Construction Monitoring Report
North East Landfill Remediation

NYSDEC SITE NO. 3-14-048

prepared for:

THE TOWN OF NORTH EAST
TOWN OF NORTH EAST, NEW YORK

prepared by:

URS CONSULTANTS, INC.
282 DELAWARE AVENUE
BUFFALO, NEW YORK 14202

March 2000

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CONSTRUCTION MONITORING REPORT
NORTH EAST LANDFILL REMEDIATION
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CERTIFICATION OF
CONSTRUCTION QUALITY ASSURANCE

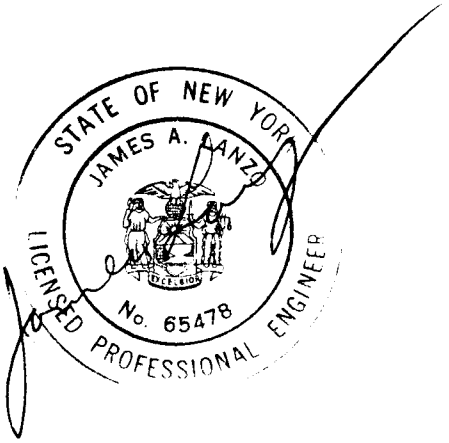
AT

NORTH EAST LANDFILL
REMEDIAL ACTION CONSTRUCTION
TOWN OF NORTH EAST, NEW YORK

URS Greiner, Inc. personnel and its subcontractors have inspected the remedial action construction at the North East Landfill according to generally accepted practices. Based on: field observations and inspections made by onsite personnel; field and laboratory test data; and data provided by the Contractor and its subcontractors, the remedial action construction at the site is considered to have been performed in substantial compliance with the NYSDEC-approved Contract Documents and as stated in this report.

URS Greiner certifies that the remedy is operational and functional.

The work was inspected and documented by competent personnel with supervision by the project manager and senior personnel under my direct supervision.



APRIL 1999

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLES

FIGURES

APPENDICES

ATTACHMENTS

DESIGN DRAWINGS (Under separate cover)

Number	Description
Cover	Title Sheet
1	Drawings Index/Legend/Abbreviations/Location Maps
2	Existing Site Conditions Plan
3	Wetland Location Plan
4	Horizontal and Vertical Survey Control
5	Tables of Coordinates and Bench Marks
6	Property Boundary Survey
7	Final Site Plan
8	Subgrade Grading Plan, Sheet 1 of 2
9	Subgrade Grading Plan, Sheet 2 of 2
10	Final Cover Grading Plan, Sheet 1 of 2
11	Final Cover Grading Plan, Sheet 2 of 2
12	Typical Final Cover System Details, Sheet 1 of 2
13	Typical Final Cover System Details, Sheet 2 of 2
14	Surface Water Drainage Details, Sheet 1 of 3
15	Surface Water Drainage Details, Sheet 2 of 3
16	Surface Water Drainage Details, Sheet 3 of 3
17	Typical Final Cover System Cross Sections
18	Miscellaneous Civil Details

SUPPLEMENTAL RECORD DRAWINGS

RECORD GEOMEMBRANE LINER DRAWINGS

SUBGRADE RECORD DRAWINGS

1.0 INTRODUCTION

1.1 Background

The North East Landfill site is located in the Town of North East, Dutchess County, New York (Figure 1-1). The limits of the site and associated features are shown on Figure 1-2. The landfill is located approximately 3 miles south of the Village of Millerton, New York, and approximately 1 mile east of Route 22 on Coleman Station Road. The gate entrance to the landfill is located on Regan Road which is off Coleman Station Road. The landfill is bounded by Regan Road to the south, a private residence to the southwest, a railroad easement to the west, and NYSDEC wetlands MT-26 to the north and east.

The landfill previously was operated as the Kimball Gravel Bank, owned by Eugene and Louise Kimball. On May 28, 1962, the property was acquired by the Town of North East and approved as a landfill site following an inspection conducted by the Dutchess County Health Department on April 26, 1963. The site apparently was operated initially as a municipal and commercial landfill authorized for restricted burning of paper and wood.

