result in any impacts to downstream flooding. In addition, runoff is expected to be controlled on-site and would not adversely impact surrounding neighborhoods or open spaces. In sum, it is expected that the proposed project can manage the increases in site-generated runoff while contributing positively to the local wetland systems and habitats.

The stormwater management projects proposed as part of the park would be designed to complement and enhance the aesthetic and ecological aspects of the proposed park, while meeting the above-described stormwater management objectives, and improving upon the current hydrologic and water quality management provided by the existing stormwater infrastructure. To achieve these goals, the approach would utilize a mix of traditional conveyance and storage measures (including the existing downchutes and large-scale detention basins) and smaller controls selectively located throughout each sub drainage area. By utilizing stormwater controls, runoff flows would also be routed through multiple levels of treatment prior to discharge off the site thereby protecting local water quality. In addition, any modification or reuse of stormwater basins for park-generated stormwater runoff would be subject to the review and approval of DEC and DSNY. Measures related to protecting stormwater management systems include the following:

- Develop landscape features that discourage park users from entering drainage channels and basins.
- Post signage that informs park users that the stormwater management basins are not publicly accessible (until so designed) and that entry into stormwater culverts is prohibited.

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- Authorize DPR personnel to deter malicious acts or vandalism of final cover and stormwater management features. DPR personnel would receive training to identify landfill infrastructure and would be provided with emergency contact information for responsible landfill personnel.

PROPOSED ROAD EMBANKMENT (2011)¹

OVERVIEW

The 2011 condition assumed in this SEIS is the proposed Landfill Section 6/7 Final Cover Design Report, Addendum 1, which would be implemented with final closure construction at Landfill Section 6/7. The engineering methodologies and design criteria of the proposed Modified Landfill Section 6/7 closure construction, or “Alternative Final Cover,” would be consistent with Part 360 design requirements and with final closure designs previously used and approved at Fresh Kills Landfill. The difference between the approved and modified cover plan is that the alternative cover proposal would modify the Landfill Section 6/7 final closure grades such that the finished grade of the final cover system could accommodate any of the proposed roadway alignments. Because the extent of the proposed final closure regrading and the proposed relocation of landfill infrastructure is consistent with any of the potential future roadway designs prepared for the project, the 2011 construction would create two road embankment corridors across Landfill Section 6/7 that would provide sufficient separation between the project roads and the landfill infrastructure below, such that no further relocation of the infrastructure would be necessary to accommodate construction of the proposed 2016 or 2036 park roads (specifically the proposed Yukon Avenue and Forest Hill Road Connections) under either a two-lane road or four-lane road design. The limits of the proposed road embankments across Landfill Section 6/7 are presented in the road design schematics provided in Appendix B (see also Figure 1-7 in Chapter 1, “Project Description”).

To accommodate the modified final cover, and to ensure that there would be no impacts to landfill infrastructure as a result of this design modification, numerous measures are proposed (described below) to preserve the integrity of the final cover grading, the landfill gas system, the stormwater management system and the landfill service roads, albeit that this proposed modified closure would require relocation of some landfill gas extraction wells and headers and relocation of stormwater channels and culverts. Additional details are discussed below and presented in Table 13-4.

LANDFILL GAS INFRASTRUCTURE MODIFICATIONS

Three general sections of the landfill gas extraction system are required to be relocated or modified to accommodate the proposed final cover plan. These areas include: (i) the east side Yukon Avenue corridor; (ii) the west side of the Yukon Avenue corridor; and (iii) the central portion of the proposed Forest Hill Road corridor. Tables 13-4 through 13-6 summarize the specific modifications and mitigation measures to be implemented at each of the three identified locations. Details are presented in the Landfill Section 6/7 Final Cover Design Report, Addendum 1, Design Drawings.

¹ Text in this section is summarized from the report “Fresh Kills Landfill Section 6/7 Final Cover Design Report, Addendum 1” (Geosyntec for DSNY, September 2009). Also provided in the Appendices is an analysis of potential settlement impacts from the proposed project in the report ‘Geotechnical Laboratory Testing Program, Fresh Kills Park Development Project,’ (Geosyntec, August 2008).

Table 13-4

Summary of Landfill Gas Infrastructure Modifications: Yukon Avenue Connection East (2011)

Location	Feature /Conflict Description	Mitigation Measure Description
Southeast side of Yukon Corridor	Mass grading (cut) will encroach upon existing pipe locations, affecting an 18-inch HDPE landfill gas header pipe, 2-inch HDPE landfill gas condensate transmission pipe, and 2-inch HDPE compressed air pipe (pneumatic condensate pump power supply).	<ul style="list-style-type: none"> Reconstruct approximately 714 ft of gas header pipe, condensate transmission pipe, and compressed air line pipe to accommodate revised grading. Set reconstructed pipes above the geomembrane component of the final cover and connect the relocated pipes to the existing pipes at each end. Seal the pipe penetration through the geomembrane cover using pipe boots. Minimum as-constructed slope of header pipes will be 3 percent.
Southeast side of Yukon Corridor	Reconstruction of the associated header will require establishment of a new lateral connection between the 8-inch diameter HDPE landfill gas lateral to Extraction Wells W-7, W-8, W-9, and W-10	<ul style="list-style-type: none"> Reconstruct landfill gas lateral above the geomembrane component of the final cover and connect the relocated lateral to the relocated header. Minimum a-constructed slope of the relocated lateral will be 4 percent.
East Side of Yukon Corridor	Mass grading (cut) will encroach upon existing pipe locations. Affected features include the 18-inch HDPE landfill gas header pipe; 2-inch HDPE landfill gas condensate transmission pipe; 2-inch HDPE compressed air pipe.	<ul style="list-style-type: none"> Reconstruct 309 ft of gas header pipe above <u>geomembrane component of the final cover and connect to the existing header ring north of Yukon Avenue.</u>

Source: Geosyntec, September, 2009.

Table 13-5

Summary of Landfill Gas Infrastructure Modifications: Yukon Avenue Connection West (2011)

Location	Feature and Conflict Description	Mitigation Measure Description
Yukon Corridor West	18-inch HDPE landfill gas header pipe; 4-inch HDPE landfill gas; condensate transmission pipe; 4-inch HDPE compressed air pipe (pneumatic condensate pump power supply).	Between condensate pump station 6 and the Landfill Gas Section 6/7 ground flare, cover approximately 87 ft of header pipe, condensate transmission pipe, and compressed air pipe with steel plate to provide supplemental protection for the piping from future traffic loads.

Source: Geosyntec, September, 2009.

Table 13-6

Summary of Landfill Gas Infrastructure Modifications: Forest Hill Road Connection Central (2011)

Location	Feature and Conflict Description	Mitigation Measure Description
Forest Hill Road Corridor, West of Pump Station PS-4; East of Pump Station PS-3	18-inch HDPE landfill gas header pipe; 2-inch HDPE landfill gas condensate transmission pipe 2-inch HDPE compressed air pipe (pneumatic condensate pump power supply).	Cover approximately 194 ft of header pipe, condensate transmission pipe, and compressed air pipe with steel plate to provide supplemental protection for the piping from future traffic loads.
Forest Hill Road Corridor	Mass grading (cut) and 2036 road alignment will encroach upon the well locations and existing lateral gas pipes. Affected features include Landfill Gas extraction Wells, W-62, W-69, W-74, and W-78.	Decommission gas wells and reconstruct replacement gas wells to the north side of corridor.

Source: Geosyntec, September, 2009.

POST-CLOSURE CARE—SERVICE ROAD MODIFICATIONS

The final closure design for Landfill Section 6/7 includes the establishment of multiple gravel service roads across the landfill surface to connect to the existing paved service road that currently encircles Landfill Section 6/7.

The proposed service road document in the Landfill Section 6/7 Final Cover Design Report, Addendum 1 would encroach upon the service road located at the east end of the corridor. To mitigate this encroachment, the service road would be relocated to the north and outside of the Yukon Avenue corridor. Prior to the 2016 project road construction, the Yukon Avenue Corridor would be a new and usable gravel access road for DSNY use.

The Forest Hill Road Connection bisects the only service road in the Landfill Section 6/7 Final Cover Design Report, Addendum 1 that provides access to the southernmost tip of Landfill Section 6/7; to mitigate this encroachment, a new DSNY access road will be constructed to this location. The Forest Hill Road Connection also bisects a landfill service road that enters the landfill from the south-central area of the site. Prior to the intersection point, the proposed service road would be terminated and a turn-around provided. The bisection of the service road by the Forest Hill Corridor would not isolate any portion of the landfill or landfill infrastructure and therefore no mitigation is required for this encroachment. Prior to the 2016 project road construction, the Forest Hill Road Corridor would be a new and usable gravel access road for DSNY use.

GRADING

Grading under the Landfill Section 6/7 Final Cover Design Report, Addendum 1 is comprised of two separate surfaces: a subgrade plan, which is the grade for the geomembrane barrier (i.e., bottom of the cover section); and a final grade plan, which is the finished surface elevation. The Landfill Section 6/7 Final Cover Design Report, Addendum 1 plan incorporates a minimum 4 percent grade and maximum 33 percent grade as required by New York Part 360 Landfill Regulation design criteria. The final closure design embankment grading along each future project roadway alignment is shown in Appendix A of the Landfill Section 6/7 Final Cover Design Report, Addendum 1 (Geosyntec, September 2009, Design Drawings 3 and 4 for subgrade along the Yukon Avenue Corridor and Design Drawings 13 and 14 subgrade, Design Drawings 15 and 16 final grade for the Forest Hill Road Connection).

