The City of New York

DEPARTMENT OF ENVIRONMENTAL PROTECTION

96-05 Horace Harding Expressway
Corona, New York 11368

Emily Lloyd
Commissioner

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Deputy Commissioner

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Bureau of Engineering Design & Construction

DEC 22 2008

Mr. Joe Yavonditte, P.E.
New York State
Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, NY 12233-7013

Re: EP-8 Pennsylvania Avenue Landfill
Contract LF-PAL-G3
Registration No. 20020009105
Final Engineering Report for the
Remedial Action at Pennsylvania Avenue Landfill

Dear Mr. Yavonditte:

In accordance with the Consent Order for Pennsylvania Avenue Landfill, NYCDEP has completed construction and prepared the Final Engineering Report covering all remedial actions on the Pennsylvania Avenue Landfill site.

This work includes the construction of the leachate collection and treatment system, and the placement of final cover on the landfill.

This submission consist of one DVD and three CD's covering the Final Engineering Report Appendices, the Final Engineering Report, as-builts drawings of LF-FCB-G2 and E2. The as-builts of LF-PAL-G3 are being finalized by URS and will be converted into PDF format and send to you in the neat future. There is one (1) paper copy of the Final Engineering Report and one copy of signed certification page per your request.

If you have any questions please feel free to contact me at 718-595-6123.

Very Truly Yours,

Ray Meshkati, P.E.
Chief
Facilities Construction South

CDS/nr

xc: Borsykowsky
Schiano
Resnisk/Rogak
Shah/Ahmed
Clarke/Betemit
Goyzueta/Raha

Copy to: URS Corporation
P.O Box 290
201 Willowbrook Boulevard
Wayne, NJ 07474-0290
Attn: Mr. C. Duane Seaman, P. E.
Project Manager

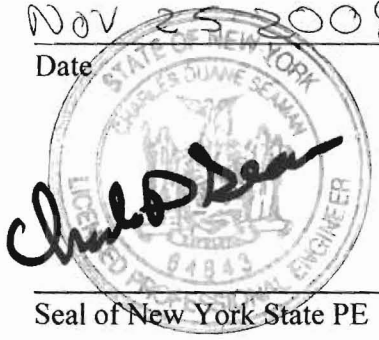
CERTIFICATION

I, C. Duane Seaman, certify that I am currently a registered professional engineer, and I certify that the Remedial Work Plan (or Remedial Design) was implemented and that all construction activities were completed in substantial conformance with the Department-approved Remedial Design.

The data submitted to the Department demonstrates that the remediation requirements set forth in the Remedial Design and any other relevant provisions of ECL 27-1419 have been or will be achieved in accordance with the time frames, if any, established in the design.

C. Duane Seaman, P.E.
Project Manager

Nov 25 2008
Date



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NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF ENGINEERING DESIGN AND CONSTRUCTION

REMEDIAL ACTION FOR PENNSYLVANIA AVENUE LANDFILL
CONTRACT LF-PAL-G3, LF-FCB-G2, LF-FCB-E2

FINAL ENGINEERING REPORT

November, 2008

Prepared for:
New York City Department of Environmental Protection
Bureau of Engineering Design and Construction
96-05 Horace Harding Expressway
Corona, NY 11368

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233

Prepared by:
URS Corporation
650 From Road, Suite 475
Paramus, NJ 07652

URS

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C. Duane Seaman, P.E.
Project Manager

21 NOV 2008
Date

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Section 1

1.0 INTRODUCTION

The purpose of this report is to describe the construction and inspection of the remediation of the Pennsylvania Avenue Landfill (the "site", or "landfill") located in Brooklyn, New York, performed under the City of New York Contract LF-PAL-G3 and LF-FCB-G-2/E2 (see Section 17): Remedial Action for Pennsylvania Avenue Landfill (herein, referred as the "Contract"). The remediation of the landfill was based on the remedy chosen in the Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC), dated February 1995.

This report also provides a New York State Licensed Professional Engineer's certification that the remediation of the landfill was conducted and completed in accordance with the relevant Contract Drawings and Specifications, including some minor revisions which do not significantly affect the intent of the design.

This Final Engineering report has been prepared to meet the requirements for preparation of a Final Engineering Report as described in NYSDEC Solid Waste Regulations 6 NYCRR Part 360-2.8 and Part 360-2.13, effective December 31, 1988.

The following entities were involved with the remediation of the landfill:

- Owner of the Landfill: The landfill's owner is the New York City Department of Environmental Protection (NYCDEP).

- Regulatory Agency: NYSDEC was involved with the review and approval, of the Contract Drawings and Specifications, as well as contributing partial payment for the remediation of the landfill.

- Professional Engineer: URS Corporation, Inc. (URS) was the Owner's Design Engineer, Resident Engineer, Quality Assurance Inspector, and Construction Manager. Also, URS is providing the New York State Licensed Professional Engineer's certification that the remediation of the landfill was conducted and completed in accordance with the relevant Contract Drawings and Specifications, including some minor revisions which do not significantly affect the intent of the design.

- General Contractor: Barbella Environmental Technology, Inc. ("BET", or the "Contractor") was the general contractor that was contracted by the NYCDEP to construct the remediation components as described in the Contract Drawings and Specifications.

The landfill is located in the Borough of Brooklyn, Kings County, City of New York. The landfill is bounded on the northwest side by the Belt Parkway, Fresh Creek Basin to the southwest, Jamaica Bay to the southeast, and Hendrix Creek to the northeast. The landfill property encompasses approximately 110 acres.

1.1 Site History

The Pennsylvania Avenue Landfill was opened in 1956 and received residential, commercial, incinerator, street cleaning, construction and demolition (C&D) wastes, demolished automobiles, and waste oil. Landfill operations were conducted under the responsibility of the New York City Department of Sanitation. By 1962, the landfill had been closed and filling activities had shifted to the adjacent Fountain Avenue Landfill. By 1968, the Fountain Avenue Landfill was expanding more rapidly than anticipated and the dumping of C&D debris was shifted to the Pennsylvania Avenue Landfill. By 1980, all filling at the site was stopped. An estimated 3.8 million cubic yards of waste have been disposed at the landfill.

The quantities and locations of hazardous wastes that may have been disposed at the site are unknown. The following waste materials were reported to have been disposed of at the landfill in liquid form: acetone, alcohols, acids, alkyl phenols, benzene, chlorides, cyanide, dichlorobenzene, dioctylphthalate, ethylbenzene, fuel oil, industrial oil, lacquer, lubricating oil, mercaptans, metals, naphthalene, sewage sludge, toluene, wastewater, and xylenes.

1.2 Site Conditions Prior To Landfill Closure

The site is comprised of one large main fill mound in the northwest half of the site, which has an elevation of approximately 85 feet. A round-shaped mound in the central portion of the southeast half of the site has an elevation of approximately 40 feet.

Vehicle access to the landfill is via the southern end of Pennsylvania Avenue and by a ramp from Exit 14 of the Belt Parkway. Security is provided by guards on duty 24 hours a day. Trailers existed for the security guards, and at the start of the Contract, a trailer was set up for the general Contractor, and a main trailer was constructed for the field offices of the NYCDEP, NYSDEC and URS.

Prior to closure activities as detailed in this report, the landfill cover was fairly permeable and densely vegetated. Vegetation, mainly phragmites, covered nearly 80 percent of the landfill. Few trees were located on site. Wildlife observed included red-tailed hawks, pheasants, ducks, Canadian geese, seagulls, rabbits, wild dogs, mice and rats.

On the southwest side of the site, there is an active waste oil/leachate interceptor trench and two pump stations along the shoreline of Fresh Creek Basin. The trench, pump station, forcemain piping and the pretreatment building, located adjacent to the site gate, were constructed under a previous contract with the City of New York, LF-FCB-G2: Remediation of Fresh Creek Basin.

1.3 Remedial Construction History

Contract bid documents for the Landfill remediation construction were entitled "*Remediation of Pennsylvania Avenue Landfill, Capital Project EP-8, Contract LF-PAL-G3, NYSDEC Site*

224002", dated October 2000, prepared by URS Corporation. The NYCDEP awarded the construction contract to Barbella Environmental Technology, Inc. (BET) of Somerville, NJ, the lowest responsible bidder, in a contract amount of $57,485,615.15. The Notice to Proceed was issued on March 6, 2006, which notified BET to fully complete the work on or before March 3, 2008 (2,190 consecutive calendar days).

BET commenced work on March 6, 2002 and was substantially complete with Milestone 1 (Landfill Capping work excluding woody planting and watering milestones) on June 15, 2006, 468 days past the originally scheduled Milestone Completion date of March 4, 2005. The Milestone 1 delays were predominantly related to the Contractor's difficulty obtaining sufficient quantities of suitable material in addition to the difficulty meeting the specified seeding windows outlined in the contract. Milestone 2 was completed on June 6, 2006 and Milestone 3 was completed on March 3, 2008.

During this project the quantity of soils delivered exceeded the quantity of materials paid for in place. This difference was a reflection of the effect of compaction upon the soils, the use of soils which the contractor did not record landfill settlement and surveying inaccuracies (+/- .1 - .2 ft). This difference in volume varied by the nature of the material, the compactive effort, and the timeliness of the survey.

URS verified that the design lines and grades as well as larger thicknesses were met independent of payment quantities by using hand dug holes to measure thickness of layers, taking field measurements and reviewing as built surveys.

1.4 Components of the Remedial Construction Contract

The Contract LF-PAL-G3 consisted of the major items of work summarized in this section and in subsequent sections of this report and specified in detail on the Drawings and Specifications of the Contract.

The major components of the Contract performed by BET included the following work:

- Site Preparation: Surveying and construction layout services; Erosion and Sediment Control measures which were maintained throughout the duration of the contract; Landfill grading and excavation to include waste regarding and contaminated beach excavation and backfill; grading fill, Type I and Type II cover soils placement for liner placement;

- Landfill Gas Management: Construction of a landfill gas (LFG) collection system, including 46 vertical extraction wells placed into the landfill mass and LFG collection header piping for the conveyance of the LFG to the blower and flare facility.

- Low Permeability Layer: Installation of 40 mil Linear Low Density Polyethylene (LLDPE) geomembrane, including geosynthetics above the geomembrane liner. The geosynthetic layers were placed directly above an approved subgrade layer.

- Liner Protection Layer (Barrier Protection Soil): Installation of a minimum 12-inch compacted barrier protection layer over the geosynthetics cap.

- Topsoil and Seeding: Installation of a 6" minimum and up to a 3.0' layer of topsoil with seeding and erosion control to establish a permanent vegetative layer.

- Contaminated Beach Excavation and Backfill: Excavation of approximately 30,000 cubic yards of contaminated shoreline sediments along the landfill's western shore of Fresh Creek Basin; backfill this area with suitable material as per the project specifications.

- Planting: The installation and maintenance of the plantings required under the contract (NOT PART OF THIS CERTIFICATION REPORT);

- Drainage Control Features: Construction of drainage channels and diversion swales including culverts and outfalls;

- LFG Blower and Flare Facility: Installation of a landfill gas blower and flare facility that thermally oxidizes the LFG that is directed to the flare via the LFG collection piping.

All work under the Contract was completed by the BET workforce, which included the following major subcontractors:

Subcontractors	Activity Performed
Kleinberg Electric, Inc.	Installation of the electrical requirements of the project
Chenango Contracting	LLDPE geomembrane liner and geosynthetics installation
Moretrench	Installation of gas extraction wells and abandonment of existing monitoring wells
Border Visions	Construction photography/video
Masgon Security	Site security
Ewell Finley	Land survey
VIP	Landscaping
Accredited	Chemical testing
L. B. Consulting	CMP Schedule
Princeton Analytical Labs.	Analytical services

1.5 Existing Documents

The following documents describe the construction, quality control and basis of the design of the remediation contract:

- *INFORMATION FOR BIDDERS, STANDARD CONSTRUCTION CONTRACT, AND SPECIFICATIONS FOR FURNISHING ALL LABOR AND MATERIAL NECESSARY FOR: Contract LF-PAL-G3, Remedial Action for Pennsylvania Avenue Landfill, Borough of Brooklyn – New York*, October 16, 2000, URS Corporation, Mack Centre II, Paramus, NJ.

- *Remediation of Pennsylvania Avenue Landfill, Capital Project EP-8, Contract No. LF-PAL-G3, NYSDEC Site 224002*, October 2000, URS Corporation.

- Record of Decision, February 1995 – Prepared by NYSDEC.

- Remedial Investigation Report, May 1994 – Prepared by URS Consultants, now URS Corporation.

- Feasibility Study Report, September 1994 – Prepared by URS Consultants, now URS Corporation.

- Pennsylvania and Fountain Avenue Landfills Geotechnical Investigation Report, July 1996 – Prepared by URS Consultants, now URS Corporation.

Section 2

2.0 SITE PREPARATION

The primary objective with respect to site preparation activities involved the clearing and rough grading of the landfill. These subgrade preparation tasks were designed to prepare the surface to receive the low permeability geosynthetic layer. The site preparation activities were divided into a progression of steps including erosion and sediment control, clearing and grubbing, rough grading and subgrade preparation to include existing waste excavation and regrading.

2.1 Erosion and Sedimentation Control

Prior to commencing construction activities, temporary sedimentation basins were constructed at strategic locations around the landfill in accordance with the Contractor's approved Erosion and Sedimentation Control Plan. The discharge ends of the basins were protected by means of riprap spillways. Weirs were constructed within the basin wall to restrict flow over the spillways and promote settlement of suspended sediment.

Supplemental flow restriction was constructed prior to and during storm events to mitigate developing flows and prevent offsite migration of sediment. Typically, hay bales and silt fences were spiked across developing flow channels in order to filter and to slow the open channel flow development. Silt fence was installed around the entire perimeter of the landfill and maintained for the duration of the contract.

Photographs of the installation of sediment control basins and silt fence are included in Appendix I.

2.2 Clearing and Grubbing

Site preparation began with the clearing of trees, brush, shrubs, other vegetation, rubbish and debris; grubbing of stumps, buried logs, root mats and organic materials within the Contract Limits of Work, and in accordance with the Contract Specifications. All trees and shrubs within the limit of the work were removed, unless designated to remain. Earthwork operations did not start in areas where clearing and grubbing was not complete, with the exception of stumps and large roots that were removed concurrent with excavation. Trees, brush and woody vegetation removed during clearing activities were chipped on site and placed in thin layers to facilitate compaction of cover soils. Waste tires were consolidated and removed from the site to an approved disposal facility.

Photographs of the clearing and grubbing activities are included in Appendix I.

2.3 Waste Excavation and Regrading

Prior to performing waste excavation and regrading work, the landfill area was surveyed to establish pre-construction topography. The pre-construction topography was used to redesign the preparatory grades to incorporate any changes in the landfill topography resulting from the landfill settlement. Waste excavation and regrading activities included excavation of waste and regrading necessary to establish the appropriate landfill side slope dimensions and proposed grades for the construction of the subgrade for the landfill capping system. Channels required for drainage features were also reflected in the subgrade design, as well as establishing the locations of the main surface features (access roads, sediment basin, and drainage structures). All excavated material at the site was relocated to areas within the limit of the site's geomembrane as shown on the approved plans. After the excavated material was relocated, all exposed waste was covered with soil from onsite borrow, or from approved offsite, sources in accordance with the plans and specifications.

Photographs of the waste excavation and regarding activities are included in Appendix I.

Section 3

3.0 CONTAMINATED BEACH EXCAVATION AND BACKFILL

An integral part of the Remediation of the Pennsylvania Avenue Landfill was the excavation and backfill operations to remove the contaminated beach soil from the western edge of the Landfill along Fresh Creek Basin. Prior to proceeding, the Contractor submitted a Beach Soil Excavation Plan for approval by the Engineer. This plan included a drilling program to determine the depths, thicknesses and elevations of the underlying tidal marsh deposit (TMD). Piezometers were installed to monitor the Upper Glacial Aquifer situated below the TMD. The construction methods included as part of the plan met the following requirements;

a) All sediments within the specified limits of the excavation were excavated to the top of the TMD based on visual observation by the Engineer. Samples of the TMD were obtained by the Engineer and are stored on site for reference.

b) Equipment and methods used by the Contractor did not affect the integrity or continuous operation of the existing interceptor trench located immediately adjacent to the excavation area.

c) Excavation was performed without disturbing the TMD and allowed verification that all soil above the TMD was removed.

d) Excavation was performed in dewatered conditions.

e) No excavated material was allowed to spread to adjacent clean areas.

3.1 Installation of Turbidity Barrier

Before installation of the steel sheeting commenced, the Contractor installed a turbidity barrier just beyond the limits of the proposed steel sheeting location in accordance with the approved Contaminated Beach Excavation Plan to control migration of any sediments. The turbidity barrier used for this application was Tough Guy Type II manufactured by Aer-Flo Canvas Products, Inc. The turbidity barrier was maintained for the duration of the excavation and backfill operations and was removed after the removal of the steel sheeting.

Photographs of the turbidity barrier are included in Appendix I.

3.2 Installation of Steel Sheeting

The Contractor submitted a steel sheeting design signed by a professional engineer licensed to practice in New York State. The sheeting was installed around the entire limits of the area to be excavated after installation of the turbidity barrier. The sheeting was installed to the limits specified in the approved sheeting design. The sheets installed were made of A-36 steel with a section modulus (Sx) of 10.55. Standard lengths of 25' were used.

Photographs of the steel sheeting installation are included in Appendix I.

3.3 Dewatering

Dewatering activities were performed independently for waters above and below the TMD. The Contractor's dewatering plan for above the TMD included a system of wells, valves, pumps and associated piping installed along the perimeter of the cofferdam. The effluent from the dewatering above the TMD was directed to an oil/water separator before being discharged into recharge pits on the landfill. The Contractor's dewatering plan for below the TMD included 6 deep wells installed in the UGA. The effluent from the deep wells was directed to a stone energy dissipater before being discharged into the neighboring Fresh Creek Basin. Effluent samples were taken for this discharge to verify it met discharge criteria. Test results are included in Appendix B.

Photographs of the dewatering operations for above and below the TMD are included in Appendix I.

3.4 Excavation and Backfill

Excavation of the contaminated area proceeded with the contractor using backhoes and front end loaders to remove the material from the excavation site for disposal on the landfill in designated areas for disposal. The material removed and placed on the landfill was covered after disposal to prevent migration of soils. Upon completion of excavation the bottom was surveyed prior to placement of backfill.

The material used for backfill of the excavation was in conformance with the Contract Specifications. All backfill used on the project was tested and approved per the QA/QC requirement of the Specifications prior to use at the Pennsylvania Avenue Landfill. See Table 3-1 for source testing requirements.

Table 3-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis With Hydrometer	ASTM D-422	One per source
Organic Content	ASTM D-2974	One per source
Atterberg Limits	ASTM D-4318	One per source
Chemical Analysis	Per Specifications	One per source
Water (Moisture) Content	ASTM D-2216	One per source

The general requirements for general fill are shown in Table 3-2.

Table 3-2
General Fill Requirements

Property	Criteria
Organic Content (%)	<5%
Plastic Index (slope > 5%)	<12
Plastic Index (slope < 5%)	<50
Moisture (as received) (%)	<OW +7%
Max Particle Size (in)	<3"
TCL & TAL	Chemical Testing
USC	SM or SC
Max Fine Content	20% - 40%

The backfill material consisted of 30,000 cy of general fill material that was of good and uniform quality. Backfill was free of refuse, hard clods, woody vegetation, stiff clay, construction debris, boulders, stones larger than one and one-half inches, hydrocarbons, petroleum materials or chemicals toxic to plants, other miscellaneous or otherwise unstable or undesirable materials, and other deleterious inclusions. The material source for this backfill was Amboy Aggregates in Pert Amboy, New Jersey.

Source testing results for the backfill are included in Appendix B.

Photographs of the contaminated beach excavation and backfill operations are included in Appendix I.

3.5 Quality Control/Quality Assurance Installation of Backfill

Quality control and quality assurance testing of materials proposed for use as backfill material are included in Appendix B. Quality assurance during the backfill placement consisted of full-time observation by the Engineer to verify that all contaminated soils were removed down to the TMD. The Contract Specifications required no compaction testing for the placement of the general fill used as backfill material. The backfill material was placed to the original grade of the contaminated soil that was removed. In accordance with Table 3-3 below, periodic quality control was performed by the contractor.

Table 3-3
Quality Control – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis With Hydrometer	ASTM D-422	One test every 5,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 5,000 yd^3
Organic Content	ASTM D-2974	One test every 5,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 5,000 yd^3
Chemical Analysis	Per Specifications	One test every 3,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 5,000 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., which is a NYSDEC certified laboratory, located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. URS verified the QC test results by performing the same test but at a lesser frequency, as per the project specifications, as shown in Table 3-4.

Table 3-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis With Hydrometer	ASTM D-422	One test every 20,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 20,000 yd^3
Organic Content	ASTM D-2974	One test every 20,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 20,000 yd^3
Chemical Analysis	Per Specifications	One test every 60,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 20,000 yd^3

QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

See Tables 3-5 thru 3-9 for summary results of backfill.

Refer to Appendix B for all frequency testing of backfill.

Photographs of the Backfill installation are included in Appendix I.