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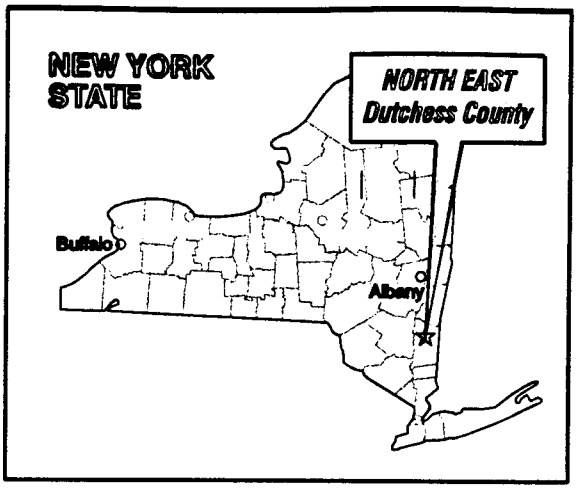

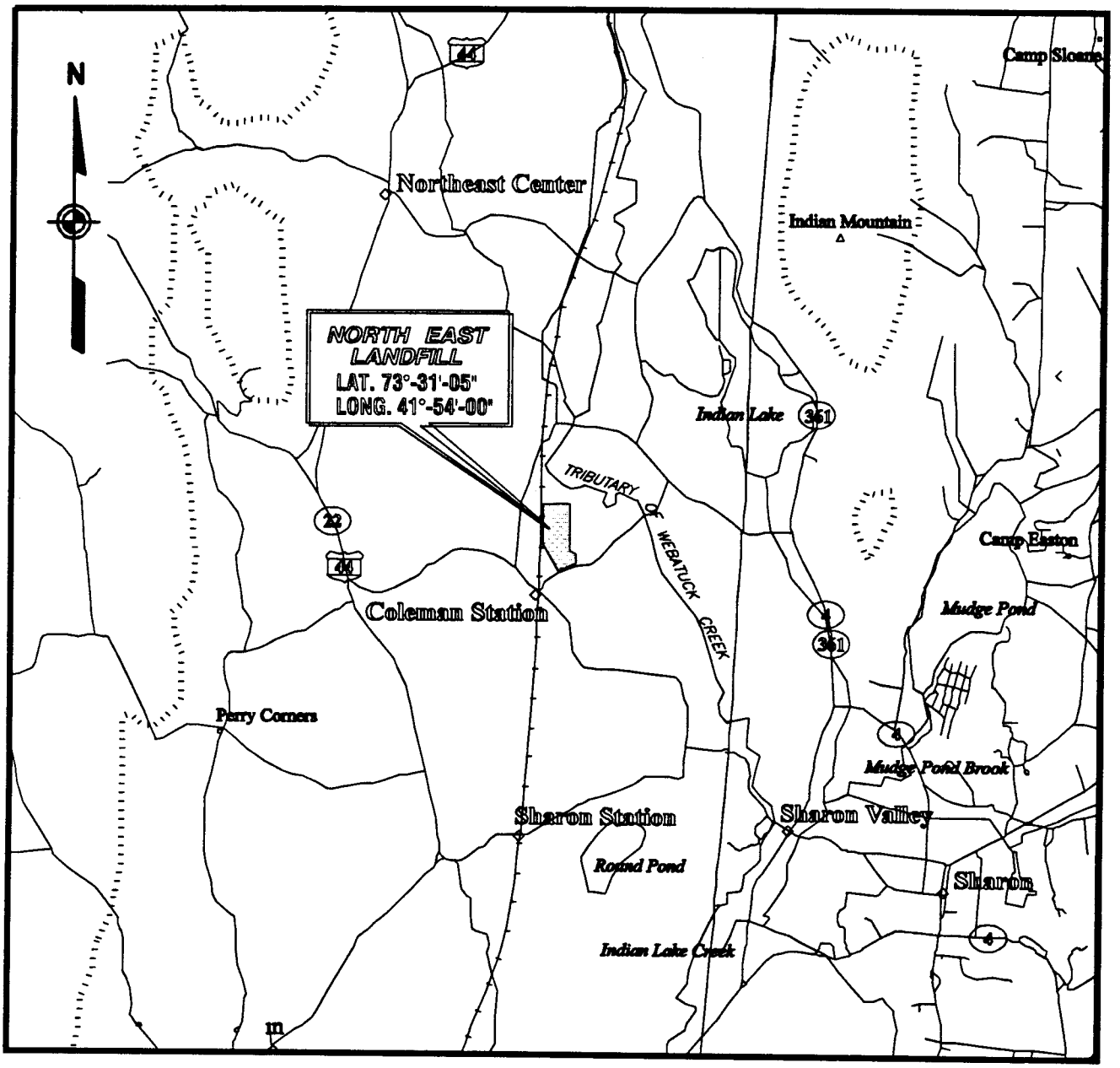

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APPROXIMATE SCALE IN MILES

AC-13785

URS Greiner Consultants, Inc.