In the areas of the Yukon Avenue and Forest Hill Road Corridors that are coincident with the future Build year project roadway alignments, the final cover system would consist of the following components from bottom to top (the cover design is illustrated in Appendix A of the Landfill Section 6/7 Final Cover Design Report, Addendum 1, Geosyntec, September 2009, see Design Drawings 17 which includes):

- 40 mil thick LDPE Geomembrane hydraulic barrier;
- 300-mil thick double sided drainage net layer;
- 48-inch thick layer of barrier protection soil (i.e., sand);
- Woven geotextile separator layer; and
- 6-inch thick layer of crushed stone (driving surface).

The 48-inch thick layer of barrier protection material is two-times the thickness of barrier protection material as required by the currently approved Final Cover Design Report. The increased thickness

is used for this proposed final cover to ensure that the minimum NYSDOT recommended separation distance of 4 feet between pavement structures and waste is achieved.

In other areas of the corridors which require grading but are outside of the future roadway alignment, the cap section would be determined by the design criteria established in the Final Cover Design Report (i.e., Cap Type I for slopes between 15 and 33 percent, Cap Type II for slopes between 4 and 15 percent). The Landfill Section 6/7 Final Cover Design Report, Addendum 1 grading results in Cap Type I and Cap Type II slope lengths that are equal to or less than the maximum slope length, as established for the approved Final Cover Design Report.

As described in the introduction to this section, the proposed closure design requires mass grading of existing soil and waste to achieve the desired grading plan that is compatible with the project roadway alignments planned for 2016 and 2036. Estimated cut quantities to achieve the embankment elevation for the four-lane road option are 83,113 cubic yards for the Yukon Avenue Connection and 115,770 cubic yards for the Forest Hill Road Connection on the landfill section. For the two-lane road option, the quantities of cut are 43,468 cubic yards for the Yukon Avenue Connection and 98,770 cubic yards for the Forest Hill Road Connection.

STORMWATER MANAGEMENT SYSTEM MODIFICATIONS

Minor modifications to the approved stormwater management system would be necessary under this modified 2011 plan. These include modified cover types, drainage pipe outlets, channel modifications, relocation of swales, construction of new swales and culverts, and conveyance to the existing stormwater drainage basins. Details of these modifications are provided in the Landfill Section 6/7 Final Cover Design Report, Addendum 1 (Geosyntec for DSNY, September 2009). That report also includes an analysis and discussion of the hydrologic conditions under this modified cover plan. An assessment of the proposed modifications with respect to potential impacts on water quality is provided in Chapter 10 “Natural Resources.”

As described in greater detail in the proposed Final Cover Design Report, Addendum 1, the proposed modified stormwater management plan for Fresh Kills Landfill Section 6/7 maintains the primary functions of the existing stormwater drainage system which includes: minimizing infiltration into the final cover; collecting all landfill generated stormwater runoff; and removing pollutants and sediment prior to discharge into adjacent waterways. As part of the modified closure design, the Forest Hill Road and Yukon Avenue Connection embankments would direct several of the existing drainage areas to existing stormwater control basins. After completion (2011), it is assumed that the Forest Hill Road and Yukon Avenue Connections would be 15-foot-wide gravel roads.

Stormwater runoff from the proposed Forest Hill Road and Yukon Avenue Connection road embankments would be collected by roadside drainage swales. These park road drainage swales have been designed, using depth of flow for high grass, to convey the 100 year, 24 hour storm event while maintaining a freeboard (clearance) of one foot or greater. The lining for the park road drainage swales has been designed to resist erosive forces from a 25 year, 24 hour storm event. The roadside drainage swales would connect to existing swales or gabion downchutes. The existing swales and gabion downchutes receiving flow from the roadside drainage swales have been analyzed to determine proper size and lining based on the adjusted flows and have been modified accordingly where necessary. The existing gabion downchutes discharge into existing drop inlet boxes which drain to existing HDPE inlet pipes. The existing HDPE inlet pipes have been analyzed for the modified closure design conditions and found to be adequately sized to convey the 100-year, 24-hour storm event. The stormwater runoff discharges from the

existing HDPE inlet pipes outfall to one of five existing stormwater control basins located along the perimeter of Landfill Section 6/7. The inflow discharge rates and contributing drainage area to each existing basin are summarized in Table 13-7.

Table 13-7

Proposed Stormwater Control Basin Inflow Discharge Rates and Drainage Areas

Basin	Discharge Rate	Drainage Area
A	172.23 cfs	46.13 ac.
B1	178.40 cfs	42.41 ac.
B2	96.74 cfs	24.27 ac.
C	479.54 cfs	118.81 ac.
R	77.71 cfs	21.23 ac.

Note: (1) Analysis based on the 100 year, 24 hour storm event with a precipitation total of 7.5 inches. Stormwater runoff volumes were computed using the computer program entitled "HydroCad Stormwater Modeling System Manual", Version 7.1 by Applied Microcomputer Systems. The program uses the United States Department of Agriculture, Soil Conservation Service Methods TR-20 and TR-55
Source: Geosyntec, May, 2009.

No modifications to the existing stormwater control basins are necessary to accommodate the 2011 proposed final closure plan. The existing basins would continue to manage the quantity and quality of stormwater discharged into existing adjacent waterways.

FIREWATER AND OVERHEAD ELECTRIC LINES

There are water supply/revised grading conflicts with the existing 8-inch diameter firewater main and overhead electric supply that service the site. To mitigate the firewater main conflict a portion of the existing firewater main will be relocated to a lower elevation, below the modified final cover membrane elevation. To mitigate the overhead electric supply conflict, the electric line will be relocated to the north and east.

YUKON AVENUE CONNECTION (2016)

LANDFILL INFRASTRUCTURE

As described above, the modifications to landfill infrastructure to accommodate the proposed Yukon Avenue Connection across Landfill Section 6/7 would be addressed as part of the 2011 Landfill 6/7 Final Cover Design Report, Addendum 1. Thus, no further modification is needed for the 2016 condition where the proposed road segment across the landfill would be developed on top of the previously prepared embankment. No additional measures would be necessary relative to the fire and electrical service modifications discussed above for 2011.

For the segment of road between the base of the landfill and Richmond Avenue work would encroach upon the existing service road that provides access to environmental monitoring points located to the north of the alignment. No monitoring points are located within the proposed alignment and therefore no further modifications to the landfill infrastructure would be required.

In the vicinity of the leachate management system slurry cutoff wall a reinforced concrete slab would be installed to distribute the vehicle loads and prevent excessive deformation of the top of the cutoff wall. With these measures in place, it is expected that the proposed project could be constructed

without any impacts to the slurry wall. The final design of the cutoff wall protective measures will be prepared as part of a subsequent regulatory submittal associated with road design and construction.¹

STORMWATER MANAGEMENT

As part of the roads construction, the existing sediment basins (B1, B2) which would receive runoff from the Yukon Avenue Connection road segment would be modified to perform a water quality improvement function. According to the *New York State Stormwater Management Design Manual* (Design Manual), dated April 2008, the existing storm water sediment basins would need to follow the design criteria described below to be converted into a stormwater management feature sized to treat the water quality volume. In order to size a stormwater management feature to meet pollutant removal goals, reduce channel erosion, prevent overbank flooding, and help control extreme floods, the following four sizing criteria would be used:

- Water Quality Volume (WQv): designed to improve water quality sizing to capture runoff;
- Channel Protection Volume (Cpv): Provide 24-hour extended detention of post-developed 1-year, 24-hour storm event (however, does not apply if basin discharges directly to tidally influenced waters);
- Overbank Flood (Qp): Control the peak discharge from the 10-year storm to 10-year pre-development rates; and
- Extreme Storm (Qf): Control the peak discharge from the 100-year storm to 100-year pre-development rates.

Several different storm water management features (i.e., wet pond, wet extended detention pond, stormwater wetland) could be used to treat the stormwater runoff; however, the following text utilizes the wet pond design criterion as an example. To meet the Design Manual water quality treatment goals, stormwater ponds must have the following design elements:

- A pretreatment sediment forebay at each inlet location, unless an inflow point contributes less than 10 percent of the total design storm flow to the pond, sized to contain 10 percent of the water quality volume;
- 100 percent minimum water quality volume treatment in the permanent pool; and
- Landscaping to include a safety bench extending from the high water mark and wetland plantings are encouraged for maximum water quality treatment.

The basins would also be designed to control and handle the 100-year design flow and would therefore be consistent with the current landfill swale and culvert designs which are sized to convey the 100 year design storm. The basins would also be modified to provide ecological functions (see Chapter 23, “Impact Avoidance Measures and Mitigation”).

POST CLOSURE CARE—SERVICE ROAD MODIFICATIONS

The park road designs would include the necessary turn lanes and controlled access gated entry from the park public roads onto landfill service roads. The gates and turn lanes would allow

¹ Calculations demonstrating the acceptability of an assumed concrete slab design, based on the estimated cutoff wall deformations are provided in Appendix D to this SEIS, see “Finite Element Analysis for Slurry Wall,” (Geosyntec, May 2009).

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DSNY personnel access to the site to perform post-closure care, maintenance, and monitoring and prohibit access by the public.