Table 3-5
QA/QC Summary Results for Beach Backfill
Geotechnical

General Requirements	Criteria	AMBOY RANGE		
Organic Content (%)*	<5%	0.26	-	1.00
Plastic Index (slope > 5%)	<12	0	-	0
Plastic Index (slope < 5%)	<50	0	-	0
Standard Proctor Test	Max. Density (pcf)	105.0	-	105.1
	Opt. Moisture (%)	12.4	-	17.4
Moisture (as received) (%)	< OW + 7%	12.4	-	17.4
Particle Size (in)	< 3"	1/4	-	1/2
USC	SW-SP	SP	-	SP
Max. Fine Content (%) *	20% - 40%	1.1	-	2.2

(*) Note: Acceptable for Beach Backfill

Table 3-6
QA/QC Summary Results for Beach Backfill
Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg)	AMBOY RANGE		
1	Chloromethane	*	ND	-	ND
2	Vinyl Chloride	0.2	ND	-	ND
3	Bromomethane	*	ND	-	ND
4	Chloroethane	1.9	ND	-	ND
5	1,1-Dichloroethene	0.4	ND	-	ND
6	1,2-Dichloroethene (Total)	*	ND	-	ND
7	Methylene Chloride	0.1	ND	-	0.006
8	1,1-Dichloroethane	0.2	ND	-	ND
9	Chloroform	0.3	ND	-	ND
10	1,1,1-Trichloroethane	0.8	ND	-	ND
11	Carbon Tetrachloride	0.6	ND	-	ND
12	1,2-Dichloroethane	0.1	ND	-	ND
13	Benzene	0.06	ND	-	ND
14	Trichloroethene	0.7	ND	-	ND
15	1,2-Dichloropropane	*	ND	-	ND
16	Bromodichloromethane	*	ND	-	ND
17	Cis-1,3-Dichloropropene	*	ND	-	ND
18	Toluene	1.5	ND	-	ND
19	Trans-1,3-Dichloropropene	*	ND	-	ND
20	1,1,2-Trichloroethane	*	ND	-	ND
21	Tetrachloroethene	1.4	ND	-	ND
22	Dibromochloromethane	*	ND	-	ND
23	Ethylbenzene	5.5	ND	-	ND
24	Chlorobenzene	1.7	ND	-	ND
25	Styrene	*	ND	-	ND
26	Bromoform	*	ND	-	ND
27	1,1,2,2-Tetrachloroethane	0.6	ND	-	ND
28	Carbon Disulfide	2.7	ND	-	ND
29	Acetone	0.2	ND	-	ND
30	2-Butanone	0.3	ND	-	ND
31	4-Methyl-2-Pentanone	1	ND	-	ND
32	2-Exanone	*	ND	-	ND
33	Xylenes (Total)	1.2	ND	-	ND
34	Total VOC's	10.0	ND	-	0.006

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total VOC's

Table 3-7
QA/QC Summary Results for Beach Backfill
Semi-Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RESULTS		
1	Phenol	0.03 or MDL	ND	-	ND
2	bis(2-chloroethyl)ether	0.58	ND	-	ND
3	2-Chlorophenol	0.8	ND	-	ND
4	1,3-Dichlorobenzene	50.0	ND	-	ND
5	1,4-Dichlorobenzene	50.0	ND	-	ND
6	1,2-Dichlorobenzene	50.0	ND	-	ND
7	2-Methylphenol	0.1 or MDL	ND	-	ND
8	3&4-Methylphenol	0.091	ND	-	ND
9	N-Nitroso-di-n-propylamine	0.1	ND	-	ND
10	Hexachloroethane	46.0	ND	-	ND
11	Nitrobenzene	0.2 or MDL	ND	-	ND
12	Isophorone	4.4	ND	-	ND
13	2-Nitrophenol	.33 or MDL	ND	-	ND
14	2,4-Dimethylphenol	50.0	ND	-	ND
15	bis(2-chloroethoxy)methane	50.0	ND	-	ND
16	2,4-Dichlorophenol	0.4	ND	-	ND
17	1,2,4-Trichlorobenzene	50.0	ND	-	ND
18	Naphtalene	13.0	ND	-	ND
19	4-Chloraniline	0.22 or MDL	ND	-	ND
20	Hexachlorobutadiene	8.2	ND	-	ND
21	4-Chloro-3-methylphenol	0.24 or MDL	ND	-	ND
22	2-Methylnaphthalene	36.4	ND	-	ND
23	Hexachlorociclopentadine	50.0	ND	-	ND
24	2,4,6-Trichlorophenol	50.0	ND	-	ND
25	2,4,5-Trichlorophenol	0.1	ND	-	ND
26	2-Chloronaphthalene	50.0	ND	-	ND
27	2-Nitroaniline	0.43 or MDL	ND	-	ND
28	Dimethylphthalate	2.0	ND	-	ND
29	Acenaphthylene	41.0	ND	-	ND
30	3-Nitroaniline	0.5 or MDL	ND	-	ND
31	Acenaphthene	50.0	ND	-	ND
32	2,4-Dinitrophenol	0.2 or MDL	ND	-	ND
33	4-Nitrophenol	0.1 or MDL	ND	-	ND
34	Dibenzofuran	6.2	ND	-	ND
35	2,6-Dinitrotoluene	1.0	ND	-	ND
36	2,4-Dinitrotoluene	50.0	ND	-	ND
37	Diethylphthalate	7.1	ND	-	ND
38	4-Chlorophenyl-phenylether	50.0	ND	-	ND
39	Fluorene	50.0	ND	-	ND

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RESULTS		
40	4-Nitroaniline	50.0	ND	-	ND
41	4,6-Dinitro-2-Methylphenol	50.0	ND	-	ND
42	n-Nitrosodiphenylamine	50.0	ND	-	ND
43	4-Bromophenyl-phenylether	50.0	ND	-	ND
44	Hexaclorobenzene	0.41	ND	-	ND
45	Pentachlorophenol	1.0 or MDL	ND	-	ND
46	Phenanthrene	50.0	ND	-	0.11
47	Anthracene	50.0	ND	-	ND
48	Di-n-butylphthalate	8.1	ND	-	0.067
49	Fluoroanthene	50.0	ND	-	0.15
50	Pyrene	50.0	ND	-	0.13
51	Butylbenzylphthalate	50.0	ND	-	ND
52	3,3'-Dichlorobenzidine	1.4	ND	-	ND
53	bis-(2-Ethylhexyl)phthalate	50.0	ND	-	ND
54	Di-n-octylphthalate	50.0	ND	-	ND
55	Benzo[g,h,l]perylene	50.0	ND	-	0.72
56	Carbazole	32.0	ND	-	ND
57	2,2'-Oxybis(1-Chloropropane)	50.0	ND	-	ND
58	Benzo(a)anthracene	**	ND	-	0.07
59	Benzo(a)pyrene		ND	-	0.12
60	Benzo(b)fluoranthene		ND	-	0.095
61	Benzo(k)fluoranthene		ND	-	0.068
62	Chrysene		ND	-	0.064
63	Dibenzo(a,h)anthracene		ND	-	ND
64	Indeno(1,2,3-cd)pyrene		ND	-	0.069
65	Total SVOC's	500	ND	-	1.177
66	Total CPAH's	10	ND	-	0.486

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
** = Soil Use Criteria controlled by Total CPAH's

Table 3-8
QA/QC Summary Results for Beach Backfill
Organic Pesticides and PCB's

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RANGE		
1	A-BHC	0.11	ND	-	ND
2	B-BHC	0.2	ND	-	ND
3	G-BHC (Lindane)	0.06	ND	-	ND
4	D-BHC	0.3	ND	-	ND
5	Heptachlor	0.10	ND	-	ND
6	Aldrin	0.041	ND	-	ND
7	Heptachlor Epoxide	0.02	ND	-	ND
8	Endosulfan I	0.9	ND	-	ND
9	A-Chlordane	*	ND	-	ND
10	G-Chlordane	0.54	ND	-	ND
11	Dieldrin	0.044	ND	-	ND
12	4,4'-DDE	2.1	ND	-	ND
13	Endrin	0.10	ND	-	ND
14	Endosulfan II	0.9	ND	-	ND
15	4,4'-DDD	2.9	ND	-	ND
16	Endrin Aldehyde	*	ND	-	ND
17	Endosulfan Sulfate	1	ND	-	ND
18	4,4'-DDT	2.1	ND	-	ND
19	Endrine Ketone	N/A	ND	-	ND
20	Methoxychlor	*	ND	-	ND
21	Toxaphene	*	ND	-	ND
22	Total Pesticides	10 ppm	ND	-	ND
23	Arochlor-1016	1.0	ND	-	ND
24	Arochlor-1221			-	
25	Arochlor-1232			-	
26	Arochlor-1242			-	
27	Arochlor-1248			-	
28	Arochlor-1254			-	
29	Arochlor-1260			-	

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total Pesticides

Table 3-9
QA/QC Summary Results for Beach Backfill
Heavy Metals, Asbestos and Conventionals

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RANGE		
1	Aluminum	5,680	937 mg/Kg	-	1,660 mg/Kg
2	Antimony	5.1	ND	-	ND
3	Arsenic	7.5	ND	-	2.67 mg/Kg
4	Barium	300	ND	-	14.80 mg/Kg
5	Beryllium	0.16	ND	-	ND
6	Cadmium	1.00	ND	-	ND
7	Chromium	23.2	4.70 mg/Kg	-	16.10 mg/Kg
8	Cobalt	30.0	ND	-	1.72 mg/Kg
9	Copper	30.6	ND	-	2.78 mg/Kg
10	Cyanide	3.9	ND	-	ND
11	Iron	13,652	2,400 mg/Kg	-	6,970 mg/Kg
12	Lead	112.8	ND	-	ND
13	Manganese	119.5	31.0 mg/Kg	-	84.9 mg/Kg
14	Mercury	0.1	ND	-	ND
15	Nikel	13	ND	-	7.68 mg/Kg
16	Selenium	2	ND	-	ND
17	Silver	200	ND	-	ND
18	Thallium	20	ND	-	1.72 mg/Kg
19	Vanadium	150	ND	-	9.79 mg/Kg
20	Zinc	70.8	ND	-	15.00 mg/Kg
21	Asbestos Fiber Cont.	1% by weight	ND	-	ND
22	pH (*)	5.5 - 7.5	8.01	-	9.40
23	Sulfides	50,000	ND	-	7.40 mg/Kg
24	Ammonia	40	ND	-	20.2 mg/Kg

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) Acceptable for Beach Backfill

Section 4

4.0 SHORELINE REVETMENT CONSTRUCTION

An integral part of the Remediation of the Pennsylvania Avenue Landfill was the shoreline revetment construction along the southwestern shoreline of the landfill that abuts Fresh Creek Basin and Jamaica Bay. The revetment construction was installed to the lines and grades as indicated on the plans and specifications and serves as a permanent barrier to shoreline erosion of the landfill in the area.

4.1 Installation of Silt Fence and Turbidity Barrier

Before installation of the steel sheeting commenced, the Contractor installed a turbidity barrier just beyond the limits of the proposed steel sheeting location in accordance with the approved Contaminated Beach Excavation Plan to control migration of any sediments. The turbidity barrier used for this application was Tough Guy Type II manufactured by Aer-Flo Canvas Products, Inc.

4.2 Dewatering

Dewatering activities were performed by the Contractor for the excavation and backfill operations using a system of well points, valves, pumps and associated piping installed along the perimeter of the excavation. The water was discharged into the adjacent Fresh Creek Basin.

4.3 Excavation

Excavation operations followed the dewatering efforts to the line and grades specified in the contract. Excavated material was relocated to the landfill and used as grading fill.

4.4 Geotextile and Revetment Stone Backfill

Upon successful completion of the excavation operations, a layer of geotextile was placed on the subgrade underneath the stone backfill layers.

The material used for backfill of the excavation was in conformance with the Contract Specifications. All backfill used on the project was tested and approved per the QA/QC requirement of the Specifications prior to use at the Pennsylvania Avenue Landfill. URS visually inspected the operations at the Clinton Point, NY Quarry and the loading facility at Tilcon New York, Inc. 3,378 cy of underlayment stone and 7,745 cy of armor stone were delivered onsite.

The backfill material was placed as two separate layers. The first layer of underlayment stone was placed directly over the geotextile to the lines and grades in the plans and specifications. The underlayment stone was quarry processed, rough, angular material graded with a median

diameter of approximately 6". Armor stone was then placed over the underlayment stone to complete the revetment. The armor stone was also quarry processed, rough angular material with a median diameter of approximately 18".

4.5 Quality Control/Quality Assurance Installation of Backfill

Quality control and quality assurance testing of materials proposed for use as revetment underlayment and armor stone are included in Appendix B. Quality assurance during the backfill placement consisted of full-time observation by the Engineer to verify that all underlayment and armor stones were placed to the lines and grade as indicated on the approved plans and specifications and material placed met size requirements. The Contract Specifications required no compaction testing for the placement of this material.

As the construction progressed, new tests required only if a new source of riprap needed acceptance. Table 4-1 shows the source testing requirements for QC and QA.

Table 4-1
Quality Control / Quality Assurance – Laboratory Minimum Testing Requirements

Property	Test Method	Requirement
Specific Gravity	COE C.D.-C-107	Dry unit weight 165 lbs/cu ft or greater
Absorption	COE C.D.-C-107	Less than 1 percent
Soundness	COE C.D.-C-137	Less than 5 percent loss
Freezing and Thawing	COE C.D.-C-144	Less than 12 percent loss in 12 cycles
Abrasion Analysis	COE C.D.-C-145	Less than 20 percent loss for 500 revolutions
Wetting and Drying	Spec D-12.1 part 2.2 B.3	No major progressive cracking
Expansive Breakdown	COE C.D-C-148	No deterioration except minor crumbs from surface
Drop Test	Spec D-12.1 Part 2.2 B.4	No breakage or cracking

For NYSDOTSS items, certifications were submitted instead of actual laboratory test results which attest that the riprap meets all NYSDOTSS requirements for riprap.

QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

Refer to Appendix B for the source testing of RipRap.

Photographs of the stone revetment construction are included in Appendix I.

Section 5

5.0 TYPE I GRADING FILL

Type I grading fill was used to prepare the subgrade for placement of select Type II grading fill (Type II cover soil) in order to achieve the final cover subgrade directly below the geomembrane. Depths of general grading fill varied in order to achieve the subgrade throughout the landfill required for placement of the Type II grading fill.

5.1 Material Source – Type I Grading Fill

The material used for the Type I grading fill was non-hazardous earthen soil that was in conformance with the Contract Specifications. Toxicity Characteristic Leaching Procedure (TCLP) tests were conducted to ensure that the soils meet the chemical standards for grading fill. The general grading fill used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill.

The 65,767 cy of Type I grading fill was imported from three sites: Quarry Process material from the Duraport loading facility located in Bayonne, New Jersey, and two construction sites; Calverton, located in Long Island, New York, and Bushwick located in Brooklyn, New York. All Type I grading fill material was delivered to the Pennsylvania Avenue Landfill pier via barge transportation.

NYCDEP and URS inspected the borrow sites and loading facilities prior to general acceptance and procurement. Source testing was performed on all three sources of Type I grading fill. Table 5-1 shows the source testing requirement.

Table 5-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Standard Proctor Density	ASTM D-698	One per source
Organic Content	ASTM D-2974	One per source
Atterberg Limits	ASTM D-4318	One per source
Chemical Analysis	Per Specifications	One per source
Water (Moisture) Content	ASTM D-2216	One per source

The general requirements for Type I grading fill are shown in Table 5-2.

Table 5-2
Type I Grading Fill Requirements

Property	Criteria
Organic Content (%)	<15%
Plastic Index (slope > 5%)	<12
Plastic Index (slope < 5%)	<50
Standard Proctor Test	Max Density(pcf)
Standard Proctor Test	Opt. Moisture (%)
Moisture (as received) (%)	<OW +7%
Max Particle Size (in)	<6"
TCLP	Chemical Testing

Refer to Appendix C for Source testing of Type I Grading Fill.

5.2 Installation – Type I Grading Fill

The Type I grading fill was stockpiled and then loaded with earthmoving equipment such as excavators and loaders into articulated trucks for transport and placement onto approved locations.

For the placement of the Type I grading fill underlying the Type II grading fill and composite liner, special attention was used to ensure proper grading. Type I grading fill was installed with varying degrees of thickness specified and required as shown on the Contract Drawings. Lifts thicknesses were limited to 1' layers and material was compacted in place using a smooth drum vibratory roller prior to the placement of subsequent lifts.

5.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the Type I grading fill layer consisted of full-time observation in addition to laboratory and field-testing.

All QC laboratory and field testing was performed by the approved independent chemical laboratory and approved independent geotechnical laboratory, employed by BET. Chemical analyses were provided by Accredited Laboratories, Inc., located in Carteret, New Jersey. Geotechnical analyses were provided by Testwell Laboratories, Inc., located in Ossining, New York. In accordance with Table 5-3 below, periodic quality control was performed by the contractor.

Table 5-3
Quality Control – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 5,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 5,000 yd^3
Organic Content	ASTM D-2974	One test every 5,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 5,000 yd^3
Field-Moisture Density	ASTM D-2922	Nine tests per Acre
Chemical Analysis	Per Specifications	One test every 3,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 5,000 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. QA testing was performed in accordance with Table 5-4 below, periodic quality assurance (QA) inspection and testing was performed by URS to verify the QC testing.

Table 5-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 20,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 20,000 yd^3
Organic Content	ASTM D-2974	One test every 20,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 20,000 yd^3
Field-Moisture Density	ASTM D-2922	Four tests per Acre
Chemical Analysis	Per Specifications	One test every 60,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 20,000 yd^3

The Type I grading fill was compacted to an in-place minimum density of 90 percent of the maximum dry density, as determined by ASTM D-698. In addition, QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

Refer to Tables 5-5 and 5-6 for summary results of frequency testing.

Refer to Appendix C for all field, chemical and geotechnical test results.

Photographs of the Type I grading fill installation are included in Appendix I.

Table 5-5
QA/QC Summary Results for Type I Grading Fill
Geophysical Test Results

General Requirements	Criteria	BUSHWICK RANGE			DURAPORT RANGE			CALVERTON RANGE		
Organic Content (%)	<15%	1.89	-	2.64	1.64	-	7.80	3.22	-	6.49
Plastic Index (slope > 5%)	<12	0	-	0	0	-	0	0	-	0
Plastic Index (slope < 5%)	<50	0	-	0	0	-	0	0	-	0
Standard Proctor Test	Max. Density (pcf)	119.20	-	132.90	75.60	-	126.50	82.20	-	123.10
	Opt. Moisture (%)	7.1		12.1	7.6	-	30.5	10.7	-	25.0
Moisture (as received) (%)	< OW + 7%	9.6	-	12.1	7.6	-	22.3	10.7	-	25.0
Max. Particle Size (in)	< 6"	1/2	-	1 1/4	1/2	-	2	3/8	-	1

Table 5-6
QA/QC Summary Results for Type I Grading Fill
Chemical Test Results

Waste Characteristics	Criteria	BUSHWICK			DURAPORT			CALVERTON		
		RANGE			RANGE			RANGE		
Igniability	>140 ° F	200 F°	-	>200 F°	200 F°	-	>200 ° F	200 F°	-	>200 ° F
Corrosivity	2 < pH <12.5	6.16	-	8.23	6.24	-	12	7.16	-	9.7
Reactivity (Cyanide)	<250 ppm reactive	ND	-	ND	ND	-	ND	ND	-	ND
Reactivity (Sulfide)	<500 ppm reactive	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Arsenic	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Barium	100.0 mg/L	ND	-	0.866	0.281	-	0.768	0.346	-	0.696
TCLP Benzene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Cadmium	1.0 mg/L	ND	-	ND	ND	-	0.067	ND	-	0.099
TCLP Carbon tetrachloride	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Chlordane	0.03 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Chlorobenzene	100.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Chloroform	6.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Chromium	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	0.109
TCLP o-Cresol (2-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP m-Cresol (3-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP p-Cresol (4-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 2,4'-D	10.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 1,4-Dichlorobenzene	7.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 1,2-Dichloroethane	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 1,1-Dichloroethylene	0.7 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 2,4-Dinitrotoluene	0.13 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Endrin	0.02 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Heptachlor	0.008 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Hexachlorobenzene	0.13 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Hexachloro-1,3-butadiene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Hexachloroethane	3.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Lead	5.0 mg/L	ND	-	0.86	ND	-	1	ND	-	0.864
TCLP Lindane (G-BHC)	0.4 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Mercury	0.2 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Methoxychlor	10.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Methylethylketone	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Nitrobenzene	2.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Pentachlorophenol	100.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Pyridine	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Selenium	1.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Silver	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Tetrachloroethylene	0.7 mg/L	ND	-	ND	ND	-	0.124	ND	-	0.038
TCLP Toxaphene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Trichloroethylene	0.5 mg/L	ND	-	ND	ND	-	0.06	ND	-	0.013
TCLP 2,4,5-Trichlorophenol	400.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 2,4,6-Trichlorophenol	2.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP 2,4,5-TP	1.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
TCLP Vinyl Chloride	0.2 mg/L	ND	-	ND	ND	-	ND	ND	-	ND
PCBs, Total	10 mg/kg	ND	-	4.68	ND	-	0.93	ND	-	4.94
Sulfides	5000 mg/kg	ND	-	ND	ND	-	ND	ND	-	ND
Ammonia	200 mg/kg	19.7	-	94.5	ND	-	163	85.8	-	160
Asbestos Fiber	1% (by weight)[3]	ND	-	ND	ND	-	ND	ND	-	ND

Note: ND = Not detected (Detection limits below Soil Use Criteria)

Section 6

6.0 TYPE II GRADING FILL

Type II grading fill was used as bedding for the geomembrane and therefore was used to achieve the final cover subgrade for placement of the liner and its components. Type II grading fill had a minimum depth of six inches directly below the geomembrane.

6.1 Material Source – Type II Grading Fill

The material used for the Type II grading fill was environmentally clean earthen soil that was in conformance with the Contract Specifications. The Type II grading fill used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill.

The 55,976 cy of Type II grading fill was imported from several sites: two quarries from Tilcon New York, Inc. located in Tomkin's Cove, New York and Haverstraw, New York, Amboy Aggregates located in South Amboy, New Jersey, and Quarry Process material from the Duraport facility located in Bayonne, New Jersey. All Type II material was delivered to the Pennsylvania Avenue Landfill pier via barge transportation

NYCDEP and URS inspected the borrow sites and loading facilities prior to acceptance and procurement. Source testing was performed on all four sources. Table 6-1 shows the source testing requirement.

Table 6-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Standard Proctor Density	ASTM D-698	One per source
Organic Content	ASTM D-2974	One per source
Atterberg Limits	ASTM D-4318	One per source
Chemical Analysis	Per Specifications	One per source
Water (Moisture) Content	ASTM D-2216	One per source

The general requirements for Type II grading fill are shown in Table 6-2.

Table 6-2
Type II Grading Fill Requirements

Property	Criteria
Organic Content (%)	<15%
Plastic Index (slope > 5%)	<12
Plastic Index (slope < 5%)	<50
Standard Proctor Test	Max Density(pcf)
Standard Proctor Test	Opt. Moisture (%)
Moisture (as received) (%)	<OW +7%
Max Particle Size (in)	<1"
TCLP	Chemical Testing

Refer to Appendix D for all Source testing results.

6.2 Installation – Type II Grading Fill

The Type II grading fill was stockpiled and then loaded with earthmoving equipment such as excavators and loaders into articulated trucks for transport and placement onto approved locations.

Care was used in the placement of the Type II grading fill underlying the LLDPE geomembrane. Type II grading fill was installed with a minimum thickness of six inches as specified and required per the Contract Drawings. Material was compacted in place using a smooth drum vibratory roller.

6.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the Type II grading fill consisted of full-time observation in addition to laboratory and field-testing.

All QC laboratory and field testing was performed by the approved independent chemical laboratory and approved independent geotechnical laboratory, employed by BET. Chemical analyses were provided by Accredited Laboratories, Inc., located in Carteret, New Jersey. Geotechnical analyses were provided by Testwell Laboratories, Inc., located in Ossining, New York. In accordance with Table 6-3 below, periodic quality control was performed by the contractor.

Table 6-3
Quality Control – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 5,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 5,000 yd^3
Organic Content	ASTM D-2974	One test every 5,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 5,000 yd^3
Field-Moisture Density	ASTM D-2922	Nine tests per Acre
Chemical Analysis	Per Specifications	One test every 3,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 5,000 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. In accordance with Table 6-4 below, periodic quality assurance (QA) inspection and testing was performed by URS to verify the QC testing.

Table 6-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 20,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 20,000 yd^3
Organic Content	ASTM D-2974	One test every 20,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 20,000 yd^3
Field-Moisture Density	ASTM D-2922	Four tests per Acre
Chemical Analysis	Per Specifications	One test every 60,000 yd^3
Water (Moisture) Content	ASTM D-2216	One test every 20,000 yd^3

The Type II grading fill was compacted to an in-place minimum density of 90 percent of the maximum dry density, as determined by ASTM D-698. In addition, QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

Refer to Tables 6-5 and 6-6 for summary test results.

Refer to Appendix D for all field, chemical and geotechnical testing.

Photographs of the Type II grading fill installation are included in Appendix I.

Table 6-5
QA/QC Summary Results for Type II Grading Fill
Geophysical Test Results

General Requirements	Criteria	AMBOY			DURAPORT QP			HAVERSTRAW			TOMKINS COVE		
		RANGE			RANGE			RANGE			RANGE		
Organic Content (%)	<15%	0.20	-	3.90	2.50	-	6.61	0.45	-	0.68	0.08	-	3.20
Plastic Index (slope > 5%)	<12	0	-	0	0	-	0	0	-	0	0	-	0
Plastic Index (slope < 5%)	<50	0	-	0	0	-	0	0	-	0	0	-	0
Standard Proctor Test	Max. Density (pcf)	99.90	-	156.00	105.50	-	124.10	131.50	-	137.00	113.80	-	122.50
	Opt. Moisture (%)	8.1	-	17.2	9.9	-	17.6	8.0	-	11.0	3.1	-	13.7
Moisture (as received) (%)	< OW + 7%	0.6	-	4.3	7.8	-	21.1	2.1	-	6.7	0.1	-	1.2
Max. Particle Size (in)	< 6"	0.1	-	3/4	3/4	-	1 1/2	0	-	3/4	3/8	-	3

Table 6-6
QA/QC Summary Results for Type II Grading Fill
Chemical Test Results

Waste Characteristic	Criteria	AMBOY			DURAPORT QP			HAVERSTRAW			TOMKINS COVE		
		RANGE			RANGE			RANGE			RANGE		
Igniability	>140 ° F	>200° F	-	>200° F	>200° F	-	>200° F	>200 F°	-	>200° F	<100	-	<100
Corrosivity	2 < pH <12.5	8.31	-	12	9.6	-	11	8.81	-	9.69	9.2	-	9.7
Reactivity (Cyanide)	<250 ppm reactive	ND	-	ND	ND	-	ND	ND	-	ND	<10	-	<10
Reactivity (Sulfide)	<500 ppm reactive	ND	-	ND	ND	-	ND	ND	-	ND	<40	-	<40
TCLP Arsenic	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	0.028	-	0.028
TCLP Barium	100.0 mg/L	ND	-	0.8	0.342	-	0.685	ND	-	ND	0.128	-	0.28
TCLP Benzene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	0.0036	-	0.0036
TCLP Cadmium	1.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	0.004	-	0.0046
TCLP Carbon tetrachloride	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0024	-	<0.0024
TCLP Chlordane	0.03 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.00013	-	<0.00013
TCLP Chlorobenzene	100.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0039	-	<0.0039
TCLP Chloroform	6.0 mg/L	ND	-	0.0021	ND	-	0.0011	ND	-	ND	<0.003	-	<0.003
TCLP Chromium	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.006	-	<0.006
TCLP o-Cresol (2-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP m-Cresol (3-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0028	-	<0.0028
TCLP p-Cresol (4-Methylphenol)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0018	-	<0.0018
TCLP 2,4'-D	10.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.00002	-	<0.00002
TCLP 1,4-Dichlorobenzene	7.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP 1,2-Dichloroethane	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0028	-	<0.0028
TCLP 1,1-Dichloroethylene	0.7 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0034	-	<0.0034
TCLP 2,4-Dinitrotoluene	0.13 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0011	-	<0.0011
TCLP Endrin	0.02 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.00002	-	<0.00002
TCLP Heptachlor	0.008 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.000007	-	<0.000007
TCLP Hexachlorobenzene	0.13 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0011	-	<0.0011
TCLP Hexachloro-1,3-butadiene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0015	-	<0.0015
TCLP Hexachloroethane	3.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0011	-	<0.0011
TCLP Lead	5.0 mg/L	ND	-	0.438	ND	-	1.25	ND	-	ND	<0.021	-	0.0353

Waste Characteristic	Criteria	AMBOY			DURAPORT QP			HAVERSTRAW			TOMKINS COVE		
		RANGE			RANGE			RANGE			RANGE		
TCLP Lindane (G-BHC)	0.4 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.000009	-	<0.000009
TCLP Mercury	0.2 mg/L	ND	-	ND	ND	-	0.082	ND	-	ND	<0.002	-	<0.002
TCLP Methoxychlor	10.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.000008	-	<0.000008
TCLP Methyl ethyl ketone (2 Butanone)	200.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.012	-	<0.012
TCLP Nitrobenzene	2.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP Pentachlorophenol	100.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0019	-	<0.0019
TCLP Pyridine	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP Selenium	1.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.03	-	<0.03
TCLP Silver	5.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.01	-	0.0104
TCLP Tetrachloroethylene	0.7 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0035	-	<0.0035
TCLP Toxaphene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.00012	-	<0.00012
TCLP Trichloroethylene	0.5 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.0036	-	<0.0036
TCLP 2,4,5-Trichlorophenol	400.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP 2,4,6-Trichlorophenol	2.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.001	-	<0.001
TCLP 2,4,5-TP	1.0 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.00001	-	<0.00001
TCLP Vinyl Chloride	0.2 mg/L	ND	-	ND	ND	-	ND	ND	-	ND	<0.004	-	<0.004
PCBs, Total	10 mg/kg	ND	-	0.611	ND	-	0.164	ND	-	ND	ND	-	ND
Sulfides	5000 mg/kg	ND	-	150	ND	-	ND	ND	-	ND	<11	-	<11
Ammonia	200 mg/kg	ND	-	121	17.9	-	102	ND	-	20.2	<2.14	-	<2.18
Asbestos Fiber	1% (by weight)[3]	ND	-	ND	ND	-	ND	ND	-	ND	ND	-	ND

Note: ND = Not detected (Detection limits below Soil Use Criteria)

Section 7

7.0 LLDPE GEOMEMBRANE

The Contract Specifications and Drawings required the installation of a co-extruded, light reflective white Linear Low Density Polyethylene (LLDPE) Geomembrane layer of the Final Cover System. Two types of LLDPE Geomembrane cover systems were installed: 40-mil Smooth LLDPE Geomembrane and 40-mil Textured LLDPE Geomembrane.