NORTHEAST LANDFILL
REGIONAL PLAN

FIGURE 1

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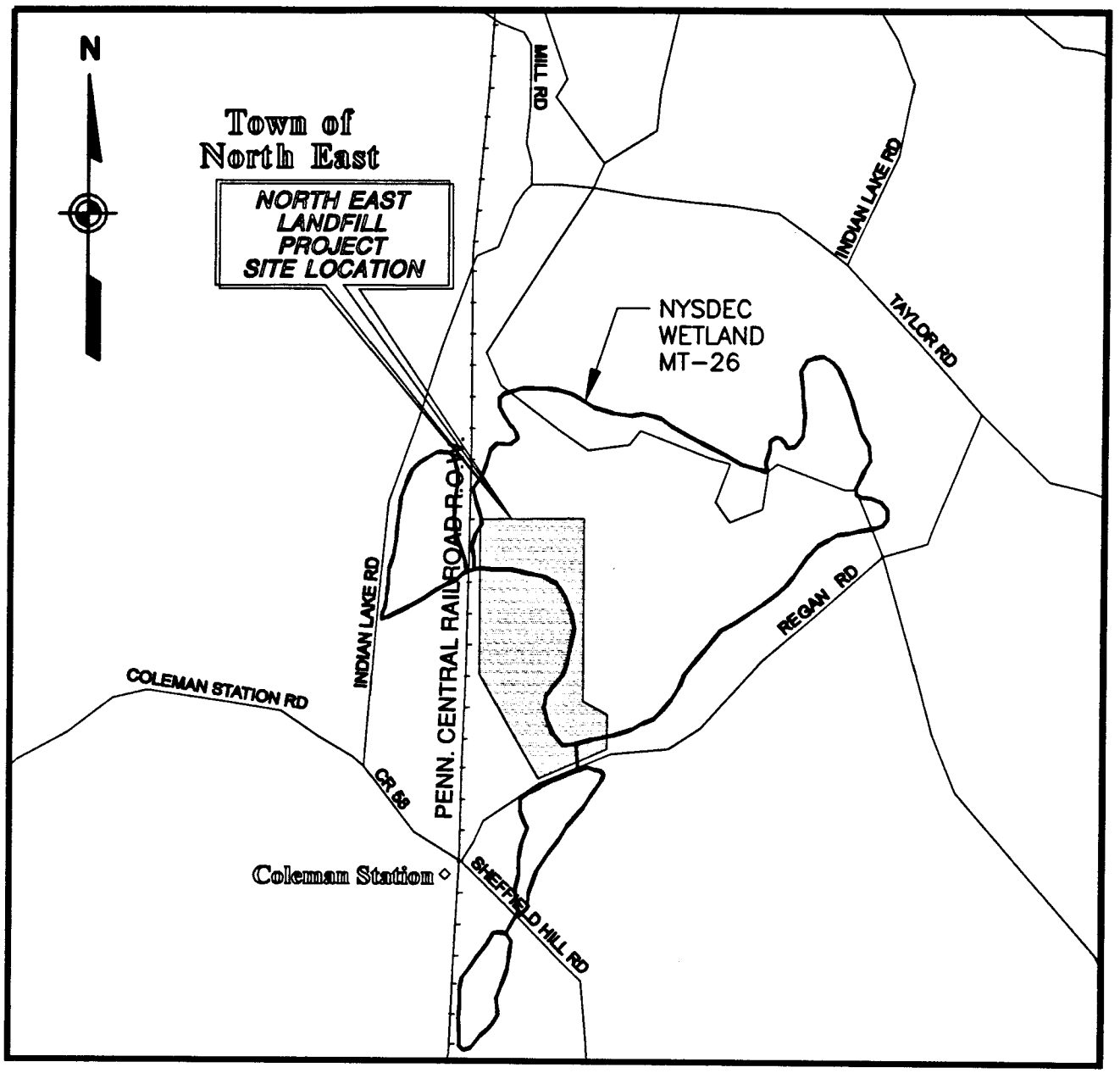

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SCALE IN FEET

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URS Greiner Consultants, Inc.