As also described in Chapter 1 ‘Project Description,’ the landfill service roads provide access to various components of the landfill environmental protection and monitoring systems, which are located throughout the entire Fresh Kills Landfill. Although each of the individual landfill environmental protection systems may only be accessed on a regularly scheduled periodic interval, the combination of all the activities associated with multiple systems results in a requirement for nearly continuous access throughout the site. Consequently, it is essential to establish dedicated landfill service roads that are separate from the Fresh Kills Park East Park public vehicular road system. It is recognized, however, that multi-use pedestrian and bike paths within the park circulation system are operationally compatible with landfill service maintenance and management operations. For instance, DSNY service vehicles would travel at slow speeds on shared paths, and partial blockage of multi-use paths for landfill operational requirements could be performed while still accommodating foot or bicycle traffic. Some examples of the landfill environmental protection infrastructure elements that require operation or monitoring, the types of vehicles used and the frequency of use are presented in Table 13-8.

Table 13-8
Standard Monitoring and Maintenance Practices at Fresh Kills Landfill
Requiring Vehicle Access

Infrastructure Element	Location	Activity	Vehicle used, Approach Technique	Frequency, Duration
Hydraulic monitoring well	Perimeter of West and East mounds	Test water level	Light truck, drive	Monthly, 1 day
Piezometer	Perimeter of North and South mounds	Testing water level	Light truck, drive	Monthly, 1 day
Ground Monitoring Wells	Entire Site Perimeter	Sampling, pump maintenance	Light truck, drive/foot	Quarterly, 4 to 10 weeks
Leachate Recovery Well	Top of North and South Mounds	Maintenance only	Light truck, drive	As needed
Leachate Pumping Stations	Southwest corner of Section 6/7 and perimeter of Section 6/7 and 1/9	Maintenance only	Light truck, drive	Daily, Ongoing
LFG Condensate Tanks	Base of landfill mounds, all four mounds	Empty tanks of liquid	Heavy articulated truck (5,000 gallon tanker), drive	Daily to Twice a week
LFG Condensate Monitoring Well	All four mounds	Sampling and pump maintenance	Jeep, on foot	Daily
LFG Extraction Well	Entire landfill surface, All four mounds	Sampling and adjustment, Maintenance	Jeep, on foot	Daily, Ongoing
LFG Migration Monitoring Well	Entire Site Perimeter	Sampling	Light truck, drive	Monthly to quarterly, 1-3 days
LFG flares operation and maintenance	Landfill gas flare stations located at Sections 2/8, 3/4 and 6/7	Monitoring and operation	Light truck, drive	Ongoing
Stormwater basin outfall monitoring	Stormwater basin outfalls located along the perimeter of Sections 1/9 and 6/7	Sampling and maintenance	Light truck, drive	Monthly 1 - 2 days
Surface water and sediment sampling	Arthur Kill, Fresh Kills Creek, Richmond Creek, Main Creek	Water sampling	Boat	Annual, 1-2 days
Landfill cover	All four mounds	Surface emissions monitoring with hand-held gas meters	Jeep, on-foot	Quarterly, 5 - 10 days

Source: Field Operations, 2008.

EAST PARK ROAD SYSTEM (2036)

INTRODUCTION

The proposed East Park Roads that are the subject of this SEIS are all located within the East Park planning area of Fresh Kills Park (see Figure 1-4). For the 2036 analysis year, DPR is considering various options for completion of the East Park Road system. These could include two- or four-lane roads across East Park with new connections at Richmond Hill Road, Yukon Avenue, and Forest Hill Road, or a two-lane East Park Loop Park Road around the base of Landfill Section 6/7 with connections at Richmond Hill Road, Yukon Avenue, and Forest Hill Road. These options are reviewed below for the potential impacts with the landfill infrastructure.

FOREST HILL ROAD AND RICHMOND HILL ROAD CONNECTIONS—FOUR-LANE ROAD OPTION

Forest Hill Road Connection (Four-Lane Road)

Landfill Infrastructure

On Landfill Section 6/7. As described above, the modifications to landfill infrastructure in order to accommodate the proposed Forest Hill Road Connection across Landfill Section 6/7 would already be addressed as part of the Landfill Section 6/7 Final Cover Report, Addendum 1. Thus, no further modification is needed for the 2036 condition where the proposed road segment across the landfill would be developed on top of the previously prepared embankment. In addition, no additional measures would be necessary relative to the fire and electrical service modifications discussed above for 2011.

Off Landfill Section 6/7. For the segment of the Forest Hill Road between the base of Landfill Section 6/7 and Richmond Avenue the alignment would encroach upon the landfill gas vent trench. Landfill gas migration monitoring point GX-40 is located in the vicinity of the proposed alignment, but not within the proposed alignment. Therefore, to avoid impacts, GX-40 would be flagged and protected from disturbance during construction. In addition, a gravel venting layer would be placed above the landfill gas vent trench to ensure a permeable conduit to the surface. Placement of fill soil or pavement over a limited section of the gas vent trench is consistent with as-built conditions along the vent trench. Therefore, the fill placement, along with the permeable layer would not compromise the vent trench's ability to function. Specific design details for crossing the gas vent trench and protection of the gas monitoring probe would be prepared and submitted as part of a separate regulatory submittal at the time of roadway design.

Stormwater

As part of the roads construction, the existing basins (R, C1, and C2) which would receive runoff from the Forest Hill Road Connection would be modified to perform a water quality treatment function. The portion of the Forest Hill Road Connection between Richmond Avenue and the base of Landfill 6/7 would drain directly to the wetland area it crosses (with BMP water quality treatment), since there are no sediment basins in close proximity to this segment of the proposed road. Specific design details of stormwater controls and BMP application would be prepared and submitted as part of a separate regulatory submittal at the time of roadway design.

Richmond Hill Road Connection (Four-Lane Road)

Landfill Infrastructure

As it negotiates the narrow passage between the DSNY District 2 Garage and the landfill, the proposed Richmond Hill Road would cover the outlet stream from Basin A, which requires that

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a closed drainage system adjacent to Basin A be extended to a location south of the existing DSNY garage. The proposed road would also overlap the landfill cut-off wall at two separate points, for which protective slabs are proposed to shield the cut-off wall from the effects of roadway loads. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of roadway design.

In addition, the proposed road embankments across Basin B1 would divide the basin. Preliminary analyses indicate that the remaining landfill stormwater basin would be sufficient to meet its functional purpose. Culverts or archways would be added to maintain hydraulic continuity and balance water levels (HDR, May 2009).

For the segment of the Richmond Hill Road Connection between the base of the landfill and Richmond Avenue the alignment would pass near groundwater monitoring wells 154D, 174S, and 153D. The alignment would also pass by gas migration monitoring wells G-44, G-17, G-18, G-46, and G-19. Each of these features would also be protected during construction, but not disturbed.

Stormwater

As described above, the details of the proposed stormwater management system would be developed as each park capital project and segment of road design is further developed. Since the proposed project would be located directly along the coastal waterways of Richmond and Main Creeks, it is not expected that the project would result in any impacts on downstream flooding. Moreover, runoff is expected to be controlled on-site and would not adversely impact surrounding neighborhoods or open spaces. In addition, to avoid stormwater impacts from increases in impervious surfaces, individual stormwater BMPs would be used to enhance proposed park features, and provide water quality treatment and runoff volume control, particularly for the road elements. In sum, by 2036, the proposed project could be expected to manage all increases in site-generated runoff while contributing positively to the local wetlands.

As part of the roads construction, the existing sediment basins (A, B1, and B2), which will receive runoff from the Richmond Hill Road Connection, would be modified to perform a water quality improvement function. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of roadway design. The proposed roadway bisects Basin B2 and the retention basin, and it is anticipated that culverts or archways with natural bottoms will be provided for connectivity of the basins. Though the capacities of the basins are reduced by the roadway embankments, there is adequate capacity remaining in the basins to maintain their functionality as originally designed. The proposed roadway will also require the installation of a culvert along the emergency overflow ditch from the spillway at Basin A. This culvert would outlet to the retention basin north of Basin B1. This would result in Basins A, B1, and B2 operating as they currently function.

Moreover, runoff is expected to be controlled on-site and discharged in a controlled manner into the coastal waterways of Richmond and Main Creeks. It is therefore not expected that the project would result in any impacts on downstream flooding.

FOREST HILL AND RICHMOND HILL ROAD CONNECTIONS —TWO LANE ROAD OPTION

Overview

Like the four-lane proposal, the Two-Lane Park Road option involves construction of a road over the modified Landfill Section 6/7 final cover and the road segments east of Landfill Section

6/7. Therefore, the proposed two-lane-road must also account for the landfill infrastructure conditions and potential conflicts in the same manner as the Four-Lane option. The specific features and systems that may be influenced by the road alignment include: final cover protections and the foundation support properties of the solid waste in the landfill and protection of the landfill gas, stormwater, leachate management and monitoring systems.

With regard to the landfill closure cover system, the horizontal extent of the road embankments under this alternative would be greater under the Four-Lane design than this Two-Lane option, and the wider embankments would result in settlement over a larger area.