7.1 Manufacturer – LLDPE Geomembrane

The manufacturer of the LLDPE geomembrane was Poly-Flex, Inc. of Grand Prairie, Texas. Poly-Flex, Inc. was responsible for the production of the materials and for quality control during production including certification that its materials conformed to the Contract Specifications. Poly-Flex, Inc. was required to submit certification that the LLDPE geomembrane was formulated and manufactured from 100% virgin raw material, specifically compounded for use in hydraulic structures, and only first quality plastics and elastomers were used. In addition, Poly-Flex, Inc. was required to submit written certification that each lot of material met or exceeded the Technical Specifications. Certificate of Analysis Testing is presented in Appendix E.

The 1,821,474 sq ft of smooth and 1,185,255 sq ft of textured LLDPE geomembrane used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for placement at the Pennsylvania Avenue Landfill. The manufacturer submitted certified test results that attested to the compliance of the geomembrane based on Table 7-1 below.

Table 7-1
Specifications for Geomembrane

Property	Test Method	LLDPE Values
Thickness	ASTM D-5199 (Smooth) ASTM D-5994 (Textured)	40 mils
Density (finished sheet)	ASTM D-792 or ASTM D-1505	0.915 – 0.940 g/cm^3 0.915 – 0.927 g/cm^3
Carbon Black Content	ASTM D-1603	2.0 – 3.0 %
Carbon Black Dispersion	ASTM D-5596	Cat. 1 or 2
Min Tensile Properties (machine direction): (c)Tensile Strength at break (d) Elongation at break (2" G.L.)	ASTM D-638 Type IV	 ≥ 152 Smooth lbs/in width ≥ 60 Textured lbs/in width ≥ 800 Smooth % ≥ 250 Textured %

Property	Test Method	LLDPE Values
Tear Resistance	ASTM D-1004 Die C	≥ 22 lbs
Puncture Resistance	ASTM D-4833	≥ 44 lbs
Low Temperature Impact	ASTM D-746 procedure B	≤ -70 °C
Dimensional Stability	ASTM D-1204 212°F, for 1 hour	±3.0 % change max
Environmental Stress Crack	ASTM D-1693	≥ 1500 hours
Roll Width	----	15 ft
Roll Length	----	400 ft
Field Seam Requirements: (a) Shear (b) Peel Adhesion	 ASTM D-4437 ASTM D-4437	 ≥ 56 lbs/in width ≥ 45 lbs/in width
Vacuum Test 100%	ASTM D	

During the manufacturing process, representatives of URS and the NYCDEP visited the manufacturing plant to observe the manufacturing process to ensure the quality assurance testing was conducted in accordance with the contract specifications.

7.2 Installation – LLDPE Geomembrane

The geosynthetics on this project were installed by Chenango Contracting, Inc. (Chenango) of Johnson City, New York. As a subcontractor to BET, Chenango was responsible for on-site management of the LLDPE geomembrane, including handling, storage, placement, and installation in accordance with the approved LLDPE geomembrane panel layout.

All roll goods were unwound and inspected on both sides for unmixed or poorly dispersed ingredients, thin spots, the presence of contaminants or foreign particles, pin holes, tears, punctures, blisters, and any other defects. All defects and impurities were removed or repaired before the membrane was placed on the landfill.

7.3 Quality Control/Quality Assurance During Installation

Quality Control (QC) during LLDPE geomembrane installation was performed by Chenango and observed by the Engineer. Sections 7.3.1-7.3.5 discuss in detail the QA/QC program followed by URS and Chenango. See Table 7-1 for testing.

Refer to Appendix A for copies of the QA Geosynthetic Daily Inspection Reports.

Refer to Appendix E for all QA and QC testing results of geomembrane.

7.3.1 Placement – LLDPE Geomembrane

When the sub-base was approved, the LLDPE geomembrane panels were deployed to the intended location by Chenango using earth moving equipment and laborers.

Refer to Appendix E for Certificate of Acceptance: Soil Subgrade: Panel Placement.

Refer to Appendix E for Certificate of Acceptance: Soil Subgrade: Extraction Wells.

The respective limits of smooth and textured LLDPE geomembrane were determined as per the Contract Drawings and existing field conditions. Only textured LLDPE geomembrane was used on slopes at or exceeding 15 percent.

In general, seams were oriented parallel to the line of maximum slope, (i.e., oriented along, not across the slope). Seams on slopes exceeding 15 percent were not permitted to be at more than 30 degrees from parallel with the direction of the slope. Cross-slope seams were kept to a minimum and in no case were within five feet of adjacent panel cross-slope seams.

The LLDPE geomembrane panels were carefully placed at the proper location and each panel was overlapped at a minimum of three inches, as required for proper seaming. Each LLDPE geomembrane was inspected by URS and Chenango personnel for any defects as it was placed, and assigned its corresponding panel number. The LLDPE geomembrane panels were installed in a relaxed condition free of tension or stress.

Refer to Appendix E for Panel Placement Logs.

Refer to Appendix E for Panel Placement Drawing.

7.3.2 Trial Seams (Start-Ups) – LLDPE Geomembrane

LLDPE geomembrane trial seams, also known as qualifying seams or start-ups, are an integral aspect of the QA/QC procedures. The purpose of these trail seams are to serve as pre-qualifying experience for personnel, equipment and procedures for field fabricating seams on the geomembrane material under the same climatic conditions as the actual field production seams are performed. The test strips were made on narrow pieces of excess geomembrane with a minimum length of three feet.

The goal of the start-ups was to reproduce all aspects of the actual production field seaming activities intended to be performed in the immediately upcoming work sessions in order to determine equipment and operator proficiency. For the double hot-wedge fusion welding process, URS required that start-ups be performed every four hours, whenever personnel or equipment changed, and when climatic conditions reflected wide changes in geomembrane temperature (based on changes in ambient air temperature).

The start-ups were destructively tested for peel and shear as soon as the seam cooled using a field tensiometer. A minimum of six one-inch wide specimens of each cutout test weld were subjected to shear and peel adhesion testing at the site (i.e., three one-inch specimens for peel, and three one-inch specimens for shear testing.) If all specimens passed, the technician was approved to weld. If any one of the test specimens failed, a new test strip was fabricated by varying the temperature, speed or pressure, as applicable. If additional specimens failed, the seaming apparatus and technician were not allowed to seam until the deficiencies were corrected and successful start-ups were achieved.

Refer to Appendix E for Trial seam results.

7.3.3 LLDPE Geomembrane Field Seaming and Joining

The field seaming of the deployed LLDPE geomembrane panels is an integral aspect of the proper functioning of the LLDPE geomembrane as the low permeability barrier of the final cover system.

Prior to field seaming, the contact surfaces of the panels to be seamed were wiped clean to remove all dirt, dust, moisture and other foreign materials. The lap joints were formed by lapping the edges of the panels at a minimum of three inches. Any portion of the LLDPE geomembrane damaged during installation was removed or repaired using an additional piece of LLDPE geomembrane, as per the Technical Specifications. Refer to Appendix E for Repair Logs.

All penetrations, such as pipes, monitoring wells and gas extraction wells, were "booted" with 40-mil LLDPE geomembrane in accordance with the Contract Drawings and Specifications.

Refer to Appendix E for Extraction Well Vault Logs.

Refer to Appendix E for Certificate of Appendix: Extraction Wells.

7.3.4 Non-Destructive Testing of Field Seams – LLDPE Geomembrane

The primary purpose of the non-destructive seam testing was to ensure continuity along the entire seam length. Non-destructive testing was performed by Chenango and witnessed by URS to validate 100% of the seams.

For this project, all field seams were non-destructively tested over their full length using either vacuum box or pressurized air-channel testing. Air lance testing was not permitted as stated in the Contract Specifications.

Refer to Appendix E for the non-destructive test methods and results used for the LLDPE geomembrane.

7.3.5 Destructive Testing of Field Seams – LLDPE Geomembrane

Samples from the production of field-fabricated geomembrane seams for destructive testing were taken at a minimum frequency of one destructive test sample for every 500 linear feet of field seam, as specified in the Contract Specifications. Destructive testing of the geomembrane seams was performed by cutting out and removing a portion of the completed production field seam, and then further dividing the sample into specimens for testing in accordance with ASTM D 4437 – Practice for Determining the Integrity of Field Seams used in Joining Flexible Polymetric Sheet Geomembranes.

Field cutouts were conducted on the field seams. For every 500 linear feet of field seam (including seams created for repairs), and as directed by URS, a short section (3 feet long) of the fabricated seam was cut from the installed geomembrane and distributed as follows:

- one portion field tested on site by the Contractor (BET) for peel adhesion and shear strength;
- one portion for laboratory tensile testing by BET's independent QC testing laboratory;
- one portion to URS for testing by the independent QA testing laboratory, Shaw EMCON/OWT, Inc. of Tuxedo, New York;
- one portion to URS for NYCDEP's archive storage.

Refer to Appendix E for the results of all testing of the LLDPE geomembrane.

Photographs of the installation of the LLDPE geomembrane are included in Appendix I.

Section 8

8.0 GEOCOMPOSITE

The geosynthetic drainage system, referred to as geocomposite, included the use of a geonet and geotextile as part of the drainage composite of the final cover. As a synthetic layer which permits a high degree of in-plane flow (transmissivity), the geocomposite was comprised of a geonet with adjacent layers of geotextile fabric. The geocomposite includes the filter geotextile bonded to the geonet.

8.1 Manufacturer – Geocomposite

The manufacturer used for the 1,153,255 sq ft of geocomposite was Poly-Flex, Inc. of Grand Prairie, Texas. The material used for the geocomposite was manufactured from appropriate polymers and compounding ingredients that was in conformance with the Contract Specifications. The geocomposite used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill. The manufacturer submitted certified test results for the geonet, geotextile and geocomposite components of the geosynthetic drainage system. See Tables 8-1, 8-2 and 8-3 for the tests required. Table 8-4 summarizes the specifications for the geonet.

Table 8-1
Geonet - Minimum Testing Requirements

Property	Test Method	Frequency
Tensile Strength	ASTM D-638	One per source
Polymer Melt Index	ASTM D-1238 Condition E	One per source
Polymer Density	ASTM D-1505	One per source
Carbon Black Content	ASTM D-1603	One per source
Nominal Thickness	ASTM D-5199	One per source

Table 8-2
Geotextile - Minimum Testing Requirements

Property	Test Method	Frequency
Burst Strength	ASTM D-3786	One per source
Ultaviolet stability	ASTM D-4355	One per source
Tear Strength	ASTM D-4533	One per source
Grab Tensile strength	ASTM D-4632	One per source
Apparent opening size test	ASTM D-4751	One per source
Puncture strength	ASTM D-4833	One per source
Seam Strength	ASTM D-4884	One per source
Mass per unit area	ASTM D-5261	One per source

Table 8-3
Geocomposite - Minimum Testing Requirements

Property	Test Method	Frequency
Transmissivity: (a) At Normal Pressure (b) Hydraulic Gradient of 0.1 (c) Hydraulic Gradient of 0.3	ASTM D-4716	One per source 350 psf (min) $T= 5 \times 10^{-4}$ m2/s $T= 5 \times 10^{-5}$ m2/s
Interface Friction Tests	ASTM D-5321	One per source

Table 8-4
Geonet Specifications

Property	Test Method	Values
Raw Material (all domestic and virgin material)	-----	Polyethylene
Manufacturing	-----	Extruded
Carbon Black	ASTM D-1603	2% - 3%
Blended Resin Density (g/cm^3)	ASTM D-1505	≥0.94
Melt Flow Index (g/10 min)	ASTM D-1238 condition E	0.1 – 1.0
Tensile Strength at Break (lbs/ft)	ASTM D-638	≤575
Elongation at Break (Mach Direction)	ASTM D-638	≥200%
Elongation at Break (Cross direction)	ASTM D-638	≥200%
UV resistance	-----	Resistant to UV
Thickness at Strand Intersection	-----	Min. 0.200
Weight (lbs/sf)	ASTM D-3776	≥0.16

8.2 Installation – Geocomposite

The geosynthetic drainage system (geocomposite) within the final cover system was installed by BET after the underlying geomembrane was installed and accepted. Prior to installation of the geocomposite, the underlying geomembrane was cleaned and free of dirt, dust, or any other objectionable materials, which could inhibit the ability of the drainage system to transmit water. During placement, the geocomposite was inspected by URS on both sides for imperfections, damage, or defects. All necessary precautions were taken to prevent damage to the underlying layers of geosynthetics. Field personnel were prohibited from using sharp tools, cigarettes, solvents, or any other materials which could cause damage to the geocomposite and/or underlying geosynthetics.

The geocomposite was installed as indicated on the Contract Drawings. The geocomposite was secured and then rolled downslope perpendicular to the grading contour lines in such a way as to keep the sheet in tension under self-weight only. Adjacent rolls were overlapped by at least six inches while horizontal overlaps (seams parallel to grading contour lines) were not permitted on slopes exceeding 12 percent unless approved by URS, and unless the manufacturer's recommendations of additional permanent reinforcement for horizontal overlaps were incorporated.

Overlaps were secured by tying (the geonet) and sewing (the geotextile). The geonet was tied by using white plastic fasteners (white for easy inspection). Metallic tying devices were not permitted as per Contract Specifications. The geonet overlaps were tied every five feet down the slope, every two feet across the slope, and every six inches in anchor trenches.

The geotextile component of the geocomposite was stitched using a handheld sewing machine and a polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. Longitudinal overlaps were a minimum of six inches while end of roll overlaps were a minimum of three feet.

Any and all geotextile/geocomposite was covered with Barrier Protection Layer soil within the two weeks specified in the Contract Specifications.

8.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the geonet consisted of physical laboratory testing as outlined in the Contract Specifications. Refer to Appendix E for the physical laboratory testing results and locations. Refer to Table 8.5 for QA/QC summary of results of Interface Friction Tests.

URS retained samples of the geonet and forwarded them to an independent laboratory for testing to ensure conformance to the Contract Specifications. Samples were taken across the entire width of the roll and did not include the first three feet of the roll's long dimension. Samples were three feet long times the roll width. BET conspicuously marked the machine direction of the sample on the sample itself. URS examined all results from the laboratory for conformance testing.

Any gaps or tears which developed in the geonet were repaired by BET, by placing a patch extending two feet beyond the edges of the gap or tear. The patch was secured to the original geonet by spot gluing, spot welding to geonet or tying every six inches. If the gap or tear width across the roll was more than 50 percent of the width of the roll, the damaged area was cut out as directed by URS and the two portions of the geonet were joined as indicated in the Contract Specifications for geonet sheet overlaps.

Photographs of the installation of the geocomposite are included in Appendix I.

Section 9

9.0 GEOTEXTILE

The geotextile component of the final cover drainage layer consisted of three types of geotextiles: cushion, filter and separation geotextile.

9.1 Manufacturer – Geotextile

The manufacturer of the 190,484 sq yards of cushion, 7,287 sq yards of filter and 20,402 sq yards of separation geotextile was TNS Advanced Tech/Nevown, Inc. of Greer, South Carolina. Geotextile consisted of a non-woven, needle-punched polypropylene polymer. Separation geotextile fabric consisted of a pervious sheet woven or spun bonded of polypropylene filament consisting by weight of at least 85 percent polypropylene and containing stabilizers and inhibitors added to the bare plastic to make the filaments resistant to deterioration due to ultraviolet and/or heat exposure. The material used for the geotextile was manufactured from polymers formulated with hindered amine light stabilizers (HALS) to enhance the geotextiles' resistance to environmental degradation.

See Table 9-1 summarizes the testing requirements for the geotextile material.

Table 9-1
Geotextile – Minimum Physical Requirements

Property	Test Method	Cushion	Filter	Separation
Burst Strength	ASTM D-3786	750 psi	NA	225
Grab Strength	ASTM D-4632	390 lbs	160	NA
Tear Strength	ASTM D-4533	150 lbs	60	NA
Grab Tensile strength	ASTM D-4632	NA	50 %	NA
Apparent opening size test	ASTM D-4751	NA	#70	NA
Puncture strength	ASTM D-4833	180 lbs	75	90
Permittivity	ASTM D-4491	0.4 sec^{-1}	1.3	1.3
Mass per unit area	ASTM D-5261	16oz/yd^2	6	6

9.2 Installation – Geotextile

All geotextiles delivered to the site were tested by the manufacturer prior to shipment to ensure that the physical and mechanical properties of the delivered geotextiles were in accordance with the required material properties, test methods, values and units as per the Contract Specifications. Refer to Appendix E for copies of the geotextile certified test reports.

The geotextiles were installed by BET at the locations shown on the Contract Drawings. All bedding geotextile seams within drainage channels, and geotextile seams within the final cover system drainage layer, consisted of adjacent panels sewn securely together.

The geotextiles were installed to the lines and grades as shown on the Contract Drawings. The geotextiles were rolled down the slope in such a manner as to continually keep the sheet in tension of self-weight. The geotextile was securely anchored in an anchor trench where applicable. A minimum buried flap of geotextile of two feet anchor was required for anchor trenches, unless otherwise determined by URS. Geotextiles were not exposed to precipitation prior to installation and was not exposed to direct sunlight for more than 24 hours prior to placement.

All geotextile used with the final cover system were seamed by stitching methods as recommended by the manufacturer and approved by URS. Any sewing was done using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. All sewn seams were continuous and spot seaming was not permitted for sewn seams. Prior to stitching, longitudinal geotextile overlaps were a minimum of six inches and end of roll overlaps were a minimum of three feet. Seams were oriented down slopes perpendicular to grading contours unless otherwise specified by URS.

9.3 Quality Assurance/Quality Control During Installation – Geotextile

URS examined the geotextile rolls upon delivery to the site and reported any deviation from the Contract Specifications to BET. In these instances, BET performed the necessary repairs and replaced any damaged products delivered to the site, as directed by URS.

Upon delivery of the rolls of geotextiles, URS retained samples and forwarded them to an independent laboratory for testing to ensure conformance to the Contract Specifications. These samples were taken across the entire width of the roll and did not include the first three linear feet. Samples measured three feet in the roll long dimension, and were removed along the entire roll width. Quality assurance and quality control during construction of the geotextile consisted of physical laboratory testing as outlined in the Contract Specifications.

Refer to Table 9.2 for QA/QC summary results of Interface Friction Tests.

Refer to Appendix E for the physical laboratory testing results and locations.

Any holes or tears which developed in the geotextile were repaired by BET, by placing a fabric patch of the same geotextile into place no closer than three inches from any edge of the patch. Prior to repair, BET completely removed any soil or other material which penetrated a damaged geotextile. Tears, holes, or other damage to the fabric were repaired to the satisfaction of URS and the NYCDEP.

Photographs of the installation of the geotextile are included in Appendix I.

Section 10

10.0 BARRIER PROTECTION LAYER

The Barrier Protection Layer (BPL) was placed over the geosynthetics to protect their integrity from frost action, root penetration, burrowing animals and other damage. A minimum of twelve inch thickness of compacted BPL soil was placed directly on top of the geosynthetic layer (geonet and LLDPE geomembrane).

10.1 Material Source – Barrier Protection Layer

The material used for the BPL construction was environmentally clean earthen soil that was in conformance with the Contract Specifications. The barrier protection soil used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill. Approximately 130,000 cubic yards of material were used as BPL over the geosynthetics.

The BPL soil was imported from a borrow site, Callahan and Naninni, located in Newburgh, New York, as well as a loading facility, Amboy Aggregates, located in South Amboy, New Jersey. Amboy Aggregates mixed the sand and till material from the Toto Pit facility in Kingston, New Jersey. NYCDEP and URS inspected the borrow site and loading facility prior to general acceptance and procurement. Source testing was performed on the 2 sources used. All BPL soil material was delivered to the Pennsylvania Avenue Landfill pier via barge transportation.

Table 10-1 shows the source testing requirement.

Table 10-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Standard Proctor Density	ASTM D-698	One per source
Organic Content	ASTM D-2974	One per source
Atterberg Limits	ASTM D-4318	One per source
Chemical Analysis	Per Specifications	One per source
Water (Moisture) Content	ASTM D-2216	One per source
Soil Classification	ASTM D-2487	One per source

The general requirements for BPL are shown in Table 10-2.

Table 10-2
BPL Requirements

Property	Criteria
Organic Content (%)	<15%
Plastic Index (slope > 5%)	<12
Plastic Index (slope < 5%)	<50
Standard Proctor Test	Max Density(pcf)
Standard Proctor Test	Opt. Moisture (%)
Moisture (as received) (%)	<OM +7%
Max Particle Size (in)	<3"
TCL & TAL	Chemical Testing
USC	SM or SC
Max Fine Content	20% - 40%
Clay Content (hydrometer) (%)	<10%
Hydraulic Conductivity	< $1x10^{-5}$ cm/sec

Refer to Appendix F for Source testing results.

10.2 Installation – Barrier Protection Layer

Extreme care was used in the placement of the BPL over the LLDPE geomembrane and composite liner. BPL soil was installed having a minimum thickness of twelve inches with a tolerance of –1.2 inches.

The BPL soil was stockpiled onsite and then loaded with earthmoving equipment such as excavators and payloaders into articulated trucks for transport and placement onto approved locations. Temporary roads constructed of additional BPL material were first built with low ground pressure (LGP) bulldozers to avoid undue stress on the underlying geosynthetics by the earth moving equipment. The articulated trucks utilized these temporary roads to transport and deposit the BPL soil, while the LGP bulldozer spread the material onto the geosynthetics. CAT D-6 and Kamatsu D-65 large bulldozers were utilized for mass pushing of the material, while fine-grading of the BPL was achieved by a D-41 Kamatsu bulldozer, where necessary. LGP Bulldozers scarified and disked the BPL placed for conformance to permeability requirements above the geocomposite layer. In addition, sulfur was applied to the top two inches of BPL for reducing pH as outlined in the Contract Specifications. Soil placement was restricted to proceed from the bottom of the slope to the top with tracked LGP bulldozers.

10.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the BPL consisted of full-time observation in addition to laboratory and field-testing. The minimum thickness of twelve inches of compacted BPL soil was monitored by means of placing marked grade stakes on a 100-foot by 100-foot grid.

The thickness of the BPL was also verified by hand digging several test pits, as directed by URS. No test holes were dug without a URS inspector present. After measurements were made, the holes were backfilled with the excavated or imported BPL soil, and hand tamped. During digging and backfilling test holes, URS exercised extreme care not to damage the underlying geosynthetic materials.