NORTHEAST LANDFILL
LOCATION PLAN

FIGURE 2

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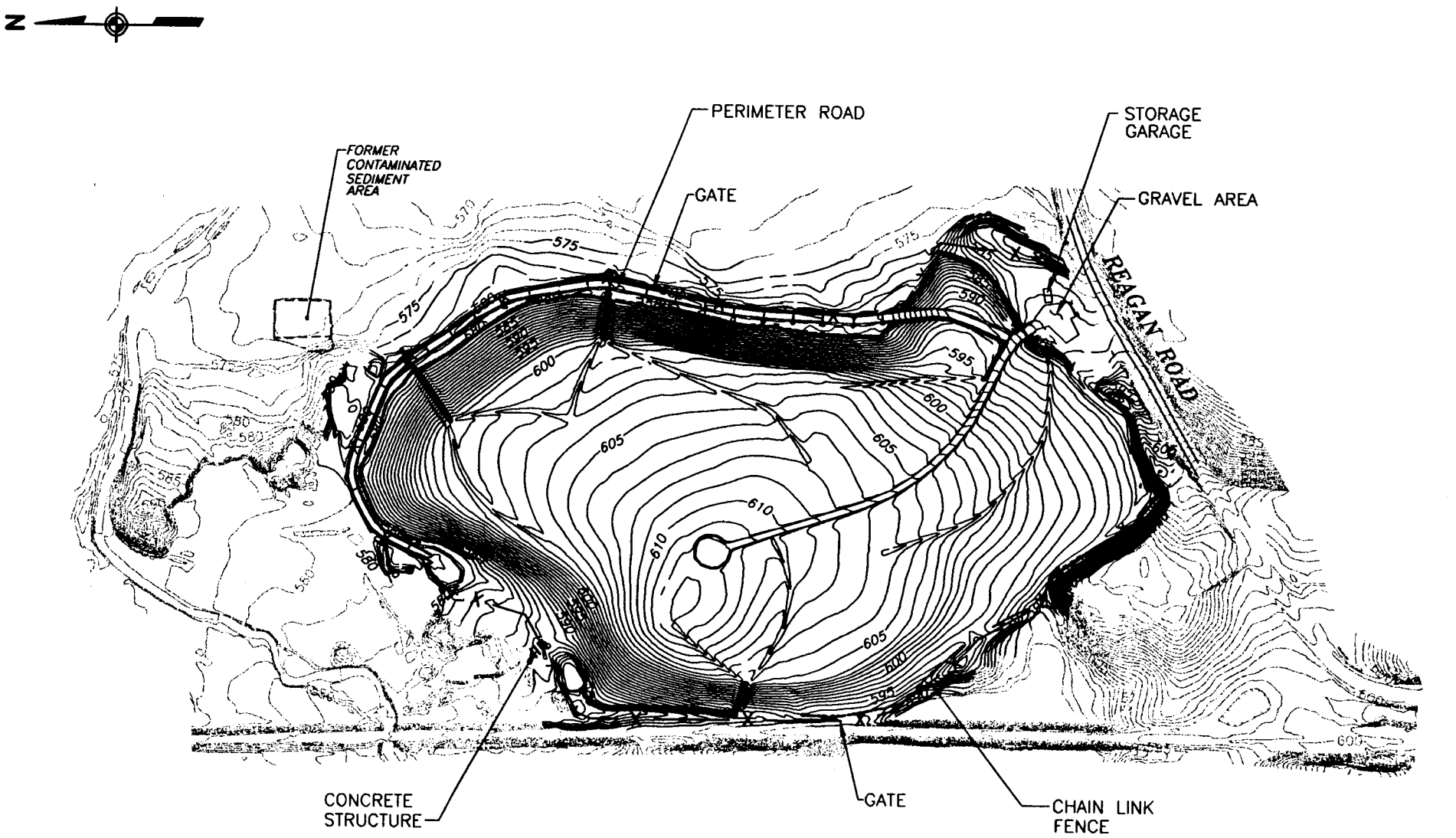

URS Greiner Consultants, Inc.