Due to the narrower road width in the Two-Lane Road option, a lesser load is expected to be applied to the landfill than under the Four-Lane option. Consequently, the impacts to the landfill and its environmental protection systems would be expected to be equal to or less than the four-lane option. Like the Four Lane option, this alignment crosses: (1) the southern landfill gas collection header ring at two locations, (2) eight lateral landfill gas collection pipes, and (3) passes over one landfill gas extraction well. Like the four-lane option, this alignment will utilize protective steel casings or plates to protect gas pipes. With this alignment, three rather than four gas wells along Forest Hill Road on Landfill Section 6/7 would require relocation.

As with the four-lane option, swales and ditches would be introduced to intercept runoff that would otherwise flow onto the road. Swales would be placed along much of the north edge of the road to intercept mound runoff on the uphill side. A culvert would also be added under the roadway on the west side to convey flows westward toward Basin C2. The length of this culvert under this option is less than that required for the Four-Lane option.

Likewise, with the appropriate construction-period protection measures, there would not be any impacts on the production of leachate nor would there be hazards for landfill slope stability. With both the proposed four-lane and two-lane park roads, there would be changes in hydrology due to road runoff and changes in the DSNY stormwater management basins; however the volume of runoff generated under this option would be less that under the four-lane option given that there would be less impervious surface area (an analysis of potential water quality impacts is presented in Chapter 10 “Natural Resources”). In addition, given the reduced volume of stormwater, it is expected that under this option, like the four-lane proposal, stormwater management issues could be addressed without adverse impacts. There are no significant differences between the Two-Lane and Four-Lane options in terms of impacts or conflicts with landfill environmental monitoring systems.

Additional details with respect to landfill infrastructure impacts are presented below by road segment.

Forest Hill Road Connection (Two-Lane Road)

Overview

As with the Four-Lane option, the alignment under the proposed Two-Lane option for the Forest Hill Road segment passes over the landfill. Some of the specific differences between the two-lane park road and the four proposals with respect to landfill infrastructure are described below.

In both the Four-Lane option and this Two-Lane option the design must account for the unusual embankment conditions, as well as the road’s influence on continuing landfill post-closure operations. In general, the park road foundation design and analysis of landfill related impacts are similar to those described above.

Landfill Infrastructure

As described above, the modifications to landfill infrastructure in order to accommodate the proposed Forest Hill Road Connection across Landfill Section 6/7 would already be addressed as part of the Landfill Section 6/7 Final Cover Design Report, Addendum 1. Thus, no further modification is needed for the 2036 condition where the proposed road segment across the landfill would be developed on top of the previously prepared embankment. In addition, no additional measures would be necessary relative to the fire and electrical service modifications discussed above for 2011.

Impacts on landfill infrastructure would be somewhat less with this option since the road itself would be narrower. This would result in less road coverage and also opens the option to allowing minor changes in road alignment.

As described above for the four-lane road option, for the segment of the Forest Hill Road between the base of the landfill and Richmond Avenue the alignment would encroach upon a landfill gas vent trench. Landfill gas migration monitoring point GX-40 is located in the vicinity of the alignment. Therefore, to avoid impacts GX-40 would be flagged and protected from disturbance during construction. To mitigate these encroachments, a gravel venting layer would also be placed above the landfill gas vent trench to ensure a permeable conduit to the surface. Placement of fill soil or pavement over a limited section of the gas vent trench is consistent with as-built conditions along the vent trench. Therefore, the fill placement, along with the permeable layer would not compromise the vent trench's function. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of the proposed roadway design.

Both the four-lane and two-lane road options cross the leachate management system; however, the four-lane design affects an additional 20-foot-wide section of cutoff wall and leachate collection trench. Thus, this Two-Lane Park Road option requires less extensive protective measures due to its narrower footprint. Impacts on the landfill gas management system are on the whole relatively minor, but are slightly less for the two-lane option.

Stormwater

As part of the park road construction, the existing basins (R, C1, and C2) which receive runoff from the Forest Hill Road alignment would be modified to perform a water quality improvement function in the same manner as described for the 2016 basin modifications. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of the proposed roadway design.

Richmond Hill Road Connection (Two-Lane Road)

Landfill Infrastructure

As it negotiates the narrow passage between the DSNY District 2 Garage and the landfill, the proposed park road would impact the emergency spillway from Basin A to the retention basin. This impact requires that a closed drainage system adjacent to Basin A be extended to a location south of the existing DSNY garage. The proposed road would also overlap the landfill cut-off wall at two separate points, for which protective slabs are proposed to shield the cut-off wall from the effects of roadway loads. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of the proposed roadway design.

This crossing requires a culvert to maintain its hydraulic function between the basins. Similarly, natural bottom arches are therefore proposed to maintain the hydraulic connection at the north end of Basin B1. In between, the alignment takes up the space of an existing gravel access road

leading to groundwater and landfill gas monitoring wells. Protected pullouts are to be provided at each monitoring well. The landfill gas interceptor venting system is also affected along this segment of roadway. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of the proposed roadway design.

For the segment of the Richmond Hill Road Connection between the base of the landfill and Richmond Avenue, as with the four-lane-road option, the two-lane-road option would pass near groundwater monitoring wells 154D, 174S, and 153D. The alignment would also pass near gas migration monitoring wells G-44, G-17, G-18, G-46, and G-19. Each of these features would be protected during construction, but not disturbed.

In addition, the proposed embankments across Basin B1 would divide the basin. However, preliminary hydrology analyses indicate that the remaining landfill stormwater basin would be sufficient to meet its functional purpose. Culverts would also be added to maintain hydraulic continuity and balance water levels.

Stormwater

As described above, the details of the proposed stormwater management system would be developed as each park capital project and segment of road design is further developed. In addition, to avoid stormwater impacts from increases in impervious surface to the receiving waters, individual stormwater BMPs would be used along the park roads to enhance existing wetlands and basins and to provide water quality treatment and runoff volume control. With these measures in place, by 2036, the proposed project would be expected to manage all increases in site-generated runoff while contributing positively to the local wetlands.

As part of the road construction, the existing sediment basins (R, C1, and C2) which receive runoff from the Forest Hill Road alignment would be modified to perform a stormwater runoff treatment function in the same manner as described for the 2016 basin modifications. Specific design details would be prepared and submitted as part of a separate regulatory submittal at the time of the proposed roadway design.

All runoff is expected to be controlled on site and not impact any downstream uses. Since the proposed project would discharge runoff to the coastal waterways of Richmond and Main Creeks, it is not expected that the project would result in any impacts on downstream flooding.

YUKON AVENUE CONNECTION —FOUR LANE ROAD

As with the two lane proposal described above (2016) the Yukon Avenue Connection under the four-lane option crosses Landfill Section 6/7.

In both the four-lane option and the two-lane option the park road design must account for the unusual embankment conditions, as well as the road's influence on continuing landfill post-closure operations. In general, the park road foundation design and analysis of landfill-related impacts are similar to those described above and would be addressed as part of the modified final closure design. Among the affected landfill infrastructure elements along the Yukon Avenue Connection are landfill gas collection laterals, and crossing of landfill gas collection headers. Culverts would also be introduced to maintain drainage conveyance patterns.

As it descends from Landfill Section 6/7, the alignment crosses the leachate collection trench and cutoff wall. In both the Four-Lane and the Two-Lane park road options, the Yukon Avenue Connection traverses the filled land and road land between Basins B1 and B2.

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The four-lane option requires limited filling a small portion of Basin B2 (see Chapter 10, “Natural Resources”). The estimated encroachments into the basin occur under this four-lane road; however, in neither case are these impacts significant with respect to landfill infrastructure operations.

EAST PARK LOOP ROAD AND RICHMOND AVENUE CONNECTIONS

As described in greater detail below, with this option, as is the case with the above options, there would be some delay in the closure of Landfill Section 6/7; however this delay would be limited to accommodating the Yukon Avenue Connection and not both the Yukon Avenue and Forest Hill Road connections. Similarly to the above options, there would also be a need to avoid, minimize, or mitigate landfill impacts from the proposed roads. As with the above options, it is expected these measures could eliminate project impacts.

Under this option, with the appropriate construction protection measures, there would not be any impacts on the collection and treatment of leachate, nor would there be hazards for landfill slope stability. However, with this option there is a greater need to modify landfill infrastructure around the base of Landfill Section 6/7, including the leachate collection and pumping systems. With this option there are also changes in hydrology due to road runoff and changes in the DSNY stormwater management basins. It is expected that the Loop Park Road Option would use the DSNY basins, as well as the Main Creek and Richmond Creek wetlands for runoff management given the alignment around the entire base of the landfill. Unlike the above options, this option would avoid the filling and associated hydrology impacts on Basins B1 and A that occurs with the Richmond Hill Road segment described above.

Where the above options and this option differ is primarily in the areas of road design and engineering, conflicts with landfill systems, natural resources, and park design. These differences are described in greater detail below with respect to landfill infrastructure.

Pump Stations and Landfill Cover

As part of the leachate conveyance system there are 14 existing pump stations located on the outboard side of the existing haul road (around Landfill Section 6/7), 13 of which are located in the proximity of the proposed East Park Loop Road alignment. Due to space constraints with this road alignment, this option does not allow for a shoulder in the proximity of the existing pump stations. The following are other potential impacts the East Park Loop Road option may have with respect to the pump stations:

- Roofs of pump stations located adjacent could carry loading in excess of H-20 from an errant vehicle.
- Maintenance procedures would have to be altered in order for maintenance workers to safely perform their duties at any station located within the traveled-way.
- Gas vents and electrical cabinets could be struck by an errant vehicle, endangering operation of the pump station.