All QC laboratory and field testing was performed by the approved independent chemical laboratory and approved independent geotechnical laboratory, employed by BET. Chemical analyses were provided by Accredited Laboratories, Inc., located in Carteret, New Jersey. Geotechnical analyses were provided by Testwell Laboratories, Inc., located in Ossining, New York. In accordance with Table 10-3 below, periodic quality control was performed by the contractor.

Table 10-3
Quality Control – Field and Laboratory Minimum Testing Requirements for BPL

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 2,500 yd^3
Standard Proctor Density	ASTM D-698	One test every 5,000 yd^3
Soil Classification	ASTM D-2487	One test every 5,000 yd^3
Organic Content	ASTM D-2974	One test every 5,000 yd^3
Visual Identification	ASTM D-2488	One test every 1,000 yd^3
Atterberg Limits	ASTM D4318	One test every 1,000 yd^3
Field-Moisture Density	ASTM D-2922	Four tests per Acre
Chemical Analysis	Per Specifications	One test every 3,000 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. In accordance with Table 10-4 below, periodic quality assurance (QA) inspection and testing was performed by URS to verify the QC testing.

Table 10-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements for BPL

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One test every 10,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 20,000 yd^3
Soil Classification	ASTM D-2487	One test every 5,000 yd^3
Organic Content	ASTM D-2974	One test every 5,000 yd^3
Visual Identification	ASTM D-2488	One test every 2,000 yd^3
Atterberg Limits	ASTM D4318	One test every 2,000 yd^3
Field-Moisture Density	ASTM D-2922	Four tests per Acre
Chemical Analysis	Per Specifications	One test every 60,000 yd^3

The BPL was compacted to a minimum density of 95 percent of the maximum dry density with the optimum moisture based on the standard Proctor Test, as determined by ASTM D-698. The moisture and density of the BPL were measured in the field to a six-inch depth by a nuclear densometer. Field density and moisture tests on the BPL were performed at approximately 100-foot intervals.

Refer to Tables 10-5 thru 10-9 for summary test results of BPL.

Refer to Appendix F for all field, chemical and geotechnical test results for BPL.

Photographs of the installation of the BPL are included in Appendix I.

Table 10-5
QA/QC Summary Results for BPL
Geotechnical

General Requirements	Criteria	AMBOY			NEWBURGH		
		RANGE			RANGE		
Organic Content (%)*	<5%	1.10	-	2.23	0.26	-	1.00
Plastic Index (slope > 5%)	<12	0	-	8	0	-	0
Plastic Index (slope < 5%)	<50	0	-	8	0	-	0
Standard Proctor Test	Max. Density (pcf)	114.9	-	127.3	105.0	-	105.1
	Opt. Moisture (%)	10.5	-	15.6	12.4	-	17.4
Moisture (as received) (%)	< OW + 7%	8.0	-	18.1	12.4	-	17.4
Particle Size (in)	< 3"	3/8	-	1 1/2	1/4	-	1/2
USC	SM or SC	SM	-	SC	SP	-	SP
Max. Fine Content (%) *	20% - 40%	20.2	-	28.7	1.1	-	2.2

Table 10-6
QA/QC Summary Results for BPL
Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg)	AMBOY RANGE			NEWBURGH RANGE		
1	Chloromethane	*	ND	-	ND	ND	-	ND
2	Vinyl Chloride	0.2	ND	-	ND	ND	-	ND
3	Bromomethane	*	ND	-	ND	ND	-	ND
4	Chloroethane	1.9	ND	-	ND	ND	-	ND
5	1,1-Dichloroethene	0.4	ND	-	ND	ND	-	ND
6	1,2-Dichloroethene (Total)	*	ND	-	ND	ND	-	ND
7	Methylene Chloride	0.1	ND	-	0.006	ND	-	0.006
8	1,1-Dichloroethane	0.2	ND	-	ND	ND	-	ND
9	Chloroform	0.3	ND	-	ND	ND	-	ND
10	1,1,1-Trichloroethane	0.8	ND	-	ND	ND	-	ND
11	Carbon Tetrachloride	0.6	ND	-	ND	ND	-	ND
12	1,2-Dichloroethane	0.1	ND	-	ND	ND	-	ND
13	Benzene	0.06	ND	-	ND	ND	-	ND
14	Trichloroethene	0.7	ND	-	ND	ND	-	ND
15	1,2-Dichloropropane	*	ND	-	ND	ND	-	ND
16	Bromodichloromethane	*	ND	-	ND	ND	-	ND
17	Cis-1,3-Dichloropropene	*	ND	-	ND	ND	-	ND
18	Toluene	1.5	ND	-	ND	ND	-	ND
19	Trans-1,3-Dichloropropene	*	ND	-	ND	ND	-	ND
20	1,1,2-Trichloroethane	*	ND	-	ND	ND	-	ND
21	Tetrachloroethene	1.4	ND	-	ND	ND	-	ND
22	Dibromochloromethane	*	ND	-	ND	ND	-	ND
23	Ethylbenzene	5.5	ND	-	ND	ND	-	ND
24	Chlorobenzene	1.7	ND	-	ND	ND	-	ND
25	Styrene	*	ND	-	ND	ND	-	ND
26	Bromoform	*	ND	-	ND	ND	-	ND
27	1,1,2,2-Tetrachloroethane	0.6	ND	-	ND	ND	-	ND
28	Carbon Disulfide	2.7	ND	-	ND	ND	-	ND
29	Acetone	0.2	ND	-	ND	ND	-	ND
30	2-Butanone	0.3	ND	-	ND	ND	-	ND
31	4-Methyl-2-Pentanone	1	ND	-	ND	ND	-	ND
32	2-Exanone	*	ND	-	ND	ND	-	ND
33	Xylenes (Total)	1.2	ND	-	ND	ND	-	ND
34	Total VOC's	10.0	ND	-	0.006	ND	-	0.006

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total VOC's

Table 10-7
QA/QC Summary Results for BPL
Semi-Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY			NEWBURGH		
			RESULTS			RESULTS		
1	Phenol	0.03 or MDL	ND	-	ND	ND	-	ND
2	bis(2-chloroethyl)ether	0.58	ND	-	ND	ND	-	ND
3	2-Chlorophenol	0.8	ND	-	ND	ND	-	ND
4	1,3-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
5	1,4-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
6	1,2-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
7	2-Methylphenol	0.1 or MDL	ND	-	ND	ND	-	ND
8	3&4-Methylphenol	0.091	ND	-	ND	ND	-	ND
9	N-Nitroso-di-n-propylamine	0.1	ND	-	ND	ND	-	ND
10	Hexachloroethane	46.0	ND	-	ND	ND	-	ND
11	Nitrobenzene	0.2 or MDL	ND	-	ND	ND	-	ND
12	Isophorone	4.4	ND	-	ND	ND	-	ND
13	2-Nitrophenol	.33 or MDL	ND	-	ND	ND	-	ND
14	2,4-Dimethylphenol	50.0	ND	-	ND	ND	-	ND
15	bis(2-chloroethoxy)methane	50.0	ND	-	ND	ND	-	ND
16	2,4-Dichlorophenol	0.4	ND	-	ND	ND	-	ND
17	1,2,4-Trichlorobenzene	50.0	ND	-	ND	ND	-	ND
18	Naphtalene	13.0	ND	-	ND	ND	-	ND
19	4-Chloraniline	0.22 or MDL	ND	-	ND	ND	-	ND
20	Hexachlorobutadiene	8.2	ND	-	ND	ND	-	ND
21	4-Chloro-3-methylphenol	0.24 or MDL	ND	-	ND	ND	-	ND
22	2-Methylnaphthalene	36.4	ND	-	ND	ND	-	ND
23	Hexachlorociclopentadine	50.0	ND	-	ND	ND	-	ND
24	2,4,6-Trichlorophenol	50.0	ND	-	ND	ND	-	ND
25	2,4,5-Trichlorophenol	0.1	ND	-	ND	ND	-	ND
26	2-Chloronaphthalene	50.0	ND	-	ND	ND	-	ND
27	2-Nitroaniline	0.43 or MDL	ND	-	ND	ND	-	ND
28	Dimethylphthalate	2.0	ND	-	ND	ND	-	ND
29	Acenaphthylene	41.0	ND	-	ND	ND	-	ND
30	3-Nitroaniline	0.5 or MDL	ND	-	ND	ND	-	ND
31	Acenaphthene	50.0	ND	-	ND	ND	-	ND
32	2,4-Dinitrophenol	0.2 or MDL	ND	-	ND	ND	-	ND
33	4-Nitrophenol	0.1 or MDL	ND	-	ND	ND	-	ND
34	Dibenzofuran	6.2	ND	-	ND	ND	-	ND
35	2,6-Dinitrotoluene	1.0	ND	-	ND	ND	-	ND
36	2,4-Dinitrotoluene	50.0	ND	-	ND	ND	-	ND
37	Diethylphthalate	7.1	ND	-	ND	ND	-	ND
38	4-Chlorophenyl-phenylether	50.0	ND	-	ND	ND	-	ND
39	Fluorene	50.0	ND	-	ND	ND	-	ND

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RESULTS			NEWBURGH RESULTS		
40	4-Nitroaniline	50.0	ND	-	ND	ND	-	ND
41	4,6-Dinitro-2-Methylphenol	50.0	ND	-	ND	ND	-	ND
42	n-Nitrosodiphenylamine	50.0	ND	-	ND	ND	-	ND
43	4-Bromophenyl-phenylether	50.0	ND	-	ND	ND	-	ND
44	Hexaclorobenzene	0.41	ND	-	ND	ND	-	ND
45	Pentachlorophenol	1.0 or MDL	ND	-	ND	ND	-	ND
46	Phenanthrene	50.0	ND	-	0.11	ND	-	0.11
47	Anthracene	50.0	ND	-	ND	ND	-	ND
48	Di-n-butylphthalate	8.1	ND	-	0.067	ND	-	0.067
49	Fluoroanthene	50.0	ND	-	0.15	ND	-	0.15
50	Pyrene	50.0	ND	-	0.13	ND	-	0.13
51	Butylbenzylphthalate	50.0	ND	-	ND	ND	-	ND
52	3,3'-Dichlorobenzidine	1.4	ND	-	ND	ND	-	ND
53	bis-(2-Ethylhexyl)phthalate	50.0	ND	-	ND	ND	-	ND
54	Di-n-octylphthalate	50.0	ND	-	ND	ND	-	ND
55	Benzo[g,h,I]perylene	50.0	ND	-	0.72	ND	-	0.72
56	Carbazole	32.0	ND	-	ND	ND	-	ND
57	2,2'-Oxybis(1-Chloropropane)	50.0	ND	-	ND	ND	-	ND
58	Benzo(a)anthracene	**	ND	-	0.07	ND	-	0.07
59	Benzo(a)pyrene		ND	-	0.12	ND	-	0.12
60	Benzo(b)fluoranthene		ND	-	0.095	ND	-	0.095
61	Benzo(k)fluoranthene		ND	-	0.068	ND	-	0.068
62	Chrysene		ND	-	0.064	ND	-	0.064
63	Dibenzo(a,h)anthracene		ND	-	ND	ND	-	ND
64	Indeno(1,2,3-cd)pyrene		ND	-	0.069	ND	-	0.069
65	Total SVOC's	500	ND	-	1.177	ND	-	1.177
66	Total CPAH's	10	ND	-	0.486	ND	-	0.486

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
** = Soil Use Criteria controlled by Total CPAH's

Table 10-8
QA/QC Summary Results for BPL
Organic Pesticides and PCB's

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RANGE			NEWBURGH RANGE		
1	A-BHC	0.11	ND	-	ND	ND	-	ND
2	B-BHC	0.2	ND	-	ND	ND	-	ND
3	G-BHC (Lindane)	0.06	ND	-	ND	ND	-	ND
4	D-BHC	0.3	ND	-	ND	ND	-	ND
5	Heptachlor	0.10	ND	-	ND	ND	-	ND
6	Aldrin	0.041	ND	-	ND	ND	-	ND
7	Heptachlor Epoxide	0.02	ND	-	ND	ND	-	ND
8	Endosulfan I	0.9	ND	-	ND	ND	-	ND
9	A-Chlordane	*	ND	-	ND	ND	-	ND
10	G-Chlordane	0.54	ND	-	ND	ND	-	ND
11	Dieldrin	0.044	ND	-	ND	ND	-	ND
12	4,4'-DDE	2.1	ND	-	ND	ND	-	ND
13	Endrin	0.10	ND	-	ND	ND	-	ND
14	Endosulfan II	0.9	ND	-	ND	ND	-	ND
15	4,4'-DDD	2.9	ND	-	ND	ND	-	ND
16	Endrin Aldehyde	*	ND	-	ND	ND	-	ND
17	Endosulfan Sulfate	1	ND	-	ND	ND	-	ND
18	4,4'-DDT	2.1	ND	-	ND	ND	-	ND
19	Endrine Ketone	N/A	ND	-	ND	ND	-	ND
20	Methoxychlor	*	ND	-	ND	ND	-	ND
21	Toxaphene	*	ND	-	ND	ND	-	ND
22	Total Pesticides	10 ppm	ND	-	ND	ND	-	ND
23	Arochlor-1016	1.0	ND	-	ND	ND	-	ND
24	Arochlor-1221			-			-	
25	Arochlor-1232			-			-	
26	Arochlor-1242			-			-	
27	Arochlor-1248			-			-	
28	Arochlor-1254			-			-	
29	Arochlor-1260			-			-	

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total Pesticides

Table 10-9
QA/QC Summary Results for BPL
Heavy Metals, Asbestos and Conventionals

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY			NEWBURGH		
			RANGE			RANGE		
1	Aluminum	5,680	937 mg/Kg	-	1,660 mg/Kg	937 mg/Kg	-	1,660 mg/Kg
2	Antimony	5.1	ND	-	ND	ND	-	ND
3	Arsenic	7.5	ND	-	2.67 mg/Kg	ND	-	2.67 mg/Kg
4	Barium	300	ND	-	14.80 mg/Kg	ND	-	14.80 mg/Kg
5	Beryllium	0.16	ND	-	ND	ND	-	ND
6	Cadmium	1.00	ND	-	ND	ND	-	ND
7	Chromium	23.2	4.70 mg/Kg	-	16.10 mg/Kg	4.70 mg/Kg	-	16.10 mg/Kg
8	Cobalt	30.0	ND	-	1.72 mg/Kg	ND	-	1.72 mg/Kg
9	Copper	30.6	ND	-	2.78 mg/Kg	ND	-	2.78 mg/Kg
10	Cyanide	3.9	ND	-	ND	ND	-	ND
11	Iron	13,652	2,400 mg/Kg	-	6,970 mg/Kg	2,400 mg/Kg	-	6,970 mg/Kg
12	Lead	112.8	ND	-	ND	ND	-	ND
13	Manganese	119.5	31.0 mg/Kg	-	84.9 mg/Kg	31.0 mg/Kg	-	84.9 mg/Kg
14	Mercury	0.1	ND	-	ND	ND	-	ND
15	Nikel	13	ND	-	7.68 mg/Kg	ND	-	7.68 mg/Kg
16	Selenium	2	ND	-	ND	ND	-	ND
17	Silver	200	ND	-	ND	ND	-	ND
18	Thallium	20	ND	-	1.72 mg/Kg	ND	-	1.72 mg/Kg
19	Vanadium	150	ND	-	9.79 mg/Kg	ND	-	9.79 mg/Kg
20	Zinc	70.8	ND	-	15.00 mg/Kg	ND	-	15.00 mg/Kg
21	Asbestos Fiber Cont.	1% by weight	ND	-	ND	ND	-	ND
22	pH (*)	5.5 - 7.5	8.01	-	9.40	8.01	-	9.40
23	Sulfides	50,000	ND	-	7.40 mg/Kg	ND	-	7.40 mg/Kg
24	Ammonia	40	ND	-	20.2 mg/Kg	ND	-	20.2 mg/Kg

Notes: ND = Not detected (Detection limits below Soil Use Criteria)

Section 11

11.0 GENERAL FILL

General fill was used to construct drainage swales, berms, roadway embankments, as backfill for the contaminated beach excavation and mass areas throughout the landfill as per the Specifications. Depths of general fill varied as required per the Contract Drawings.

11.1 Material Source – General Fill

The material used for the general fill was environmentally clean earthen soil that was in conformance with the Contract Specifications. The general fill used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill. All general fill material was delivered to the Pennsylvania Avenue Landfill pier via barge transportation.

The 91,781 cy of general fill was imported from two borrow sites: Callahan and Naninni, located in Newburgh, New York and Amboy Aggregates, located in South Amboy, New Jersey. NYCDEP and URS inspected the borrow sites and loading facilities prior to acceptance and procurement. Source testing was performed on the 2 sources. Table 11-1 shows the source testing requirements.

Table 11-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Standard Proctor Density	ASTM D-698	One per source
Organic Content	ASTM D-2974	One per source
Atterberg Limits	ASTM D-4318	One per source
Chemical Analysis	Per Specifications	One per source
Water (Moisture) Content	ASTM D-2216	One per source

The general requirements for general fill are shown in Table 11-2.

Table 11-2
General Fill Requirements

Property	Criteria
Organic Content (%)	<15%
Plastic Index (slope > 5%)	<12
Plastic Index (slope < 5%)	<50
Standard Proctor Test	Max Density (pcf)
Standard Proctor Test	Opt. Moisture (%)
Moisture (as received) (%)	<OM +7%
Max Particle Size (in)	<3"
TCL & TAL	Chemical Testing
USC	SM or SC
Max Fine Content	20% - 40%

Refer to Appendix F for Source testing results.

11.2 Installation – General Fill

Care was used in the placement of the general fill throughout the landfill. General fill was installed with degrees of varying thickness specified and required as shown on the Contract Drawings.

The general fill was stockpiled, mechanically screened and then loaded with earthmoving equipment, such as excavators and payloaders, into articulated trucks for transport and placement onto approved locations in order to construct roads and swales.

11.3 Quality Control/Quality Assurance During Installation – General Fill

Quality control and quality assurance during construction of the general fill layer consisted of full-time observation in addition to laboratory and field-testing.

All QC laboratory and field testing was performed by the approved independent chemical laboratory and approved independent geotechnical laboratory, employed by BET. Chemical analyses were provided by Accredited Laboratories, Inc., located in Carteret, New Jersey. Geotechnical analyses were provided by Testwell Laboratories, Inc., located in Ossining, New York. In accordance with Table 11-3 below, periodic quality control was performed by the contractor.

Table 11-3
Quality Control – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422 (latest revision)	One test every 5,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 5,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 5,000 yd^3
Field-Moisture Density	ASTM D-2922	Minimum of one test every 200 linear feet every compacted lift or 9/acre/lift
Chemical Analysis	Per Specifications	One test every 3,000 yd^3
Organic Content	ASTM D-2974 (latest revision)	One test every 5,000 yd^3
Water Moisture Content	ASTM D-2216 (latest revision)	One test every 5,000 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. In accordance with Table 11-4 below, periodic quality assurance (QA) inspection and testing was performed by URS to verify the QC testing.

Table 11-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422 (latest revision)	One test every 20,000 yd^3
Standard Proctor Density	ASTM D-698	One test every 20,000 yd^3
Atterberg Limits	ASTM D-4318	One test every 20,000 yd^3
Field-Moisture Density	ASTM D-2922	Minimum of one test every 200 linear feet every compacted lift or 9/acre/lift
Chemical Analysis	Per Specifications	One test every 60,000 yd^3

The general fill was compacted to an in-place minimum density of 95 percent of the maximum dry density, as determined by ASTM D-698. In addition, QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

Refer to Tables 11-5 thru 11-9 for summary results.

Refer to Appendix F for all field, chemical and geotechnical test results.

Photographs of the installation of the general fill are included in Appendix I.

Table 11-5
QA/QC Summary Results for General Fill
Geotechnical

General Requirements	Criteria	AMBOY RANGE			NEWBURGH RANGE		
Organic Content (%)*	<5%	1.10	-	2.23	0.26	-	1.00
Plastic Index (slope > 5%)	<12	0	-	8	0	-	0
Plastic Index (slope < 5%)	<50	0	-	8	0	-	0
Standard Proctor Test	Max. Density (pcf)	114.9	-	127.3	105.0	-	105.1
	Opt. Moisture (%)	10.5	-	15.6	12.4	-	17.4
Moisture (as received) (%)	< OW + 7%	8.0	-	18.1	12.4	-	17.4
Particle Size (in)	< 3"	3/8	-	1 1/2	1/4	-	1/2
USC	SM or SC	SM	-	SC	SP	-	SP
Max. Fine Content (%) *	20% - 40%	20.2	-	28.7	1.1	-	2.2

Table 11-6
QA/QC Summary Results for General Fill
Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg)	AMBOY RANGE			NEWBURGH RANGE		
1	Chloromethane	*	ND	-	ND	ND	-	ND
2	Vinyl Chloride	0.2	ND	-	ND	ND	-	ND
3	Bromomethane	*	ND	-	ND	ND	-	ND
4	Chloroethane	1.9	ND	-	ND	ND	-	ND
5	1,1-Dichloroethene	0.4	ND	-	ND	ND	-	ND
6	1,2-Dichloroethene (Total)	*	ND	-	ND	ND	-	ND
7	Methylene Chloride	0.1	ND	-	0.006	ND	-	0.006
8	1,1-Dichloroethane	0.2	ND	-	ND	ND	-	ND
9	Chloroform	0.3	ND	-	ND	ND	-	ND
10	1,1,1-Trichloroethane	0.8	ND	-	ND	ND	-	ND
11	Carbon Tetrachloride	0.6	ND	-	ND	ND	-	ND
12	1,2-Dichloroethane	0.1	ND	-	ND	ND	-	ND
13	Benzene	0.06	ND	-	ND	ND	-	ND
14	Trichloroethene	0.7	ND	-	ND	ND	-	ND
15	1,2-Dichloropropane	*	ND	-	ND	ND	-	ND
16	Bromodichloromethane	*	ND	-	ND	ND	-	ND
17	Cis-1,3-Dichloropropene	*	ND	-	ND	ND	-	ND
18	Toluene	1.5	ND	-	ND	ND	-	ND
19	Trans-1,3-Dichloropropene	*	ND	-	ND	ND	-	ND
20	1,1,2-Trichloroethane	*	ND	-	ND	ND	-	ND
21	Tetrachloroethene	1.4	ND	-	ND	ND	-	ND
22	Dibromochloromethane	*	ND	-	ND	ND	-	ND
23	Ethylbenzene	5.5	ND	-	ND	ND	-	ND
24	Chlorobenzene	1.7	ND	-	ND	ND	-	ND
25	Styrene	*	ND	-	ND	ND	-	ND
26	Bromoform	*	ND	-	ND	ND	-	ND
27	1,1,2,2-Tetrachloroethane	0.6	ND	-	ND	ND	-	ND
28	Carbon Disulfide	2.7	ND	-	ND	ND	-	ND
29	Acetone	0.2	ND	-	ND	ND	-	ND
30	2-Butanone	0.3	ND	-	ND	ND	-	ND
31	4-Methyl-2-Pentanone	1	ND	-	ND	ND	-	ND
32	2-Exanone	*	ND	-	ND	ND	-	ND
33	Xylenes (Total)	1.2	ND	-	ND	ND	-	ND
34	Total VOC's	10.0	ND	-	0.006	ND	-	0.006

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total VOC's

Table 11-7
QA/QC Summary Results for General Fill
Semi-Volatile Organic Compounds