NORTHEAST LANDFILL
SITE PLAN

FIGURE 3

On June 10, 1963, the Town voted to begin using the Coleman Station site for disposal of municipal waste. According to an October 10, 1963 New York State Department of Health (NYSDOH) inspection report, the landfill covered an estimated 3 acres and received approximately 20 tons of refuse per week from residents and businesses in the Town of North East and the Village of Millerton. Mr. Grove Leffingwell was reportedly the local refuse collector. Access to the site was controlled by the Town Highway Department. When no attendant was present, the front gate was locked to secure the site from unauthorized access.

Refuse reportedly was dumped on the north end of the site and covered periodically with onsite sand and gravel using a bulldozer and payloader. Paper and wood were burned to reduce volume, and rodenticide was placed around the landfill to control the rodent population.

During October 1963, an uncontrolled fire broke out at the landfill, but was extinguished quickly by the Town Fire Department. Complaints concerning early landfill operations were filed with the State and County Health Departments concerning fire hazards, as well as surface water impacts, flies, the lack of cover, and the unlocked gate.

During 1964, the Town obtained permission from the Dutchess County Health Department to burn readily-combustible material. However, during this time, complaints continued relative to blowing ash from burning on site, lack of attendants at the site, unsecured access, uncovered refuse, poor access road condition, and use of the dump by non-residents. On March 3, 1965, the Town obtained a burning permit from the Health Department. It is uncertain whether subsequent annual applications for permits were approved or denied, however, burning and associated complaints continued through 1968. As of January 1, 1969, Part 19 of the New York State Sanitary Code banned open burning of refuse at any refuse disposal area. After that time, the Town reportedly obtained permits for restricted burning at the site.

From January 1969 to December 1971, the site received waste solvents from Keuffel & Esser (K&E) Taconic Products Plant located in Millerton, New York. K&E was a manufacturer of drafting supplies in Millerton from 1952 until the plant was closed in December 1991. During the

years of operation, K&E reportedly generated approximately 1,000 gallons per week of a flammable mixture of solvents believed to contain acetone, ethyl acetate, isobutyl alcohol, methanol, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIK), and toluene. From January 1969 to December 1971, K&E contracted local contractors to haul this waste to the North East Landfill. Contractors reportedly employed by K&E for transportation and disposal of waste were Marisol Chemical of Middlesex, New Jersey, a licensed industrial waste hauler, and the unlicensed R&R Sanitation Services, Inc. of Dover, New Jersey.

Frequent Health Department inspections continued to note site operational problems including: chemical waste on the ground surface and concentrated in a pool, the unattended site, blowing paper and polyethylene sheeting, wood burning, and an inadequate cover. As early as January 1972, the NYSDEC had threatened the Town with legal action if these problems were not corrected and if the site was not brought under State operational guidelines.

In 1976, the Dutchess County Health Department mandated that the Town of North East provide a development plan for the landfill. In July 1976, the Town Board retained Morris and Andros Consulting Engineers to prepare an engineering study of the landfill which concluded a useful life of 10 years for the site.

During 1977 through 1978, the NYSDEC permitted restricted burning at the site. Following an amendment of 6 New York Code of Rules and Regulations (NYCRR) Part 360 in August 1977, the Town applied to the NYSDEC for formal approval of the landfill and in January 1979, retained Morris and Andros to perform an additional subsurface investigation required for the approval. The study included the advancement of five borings into the fill and the installation of two monitoring wells. On March 15, 1979, the draft Permit to Operate a Solid Waste Management Facility was issued to the Town, followed by the final permit on May 15, 1979.

In 1983, the North East Landfill site was added to the NYSDEC Registry of Inactive Hazardous Waste Sites. In November 1983, Wehran Engineering, P.C. and Camp, Dresser, & McKee completed the New York State Superfund Phase I Investigation. Findings of the study noted leachate entering surface water on the eastern and southern edges of the fill. In November 1984, the Phase II Investigation of the landfill was completed and included the installation of two wells,

groundwater sampling, surface water sampling, and sediment sampling. Results of groundwater analysis found contamination consisting of numerous organic compounds at approximately 15 feet below ground surface within downgradient well MW-01.