Final cover of the northern portion of the site (approximately defined as those areas to the north of Yukon Avenue) is complete. As a result, impact avoidance on these road segments above could require excavation and backfilling a portion of the landfill cover in order to provide the desired road alignment and cross section. These modifications could impact the integrity of the landfill liner, and therefore are not recommended in the northern segment of the road design.

Gas Management System

Active Landfill Gas Collection System

Extraction wells and gas header pipes are unaffected by this option, as they are all located in the interior of the mound and outside of the roadway grading limits.

However, eight condensate tanks for the north would be impacted by this option because they are currently located underneath the existing and proposed roadway. At these locations, equipment, loading, and excavation constraints would be implemented to avoid any damage to the existing gas collection system. In addition, six drip leg vaults lie within the proposed roadway.

Passive Landfill Gas Venting System

In Landfill Section 6/7, a geocomposite gas venting layer with passive vents along the landfill section perimeter is proposed for the southern portion of Landfill Section 6/7. Several of the passive gas vents in this area fall within the southern portion of the landfill section and within the grading limits of this alternative alignment.

On the northern section of Landfill Section 6/7, several gas vents fall within the roadway grading limits. In this case, minor realignment along with other design solutions would need to be addressed to avoid these impacts.

Stormwater Management

The landfill stormwater management system consists of a series of swales, gabion downchutes, culverts, inlet pipes and control basins. The design intent of this option is to direct the runoff of the last tier/terrace of Landfill Section 6/7 across the roadway pavement by providing a two percent roadway cross-slope. This design conflicts with standard design practice and has the potential to contribute to hydroplaning and icing conditions on a public road, because this option would continue to allow some of the surface runoff from the landfill mound to be carried across the roadway surface. However, there are techniques to avoid this impact. Since the drainage area contributing to runoff that crosses the roadway varies through the site, it is recommended that further studies be performed during advanced design to avoid this impact.

Final cover of the southern portion of Landfill Section 6/7 (i.e., areas south of Yukon Avenue) has not yet been completed. This may allow for the modification of stormwater management plans to accommodate this option which would reduce the quantity of stormwater runoff flowing across the proposed roadway. Such a proposal would require DSNY review and DEC approval.

DSNY Maintenance

It is important to note that under this option, maintenance of the Fresh Kills Park leachate pump system would require periodic closure of traffic lanes. The leachate pumps are all located along the outer lane of the Loop Road. This would require periodic capacity reductions from two lanes to one. There are no pumps located along the bidirectional link between the Main Creek and Richmond Creek Bridges. There are also no pumps along the Yukon Avenue Connection.

CONCLUSIONS

The following conclusions apply to the proposed project with respect to infrastructure:

- While DPR may need to extend water lines into the project site to serve the proposed East Park facilities, but there would be only limited added demands from the proposed roads.

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- All elements of the proposed project including the proposed final cover (2011), the Yukon Avenue Connection (2016) and the completed East Park road system require design review by DSNY and approval of DEC.
- It is expected that with the road embankment incorporated into the final closure design, the proposed project could accommodate both an adequate final cover closure for Landfill Section 6/7 and a future road embankment without any impacts to the proposed landfill infrastructure.
- It is expected that with the road embankment across Landfill Section 6/7 incorporated into final closure, and designed to accommodate future park roads under either a two-lane or four-lane width, the proposed park roads could be constructed in the future over the landfill on top of the pre-prepared embankment without any future adverse impacts to landfill infrastructure.
- It is expected that segments of park roads that are constructed off the landfill would also require grading and landfill infrastructure modifications with respect to drainage basins, vent trenches, gas wells and other infrastructure. It is expected that with engineering design any impacts to these off-landfill systems can be avoided or minimized and/or mitigated. Details of these modifications would be provided in a separate regulatory submittal at the time of road design.
- There are more extensive impacts on landfill infrastructure under the East Park Loop Park Road option given that it calls for installing a road along the alignment of the existing DSNY landfill service road and follows the base of Landfill Section 6/7. In this option, more extensive impact avoidance and mitigation is likely to be necessary which would have to be addressed in final design. Details would therefore need to be provided in a separate regulatory submittal at the time of road design. *



— Fresh Kills Park Site Boundary

- - - Solid Waste Management Units

① Landfill Section 3/4

② Landfill Section 2/8

③ Landfill Section 6/7

④ Landfill Section 1/9

⑤ DSNY Staten Island Waste Transfer Station and Crushing and Screening Facility

⑥ DSNY Construction Staging Area

⑦ DSNY Staten Island District 2 Garage

⑧ Stormwater Basins

⑨ DSNY Construction Operations Area

⑩ DSNY Landfill Gas And Purification System

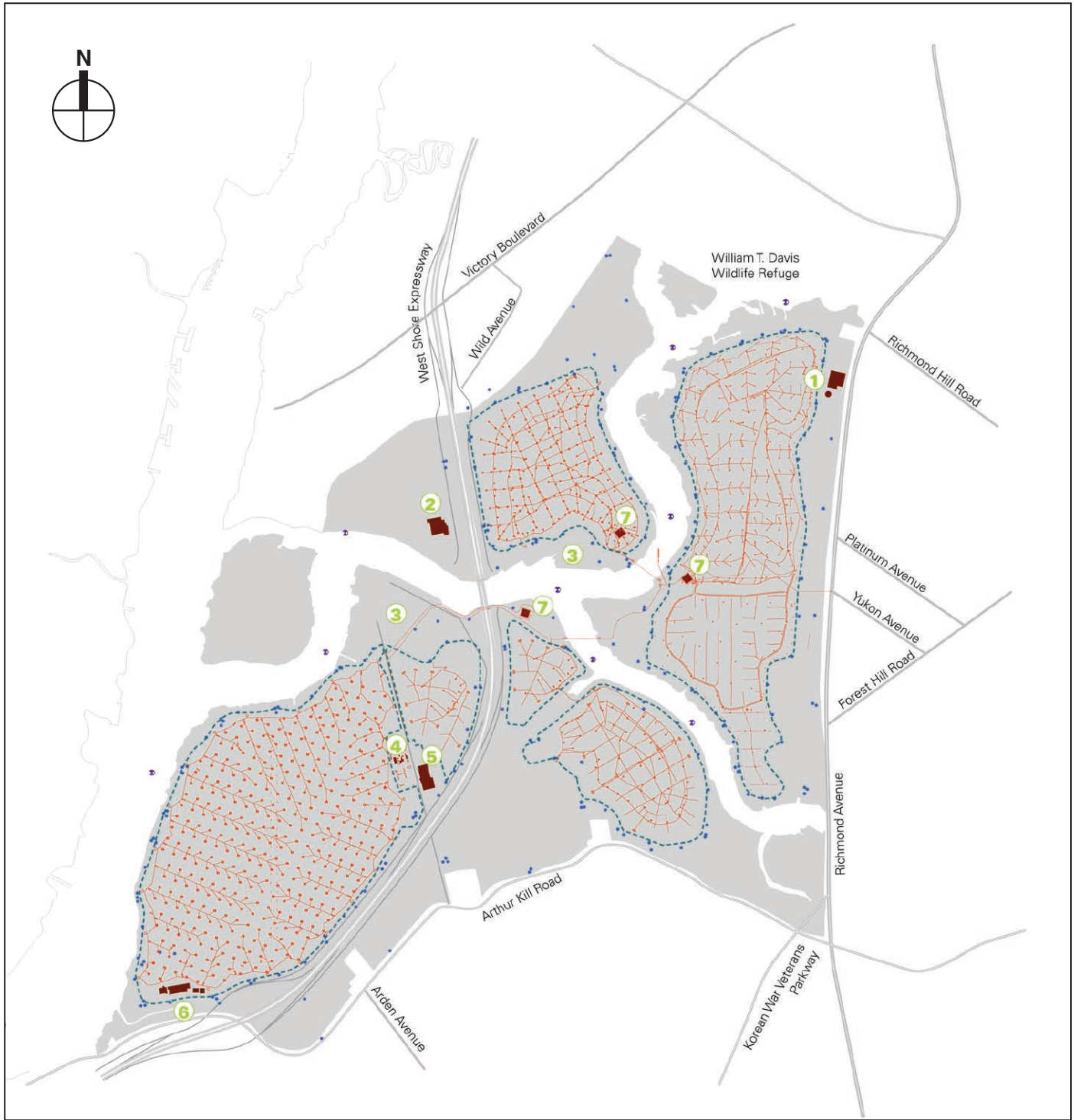
⑪ DSNY Staten Island District 3 Garage and Borough Repair Shop