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY			NEWBURGH		
			RESULTS			RESULTS		
1	Phenol	0.03 or MDL	ND	-	ND	ND	-	ND
2	bis(2-chloroethyl)ether	0.58	ND	-	ND	ND	-	ND
3	2-Chlorophenol	0.8	ND	-	ND	ND	-	ND
4	1,3-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
5	1,4-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
6	1,2-Dichlorobenzene	50.0	ND	-	ND	ND	-	ND
7	2-Methylphenol	0.1 or MDL	ND	-	ND	ND	-	ND
8	3&4-Methylphenol	0.091	ND	-	ND	ND	-	ND
9	N-Nitroso-di-n-propylamine	0.1	ND	-	ND	ND	-	ND
10	Hexachloroethane	46.0	ND	-	ND	ND	-	ND
11	Nitrobenzene	0.2 or MDL	ND	-	ND	ND	-	ND
12	Isophorone	4.4	ND	-	ND	ND	-	ND
13	2-Nitrophenol	.33 or MDL	ND	-	ND	ND	-	ND
14	2,4-Dimethylphenol	50.0	ND	-	ND	ND	-	ND
15	bis(2-chloroethoxy)methane	50.0	ND	-	ND	ND	-	ND
16	2,4-Dichlorophenol	0.4	ND	-	ND	ND	-	ND
17	1,2,4-Trichlorobenzene	50.0	ND	-	ND	ND	-	ND
18	Naphtalene	13.0	ND	-	ND	ND	-	ND
19	4-Chloraniline	0.22 or MDL	ND	-	ND	ND	-	ND
20	Hexachlorobutadiene	8.2	ND	-	ND	ND	-	ND
21	4-Chloro-3-methylphenol	0.24 or MDL	ND	-	ND	ND	-	ND
22	2-Methylnaphthalene	36.4	ND	-	ND	ND	-	ND
23	Hexachlorociclopentadine	50.0	ND	-	ND	ND	-	ND
24	2,4,6-Trichlorophenol	50.0	ND	-	ND	ND	-	ND
25	2,4,5-Trichlorophenol	0.1	ND	-	ND	ND	-	ND
26	2-Chloronaphthalene	50.0	ND	-	ND	ND	-	ND
27	2-Nitroaniline	0.43 or MDL	ND	-	ND	ND	-	ND
28	Dimethylphthalate	2.0	ND	-	ND	ND	-	ND
29	Acenaphthylene	41.0	ND	-	ND	ND	-	ND
30	3-Nitroaniline	0.5 or MDL	ND	-	ND	ND	-	ND
31	Acenaphthene	50.0	ND	-	ND	ND	-	ND
32	2,4-Dinitrophenol	0.2 or MDL	ND	-	ND	ND	-	ND
33	4-Nitrophenol	0.1 or MDL	ND	-	ND	ND	-	ND
34	Dibenzofuran	6.2	ND	-	ND	ND	-	ND
35	2,6-Dinitrotoluene	1.0	ND	-	ND	ND	-	ND
36	2,4-Dinitrotoluene	50.0	ND	-	ND	ND	-	ND
37	Diethylphthalate	7.1	ND	-	ND	ND	-	ND
38	4-Chlorophenyl-phenylether	50.0	ND	-	ND	ND	-	ND
39	Fluorene	50.0	ND	-	ND	ND	-	ND

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RESULTS			NEWBURGH RESULTS		
40	4-Nitroaniline	50.0	ND	-	ND	ND	-	ND
41	4,6-Dinitro-2-Methylphenol	50.0	ND	-	ND	ND	-	ND
42	n-Nitrosodiphenylamine	50.0	ND	-	ND	ND	-	ND
43	4-Bromophenyl-phenylether	50.0	ND	-	ND	ND	-	ND
44	Hexaclorobenzene	0.41	ND	-	ND	ND	-	ND
45	Pentachlorophenol	1.0 or MDL	ND	-	ND	ND	-	ND
46	Phenanthrene	50.0	ND	-	0.11	ND	-	0.11
47	Anthracene	50.0	ND	-	ND	ND	-	ND
48	Di-n-butylphthalate	8.1	ND	-	0.067	ND	-	0.067
49	Fluoroanthene	50.0	ND	-	0.15	ND	-	0.15
50	Pyrene	50.0	ND	-	0.13	ND	-	0.13
51	Butylbenzylphthalate	50.0	ND	-	ND	ND	-	ND
52	3,3'-Dichlorobenzidine	1.4	ND	-	ND	ND	-	ND
53	bis-(2-Ethylhexyl)phthalate	50.0	ND	-	ND	ND	-	ND
54	Di-n-octylphthalate	50.0	ND	-	ND	ND	-	ND
55	Benzo[g,h,I]perylene	50.0	ND	-	0.72	ND	-	0.72
56	Carbazole	32.0	ND	-	ND	ND	-	ND
57	2,2'-Oxybis(1-Chloropropane)	50.0	ND	-	ND	ND	-	ND
58	Benzo(a)anthracene	**	ND	-	0.07	ND	-	0.07
59	Benzo(a)pyrene		ND	-	0.12	ND	-	0.12
60	Benzo(b)fluoranthene		ND	-	0.095	ND	-	0.095
61	Benzo(k)fluoranthene		ND	-	0.068	ND	-	0.068
62	Chrysene		ND	-	0.064	ND	-	0.064
63	Dibenzo(a,h)anthracene		ND	-	ND	ND	-	ND
64	Indeno(1,2,3-cd)pyrene		ND	-	0.069	ND	-	0.069
65	Total SVOC's	500	ND	-	1.177	ND	-	1.177
66	Total CPAH's	10	ND	-	0.486	ND	-	0.486

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
** = Soil Use Criteria controlled by Total CPAH's

Table 11-8
QA/QC Summary Results for General Fill
Organic Pesticides and PCB's

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY RANGE			NEWBURGH RANGE		
1	A-BHC	0.11	ND	-	ND	ND	-	ND
2	B-BHC	0.2	ND	-	ND	ND	-	ND
3	G-BHC (Lindane)	0.06	ND	-	ND	ND	-	ND
4	D-BHC	0.3	ND	-	ND	ND	-	ND
5	Heptachlor	0.10	ND	-	ND	ND	-	ND
6	Aldrin	0.041	ND	-	ND	ND	-	ND
7	Heptachlor Epoxide	0.02	ND	-	ND	ND	-	ND
8	Endosulfan I	0.9	ND	-	ND	ND	-	ND
9	A-Chlordane	*	ND	-	ND	ND	-	ND
10	G-Chlordane	0.54	ND	-	ND	ND	-	ND
11	Dieldrin	0.044	ND	-	ND	ND	-	ND
12	4,4'-DDE	2.1	ND	-	ND	ND	-	ND
13	Endrin	0.10	ND	-	ND	ND	-	ND
14	Endosulfan II	0.9	ND	-	ND	ND	-	ND
15	4,4'-DDD	2.9	ND	-	ND	ND	-	ND
16	Endrin Aldehyde	*	ND	-	ND	ND	-	ND
17	Endosulfan Sulfate	1	ND	-	ND	ND	-	ND
18	4,4'-DDT	2.1	ND	-	ND	ND	-	ND
19	Endrine Ketone	N/A	ND	-	ND	ND	-	ND
20	Methoxychlor	*	ND	-	ND	ND	-	ND
21	Toxaphene	*	ND	-	ND	ND	-	ND
22	Total Pesticides	10 ppm	ND	-	ND	ND	-	ND
23	Arochlor-1016	1.0	ND	-	ND	ND	-	ND
24	Arochlor-1221			-			-	
25	Arochlor-1232			-			-	
26	Arochlor-1242			-			-	
27	Arochlor-1248			-			-	
28	Arochlor-1254			-			-	
29	Arochlor-1260			-			-	

Notes: ND = Not detected (Detection limits below Soil Use Criteria)
(*) = Contaminants without specific individual limit. Maximum concentration controlled by Total Pesticides

Table 11-9
QA/QC Summary Results for General Fill
Heavy Metals, Asbestos and Conventionals

No.	Contaminant	Soil Use Criteria (mg/kg) or ppm	AMBOY			NEWBURGH		
			RANGE			RANGE		
1	Aluminum	5,680	937 mg/Kg	-	1,660 mg/Kg	937 mg/Kg	-	1,660 mg/Kg
2	Antimony	5.1	ND	-	ND	ND	-	ND
3	Arsenic	7.5	ND	-	2.67 mg/Kg	ND	-	2.67 mg/Kg
4	Barium	300	ND	-	14.80 mg/Kg	ND	-	14.80 mg/Kg
5	Beryllium	0.16	ND	-	ND	ND	-	ND
6	Cadmium	1.00	ND	-	ND	ND	-	ND
7	Chromium	23.2	4.70 mg/Kg	-	16.10 mg/Kg	4.70 mg/Kg	-	16.10 mg/Kg
8	Cobalt	30.0	ND	-	1.72 mg/Kg	ND	-	1.72 mg/Kg
9	Copper	30.6	ND	-	2.78 mg/Kg	ND	-	2.78 mg/Kg
10	Cyanide	3.9	ND	-	ND	ND	-	ND
11	Iron	13,652	2,400 mg/Kg	-	6,970 mg/Kg	2,400 mg/Kg	-	6,970 mg/Kg
12	Lead	112.8	ND	-	ND	ND	-	ND
13	Manganese	119.5	31.0 mg/Kg	-	84.9 mg/Kg	31.0 mg/Kg	-	84.9 mg/Kg
14	Mercury	0.1	ND	-	ND	ND	-	ND
15	Nikel	13	ND	-	7.68 mg/Kg	ND	-	7.68 mg/Kg
16	Selenium	2	ND	-	ND	ND	-	ND
17	Silver	200	ND	-	ND	ND	-	ND
18	Thallium	20	ND	-	1.72 mg/Kg	ND	-	1.72 mg/Kg
19	Vanadium	150	ND	-	9.79 mg/Kg	ND	-	9.79 mg/Kg
20	Zinc	70.8	ND	-	15.00 mg/Kg	ND	-	15.00 mg/Kg
21	Asbestos Fiber Cont.	1% by weight	ND	-	ND	ND	-	ND
22	pH (*)	5.5 - 7.5	8.01	-	9.40	8.01	-	9.40
23	Sulfides	50,000	ND	-	7.40 mg/Kg	ND	-	7.40 mg/Kg
24	Ammonia	40	ND	-	20.2 mg/Kg	ND	-	20.2 mg/Kg

Notes: ND = Not detected (Detection limits below Soil Use Criteria)

Section 12

12.0 TOPSOIL AND SEEDING

The final step in the landfill final cover system was the construction of a six-inch thick layer (minimum) of topsoil in non-planting island areas and up to a three-foot thick layer (minimum) of topsoil in areas designated as planting islands, to sustain a well-established vegetative cover, which will protect the cap from erosion. Topsoil and seeding were placed in conjunction with the final cover system on top of the barrier protection layer (cover soil layer).

12.1 Material Source – Topsoil

The material used for the topsoil layer construction was in conformance with the Contract Specifications. All topsoil used on the project was tested and approved per the QA/QC requirement of the Specifications prior to use at the Pennsylvania Avenue Landfill.

In general, the topsoil was a fertile and friable surface soil of good and uniform quality. In addition, the topsoil did not contain subsoil materials. Topsoil was free of refuse, hard clods, woody vegetation, stiff clay, construction debris, boulders, stones larger than one and one-half inches, hydrocarbons, petroleum materials or chemicals toxic to plants, other miscellaneous or otherwise unstable or undesirable materials, and other deleterious inclusions.

The topsoil had a minimum organic content of two and one-half percent by weight as determined by the method described in the "Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin #493, 12/95." The topsoil had a pH value within a range of 5.0 to 7.0 as required by the Specifications.

The 137,490.45 cy of topsoil used on this project was a mixed material that was composed of sand from the T.E. Warren borrow source (L2F2) in Salem, New Jersey, with compost (NJC) either from Sewell, New Jersey or compost (PAC) from Conshehauken, Pennsylvania. The material was mixed according to the approved mix ratio, which involved four parts sand to one part compost. Another source of topsoil used on the project was composed of sand from a borrow source in Syosset, LI with compost from (LIC) Syosset, LI. Table 12-1 shows the source testing requirements.

Table 12-1
Source - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
pH	See Note Below	One per source
Organic Content	See Note Below	One per source
Soluble salts	See Note Below	One per source
Chemical Analysis	Per Specifications	One per source
Macro/Micro Nutrients	See Note Below	One per source

These soil tests were conducted in accordance with Soil Testing Procedure for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin #493, 12/95.

The general requirements for Topsoil are shown in Table 12-2.

Table 12-2
Topsoil Requirements

Property	Criteria
Estimated Bulk Density	1.0 - 1.4 (g/cm3)
Organic Content	2.5% - 5%
Gravel Content	≤ 8%
Sand Content	60% - 80%
Silt Content	10% - 20%
Clay Content	10% - 20%
USDA Classification	Sandy Loam
Max Grain Size	≤ 1.5''
pH	5 -7
Acid Producing Soil Test	pH > 4.5
Soluble Salts	0 - 0.4 mmhos/cm
Nitrogen Total (Nt)	0.06%-0.15%
Nitrate Content	< or = 12 ppm
Macronutrients	
Phosphorus (P)	20 – 80 lbs/acre
Potassium (K)	70 – 225 lbs/acre
Magnesium (Mg)	200–300 lbs/acre
Calcium (Ca)	400–2000 lbs/acre
Total (Mg+K+Ca)	< or = 2500 lb/acre

Property	Criteria
Micronutrients	
Zinc (Zn)	1 ppm – 12 ppm
Copper (Cu)	0.1 ppm – 4 ppm
Manganese (Mn)	2 ppm – 25 ppm
Boron (B)	0.8 ppm – 3 ppm

Refer to Appendix G for Source testing results.

The material was first roughly mixed by a loader at the proper ratio, and then processed through two pug mills at the mixing facility in Salem, New Jersey and at Syosset, LI. All material was barged to the landfill, and then stockpiled or directly placed on the landfill to meet the Specifications.

12.2 Installation – Topsoil

The topsoil was spread over the prepared and approved barrier protection layer in sufficient quantity to obtain a minimum compacted layer of six inches in areas that were not designated as planting islands. In the designated planting island areas, the topsoil was spread over the prepared and approved barrier protection layer in sufficient quantity to obtain a minimum compacted layer of up to three feet. No topsoil was permitted to be spread until the barrier protection layer and the topsoil were approved by URS and NYCDEP.

Prior to placement of the topsoil, the subgrade surface for the topsoil (i.e., finished barrier protection layer) was approved by the Engineer. Stockpiled topsoil materials were placed in Engineer-approved areas onsite only. The stockpiled materials were placed and graded for proper drainage and were not placed near the edge of side slopes. Topsoil material delivered to the site was visually and continuously inspected by the Engineer during placement to ensure consistency with the materials previously delivered to the site.

Topsoil was evenly placed with a LGP bulldozer to a minimum of either six inches or up to three feet if the area was a planting island, within the limit of final cover system and limits of disturbance. Grade stakes were used on an approximately 100-foot by 100-foot grid to ensure that the proper lift was achieved. The topsoil was pushed in an upslope direction on slopes steeper than 10%. Irregularities in the surface resulting from topsoil placement or other operations were corrected in order to prevent the formation of depressions where water would pond. Topsoil was not placed when the subgrade surface was frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed seeding program. In addition, mud, snow, ice or frozen earth was not permitted to be incorporated in the topsoil.

The topsoil placement work within the limits of the final cover system was executed in conformance with the lines and grades shown on the Drawings. For all work within the limit of the final cover system, slopes had a minimum of 4 percent and a maximum of 33 percent.

The topsoil was placed so that the surface was free draining. Runoff and other waters were conveyed in ditches and channels to the site perimeter storm water management system.

12.3 Quality Control/Quality Assurance During Installation – Topsoil

Quality control during the topsoil layer construction consisted of full-time observation, laboratory testing and field-testing. The minimum thickness of six inches (and two feet, where necessary) was monitored by means of placing grade stakes on an approximately 100-foot by 100-foot grid. In addition, BET was required to verify the thickness by hand digging test pits in the presence of URS QA inspectors. In place density testing was completed to verify compliance to the contract requirements. Thickness and density test results are included in Appendix G.

As the construction progressed, QA/QC conformance sampling and testing for agricultural and geotechnical analyses was conducted per the Specifications at a frequency of no less than one test for every 2,500 cubic yards of topsoil material delivered to the site.

All QC laboratory and field testing was performed by the approved independent chemical laboratory and approved independent geotechnical laboratory, employed by BET. Chemical analyses were provided by Accredited Laboratories, Inc., located in Carteret, New Jersey. Geotechnical analyses were provided by Testwell Laboratories, Inc., located in Ossining, New York. Nutrient analyses were provided by A&L Eastern Agricultural Laboratories located in Richmond, VA. In accordance with Table 12-3 below, periodic quality control was performed by the contractor.

Table 12-3
Quality Control – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422 (latest revision)	One test every 2,500 yd^3
Organic Content	See Note Below	One test every 2,500 yd^3
pH	See Note Below	One test every 2,500 yd^3
Macro/Micro Nutrients	See Note Below	One test every 2,500 yd^3
Chemical Analysis	Per Specifications	One test every 3,000 yd^3
Soluble Salts	See Note Below	One test every 2,500 yd^3

All QA laboratory and field testing was performed by the approved independent chemical laboratory and geotechnical laboratory, employed by URS. Chemical analyses were provided by Veritech Laboratory, a division of Hampton-Clarke, Inc., located in Fairfield, New Jersey. Geotechnical analysis was performed by URS Soil Testing Laboratory in Totowa, NJ. Nutrient analyses were performed by the Rutgers University Soil Testing Laboratories in New Brunswick, NJ.

QA testing was performed in accordance with Table 12-4 below, periodic quality assurance (QA) inspection and testing was performed by URS to verify the QC testing

Table 12-4
Quality Assurance – Field and Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422 (latest revision)	One test every 2,500 yd^3
Organic Content	See Note Below	One test every 2,500 yd^3
pH	See Note Below	One test every 2,500 yd^3
Macro/Micro Nutrients	See Note Below	One test every 2,500 yd^3
Chemical Analysis	Per Specifications	One test every 60,000 yd^3
Soluble Salts	See Note Below	One test every 2,500 yd^3

NOTE: The pH of soils, organic content, Marco and Micro Nutrients, and soluble salts were tested in accordance with the Soil Testing Procedure for the Northeastern United States, 2nd Edition, Northeastern Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.

In addition, QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager

Refer to Table 12-5 and 12-6 for summary test results.

Refer to Appendix G for all field, chemical and geotechnical test results.

Photographs of the topsoil installation are included in Appendix I.

12.4 Seeding

Seed mixture and application rates conformed to the "Seed Mixture" Table of Section D-30.1 of the Contract Specifications. BET submitted a certificate attesting that the seed mixture was composed of the specified varieties and proportions in the Detailed Specifications. Refer to Appendix G for a copy of the Certificate of Compliance – Seed Mixture.

Seed mixed prior to delivery was approved on the basis of a certification by the vendor stating the minimum percentage of germination and variety of each kind of seed, and the quantity of each kind of seed in the mixture. This was redone annually for each crop of seed.

Areas to be seeded were scarified sufficiently to break up the surface crust immediately before seeding except where the ground was loose and subject to rolling or sliding. Rocks, debris and all other objects, which were detrimental to mowing, were removed.

Seed was mechanically placed by a Trillion drill seeder. Calibration of the Trillion drill seeder was completed for each seeding application onsite in accordance with the manufacturer's recommendations. When the Trillion drill seeder was used, the seed was not planted any deeper than one-quarter of an inch. The seed was applied prior to and in a separate operation from mulching or placement of erosion control mats. Any unplanted areas observed after growth of the grass were re-seeded.

Calibration results for the Trillion drill seeder are included in Appendix G.

Organic biofertilizer was applied to the areas of seeding. Biofertilizer for warm-season grasses and wildflowers was provided at a minimum of 175 pounds per acre of Plant Health Care's "Healthy Start" (3-4-3) in accordance with the Contract Specifications.

All seeding areas were mulched or covered with erosion control mats. Areas requiring mulch received one and one-half tons of straw mulch per acre, machine or hand spread evenly and uniformly over the entire surface of the area to be covered. Mulching was completed within two days after seeding.

Photographs of the seeding installation are included in Appendix I.

12.5 Erosion Control Fabric/Mulching

Subsequent to the seeding installation, all seeded areas on the landfill received either one of two types of erosion control fabric or straw mulch in accordance with the approved plans and technical specifications. In general, landfill slopes greater than 5% slope received Type I erosion control fabric. Type I erosion control fabric was Curlex I as manufactured by American Excelsior Company. On landfill slopes less than 5%, straw mulch was installed after seeding operations. The straw mulch supplied was wood cellulose fiber mulch as supplied by DeSante Bros, Inc. In drainage swales, Type III erosion control fabric was installed in accordance with the approved plans and specifications. Type III erosion control fabric was NAG P550 as manufactured by North American Green. Cut sheets for the Type I and Type III erosion control fabric and straw mulch are included in Appendix G.

Photographs of the erosion control fabric and straw mulch installation are included in Appendix I.

Table 12-5
Topsoil QA/QC Summary Test Results
Geotechnical Tests Results

Geotechnical and Physical Properties		PENNSYLVANIA			NEW JERSEY			SYOSSET		
Top Soil	**Criteria**	**RANGE**			**RANGE**			**RANGE**		
Organic Content (%)	2.5%-5%	3.20 %	-	3.50 %	2.60 %	-	3.49 %	3.85	-	4.2
Gravel Content (%)	<= 8%	4.83 %	-	5.24 %	4.5 %	-	7.4 %	11.90	-	13.60
Sand Content (%)	60% - 80%	78.4 %	-	80.4 %	77.2 %	-	73.0 %	63.80	-	63.94
Sand Sieve Analysis			-			-			-	
* Very Coarse (%)	N/A	9.50 %	-	10.70 %	6.50 %	-	10.30 %	10.64	-	9.38
* Coarse (%)	N/A	19.30 %	-	22.10 %	19.10 %	-	20.40 %	20.34	-	19.05
* Medium (%)	N/A	48.20 %	-	46.60 %	52.80 %	-	39.80 %	33.02	-	34.73
* Fine (%)	N/A	16.00 %	-	20.50 %	18.60 %	-	25.20 %	25.98	-	24.98
* Very Fine (%)	N/A	2.50 %	-	2.50 %	2.90 %	-	4.40 %	10.02	-	11.86
Silt Content (%)	10% - 20%	11.2 %	-	13.0 %	10.0 %	-	10.0 %	18.30	-	13.82
Clay Content (%)	10% - 20%	13.2 %	-	13.2 %	12.8 %	-	17.0 %	6.00	-	8.64
pH	5 - 7	6.9	-	7	6.5	-	6.55	6.55	-	6.1
Acid Producing Soil Test	pH => 4.5	5.6	-	5.6	6.5	-	5.3	5.3	-	5.60
Soluble Salts	0 - 0.4 mmhos/cm	0.24	-	0.30	0.30	-	0.29	0.19	-	0.1
Nitrogen Total (N_t)	0.06%-0.15%	0.08	-	0.1	0.08	-	0.08	0.07	-	0.07
Nitrate Content	<12 ppm	4	-	8	4	-	4	1	-	4
Macronutrients			-			-			-	
* Phosphorus "P"	20 - 80 lb/acre	38	-	44	94	-	52	83	-	142
* Potassium "K"**	70 - 225 lb/acre	316	-	318	468	-	416	403	-	300
* Magnesium "Mg"**	200 - 300 lb/acre	372	-	380	266	-	290	241	-	184
* Calcium :"Ca"**	400 - 2000 lb/acre	1,720	-	1,760	1,488	-	1,246	1379	-	1008
Total (Mg+K+Ca)**	<2000 lb/acre	2,408	-	2,458	2,222	-	1,952	2023	-	1492
Micronutrients			-			-			-	
* Zinc "Zn"	1 ppm - 12 ppm	4.3	-	5	4.6	-	5.1	3.3	-	2.7
* Copper "Cu"	0.1 ppm - 4 ppm	0.6	-	2.5	0.8	-	1.1	1.4	-	1.5
* Manganese "Mn"	2 ppm - 25 ppm	38	-	26.2	18	-	20	63.4	-	74
* Boron "B"	0.8 ppm - 3 ppm	1.2	-	2.1	0.2	-	0.9	1.3	-	0.4

NOTES:

N/A = No Criteria available as per Contract Specifications.

(*) Test results reported in different units than specified.

(**) Values of Mg, K, Ca that are above their individual limits can be accepted if their composite limit is met.

(***) Individual minimum ranges that are not met can be increased by the application of an appropriate fertilizer containing those deficient elements.