In 1988, the NYSDEC began negotiations with the Town of North East to enter into a consent agreement to perform a remedial investigation/feasibility study (RI/FS) at the site. On August 2, 1989, the NYSDEC ordered the landfill be closed as of December 31, 1989. At that time, the NYSDEC also indicated that no further extensions or permits to operate the landfill would be considered until the Town had made a commitment to remediate of the landfill. Based on the potentially responsible party (PRP) status of K&E, the company entered into negotiations with the NYSDEC and the Town in 1989. The purpose of these negotiations was to develop details of the Order of Consent for performance of a RI/FS pursuant to Article 27, Title 13 of the Environmental Conservation Law (ECL) of the State of New York. In 1991, the Order of Consent was finalized and the Town selected Dunn Geoscience for performance of the RI/FS. It was later determined that a conflict of interest existed. The Town subsequently awarded a contract to URS Consultants, Inc. (URS or URSG) in December 1992.

URS performed the RI from June 1993 to August 1994, with the majority of the field work being conducted between October and December 1993. Supplemental sampling was performed in the spring and summer of 1994. The RI activities consisted of the following: a historic record search; a community well survey; a perimeter explosive gas survey; a soil gas survey; test trenching; subsurface drilling; monitoring well and piezometer installation; hydrogeologic testing and monitoring; sampling and analysis of subsurface soil, sediment, groundwater, surface water, leachate, landfill gas, and waste; ambient air monitoring; and fish and wildlife impact analysis.

The results of the RI sampling and analysis efforts indicated that volatile organic compounds (VOCs) have leached through soils under the landfill and are impacting the shallow aquifer. Most of the shallow groundwater contamination likely discharges to the adjacent wetland where the VOCs volatilize into the air. Additionally, groundwater was found to contain elevated levels of metals. Landfill-related groundwater contamination was not observed in the deeper bedrock aquifer which most of the nearby residents use for a potable water supply. The landfill soils were found to contain

high levels of metals which may have eroded and been transported off of the fill area. A localized area of sediment with high metals concentrations was found northeast of the landfill.

URS conducted an FS of the Town of North East Landfill site and presented the results in a final report in June 1995. The purpose of the FS was to develop, screen, and evaluate potential alternatives for the closure and remediation of the site. The alternative recommended in the FS included installation of a 6 NYCRR Part 360 final cover, removal/onsite placement of contaminated wetland sediments, wetland restoration, access restrictions, and continued environmental monitoring. The recommended alternative satisfies 6 NYCRR Part 375 and US Environmental Protection Agency (USEPA) criteria that require protection of human health and the environment, and is compliant with standards, criteria, and guidance (SCGs) values for potential future downgradient groundwater receptors.

1.3 Record of Decision Summary

On September 25, 1995, the NYSDEC Division of Hazardous Waste Remediation issued a Record of Decision (ROD). A summary of the remediation goals, as stated on page 10 of the ROD are as follows: *A Goals for the remedial program have been established through the remedy selection process stated in 6NYCRR Part 375-1.10. These goals are established under the overall goal of meeting all standard, criteria, and guidance (SCGs) and protection human health and the environment.*

At a minimum, the remedy selected should eliminate or mitigate all significant threats to the public health and to the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles. The goals selected for this site are:

- *Reduce, control, or eliminate the contamination present within the soils/waste on site (generation of leachate within the fill mass).*
- *Eliminate the threat to surface waters by eliminating any future contaminated surface runoff from the contaminated soils on site.*

- *Eliminate the potential for direct human or animal contact with the contaminated soils and sediments on site.*

- *Mitigate the impacts of contaminated groundwater to the environment.*

- *Prevent, to the extent possible, migration of contaminants in the landfill to groundwater.*

- *Provide for attainment of standards, criteria, and guidance values (SCGs) for groundwater quality at the limits of the area of concern (AOC)."*

The primary components of the selected remedy are defined on page 16 of the ROD.