⑫ DSNY Leachate Treatment Plant

⑬ DSNY LFG Flare Station

DSNY Fresh Kills Landfill Facilities

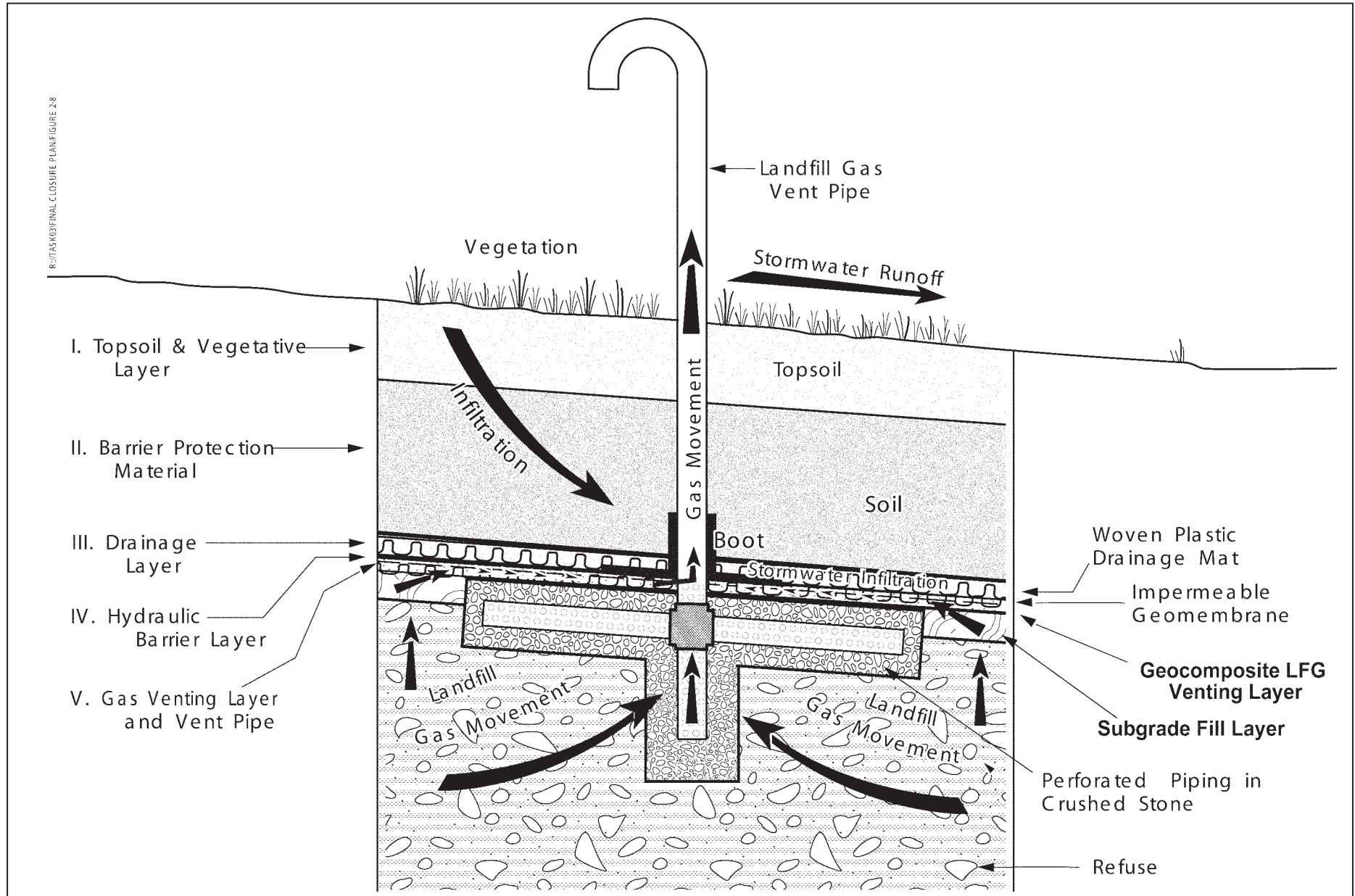
Figure 13-1



- - - - - leachate collection and containment system
- groundwater monitoring well
- surface water sampling location
- - - - - landfill gas collection system

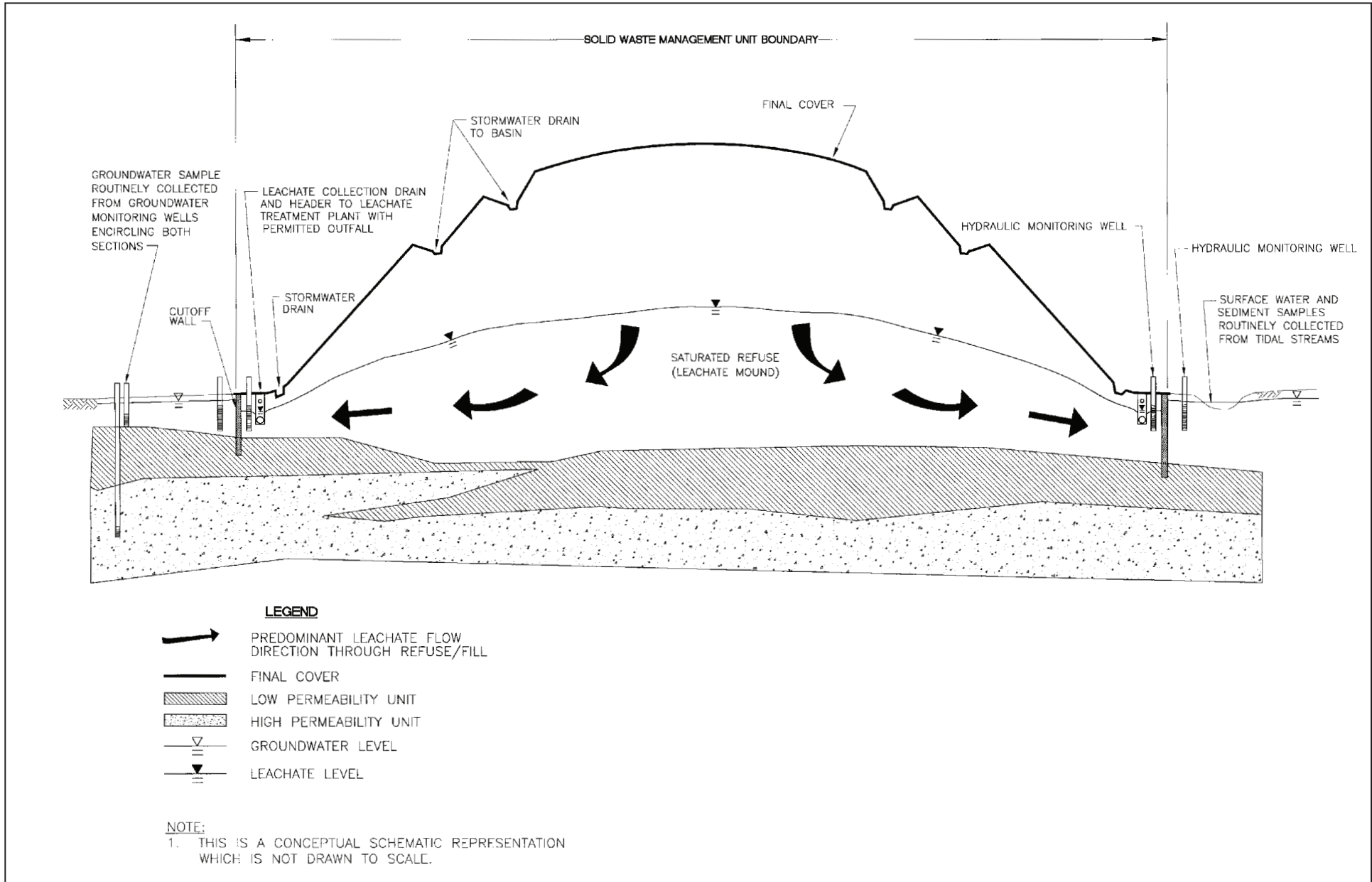
- DSNY operations facility
- 1 DSNY Staten Island District #2 Garage & Repair Shop
- 2 Staten Island Waste Transfer Station, Crushing and Screening Facility
- 3 DSNY staging area
- 4 DSNY landfill gas recovery facility
- 5 DSNY Staten Island District #3 Garage & Borough Repair Shop
- 6 DSNY leachate treatment plant
- 7 DSNY LFG flare station