Table 12-6
Topsoil QA/QC Summary Test Results
Chemical Tests Results

Waste Characteristic	Criteria	SYOSSET RANGE			PENNSYLVANIA RANGE			NEW JERSEY RANGE		
VOCs										
Total VOCs	10.0 mg/kg	0.018	-	0.054	0.041	-	0.058	0.031	-	0.228
Acetone	0.2 mg/kg	U	-	0.01	0.006	-	0.017	0.002	-	0.02
Benzene	0.06 mg/kg	U	-	U	U	-	U	U	-	U
Bromodichloromethane	*	U	-	U	U	-	U	U	-	U
Bromoform	*	U	-	U	U	-	U	U	-	U
Bromomethane	*	U	-	U	U	-	U	U	-	U
2-Butanone	0.3 mg/kg	U	-	U	U	-	U	U	-	U
Carbon Disulfide	2.7 mg/kg	U	-	U	U	-	U	U	-	U
Carbon Tetrachloride	0.6 mg/kg	U	-	U	U	-	U	U	-	U
Chlorobenzene	1.7 mg/kg	U	-	U	U	-	U	U	-	U
Chloroethane	1.9 mg/kg	U	-	U	U	-	U	U	-	U
Chloroform	0.3 mg/kg	U	-	U	U	-	U	U	-	U
Chloromethane	*	U	-	U	U	-	U	U	-	U
Cis-1,3-Dichloropropene	*	U	-	U	U	-	U	U	-	U
Dibromochloromethane	*	U	-	U	U	-	U	U	-	U
1,1-Dichloroethane	0.2 mg/kg	U	-	U	U	-	U	U	-	U
1,2-Dichloroethane	0.1 mg/kg	U	-	U	U	-	U	U	-	U
1,1-Dichloroethene	0.4 mg/kg	U	-	U	U	-	U	U	-	U
1,2-Dichloroethene (total)	*	U	-	U	U	-	U	U	-	U
1,2-Dichloropropane	*	U	-	U	U	-	U	U	-	U
1,3-Dichloropropene (trans)	*	U	-	U	U	-	U	U	-	U
Ethylbenzene	5.5 mg/kg	U	-	U	U	-	U	U	-	U
2-Hexanone	*	U	-	U	U	-	U	U	-	U
Methylene Chloride	0.1 mg/kg	U	-	0.019	0.017	-	0.036	0.0008	-	0.035
4-Methyl-2-Pentanone	1.0 mg/kg	U	-	U	U	-	U	U	-	U
Styrene	*	U	-	U	U	-	U	U	-	U
Tetrachloroethene	1.4 mg/kg	U	-	U	U	-	U	U	-	U
1,1,1-Trichloroethane	0.8 mg/kg	U	-	U	U	-	U	U	-	U
1,1,2-Trichloroethane	*	U	-	U	U	-	U	U	-	U
1,1,2,2-Tetrachloroethane	0.6 mg/kg	U	-	U	U	-	U	U	-	U
Toluene	1.5 mg/kg	U	-	U	U	-	U	U	-	U
Trichloroethene	0.7 mg/kg	U	-	U	U	-	U	U	-	U
Vinyl Chloride	0.2 mg/kg	U	-	U	U	-	U	U	-	U
Xylenes (total)	1.2 mg/kg	U	-	0.017	0.018	-	0.018	0.017	-	0.018
SVOCs										
Total SVOC's	500 mg/kg	0	-	1.064	0.046	-	0.057	0	-	1.159
Total CPAHs	10.0 mg/kg	0	-	0.308	0.042	-	0.138	0	-	0.987
Acenaphthene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Acenaphthylene	41.0 mg/kg	U	-	U	U	-	U	U	-	U

Waste Characteristic	Criteria	SYOSSET			PENNSYLVANIA			NEW JERSEY		
		RANGE			RANGE			RANGE		
Anthracene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Benzo(g,h,I)perylene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
bis(2-ethylhexyl)phthalate	50.0 mg/kg	U	-	0.33	U	-	U	U	-	0.93
bis-(2-Chloroethyl)ether	0.58 mg/kg	U	-	U	U	-	U	U	-	U
bis-(2-Chloroethoxy)methane	50.0 mg/kg	U	-	U	U	-	U	U	-	U
4-Bromophenylphenylether	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Butylbenzylphthalate	50.0 mg/kg	U	-	0.08	U	-	U	U	-	U
Carbazole	32.0 mg/kg	U	-	U	U	-	U	U	-	U
4-Chloroaniline	0.220 or MDL	U	-	U	U	-	U	U	-	U
4-Chloro-3-methylphenol	0.240 or MDL	U	-	U	U	-	U	U	-	U
2-Chlorophenol	0.8 mg/kg	U	-	U	U	-	U	U	-	U
4 Chlorophenylphenylether	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2 Chloronapthalene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2,4-Dinitrotoluene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Dibenzofuran	6.2 mg/kg	U	-	U	U	-	U	U	-	U
1,2-Dichlorobenzene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
1,3-Dichlorobenzene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
1,4-Dichlorobenzene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
3,3'-Dichlorobenzidine	1.4 mg/kg	U	-	U	U	-	U	U	-	U
2,4-Dichlorophenol	0.4 mg/kg	U	-	U	U	-	U	U	-	U
4,6 Dinitro-2-methylphenol	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2,4-Dimethylphenol	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2,4-Dinitrophenol	0.200 or MDL	U	-	U	U	-	U	U	-	U
2,6-Dinitrotoluene	1.0 mg/kg	U	-	U	U	-	U	U	-	U
Diethylphthalate	7.1 mg/kg	U	-	U	U	-	U	U	-	U
Dimethylphthalate	2.0 mg/kg	U	-	U	U	-	U	U	-	U
Di-n-butylphthalate	8.1 mg/kg	U	-	U	U	-	U	U	-	U
Di-n-octyphthalate	50.0 mg/kg	U	-	0.39	U	-	U	U	-	U
Fluoranthene	50.0 mg/kg	U	-	0.13	0.046	-	0.057	U	-	0.12
Fluorene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Hexachlorobenzene	0.41 mg/kg	U	-	U	U	-	U	U	-	U
Hexachlorobutadiene	8.2 mg/kg	U	-	U	U	-	U	U	-	U
Hexachloroethane	46.0 mg/kg	U	-	U	U	-	U	U	-	U
Hexachlorocyclopentadiene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Isophorone	4.4 mg/kg	U	-	U	U	-	U	U	-	U
2-Methylnaphthalene	36.4 mg/kg	U	-	U	U	-	U	U	-	U
2-Methylphenol	0.100 or MDL	U	-	U	U	-	U	U	-	U
4-Methylphenol	0.9 mg/kg	U	-	U	U	-	U	U	-	U
Naphthalene	13.0 mg/kg	U	-	U	U	-	U	U	-	U
Nitrobenzene	0.200 or MDL	U	-	U	U	-	U	U	-	U
2-Nitroaniline	0.430 or MDL	U	-	U	U	-	U	U	-	U
4 Nitroaniline	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2-Nitrophenol	0.330 or MDL	U	-	U	U	-	U	U	-	U

Waste Characteristic	Criteria	SYOSSET RANGE			PENNSYLVANIA RANGE			NEW JERSEY RANGE		
4-Nitrophenol	0.100 or MDL	U	-	U	U	-	U	U	-	U
3-Nitroaniline	0.500 or MDL	U	-	U	U	-	U	U	-	U
N-Nitroso-di-n-propylamine	0.091 mg/kg	U	-	U	U	-	U	U	-	U
N-Nitrosodiphenylamine	50.0 mg/kg	U	-	U	U	-	U	U	-	U
bis(2-chloroisopropyl)ether	50.0 mg/kg	U	-	U	U	-	U	U	-	U
Pentachlorophenol	1.0 or MDL	U	-	U	U	-	U	U	-	U
Phenanthrene	50.0 mg/kg	U	-	0.05	U	-	U	U	-	0.1
Phenol	0.03 or MDL	U	-	U	U	-	U	U	-	U
Pyrene	50.0 mg/kg	U	-	0.084	U	-	U	U	-	0.41
1,2,4-Trichlorobenzene	50.0 mg/kg	U	-	U	U	-	U	U	-	U
2,4,5-Trichlorophenol	0.1 mg/kg	U	-	U	U	-	U	U	-	U
2,4,6-Trichlorophenol	50.0 mg/kg	U	-	U	U	-	U	U	-	U
PCBs/Pesticides										
Total Pesticides	10 ppm	0	-	0.22971	0.01366	-	0.01449	0	-	0.989
Aldrin	0.041 mg/kg	U	-	U	U	-	0.00005	U	-	0.00078
alpha-BHC	0.11 mg/kg	U	-	U	0.00942	-	0.0103	U	-	U
Endrine aldehyde	*	U	-	U	U	-	U	U	-	U
Alpha-chlordane	*	U	-	0.0214	0.00137	-	0.00139	0.00034	-	0.987
beta-BHC	0.2 mg/kg	U	-	U	U	-	U	U	-	U
delta-BHC	0.3 mg/kg	U	-	U	U	-	U	U	-	U
4,4'-DDD	2.9 mg/kg	U	-	U	0.00056	-	0.00075	U	-	0.00122
4,4'-DDE	2.1 mg/kg	U	-	0.0751	U	-	0.00022	U	-	0.015
4,4'-DDT	2.1 mg/kg	U	-	0.104	U	-	U	U	-	0.0402
Dieldrin	0.044 mg/kg	U	-	0.00192	U	-	0.00062	U	-	0.0313
Endosulfan I	0.9 mg/kg	U	-	U	U	-	U	U	-	U
Endosulfan II	0.9 mg/kg	U	-	0.00029	U	-	U	U	-	U
Endosulfan Sulfate	1.0 mg/kg	U	-	U	U	-	U	U	-	U
Endrin	0.10 mg.kg	U	-	U	U	-	0.00033	U	-	U
Endrin ketone	N/A	U	-	U	U	-	U	U	-	U
gamma-BHC (Lindane)	0.06 mg/kg	U	-	U	U	-	U	U	-	U
gamma-chlordane	0.54 mg/kg	U	-	0.027	0.00147	-	0.00119	0.0002	-	0.0305
Heptachlor	0.10 mg/kg	U	-	U	U	-	U	U	-	0.00142
Heptachlor epoxide	0.02 mg/kg	U	-	U	U	-	U	U	-	0.00248
Methoxychlor	*	U	-	U	U	-	U	U	-	U
Toxaphene	*	U	-	U	U	-	U	U	-	U
Total PCBs	1.0 mg/kg	U	-	U	U	-	U	U	-	0.000348
Heavy Metals, Asbestos, and Conventionals										
Aluminum	33,000	4800	-	11100	6710	-	7170	2980	-	8660
Antimony	5.1	U	-	U	U	-	U	U	-	U
Arsenic	7.5	2.04	-	4.47	2.25	-	2.47	2.13	-	5.51
Barium	300	25.5	-	40.8	22	-	23.1	6	-	27.7
Beryllium	0.55	0.253	-	0.352	U	-	0.123	U	-	0.284
Cadmium	1	U	-	U	U	-	U	U	-	U
Chromium	*25*	7.54	-	12.3	9.85	-	10.6	6.4	-	21

Waste Characteristic	Criteria	SYOSSET RANGE			PENNSYLVANIA RANGE			NEW JERSEY RANGE		
Cobalt	30	2.67	-	4.19	1.7	-	1.73	U	-	2.14
Copper	30.6	6.91	-	15.7	3.94	-	4.12	U	-	8.62
Cyanide	3.9	U	-	U	U	-	U	U	-	U
Iron	26,000	6880	-	10800	8130	-	8140	U	-	11200
Lead	400	8.74	-	21.4	6.34	-	6.85	U	-	12.5
Manganese	550	125	-	196	74.9	-	87.9	0.484	-	101
Mercury	0.2	U	-	U	U	-	U	U	-	0.185
Nickel	23	4.34	-	6.75	12.2	-	12.3	U	-	5.07
Selenium	2	U	-	U	U	-	U	U	-	U
Silver	200	U	-	U	U	-	U	U	-	U
Thallium	20	U	-	U	U	-	U	U	-	U
Vanadium	150	11.1	-	19.4	12.9	-	13.1	14	-	19.8
Zinc	75	17.1	-	34.2	16.2	-	16.9	U	-	30.4
Asbestos Fiber Content	1% (by weight)	U	-	U	U	-	U	U	-	U
pH	5.5~7.5	5.67	-	7.05	6.8	-	6.9	5.54	-	7.13
Sulfides	50,000	U	-	U	U	-	U	U	-	U
Ammonia	40	92.5	-	365	118	-	119	61.3	-	203

Section 13

13.0 COARSE AGGREGATE AND RIPRAP

The coarse aggregate and riprap was placed on approved locations for proper flow lines of swales and along the perimeter of the landfill for several purposes including shoreline revetment to protect its integrity from wave action and other damage.

13.1 Material Source – Coarse Aggregate and Riprap

The material used for the coarse aggregate and riprap was environmentally clean stone and was in conformance with the Contract Specifications. The coarse aggregate and riprap used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill.

The 7,653.97 cy of coarse aggregate and 661.18 cy riprap was imported from a borrow site, Clinton Point Quarry, located in Clinton Point, New York. The source of this material was supplied by Tilcon New York, Inc., located in West Nyack, New York.

Table 13-1 shows the source requirements for coarse aggregate and 13-2 shows the requirement for riprap.

Table 13-1
Source: Coarse aggregate - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Aggregate Size Analysis	ASTM D-448	One per source
Permeablility	ASTM D-2434	One per source
Index Density	ASTM D-4253	One per source

Table 13-2
Source: Riprap - Laboratory Minimum Testing Requirements

Property	Test Method	Requirement
Specific Gravity	COE C.D.-C-107	Dry unit weight 165lbs/cu ft or greater
Absorption	COE C.D.-C-107	Less than 1 percent
Soundness	COE C.D.-C-137	Less than 5 percent loss
Freezing and Thawing	COE C.D.-C-144	Less than 12 percent loss in 12 cycles
Abrasion Analysis	COE C.D.-C-145	Less than 20 percent loss for 500 revolutions

Property	Test Method	Requirement
Wetting and Drying	Spec D-12.1 part 2.2 B.3	No major progressive cracking
Expansive Breakdown	COE C.D-C-148	No deterioration except minor crumbs from surface
Drop Test	Spec D-12.1 Part 2.2 B.4	No breakage or cracking

For NYSDOTSS items, certifications were submitted instead of actual laboratory test results which attest that the item meets all NYSDOTSS requirements for that item.

QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by BET using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager.

NYCDEP and URS inspected the borrow site prior to general acceptance and procurement. All coarse aggregate and riprap material was delivered to the Pennsylvania Avenue Landfill pier via barge transportation.

13.2 Installation – Coarse Aggregate and Riprap

Special care was used by BET in the placement of the coarse aggregate and riprap at the approved locations on the landfill. Coarse aggregate consisted of Type 1 and Type 2 Stone, as classified by the New York State Department of Transportation Standard Specifications (NYSDOTSS), which was comprised of clean graded stone used for roadway subbase and for box culverts and pipe bedding underneath roadways. Riprap, with diameters of six, nine and twelve inches, was used for underlayment stone, gabions, and reno mattresses. Riprap, with a minimum diameter of eighteen inches and a maximum diameter of thirty-six inches, was placed as armor stone for shoreline revetment.

The coarse aggregate and riprap was stockpiled, mechanically screened and then transported with equipment such as excavators and payloaders into articulated trucks for transport and placement.

13.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the coarse aggregate and riprap consisted of full-time observation in addition to field-testing. URS visually and continuously inspected the material delivered to the site to ensure consistency.

All field testing was performed by the Contractor, BET, and in accordance with Table 13-3, periodic quality control (QC) inspection and testing was performed as follows:

Table 13-3
Quality Control – Frequency Testing Requirements for Coarse Aggregate

Property	Test Method	Frequency
Particle-Size Analysis	ASTM D-422 (latest revision)	One test every 5,000 yd^3 of material in place; or one test every source for material with NYSDOTSS certification
Maximum Index Density	ASTM D-4253	One test every 15,000 yd^3 of material in place for roadway stone only

Table 13-4
Quality Assurance – Frequency Testing Requirements for Coarse Aggregate

Property	Test Method	Frequency
Particle-Size Analysis	ASTM D-422 (latest revision)	One test per source
Maximum Index Density	ASTM D-4253	One test per source

There was no test frequency for riprap required during construction. As the construction progressed, BET conducted the required testing for acceptance of a new source for riprap or if the material changed and did not conform to the Specifications.

Refer to Appendix G for the field tests on Coarse Aggregate and Riprap.

Photographs of the aggregate and riprap installation are included in Appendix I.

Section 14

14.0 LANDFILL GAS BLOWER AND FLARE SYSTEM

An integral part of the Remediation of the Pennsylvania Avenue Landfill was the construction of the Landfill Gas Extraction Wells and Landfill Blower and Flare System. The purpose of this section is to describe the construction and inspection of these items.

14.1 Monitoring Well Abandonment

Prior to installation of the new landfill gas (LFG) extraction wells, the Contractor abandoned existing monitoring wells in accordance with the plans and technical specifications. Prior to commencing work, the Contractor submitted for approval the personnel, equipment and methods for abandonment. For this portion of the work, the Contractor used Moretrench as a subcontractor to perform the well abandonment. Generally, abandonment consisted of overboring or removal of the casing followed by the perforation of any casing left in place. The wells were then sealed by injection of cement bentonite grout injected through a tremie pipe at the bottom of the well. Sealing was accomplished from the bottom of the well to within 5 feet below the existing ground surface. All cuttings and debris were disposed of on site within the design limits of the geomembrane in accordance with the contract requirements and covered with daily cover to prevent migration of contaminated material.

A log of the wells abandoned for this project is included in Appendix H.

Photographs of the monitoring well abandonment are included in Appendix I.

14.2 Installation of LFG Extraction Wells and Vaults

A total of 46 LFG extraction wells were generally installed at the locations and to the depths indicated on the plans and specifications except as otherwise noted. Boreholes were drilled to the depths indicated using dry drilling equipment. Slight changes in the depths and locations of the wells were made to accommodate existing site conditions or conflicts and did not materially affect the design intent.

Boring logs for completed LFG extraction wells are included in Appendix H.

Photographs of the installation of LFG extraction wells and included in Appendix I.

14.3 Installation of Landfill Gas Collection Piping and Header System

The LFG collection piping and header system was installed in general conformance to the plans and specifications using high density polyethylene (HDPE) piping, fittings and appurtenances. Manufacturer's certificates showing that the pipe used was in conformance to the project specifications are included in Appendix H. Field joining of adjacent sections was accomplished by the butt-fusion process by qualified, experienced personnel. All sections of completed pipe were air tested for leaks with pressurized air at 5 psig for a minimum of 15

minutes. Pressure testing results for the gas collection piping and header system are included in Appendix H.

Photographs of the installation of the gas collection and header system are included in Appendix I.

14.4 Installation of LFG Blower and Flare

The LFG Blower and Flare system and appurtenances were installed in accordance with the plans and specifications. The manufacturer of the blower and flare system was Perennial Energy, West Plains, MO. The system includes the following:

- connections to the gas collection headers;
- a 2,500 gallon condensate storage tank and associated piping;
- a nitrogen bottle and appurtenances for the operation of the motorized valve;
- twin knock out pots and appurtenances;
- twin landfill gas blowers and appurtenances;
- a flare control panel, rack and supports to include connections to the power supply;
- a 54" diameter, 20' high A-36 steel flare stack and appurtenances;
- a flame arrestor, gas analysis cabinet, two ultra violet flame detectors, two combustible gas indicators and appurtenances; and
- an FDNY fire alarm panel with two manual pull stations linked to a central station monitoring unit for fire alarm notification.

The LFG blower and flare system was designed and constructed to operate for anticipated flow rates from 150 to 318 SCFM. The flare system has received a NYSDEC Air Facility Registration Certificate (Registration ID: 2-6105-00762/00001; Facility DEC ID: 2-6105-00762), and has received FDNY approval for operation. The flare system has been in long-term operation for approximately six months.

14.5 Landfill Gas Flare Emissions Stack Tests

BET retained SCS Engineers and Air Recon to perform 2 stack tests to prove that the flare operated in accordance with the specification.

The first test was performed on August 31, 2007 and the second was performed on March 4, 2008. Both tests proved that the system performed in accordance with the specifications. The results are summarized in Table 14.1.

Table 14-1
Summary of Results for Landfill Gas Flare Emissions Stack Tests

	Flow	NO_x	CO	Destruction Efficiencies %	
				THC	TMOC
Test 1 8/31/2007		.031	.043	99.99%	98.5%
Test 2 3/4/2008		.024	.002	>99.997%	>99.7%

See Appendix H for summary sheets.

Photographs of the installation of the LFG Blower and Flare System are included in Appendix I.

Section 15

15.0 DESIGN MODIFICATIONS: G3

The Remediation of the Pennsylvania Avenue Landfill was constructed in general conformance with the NYSDEC approved Plans and Specifications. However, variations from the design were made with coordination of NYSDEC, NYCDEP and BET. Executed Contract Change Orders document these changes as follows:

CHANGE ORDER # 1	**Credit for Modification of Site Security**	**$73,058.40**
CHANGE ORDER # 2	**G3 2-1R Improvements to Water Main Design**	**$444,634.00**
	G3 2-2R Improvements to Landfill Alarm Design	**$124,324.00**
CHANGE ORDER # 3	**Natural Gas Service**	**$111,956.00**
CHANGE ORDER # 4	**Construction of Entrance Gate**	**$71,600.00**
CHANGE ORDER # 5	**Leachate Pumping**	**$132,656.61**
CHANGE ORDER # 6	**Additional Grading Fill**	**$294,287.40**
CHANGE ORDER # 7	**Additional Topsoil**	**$1,302,024.38**
CHANGE ORDER # 8	**Project Sign**	**$25,857.61**
CHANGE ORDER # 9	**Type I Erosion Control Fabric**	**$226,223.66**
CHANGE ORDER # 10	**Telecommunications and Electrical Upgrades**	**$202,885.00**
CHANGE ORDER # 11	**Furnish and Install Gabions**	**$11,781.25**
CHANGE ORDER # 12	**Fences**	**$169,107.15**
CHANGE ORDER # 13	**Furnish and Install Concrete Curb and Gutter**	**$40,509.00**
CHANGE ORDER # 14	**Installation of Perimeter Landfill Gas Monitoring Wells**	**$23,614.00**
CHANGE ORDER # 15	**Stop Work Order**	**$44,277.71**

Section 16

16.0 CONSTRUCTION PHOTOGRAPHS

CONTRACT LF-PAL-G3: Photographs of construction progress were taken throughout the duration of the work. Table 16.1 provides a description of each photograph.

Table 16.1
Construction Photography Log

PHOTO NO.	VIEW	DESCRIPTION
1	East	Installation of Silt Fence
2	North	Sediment Basin Construction
3	North	B.E.T. Clearing and Grubbing LF
4	North	B.E.T. Excavating and Regrading
5	West	Installation of Turbidity Barrier
6	North	Installation of Steel Sheeting
7	West	Installation of Steel Sheeting
8	West	Dewatering Piping along Coffer dam
9	West	Dewatering Pump
10	North	Excavation on South Face of LF
11	West	Excavation & Backfilling at Contaminated Beach
12	North	Construction of Stone Reventment
13	South	B.E.T. Grading Subgrade with Type 1 Grading Fill
14	North	B.E.T. Placing and Grading Type 11 Grading Fill
15	North	Chenango Installing Textured LLDPE Geomembrane
16	East	Chenango Installing Smooth LLDPE Geomembrane
17	South	Chenango Installing Geocomposite on South Slope
18	East	Installation of 16oz. Geotextile
19	South	Placing and Grading BPL
20	West	Berm and Road Construction W/Gen'l Fill
21	South	Grading of Topsoil
22	West	Placing Topsoil on Planting Island #B-3
23	East	B.E.T. Seeding area A With Traux Trillion
24	South	Installation of Type 1 Erosion Control Fabric
25	East	Installation of Type 111 Erosion Control Fabric
26	North	Spreading of Straw Mulch
27	West	Constructing Giabons With 8" Stones
28	West	Constructing Reventment with 18" Stones
29	South	B.E.T. Constructing Reno Mattresses W/6" Stone
30	West	Monitoring Well Abandonment
31	South	Installation of Extraction Well EW-2
32	Inside EW-6	Well Head Extraction Well EW-6
33	West	Gas Collection Header on Top of LF
34	West	Four Gas Headers Connecting to Manifold at Flare Station.
35	North	LFG Blowers
36	North	54"X20' High flare Stack
37	North	Flare Control Panel and Condesate Monitoring System

CONTRACT LF-FCB-E2 ELECTRICAL (INSTALLATION OF LEACHATE COLLECTION AND PRE-TREATMENT SYSTEM): Photographs of construction progress were taken throughout the duration of the work. Table 16.2 provides a description of each photograph.

Table 16.2
Construction Photography Log

PHOTO NO.	VIEW	DESCRIPTION
1	South East	Community Elect. Installing Power Center (PC#1)
2	North East	Community Elect. Installing 2" PVC Coated Galv. Steel Conduit and Low Voltage CXL Cable to PS# 1 & 2
3	North	New Property Line Pole 2-4" Risers Pipes with 15KV Elect. Cables Extent Through Riser Pipe VIA EMH #1
4	North West	Installation of Switches on Exist Pole for Power to P.A.L. Located at the Corner of Flatlands and Penn. Ave.
5	South East	High Potential Proof Testing (HI-POT) By Con Edison Workers in Progress
6	South West	Continuity Test Performed by Con Edison Workers in Progress
7	North East	Optical Time Domain Reflector (OTDR) Testing of Optical Fiber Cables (OFC)

CONTRACT LF-FCB-G2 GENERAL (INSTALLATION OF LEACHATE COLLECTION AND PRE-TREATMENT SYSTEM): Photographs of construction progress were taken throughout the duration of the work. Table 16.3 provides a description of each photograph.

Table 16.3
Construction Photography Log

PHOTO NO.	VIEW	DESCRIPTION
1	West	Stone Bedding over Geomembrane Barrier Below Leachate Pretreament Building
2	East	Leachate Pretreatment Building Floor, Concrete over Wire Mesh
3	Northwest	Butler Building Being Constructed To House Leachate Pretreatment System
4	North	Butler Building Being Constructed To House Leachate Pretreatment System
5	East	Cinder Block Control Room in Leachate pretreatment Building
6	Northwest	Carbon Tank Being Installed in the Leachate Pretreatment Building
7	Northwest	Geo-Tech Grouting TMD as Sheeting is Removed from Interceptor Trench
8	Southeast	Soil Solutions Driving Sheet Piles Along Intercoptor Trench in Preparation for Excavation
9	West	Contractor Installing 4" HDPE By-Pass Line to Centrate Wet Well at 26th Ward
10	South	Air Monitoring on Going During Interceptor Trench Construction
11	Northwest	Contractor Installing 100-Mill HDPE Geomembrane in 750' Long Interceptor Trench
12	South	Dewatering Piping at Interceptor Trench

PHOTO NO.	VIEW	DESCRIPTION
13	South	Air Testing Geomembrane Welds in Interceptor Trench
14	North	Contractor Installing Pump Station No. 1 in Interceptor Trench
15	East	Contractor Placing and Joining Geotextile over Filter Stones in Interceptor Trench
16	South	Excavation of Interceptor Trench to 1'0 Below TMD
17	South	Samleen Doing Peel and Shear Tests on Welds of 100 Mil HDPE Liner in Interceptor Trench
18	South	Filter Stones Type 1 and 2 Being Place in Interceptor Trench
19	North	Compaction Testing of Select Fill First Lift in Interception Trench
20	West	Installation of Backflow Preventer in Leachate Pretreatment Building
21	West	DCA Placing Bedding Material for Placement of 3"X 6" Force Main
22	Northeast	DCA Installing Valve Chamber No.2 with 3"X 6" Leachate HDPE Force Main
23	South	DCA Installing Valve Chamber No.1 at Sta. A1+92
24	In MH	Air Pressure Testing of 3" Carrier Pipe at Leak Detection MH Sta. B15+00
25	Northwest	Air Pressure Testing of 6" HDPE Containment Pipe at 15 PSI
26	North	Restoration of Beach Area Spreading Select Fill
27	West	DCA Hydrostatical Tested 4" HDPE Line to 26th Ward After Pipe Repair
28	West	Centrum Jet Fuel Hydrostatical Testing All Piping in Leachate Pretreatment Bldg. for Leaks
29	North	Citric Acid Storage Tank T-203 with Acid Feed Pump P-203
30	Southwest	Leachate Pretreatment Plant Sump Pit
31	Northeast	Variable Speed Transfer Pumps P-201 and P-202 behind Pumps are (2) Bag Filters F-201 and F-202
32	Northwest	Oil Water Separator T-201 and Oil Water Separator Product Tank T-202
33	Northwest	Discharge Pumps P-301 and P-302 Discharging pretreated Leachate to 26th Ward
34	Northeast	View Showing Carbon Adsorption Tank PV-301 and PV-302 on the Right and on the Left Discharge Suction Tank T-301 in The Leachate Pretreatment Building

Section 17

CONTRACT LF-FCB-G2 GENERAL

17.0 INTRODUCTION – REMEDIATION OF FRESH CREEK BASIN LF-FCB-G-2/E-2

See introduction used for Contract No. LF-PAL-G3 except as noted

- General Contractor: DCA Construction, Inc was the general contractor that was contracted by the NYCDEP to construct the remediation components as described in the contract drawings and specifications for this contract.

- Electrical Contractor: Tisio Electric (see Section 24)

17.1 Site History

Prior to the commencement of the LF-PAL-G3 contract work, NYCDEP and NYSDEC managed the Fresh Creek Basin Remediation Project, Contract LF-FCB-G-2/E-2, along the western shore and northern boundary of the Pennsylvania Avenue Landfill. This work involved the installation of a leachate collection and pre-treatment system to serve as an interim remedial measure for mitigating the oil outbreaks from the landfill into Fresh Creek Basin and Jamaica Bay.

17.2 Existing Site Conditions

See Contract LF-FCB-G2 Spec SP-6.

17.3 Remedial Construction History

Contract bid documents for the landfill remediation construction were entitled "Remediation of Fresh Creek Basin, Capital project EP-8, Contract LF-FCB-G2/E2 NYCDEP Site 224002," dated May 2000, prepared by URS Corporation. The NYCDEP awarded the general construction contract to DCA Construction, Inc. of 148 Main Street Staten Island, NY 10307 the lowest responsible bidder, in a contract amount of $4,420,000. The NYCDEP awarded the electrical contract to Tisio. The Notice to Proceed was issued on 10/17/2000, which notified DCA/Tisio to fully complete the work on or before 10/23/2001 (273 consecutive calendar days).

DCA/Tisio commenced work on 01/24/2001 and was substantially complete on 04/19/2002, 453 Calendar days.

17.4 Components of the Remedial Construction Contract

- Site Preparation: Surveying and construction layout services; erosion and sediment control measures which were maintained throughout the duration of the contract; excavation included waste regarding and backfill; grading fill.

- Interceptor Trench: Construction of 750 foot-long Interceptor Trench along Fresh Creek Basin intercepting a high source of contaminant and conveyed to a pretreatment plant on the landfill.

- Geomembrane Barrier Protection: Installation of 100 mil and 40 mil high density polyethylene (HDPE) liner. 100 mil HDPE for the cut-off wall in the interceptor Trench and 40 mil HDPE for the gas barrier below the Leachate Pretreatment Building.

- Leachate Pretreatment System: Building housing a process system including acid injection, oil water separator, particulate filtration, carbon adsorption system, and a pretreated leachate conveyance system to the 26th Ward Wastewater Treatment Facility.

All work under the contract was completed by DCA, which utilized the following subcontractors.

SUBCONTRACTORS	ACTIVITY PERFORMED
Centrum Jet Fuel Inc.	Installation of Leachate processing Equipment
Griffin Dewatering New England, Inc.	Dewatering at interceptor Trench Construction
Geo - Tech	Grouting TMD as sheeting is removed
Environmental Energy Associates	Air Monitoring
Samleen	Geomembrane welding and nondestructive testing and start-up
PCS System Integrators & contractors	Controls and Instrumentation
STL Seven Trench Laboratories	Operating Maintenance of Leachate System

17.5 Existing Documents

The following documents describe the construction, quality control and basis of the design of the remediation contract:

- INFORMATION FOR BIDDERS, STANDARD CONSTRUCTION CONTRACT, AND SPECIFICATIONS FOR FURNISHING ALL LABOR AND MATERIAL NECESSARY FOR: Contract LF-FCB-G2 Remedial Action for Pennsylvania Avenue Landfill, Borough of Brooklyn - New York, May 2000, URS Corporation, Mack Centre II, Paramus, NJ.

- Remediation of Fresh Creek Basin, Capital Project EP-8, Contract No. LF-FCB-G2, NYSDEC Site 224002, May 2000, URS Corporation.

- Record of Decision, February 1995 - Prepared by NYSDEC.

- Remedial Investigation Report, May 1994 - Prepared by URS Consultants, now URS Corporation.

- Feasibility Study Report, September 1994 - Prepared by URS Consultants, now URS Corporation.

- Pennsylvania and Fountain Avenue Landfills Geotechnical Investigation Report, July 1996 - Prepared by URS Consultants, now URS Corporation.

Section 18

18.0 REMEDIATION OF FRESH CREEK BASIN INTERCEPTOR TRENCH

18.1 Installation of Steel Sheeting

The Contractor submitted a steel sheeting design signed by a professional engineer licensed to practice in New York State. The sheeting was installed around the entire limits of the area to be excavated. The sheeting was installed to the limits specified in the approved sheeting design. The sheets installed were made of A-36 steel with a section modulus (Sx) of 10.55. Standard lengths of twenty-five feet were used.

Photographs of the steel sheeting installation are included in Appendix I (LF-FBC-G2).

18.2 Dewatering

Dewatering activities were performed independently for waters above and below the TMD. The Contractor's dewatering plan for above the TMD included a system of wells, valves, pumps and associated piping installed along the perimeter of the cofferdam. The effluent from the dewatering above the TMD was directed to an oil/water separator before being discharged into recharge pits on the landfill. The Contractor's dewatering plan for below the TMD included 6 deep wells installed in the UGA. The effluent from the deep wells was directed to a stone energy dissipater before being discharged into the adjacent Fresh Creek Basin. Effluent samples were taken for this discharge to verify it met discharge criteria. Test results are included in Appendix J.

Photographs of the dewatering operations for above and below the TMD are included in Appendix I. (LF-FCB-G2)

18.3 Excavation and Backfill

Excavation of the Interceptor Trench area proceeded with the contractor using backhoes to remove the material from the excavation for disposal on the landfill in designated areas for disposal. The material removed and placed on the landfill was covered after disposal to prevent migration of soils.

URS continuously monitored the excavation to ensure that the TMD was not penetrated and could remain as a barrier between the leachate and the aquifer. The material used for backfill of the excavation was in conformance with the Contract Specifications. All backfill used on the project was tested and approved per the QA/QC requirement of the Specifications prior to use at the Pennsylvania Avenue Landfill.

The backfill material was a select fill material of good and uniform quality. Backfill was free of refuse, hard clods, woody vegetation, stiff clay, construction debris, boulders, stones larger than one and one-half inches, hydrocarbons, petroleum materials or chemicals toxic to plants, other miscellaneous or otherwise unstable or undesirable materials, and other deleterious

inclusions. The bottom of the excavation was surveyed prior to backfill being placed to the original grade.

Photographs of the contaminated beach excavation and backfill operations are included in Appendix I.(LF-FCB-G2).

18.4 Installation – Aggregate

Special care was used by DCA in the placement of the filtering and collection aggregate was placed in the interceptor Trench. Aggregate consisted of Type 1 Type 2 and collection Stone, as classified by the New York State Department of Transportation Standard Specifications (NYSDOTSS), which was comprised of clean graded stone used for filtering, collection and drainage. Collection stone with a minimum diameter of four inches and a maximum diameter of thirty-six inches, was placed as collection stone in the interceptor trench.

18.5 Installation of 750 Foot-Long Interceptor Trench

The interceptor trench is located on the west side of the landfill along Fresh Creek Basin intercepting a high source of contaminants in the groundwater/leachate mound in this area. The trench depth is 1'-0 below the Tidal Marsh Deposit (TMD), seven hundred and fifty feet in length and six feet wide.

The interceptor trench is constructed with filter collection stones and geomembrane. Within the interceptor trench are two five-foot-diameter HDPE pump stations located three hundred and fifty feet apart.

Each pump station includes a groundwater/leachate variable frequency drive (VFD) pump. Pump speed is based on a set point level in the pump station of -2.5'.

Within the pump stations are floating product skimmers. When product is detected, it is pumped to an above ground product storage tank. Outside each pump station is a five foot diameter HDPE valve chamber which enables each pump station to be isolated for any needed repairs. Outside each pump station is also a power source to the pump station and a Programmable Logic Controller (PLC) which enables the control and monitoring of the pump station from the control room in the leachate Pre-treatment Building.

Leachate is continuously pumped from the pump stations via a 1800 foot long HDPE double walled force main, which consists of a three-inch-diameter carrier pipe and a six-inch-diameter containment pipe. The containment pipe has leak detection at four low point locations. Along the force main is a drain manhole and an air/vacuum release manhole.

Photographs of the interceptor trench are included in Appendix I.

18.6 Leachate Pre-Treatment Building

The leachate pre-treatment system and its control room are enclosed within a single structure. The building is a 34' x 50' Butler pre-fabricated building and is approximately eighteen foot high at the eave. The building has two roll-up doors, one seven feet wide and the other ten feet wide for equipment maintenance. The building has a dedicated heating and ventilation system, and has a containment system and sump pit for any leachate system run-off.

Photographs of the Pre-treatment Building are included in Appendix I.

18.7 Leachate Pre-Treatment System

Influent to the leachate pre-treatment system is pumped from the interceptor trench. The three-inch-diameter HDPE force main transitions to two-inch-diameter Schedule 80 PVC piping at the entrance to the building. The leachate treatment scheme is as follows: Citric acid is added to the raw leachate based on the pH and influent flow (gpm). The leachate is conveyed to an oil/water separator (OWS) which removes any product to an oil/water separator product tank (OWSP). The leachate is then transferred via two variable frequency drive (VFD) pumps to two inline filtering systems containing 150 micron filter bags for solids removal. The filtrate is then treated in a Carbon Adsorption system which consists of two pressure vessels with a working pressure of 75 psi. The flow distribution within this system can be controlled by a series of valves either in parallel or in series. Each carbon tank is eight feet in diameter and thirty feet high, and holds 5,000 lbs of activated carbon. The effluent from this system is discharged to a secondary filter containing a 100 micron filter bag that traps any carbon solids.

This pre-treated leachate is pumped to a 500 gal HDPE discharge suction tank (T-301), which has a level sensor that controls two 122 gpm leachate discharge pumps. Either one or both will activate depending on the level in the discharge tank. This effluent is then discharged to the 26th Ward Wastewater Treatment Facility via a four-inch-diameter HDPE force main. The force main is approximately 4860 feet long and connects to a pressure relief manhole, and then by gravity via a four-inch-diameter steel pipe approximately thirty-five feet below grade to a junction chamber at the north end of the 26th Ward facility. The four-inch-diameter force main has two drain manholes and one air/vacuum release manhole along.

Photographs of the Leachate Pre-treatment System are included in Appendix I.

Section 19

19.0 GEOTEXTILE

A 16 oz. geotextile was used as cushion and separation material.

19.1 Manufacturer

The manufacturer of the geotextile was American Engineering Fabrics, Inc. 1 Coffin Avenue New Bedford, Massachusetts 02746. The geotextile consisted of a non-woven, needle-punched polypropylene polymer. The cushion/separation geotextile fabric consisted of a pervious sheet woven or spun bonded of polypropylene filament consisting by weight of at least 85 percent polypropylene and containing stabilizers and inhibitors added to the bare plastic to make the filaments resistant to deterioration due to ultraviolet and/or heat exposure. The material used for the geotextile was manufactured from polymers formulated with hindered amine light stabilizers (HALS) to enhance the geotextiles' resistance to environmental degradation.

19.2 Installation

All geotextiles delivered to the site were tested by the manufacturer prior to shipment to ensure that the physical and mechanical properties of the delivered geotextiles were in accordance with the required material properties, test methods, values and units as per the Contract Specifications. See Table 19-1 for the minimum physical property requirements for geotextile.

Refer to Appendix J for copies of the geotextile certified test reports.

The geotextiles were installed by DCA at the locations shown on the Contract Drawings. Geotextile seams within the Interceptor Trench, consisted of adjacent panels sewn securely together.

Geotextiles were not exposed to precipitation prior to installation and were not exposed to direct sunlight for more than 24 hours prior to placement.

All geotextiles used were seamed by stitching methods as recommended by the manufacturer and approved by URS. Any sewing was done using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. All sewn seams were continuous and spot seaming was not permitted for sewn seams. Prior to stitching, longitudinal geotextile overlaps were a minimum of six inches and end of roll overlaps were a minimum of three feet. Seams were oriented across the trench unless otherwise specified by URS.

Table 19-1
Minimum Physical Property Requirements for Geotextile
(Minimum Average Roll Values, except AOS)

Fabric Property	Unit	Test Method	Cushion	Separation
Fabric Weight	oz/yd^2	ASTM D-5261	16	NA
Grab Strength	lbs	ADTM D-4632	NA	30
Grab Elongation at break	%	ASTM D-4632	NA	35
Puncture Resistance	lbs	ASTM D-4833	NA	55
Mullen Burst Strength	psi	ASTM D-3786	400	225

NA = Not Applicable

19.3 Quality Control/Quality Assurance During Installation

URS examined the geotextile rolls upon delivery to the site and reported any deviation from the Contract Specifications to DCA. In these instances, DCA performed the necessary repairs and replaced any damaged products delivered to the site, as directed by URS.

Upon delivery of the rolls of geotextiles, URS retained samples and forwarded them to an independent laboratory for testing to ensure conformance to the Contract Specifications. These samples were taken across the entire width of the roll and did not include the first three linear feet. Samples measured three feet in the roll long dimension, and were removed along the entire roll width. Quality control and quality assurance during construction of the geotextile consisted of physical laboratory testing as outlined in the Contract Specifications.

Refer to Appendix J for the physical laboratory testing results.

Any holes or tears which developed in the geotextile were repaired by DCA, by placing a fabric patch of the same geotextile was seamed into place no closer than three inches from any edge of the patch. Prior to repair, DCA completely removed any soil or other material which penetrated a damaged geotextile. Tears, holes, or other damage to the fabric were repaired to the satisfaction of URS and the NYCDEP.

Photographs of the installation of the geotextile are included in Appendix I.

Section 20

20.0 COARSE AGGREGATE AND RIPRAP

The coarse aggregate and riprap was placed in the Interceptor Trench as filtering material for intercepting the leachate.

20.1 Material Source – Coarse Aggregate and Riprap

The material used for the coarse aggregate and riprap was environmentally clean stone and was in general conformance with the Contract Specifications. The coarse aggregate and riprap used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for use at the Pennsylvania Avenue Landfill.

The coarse aggregate and riprap was imported from a borrow site, Haverstraw Quarry. The source of this material was Tilcon supplied by Rizzo Associates Inc. P.O. Box 160 Valley Stream, New York 11582.

Table 20-1 shows the source requirements for coarse aggregate and 20-2 shows the requirement for riprap.

Table 20-1
Source: Coarse aggregate - Laboratory Minimum Testing Requirements

Property	Test Method	Frequency
Particle-Size Analysis with Hydrometer	ASTM D-422	One per source
Aggregate Size Analysis	ASTM D-448	One per source
Permeablility	ASTM D-2434	One per source
Index Density	ASTM D-4253	One per source

Table 20-2
Source: Riprap - Laboratory Minimum Testing Requirements

Property	Test Method	Requirement
Specific Gravity	COE C.D.-C-107	Dry unit weight 165 lbs/cu ft or greater
Absorption	COE C.D.-C-107	Less than 1 percent
Soundness	COE C.D.-C-137	Less than 5 percent loss
Freezing and Thawing	COE C.D.-C-144	Less than 12 percent loss in 12 cycles
Abrasion Analysis	COE C.D.-C-145	Less than 20 percent loss for 500 revolutions
Wetting and Drying	Spec D-12.1 part 2.2 B.3	No major progressive cracking
Expansive Breakdown	COE C.D-C-148	No deterioration except minor crumbs from surface
Drop Test	Spec D-12.1 Part 2.2 B.4	No breakage or cracking

For NYSDOTSS items, certifications were submitted instead of actual laboratory test results which attest that the item meets all NYSDOTSS requirements for that item.

QA Geotechnical Inspectors visually and periodically inspected the material delivered to the site to ensure consistency. If changes in the material occurred, the QA Site Manager rejected any work performed by DCA using the new material until the pre-construction QA and QC procedures were executed and approved by the QA Site Manager

20.2 Installation – Coarse Aggregate and Riprap

Special care was used by DCA in the placement of the filtering and collection aggregate in the interceptor trench. Aggregate consisted of Type 1 Type 2 and collection Stone, as classified by the New York State Department of Transportation Standard Specifications (NYSDOTSS), which was comprised of clean graded stone used for filtering, collection and pavement subbase. Collection stone with a minimum diameter of four inches and a maximum diameter of twelve inches was placed as collection stone in interceptor trench.

20.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the coarse aggregate and riprap consisted of full-time observation. URS visually and continuously inspected the material delivered to the site to ensure consistency.

All field testing was performed by the Contractor and in accordance with Table 20-3, periodic quality control (QC) inspection and testing was performed as follows:

Table 20-3
Quality Control – Frequency Testing Requirements for Coarse Aggregate

Property	Test Method	Frequency
Particle-Size Analysis	ASTM D-422 (latest revision)	One test every 5,000 yd^3 of material in place; or one test every source for material with NYSDOTSS certification
Maximum Index Density	ASTM D-4253	One test every 15,000 yd^3 of material in place for roadway stone only

Table 20-4
Quality Assurance – Frequency Testing Requirements for Coarse Aggregate

Property	Test Method	Frequency
Particle-Size Analysis	ASTM D-422 (latest revision)	One test per source
Maximum Index Density	ASTM D-4253	One test per source

There was no test frequency for riprap required during construction. As the construction progressed, the contractor conducted the required testing for acceptance of a new source for riprap or if the material changed and did not conform to the Specifications.

Refer to Appendix J for the field tests on Coarse Aggregate and Riprap.

Photographs of the aggregate and riprap installation within the interceptor trench are included in Appendix I.

Section 21

21.0 HDPE GEOMEMBRANE

The Contract Specifications and Drawings required the installation of a High Density Polyethylene (HDPE) Geomembrane cut-off wall in the interceptor trench.

21.1 Manufacturer – HDPE Geomembrane

The manufacturer of the HDPE geomembrane was responsible for the production of the materials and for quality control during production including certification that its materials conformed to the Contract Specifications. AGRU America Inc. 500 Garrison Road Georgetown, S.C. 29440 submitted certification that the HDPE geomembrane was formulated and manufactured from 100% virgin raw material, specifically compounded for use in hydraulic structures, and only first quality plastics and elastomers were used. In addition, AGRU America Inc. submitted written certification that each lot of material met or exceeded the Technical Specifications.

Refer to Appendix J for Certificate of Analysis Testing.

The HDPE geomembrane used on the project was tested and approved per the QA/QC requirements of the Specifications prior to being imported for placement at the Pennsylvania Avenue Landfill.

21.2 Installation – HDPE Geomembrane

The geosynthetics on this project were installed by DCA, who was responsible for on-site management of the HDPE geomembrane, including handling, storage, placement, and installation in accordance with the approved HDPE geomembrane contract drawings.

All roll goods were unwound and inspected on both sides for unmixed or poorly dispersed ingredients, thin spots, the presence of contaminants or foreign particles, pin holes, tears, punctures, blisters, and any other defects. All defects and impurities were removed or repaired before the membrane was placed on the landfill.

21.3 Quality Control/Quality Assurance During Installation

Quality Control (QC) during HDPE geomembrane installation was performed by DCA's geomembrane installation subcontractor, Samleen. URS performed Quality Assurance (QA) of all installation and field-testing.

Refer to Appendix J for copies of the QA Geosynthetic Daily Inspection Reports.

21.4 Placement – HDPE Geomembrane

When the TMD depth was verified, the HDPE geomembrane panels were deployed to the intended depth, height and location by DCA using earth moving equipment and laborers.

In general, seams were oriented vertically. Bottom seams were a continuation of the vertical seam.

The HDPE geomembrane panels were carefully placed at the proper location and each panel was overlapped at a minimum of three inches, as required for proper seaming. Each HDPE geomembrane was inspected by URS and Samleen personnel for any defects as it was placed. The HDPE geomembrane panels were installed in a relaxed condition free of tension or stress.

21.5 Trial Seams (Start-Ups) – HDPE Geomembrane

HDPE geomembrane trial seams, also known as qualifying seams or start-ups, were an integral aspect of the QA/QC procedures. The purpose of these trail seams are to serve as pre-qualifying experience for personnel, equipment and procedures for field fabricating seams on the geomembrane material under the same climatic conditions as the actual field production seams are performed. The test strips were made on narrow pieces of excess geomembrane with a minimum length of three feet.

The goal of the start-ups was to reproduce all aspects of the actual production field seaming activities intended to be performed in the immediately upcoming work sessions in order to determine equipment and operator proficiency. For the double hot-wedge fusion welding process, URS required that start-ups be performed every four hours, whenever personnel or equipment changed, and when climatic conditions reflected wide changes in geomembrane temperature (based on changes in ambient air temperature).

The start-ups were destructively tested for peel and shear as soon as the seam cooled using a field tensiometer. A minimum of ten one-inch wide specimens of each cutout test weld were subjected to shear and peel adhesion testing at the site (i.e., five one-inch specimens for peel, and five one-inch specimens for shear testing.) If all specimens passed, the technician was approved to weld. If any one of the test specimens failed, a new test strip was fabricated by varying the temperature, speed or pressure, as applicable. If additional specimens failed, the seaming apparatus and technician were not allowed to seam until the deficiencies were corrected and successful start-ups were achieved.

Refer to Appendix J for Trail Seam Test Results.

21.6 HDPE Geomembrane Field Seaming and Joining

The field seaming of the deployed HDPE geomembrane panels was an integral aspect of the proper functioning of the HDPE geomembrane as the cut off wall in the interceptor trench.

Prior to field seaming, the contact surfaces of the panels to be seamed were wiped clean to remove all dirt, dust, moisture and other foreign materials. The lap joints were formed by lapping the edges of the panels at a minimum of three inches. Any portion of the HDPE geomembrane damaged during installation was removed or repaired using an additional piece of HDPE geomembrane, as per the Technical Specifications.

Refer to Appendix J for Field Seaming and Joining Results.