B:\TASKS\03\FINAL CLOSURE PLAN\FIGURE 2-8



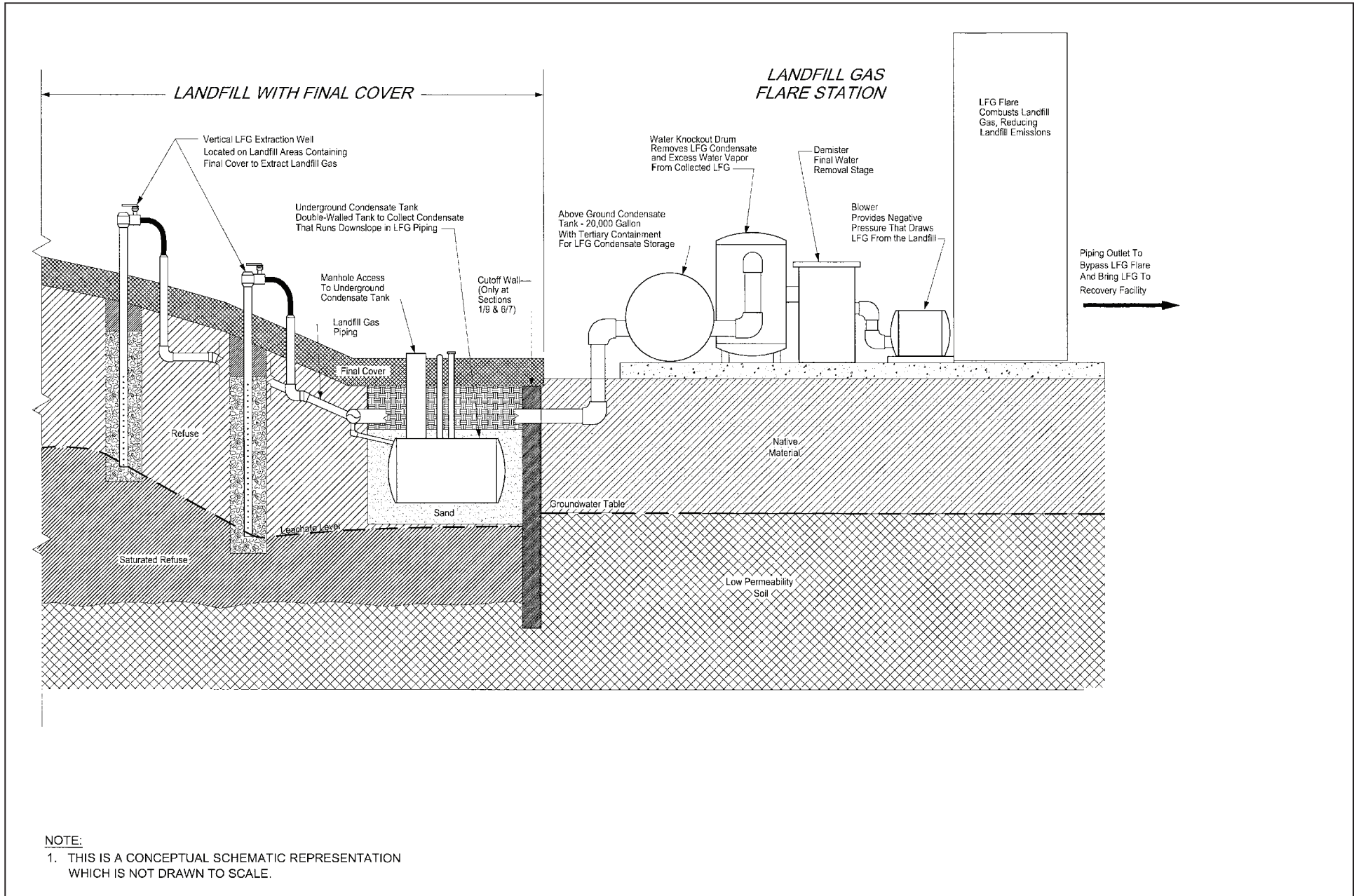
Source: DSNY

Final Cover and Landfill Gas Venting System
Landfill Sections 1/9 and 6/7
Figure 13-3



Source: DSNY

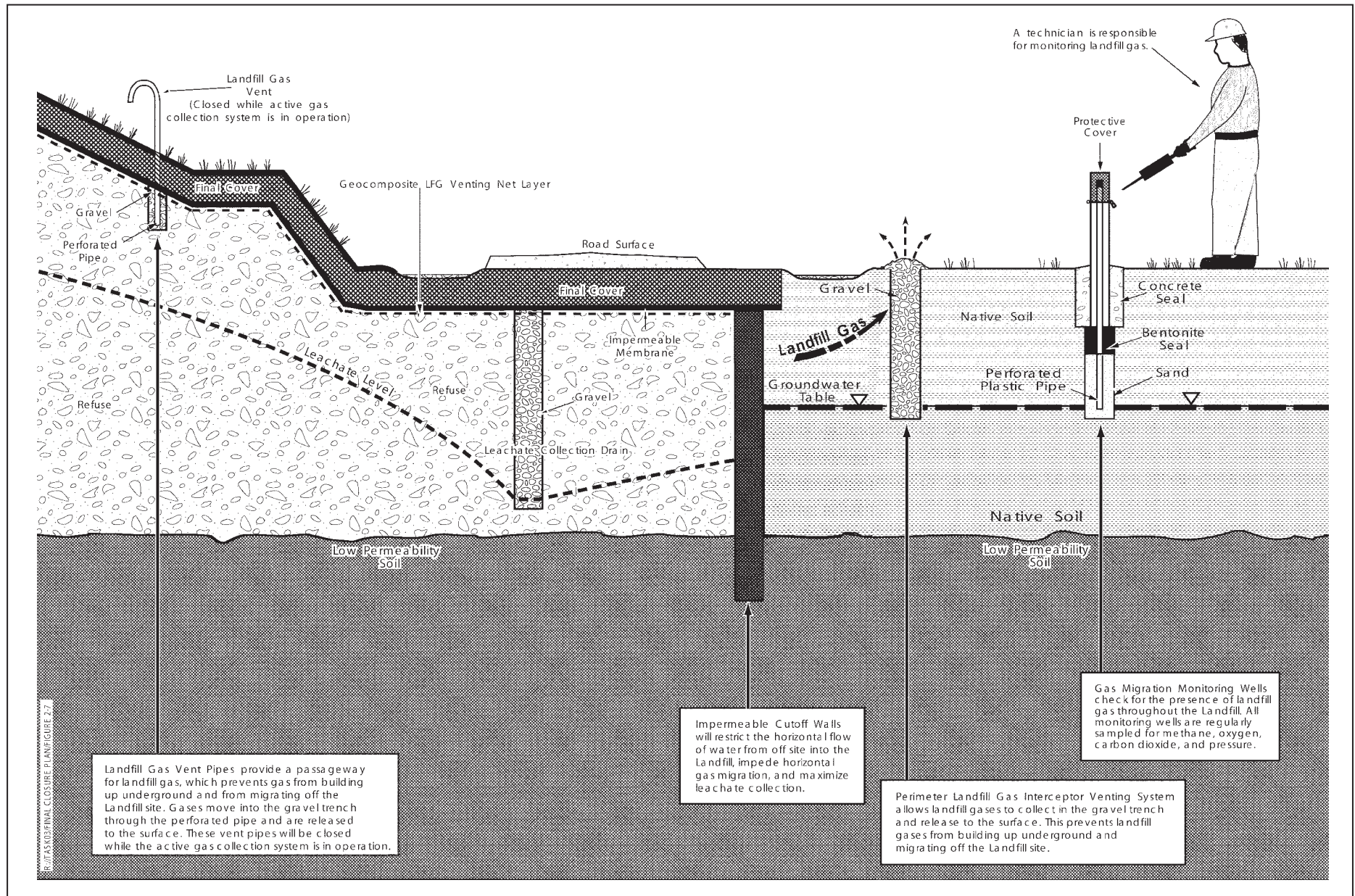
Leachate Control Systems
Landfill Sections 1/9 and 6/7
Figure 13-4



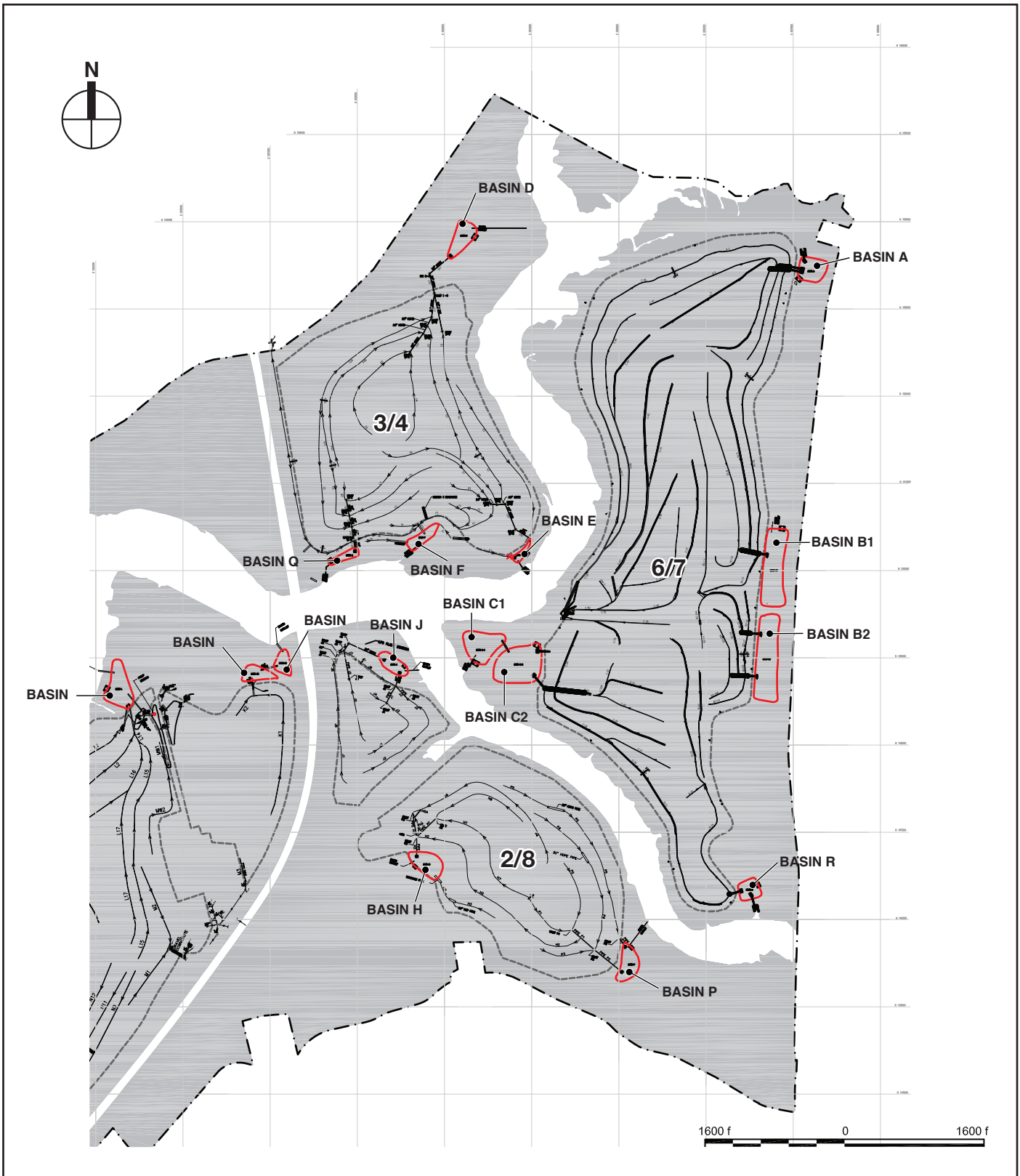
Source: DSNY

NOTE:
 1. THIS IS A CONCEPTUAL SCHEMATIC REPRESENTATION WHICH IS NOT DRAWN TO SCALE.