21.7 Non-Destructive Testing of Field Seams – HDPE Geomembrane

The primary purpose of the non-destructive seam testing was to ensure continuity along the entire seam length. Non-destructive testing was performed by Samleen and witnessed by URS to validate 100% of the seams.

For this project, all field seams were non-destructively tested over their full length using either vacuum box or pressurized air-channel testing. Air lance testing was not permitted as stated in the Contract Specifications.

Refer to Appendix J for the non-destructive test results.

21.8 Destructive Testing of Field Seams – HDPE Geomembrane

Samples from the production of field-fabricated geomembrane seams for destructive testing were taken at a minimum frequency of one destructive test sample for every 500 linear feet of field seam, as specified in the Contract Specifications. Destructive testing of the geomembrane seams was performed by cutting out and removing a portion of the completed production field seam, and then further dividing the sample into specimens for testing in accordance with ASTM D 4437 – Practice for Determining the Integrity of Field Seams used in Joining Flexible Polymetric Sheet Geomembranes.

Refer to Appendix J for the destructive testing results.

Section 22

22.0 FORCE MAIN

The Raw Leachate Force Main is a 3" X 6", SDR 21 High Density Polyethylene (HDPE) Dual Containment piping system used for transporting the groundwater/leachate from the interceptor trench to the pre-treatment building. The Pretreated Leachate Force Main is a four-inch-diameter SDR 26 (HDPE) single containment piping system used for transporting the groundwater/leachate from the pre-treatment building to the 26th Ward facility.

22.1 Excavation and Backfill

Excavation of the force main trench proceeded with the contractor using backhoes and front end loaders to remove the material from the excavation site for disposal on the landfill in designated areas for disposal. The material removed and placed on the landfill was covered after disposal to prevent migration of soils.

The material used for backfill of the excavation was in conformance with the Contract Specifications. All backfill used on the project was tested and approved per the QA/QC requirement of the Specifications prior to use at the Pennsylvania Avenue Landfill.

In general, the backfill material was a general fill material of good and uniform quality. The backfill was free of refuse, hard clods, woody vegetation, stiff clay, construction debris, boulders, stones larger than one and one-half inches, hydrocarbons, petroleum materials or chemicals toxic to plants, other miscellaneous or otherwise unstable or undesirable materials, and other deleterious inclusions. The material source for this backfill was Evergreen Recycling of Corona, 127-50 Northern Blvd Flushing, NY 11368. The bottom of the excavation was surveyed prior to backfill being placed to the original grade.

22.2 Installation of Force Main

The force main was installed to a minimum of four feet below grade to the top of pipe. All force main piping was installed in a bedding of bedding stone to six inches above the pipe. Pipe installation was in accordance with the manufacturers recommendations.

Refer to Appendix I for photos of installation of force main.

22.3 Testing

All HDPE pipe was tested for leaks in the presence of a URS inspector. The force mains were pneumatic tested at 15 PSI for a duration of four hours. A constant pressure was maintained for the duration of testing, and all piping was exposed during testing for visual inspection.

Refer to Appendix J for Daily Inspector's Reports of visual inspection of pressure test.

Section 23

23.0 LEACHATE PRE-TREATMENT PLANT

An integral part of the Remediation of the Pennsylvania Avenue Landfill was the construction of the leachate pre-treatment plant. This plant consisted of a pre-treatment building, acid feed system, oil water separator, carbon tank units and control room. The purpose is to treat the leachate, which is pumped from the interceptor trench, and then discharge the pre-treated leachate to the 26th Ward Water Pollution Control Plant (WPCP).

23.1 Installation of Pre-Treatment Building

The pre-treatment building was installed in conformance to the plans and specifications (LF-FCB-G-2) by DCA Construction (DCA). As specified in the design drawings, DCA excavated the building area to 5 feet below grade. Concrete bedding stone was then placed to 3 feet below grade which is at the top of the footings. A 40-mil HDPE geomembrane vapor barrier (AGRU America Inc), with cushion geotextile above and below the geomembrane, was installed inside the building foundations at 3 feet below grade. All pipes were fitted with a vapor barrier penetration boot. Concrete bedding stone was placed over the geomembrane to within 1 foot of the top of the foundation. DCA installed a 6-inch-thick reinforced concrete slab floor for the operation area The concrete foundation was installed using concrete from Greco Concrete Company. This foundation measures 50'6" x 34'6". An acid containment area was built on top of the slab floor measuring 4'x4'x1' for the storage of the acid feed system.

The building is a Butler pre-fabricated building and approximately 18 feet high at the eave. The building has two roll-up doors; one is 7 feet wide and the other 10 feet wide for equipment maintenance. Two metal personnel access doors were installed into the main area and one into the enclosed equipment room. The contractor erected the building based on the contract drawings and specifications and submitted for approval the following before construction:

- Structural framing system
- Roof panels
- Wall panels
- Insulation
- Vapor retarders
- Trim and closures
- Doors
- Louvers
- Dampers
- Accessories

Refer to Appendix A for Daily Reports.

Refer to the Detailed As-Built Drawings for the final layout.

23.2 Installation of Leachate Pre-Treatment Equipment, Controls and Instrumentation

The leachate pre-treatment system was installed by following the design drawings and specifications. The contractor submitted for approval the following: equipment and instrumentation lists; manufacturer's descriptive and technical literature; performance charts and graphs; complete electrical, schematic and wiring diagrams for instrumentation and equipment and logic and ladder diagrams for PLC; operating and maintenance instruction for each different type of equipment, instrument or control system; equipment layout and piping drawing; and engineering description of sequence of operations and control methodology. URS reviewed and approved all submittals, and copies of the approvals are in the project site files.

The following is a list of all component parts which make up the leachate pre-treatment system. All components were approved and inspectors oversaw the installation of all component parts:

- Submersible sump pump (P-105) and Float Switch (LSHL-105): manufactured by Deming pump. Discharge size is 1 ½ inch. Made of Stainless steel. The motor is a 115 volt, single phase, 60 cycle, 3,400 RPM, ½ horsepower with Class F insulation, explosion proof, Class I, Division 2, group D Environment. The pump operates at 20 gpm at 15 feet TDH. The float switch is explosion proof, suitable for Class I, Division 2, Group D environment and is used for automatic on/off control of pump.

- Product storage tank (T-110): manufactured by Highland Tank is a double-walled, ASTM-A-36 cold rolled steel tank which is 10 gauge. The tank capacity is 500 gallons with dimensions of 4 feet in diameter by 5 feet 5 inches in length. Pipe and instrument connections were in accordance with ANSI Class 150. The following flanged 150 lb tank fittings were furnished: one 4-inch vent with mushroom rain cap and PVC bird and insect screen; two ¾ -inch product inlets; one 2-inch drain port; one 24-inch manway with blind flange; one fitting for level transmitter (LT-110); external leakage monitoring pipe and emergency vent. The tank was tested by UL142 tank code specifications. Epoxy primer and urethane topcoat with No. 6 commercial blast was used.

- Submersible pumps (P-101 and P-103): manufactured by Goulds. These pumps have a maximum solid size of ¾-inch and a discharge size of 2-inch NPT. It is a cast iron impeller and casing, 400 series stainless steel shaft and with carbon/ceramic/BUNA mechanical seals. The motor is a 460 Volt, three phase, 60 cycle, ¾ horsepower, with Class B insulation. Minimum performance is at 15 gpm at 50 feet TDH. These pumps were designed for continuous operation using a variable frequency drive and are capable of running dry without damage to components.

- Product Recovery System (P-102 and P-104): manufacturer is ORS Environmental Systems Filter Scavenger System. It is an 18.5 inch diameter product collection buoy

assembly with lid, 60 mesh cartridge oil filter, check valve and float switches to determine product (LS-102A, LS-104A) and water (LS-102B, LS-104B). There is an explosion proof control panel with a ¼ HP, 230 V pump/motor. The gear pump has a capacity of 4 gpm at a discharge pressure of 65 psi.

- Acid Feed Pump (P-203): manufactured by Prominent Extronic. The pump operates at 3.2 gph at 87 psi and 1.66 ml/stroke with a suction lift of 16 feet. The pump is made to handle sulfuric acid so therefore the housing is epoxy coated aluminum. Its diaphragm is PTFE faced EPDM with steel core, the liquid end and seals are PTFE, and the valve balls are Duran 50. This pump is explosion proof, suitable for Class I, Division 2, Group D Environments. A Prominent PVDF multi-function valve, injection valve and foot valve with strainer were furnished. This multifunction valve is used for backpressure, anti-siphon, pressure relief, priming and draining the discharge line.

- Acid Storage Tank (T-203): manufactured by Nalgene Industrial Products. The tank is an 80 gallon, PVDF flat-bottomed cylindrical tank that measures 24 inches in diameter by 48 inches in height.

- Portable Drum Pump (P-206) and Spill Containment Dike: manufactured by Lutz drum pump. The pump motor is made of PVDF and is 115V, 60Hz, 620 Watts, explosion-proof which is suitable for Class I , Division 2, Group D Environments. This pump and attached hose are both resistant to sulfuric acid. The spill containment dike around the acid drums is 2 ½ inches high and constructed of flexible polyurethane.

- Static Mixer (M-101): manufactured by Cole Palmer. It is constructed of white schedule 40 PVC end adapters, clear schedule 40 PVC tube and six 316 stainless steel elements.

- Oil/Water Separator (T-201): manufactured by Great Lakes Environmental. The type is slant rib coalescing. It is made of Class A carbon steel with FRP coalescing media. The separator has hatches for easy access to interior components, lifting lugs for media pack, and coal tar epoxy finish and zinc primer interior coating. The unit has a pitched sludge compartment with two flanged sludge withdrawal ports. The unit is equipped with a 4-inch flanged fitting for attachment to a vent pipe, and a level tube fitting for connecting to the level transmitter (LT-201). It also has a 3 inch flanged inlet connection, 2 inch flanged connections for the solids discharge line and a 3 inch connection to the oil/water separator storage tank.

- Oil/Water Separator (OWSP) Storage Tank (T-202): manufactured by Highland Tank. This tank is constructed of ASTM-A-36 cold rolled steel and has a welded steel cone top, flat bottom with a single walled construction. It has a 12-gauge shell and bottom head and 12-gauge coned top head. The tank has a capacity of 500 gallons. The pipe and instrument connections are in accordance with ANSI Class

150. The following 150 lb. tank fittings were furnished: one 4-inch vent, one 3-inch fill, one 1 ¼-inch drain, one 24-inch manway with blind flange, and one fitting for a level transmitter. The interior and exterior finish is epoxy primer and urethane topcoat with No. 6 commercial blast. The tank was tested using UL 142 tank code specifications.

- Transfer Pumps (P-201 and P-202): manufactured by Gould Pumps, Inc. These pumps are closed-coupled centrifugal pumps with a 5 15/16-inch diameter impeller that has a maximum solid size of ½ -inch. The motor is 460 volt, 3 phase, 60 cycle, 5 horsepower and explosion proof. The pump and motor are suitable for Class I, Division 2, Group D environment. The pumps are made of AISI Type 304 stainless steel, and the minimum performance is 30 gpm at 153 feet TDH. The suction inlet is 2 inches in diameter, and discharge outlet is 1 inch in diameter.

- Oil/water Separator (OWSP) pump (P-204): manufactured by Gould Pumps Inc. This pump is a closed-coupled centrifugal pump with a 3 3/16-inch diameter impeller. The motor is a 460 volt, 3 phase, 60 cycle, ½ horsepower, and explosion proof. The pump and motor are suitable for Class I, Division 2, Group D environment. The casing, impeller and adapter are made of Cast Iron ASTM A48CL20. The shaft is made of 300 series stainless steel. It has a suction inlet of 1 ¼-inch diameter and a discharge outlet of 1-inch diameter. The pump is rated to operate at 30 gpm and 28 feet TDH.

- Sludge Pump (P-205): manufactured by CH&E manufacturing. It is a 2-inch diameter diaphragm pump with a max solid size of 1 ½-inch. The pump is made of cast iron while the diaphragm is made of a thermal plastic elastomer. The motor is 460 Volt, 3 phase, 60 cycle, 1 horsepower, and is explosion proof. The pump and motor are suitable for Class I, Division 2, Group D environment. The suction size is 2-inch diameter and the discharge size is 2-inch diameter. The output strokes are 41 spm.

- Bag filters (F-201, F-202, F-301): manufactured by Ronnigen-Peter. It is a single bag filter type with an inlet/outlet size of 2-inches. It is made of carbon steel housing in accordance with ASME Code. The connections are ANSI Class 150, and the working pressure is 150 psi. The coating is an acrylic, modified alkyd enamel, 3 mils thick. The filter media size is 10 micron.

- Carbon Adsorption System (PV-301 and PV-302): manufactured by Carbon Air Environmental Systems. Standard features are: welded steel construction in accordance with ASME; working pressure is 75 psi; four support legs; double –coated corrosion resistant epoxy interior; epoxy coated exterior; PVC and stainless steel intervals; a 4-inch carbon slurry inlet and outlet lines with quick connects and shut-off valve; two 12-inch x 16-inch manways; 5,000 lb. carbon capacity; a 1-inch air bleed with valve; and there are two of these carbon vessels that have a minimum wall thickness of ¼-inch. The contractor provided a Decon 3 piping package that included all piping, fittings, and valves needed to operate vessels in parallel, in series or

individually and to facilitate backflush and slurry operations. Sample taps and pressure gauges were included. The pipe size is 3-inch diameter. The contractor also provided 5,000 pounds of virgin carbon for each vessel.

- Discharge Suction Tank (T-301): manufactured by Highland Tank. This tank is made of ASTM-A-36 cold rolled steel with a capacity of 500 gallons and dimensions of 4-foot diameter by 5 feet, 5 inches high. The shell, bottom head and top head have a 12-gauge thickness. The tank is welded steel, coned top, dished bottom with four support legs. Pipe and instrument connections are in accordance with ANSI Class 150. The following was furnished: one 4-inch-diameter vent, one 2-inch-diameter fill pipe, one 3-inch diameter discharge pipe, one 1-inch diameter air release valve return, one 24-inch manway with blind flange and one fitting for the level transmitter (LT-301). The interior and exterior finish were epoxy primer and urethane top coat with No. 6 commercial blast. The tank testing and welding were performed using applicable UL-142 tank code specifications.

- Leachate Discharge Pumps (P-301, P-302): manufactured by Goulds Pumps. These pumps are frame mounted centrifugal pumps with a suction and discharge size of 2 ½-inch diameter. The casing and impeller are ASTM A-248, CL25 Cast iron. The motor is an explosion proof, squirrel cage electrical motor, 1 horsepower, 1750 RPM, 460 Volt, 60 Hz with grease lubricated bearings. The pump and motor are suitable for Class I, Division 2, Group D environment. The pump is capable of delivering 122 gpm at 20 feet of head at a minimum efficiency of 70%.

- Portable Sampler (S-301): This is a Cisco autosampler consisting of a three gallon polyethylene composite container with lid. It has a distributor with an arm for 24-bottle composite sampling. It contains a signal/control mechanism for flow proportional sampling.

- Submersible Level Transmitters (LT-101 and LT-103): manufactured by Viatran. The transmitters are stainless steel and explosion proof, suitable for Class I, Division 2, Group D environment. They also have a full scale pressure range of 0-5 psig.

- Tank Mounted Level Transmitters (LT-110, LT-201, LT-202, LT-203, and LT-301): manufactured by Flowline Echotouch. The transmitters have a polypropylene enclosure with a PVDF transducer. They are ultrasonic and explosion proof, suitable for Class I, Division 2, Group D environment. They have an automatic temperature compensation over a full range and push button calibration.

- Flow Transmitters (FT-100 and FT-301): manufactured by Sparling Instruments. The electrodes are stainless steel and the display has a 15 digit alphanumeric LCD. The transmitter is explosion proof, FM approved for Class I, Division 1, Groups B, C, and D.

- pH Sensor (XE-201): manufactured by Signet. It is made of CPVC with Viton O-rings with an operating temperature of 32 to 185°F. The pH sensor is explosion proof, suitable for a Class I, Division 2, Group D Environment.

- pH transmitter (XT-201): manufactured by Signet. It has a range from 0 to 14. The transmitter also has an automatic temperature compensation. The transmitter is suitable for a Class I, Division 2, Group D environment.

- Differential Pressure Transmitters (PDT-201 and PDT-301): manufactured by Orange Research. The transmitters have an operating range of 0-50 psig. They are made of Naval brass and are explosion proof, suitable for a Class I, Division 2, Group D environments.

- Temperature Indicator (TI-100): It consists of stainless steel wetted parts with an enameled steel housing. It is a rigid stem dial thermometer type with a range of 0-100°F.

- Pressure Indicators (PI-100, PI-201, PI-202A, PI-202B; PI-301, PI-302, PI-303, PI-304, PI-305, PI-306, PI-307, PI-308, PI-309 and PI-310): manufactured by Hayward Industrial Products. These are bourbon tube type with a range of 0-60 psig within an enameled steel housing.

- Float Switch (LSHH-105): manufactured by Goulds. It has a PVC housing with epoxy-sealed switch and cord conductors. It is explosion proof, suitable for Class I, Division 2, Group D environment.

- Programmable Logic Controller (PLC) (YC-1): manufactured by Allen-Bradley. The control system is capable of monitoring, trending and controlling the system. The system allows historical data to be downloaded to an IBM compatible computer for storage and presentation daily by automatic means. The system is capable of remote communications for control of the groundwater pretreatment system as well as all alarm conditioning reporting and diagnostic services from a remote computer via the automatic dialing telephone modem's communications link.

- Automatic Dialer (Event Monitor): The automatic dialer is a stand-alone system capable of initiating multiple telephone calls based upon the status of discrete inputs. It is capable of monitoring four dry contact inputs in addition to internal power failure and internal temperature.

- PLC Control Logic: The PLC system is programmed to communicate, monitor, store data on, and control the following:
  - Groundwater/Leachate Pumps
  - Product Recovery system
  - Building Sump Pump

- pH Control System
- Oil/Water Separator
- Filter Systems
- Leachate Discharge Pumping
- Exhaust Fan and Unit Heater

- Potable Water System: The contractor provided all materials needed to complete a workable potable water system including hot and cold water piping, valves, dielectric couplings, bronze body gate valves, bronze body check valves, backflow preventers, hose bibs, quick connect couplings, bronze body globe valves, safety shower and eyewash, sink, water meter, corporation stops and curb stops.

23.3 Quality Control/Quality Assurance During Installation

Quality control and quality assurance during construction of the leachate pre-treatment building consisted of full-time observation in addition to laboratory and field-testing. All applicable local, state and federal agency guidelines were followed.

Refer to Appendix J for geotextile certified test reports.

Refer to Appendix J for geomembrane test results.

Refer to Appendix J for coarse aggregate test results.

Refer to Appendix A for daily reports during construction.

Refer to Appendix J for concrete test results.

Refer to Appendix J for backflow preventer test results.

Refer to Appendix I for photographs during construction.

23.4 Start-Up Phases

Equipment Start-Up: Equipment Start-Up was intended to demonstrate that the equipment was properly installed and performed satisfactorily. The system was operated continuously for 8 hours at the design flow rate of 30 gpm using City water.

Phase I Start-Up: On 01/15/2003; this included operation and testing to demonstrate that the treatment system discharged pretreated leachate that is acceptable to the 26th ward WPCP. During this 8 hour period, a minimum of 5,000 gallons of leachate was pumped from the interceptor trench and then through the treatment plant discharging to a Baker Tank for testing and storage until approved for discharge. Samples were taken in three locations: 1)

before the Oil/Water Separator, 2) between the Oil/Water Separator and carbon units, and 3) after the carbon units. Samples were analyzed based on parameters in table 23-1.

Table 23-1
Analytical Requirements

Parameter	Analytical Method	Method Reference
Volatile Organic Compounds	95-1	NYSDEC ASP 10/95
PCBs [1]	95-3	NYSDEC ASP 10/95
Oil and Grease	413.1	NYSDEC ASP 10/95
Total Petroleum Hydrocarbons	418.1	NYSDEC ASP 10/95
Total Suspended Solids	160.2	NYSDEC ASP 10/95
Flashpoint	1010	NYSDEC ASP 10/95
pH	9041A	NYSDEC ASP 10/95

Notes:
1. Laboratory method was required to report method detection limit for PCBs which shall was 0.065 ug/1 or less.
2. Reference New York State Department of Conservation Analytical Services Protocol NYSDEC ASP), October 1995 Edition.

Phase II Start-Up: This started after samples taken as part of Phase I start-up met all discharge criteria on 03/31/2003. Phase II start-up was an 8-week period of continuous running of the leachate system (24 hours per day), however it was shutdown for maintenance during this period for a short period of time. Phase II start-up was completed after the system ran for 1064 hours minimum meeting all discharge criteria. This phase was completed on 04/28/2003.

Operating Period: This is a one-year operating period after the completion of Phase II start-up. The Operating Period was a continuous (24 hours per day) operation maintaining a minus 2.5 feet liquid level in the interceptor trench. Operation and maintenance (O&M) of the leachate system was awarded to a NYCDEP contractor, Severn Trent Services (STS), who commenced O&M services on 05/14/2007.

Section 24

24.0 ELECTRICAL INSTALLATION LF-FCB-E2

Tisio Electric performed all the necessary electrical work required to activate the leachate treatment system and site trailers as discussed below.

24.1 Con Edison Power Source

The power source for the leachate pre-treatment building and system comes from switches Con Edison installed on the existing pole at the corner of Pennsylvania Avenue and Flatlands Avenue. Con Edison added three switches to the existing pole adjacent to NYCDEP 26th Ward Facility at Flatlands Ave.

Three 15KV cables run through ten electrical manholes (MH) to a Con Edison supplied transformer (T1) behind the leachate pre-treatment building. Each manhole is spaced at approximately 500 ft apart at the 26th Ward facility, except for manhole #10 which is on Pennsylvania Avenue Landfill. There are two five-inch-diameter PVC conduits encased in concrete two to six feet below grade. One conduit is the active conduit with the three 15KV cables and one conduit is a bare ground that serves as a spare.

Electrical manhole #10 (MH #10) is the transition manhole for splices. For the LF-FAL-G3 contract, the contractor spliced into MH #10 to provide power to Power Center #3 at the Flare Station. From MH #10, there is a high voltage cable connected to Con Edison transformer T1. In the same trench (direct burial) are also the optical fiber cables. Transformer T1 steps down the high voltage and supplies power to Power Centers No. 1 and No. 2, the NYCDEP construction trailer and security trailer. Within Power Center #1 is a transformer which reduced the power to 480V. This supplies the leachate pre-treatment building and both pump stations PS-1 and PS-2.

24.2 Communication and Controls

From the NYCDEP 26th Ward control room to the leachate pre-treatment building are two (2) optical fiber CLX cables (direct burial, continuous run, no splices) for telecommunication which allows the 26th Ward to remotely shut down the leachate system, but does not enable them to start the system. From the existing telephone pole outside the main gate, the telephone service feeds the telephone punch down station (PD-1) behind the leachate pre-treatment building. PD-1 feeds PD-2 behind Power Center #2 and PD-3 near electrical manhole #10. PD-3 also feeds PD-4 at the Flare Station. PD-1 feeds the NYCDEP construction trailer and leachate pre-treatment building control room. Power Center #1 cables feed the leachate pump stations. One is direct burial 480V power CLX and the other is for instrumentation and control in a two-inch-diameter PVC coated steel conduit. All cables are two feet below grade. Con Edison has performed the High Potential Proof Testing (Hi-Pot test) on the power lines and the contractor performed the test on the optical fiber cables (OFC).

Refer to Appendix J for results of Hi-POT tests and OTDR tests.

24.3 Leachate Pre-Treatment Building

Power Center #1 provides power to the leachate pre-treatment building equipment such as the motor control center (MCC), PLC, exhaust fans, heaters, dampers, lighting and outlets.

Photographs of electrical installation are included in Appendix I.

Section 25

25.0 DESIGN MODIFICATIONS: G2/E2

The Remediation of the Pennsylvania Avenue Landfill was constructed in general conformance with the NYSDEC approved Plans and Specifications. However, variations from the design were made with coordination of NYSDEC, NYCDEP and BET. Executed Contract Change Orders document these changes as follows:

CHANGE ORDER # 1	**Natural Gas Line for Flare**	**$106,075.00**
CHANGE ORDER # 2	**Force Main Connection to the Centrate Wet Well at 26th Ward WPCP**	**$23,776.00**
CHANGE ORDER # 3	**Replace Armed Guards with Unarmed Security Guards**	**$12,836.88**
CHANGE ORDER # 4	**Replacement of Overhead Sectional Doors with Roll-Up Doors for the Pre-treatment Building**	**$2,708.00**
CHANGE ORDER # 5	**Asphalt Restoration at 26th Ward**	**$80,000.00**
CHANGE ORDER # 6	**Additional Instrumentation for PLC Equipment**	**$27,854.00**