Active Landfill Gas (LFG) Collection System
Figure 13-5

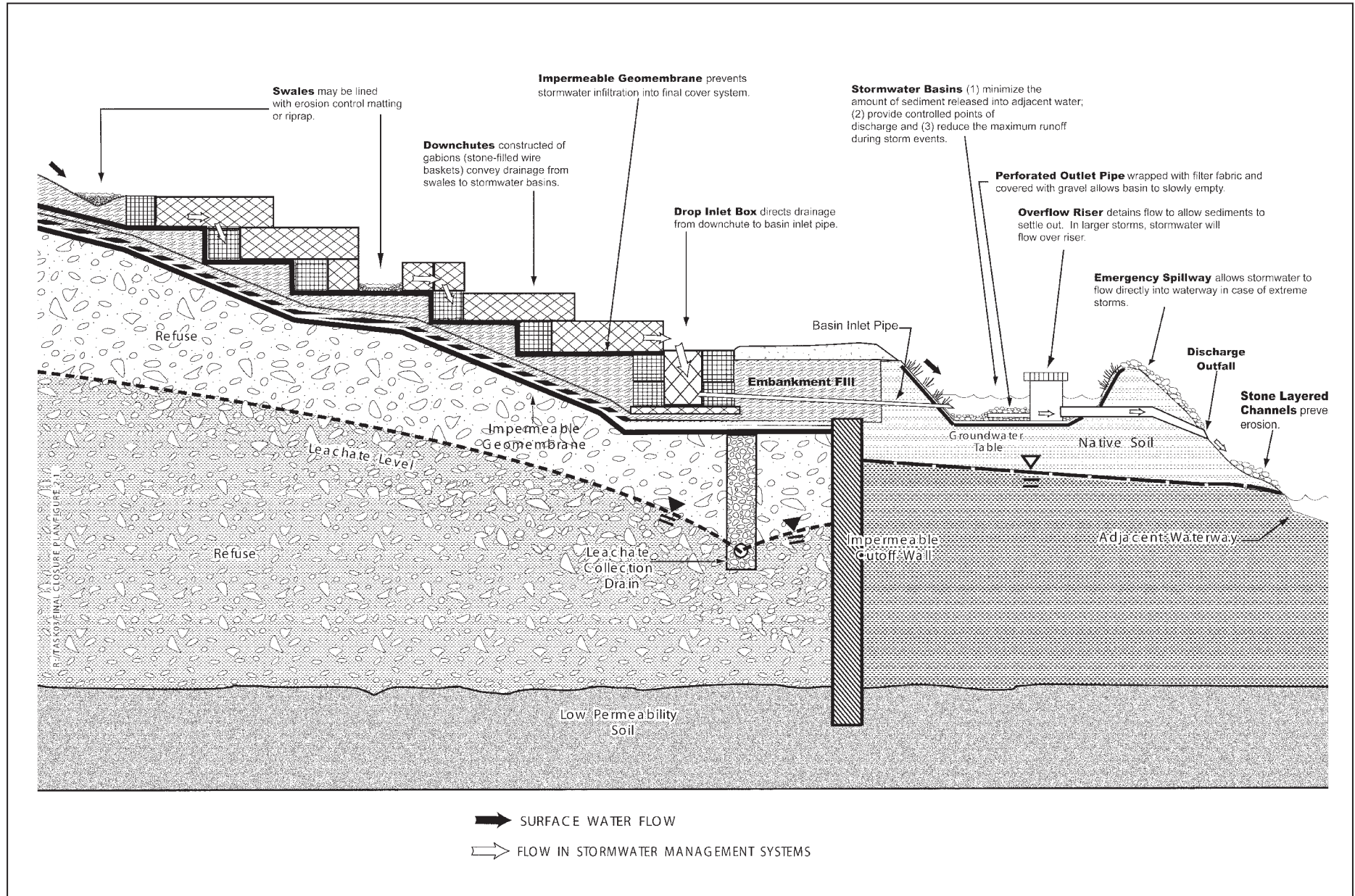


Cross-Section of the Landfill Gas Venting System
Landfill Sections 1/9 and 6/7
Figure 13-6



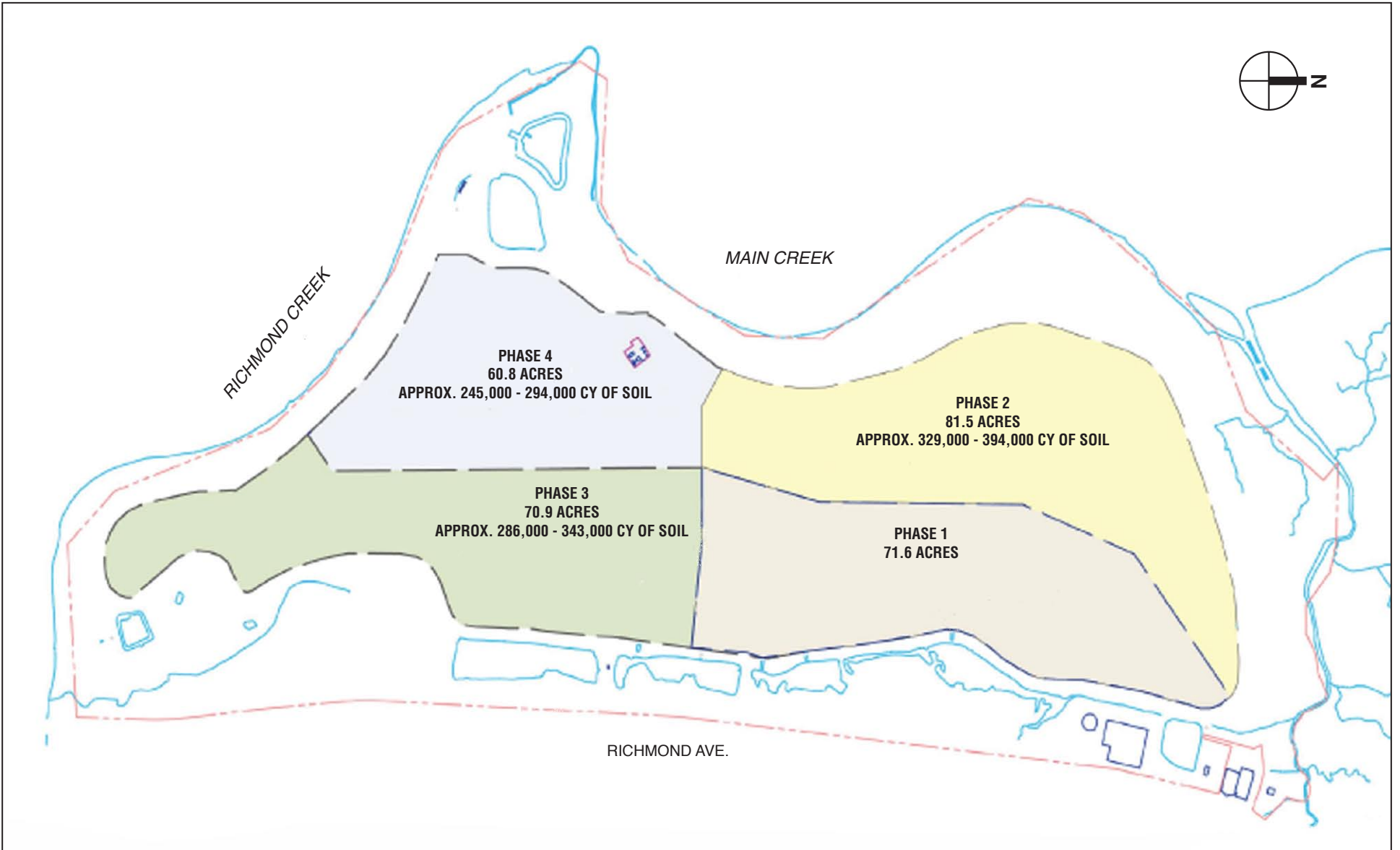
- SOLID WASTE MANAGEMENT UNIT BOUNDARY
- 50 → DRAINAGE SWALE
- DOWNCHUTE
- CULVERT
- ◡ BASINS

Existing Landfill Stormwater Management System
Figure 13-7



Source: DSNY

Cross-Section of the Landfill Drainage System
 Landfill Sections 1/9 and 6/7
Figure 13-8



Final Closure Construction Phasing for Section 6/7 (Approved Plan)

Figure 13-9