AThe elements of the selected remedy are as follows:

1. *A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Uncertainties identified during the RI/FS will be resolved.*

2. *A remedial construction program consisting of the following:*

   - *Regrading the landfill with the placement of approximately 70,000 cubic yards of clean fill or AGM;*

   - *Installation of a cap over the landfill that meets NYSDEC Part 360 standards;*

   - *Fencing, posting, and deed restrictions that prohibit the use of onsite groundwater and intrusive activities;*

- *Sediment remediation with wetland restoration in the seep area northeast of the landfill;*

- *Long-term monitoring and maintenance with periodic reviews.@*

The remedial design was approved by the Town of North East in early 1997. The NYSDEC approved the design on March 28, 1997. The project was bid on May 1, 1997 with the Notice-To-Proceed being made to Grace Industries, Inc. (Grace) on August 22, 1992. Construction started in November 3, 1997, the dates for the completion of the major construction activities were as follows:

• Subgrade	May 26, 1998
• Geosynthetic Cover	July 13, 1998
• Barrier Protection Layer	August 18, 1998
• Swales/Downchutes	August 18, 1998
• Topsoil/Seeding	September 18, 1998

1.2 Purpose

The purpose of this Construction Monitoring Report (CMR) is to document the construction phase of the North East Landfill remediation project. All discussions within this CMR show that only approved methods, materials, and equipment, as required by the Contract documents, were implemented unless otherwise clarified, and as otherwise described in the following section on variances and change orders. Provided within this document are:

- Descriptions of construction methods, materials, and equipment
- Record Drawings
- Construction Quality Assurance/Quality Control (QA/QC) results
- Discussion of any variances and change orders.

1.3 Variances and Change Orders

1.3.1 Variances

The following list identifies variances from the Contract Documents which were implemented following either a request by the construction contractor, Grace or initiated by URSG. Full discussions of variances are provided in the respective geomembrane and soils sections of this report. While the construction work was completed following the contract document requirements, several small changes or variations in the work did occur. They include:

1. Steel pole markers were added to each monitoring well located within the fenced landfill area. The reason that markers were added to the wells would be to easily find the wells during a scheduled sampling event should the grass not be cut, or snow hide the wells.
2. At each of the corrugated plastic pipe culverts under the perimeter road, rip rap was added at each outlet. The reason is that during heavy rains, flow through each pipe would have the effect of erosion at each outlet end. The work will be paid for through a future Change Order as extra 6" aggregate stone, Bid Item 18.2.
3. During the course of construction, several gas cylinders of various sizes were uncovered. A total number of 23 gas cylinders were finally unearthed. Grace industries subcontracted with MG Industries for on-site checking, stabilization and with Waste Dynamics Inc. of Old Bridge, NJ for off-site disposal of all gas cylinders. Payment for the additional work is by future Change Order.
4. Upon completion of placement of the grading fill (using AGM) and reviewing the record survey drawings of the final subgrades (shop drawing # 01720-2), it was noted that Grace has several small areas of final grading that were less than 2% slope, contrary to the requirements of the contract. Upon review including interfacing with the DEC, it was determined that this variance would be acceptable as long as the final slopes of the Barrier Protection Layer (BPL) were greater than the 2% grades required. Record survey drawings of the BPL show all grades greater than 2%. No adjustment in bid costs.
5. Fence Deletion; Approximately 325 feet of new fence installation was deleted from the contract. The section of fence was to be installed from the north west corner of the landfill, along the adjacent railroad right-of-way to the bank of the Webatuck Creek Tributary. It was determined that this section of the new fence was not needed since it did not add to the security of the

landfill. The fence was deleted and the price of the contract was adjusted based upon the bid price unit.

6. Seeding change. Another minor change to the contract was the change to the seed mixture. First, the COE, as part of the reply to the application of excavation in the wetlands, required a change in the seed mixture. Change was made at no change to the contract price. Second, the landscaper recommended adding rye grass to the mix. This was based upon his experience on seeding at the fall of the year (seeding applied September). This was accepted by URS at no change in contract price.

1.3.2 Change Orders

Appendix C identifies Contract modifications that were incorporated into the project by approved Change Orders, or are pending by future change orders.

CHANGE ORDER	DATE ISSUED	CONTENT
G-1	July 29, 1998	See Appendix C
G-2	July 26, 1999	See Appendix C

1.4 Substantial Completion/Final Inspections

The Substantial Completion Inspection was conducted on September 28, 1998. The inspection was attended by representatives from the NYSDEC, Town of North East, URSG, and Grace.

Based on the Substantial Completion Inspection, it was determined that the construction of the project was substantially complete with the exception of the punchlist items noted below:

1. Establish an acceptable growth of grass
2. Rip rap outlet ends of roadway cross culverts
3. Provide and install markers for all monitoring wells
4. Correct/repair all minor washouts as result of recent rains

Punchlist items 1 through 4 were acceptably completed subsequent to the Final Inspection on December 18, 1998.

1.5 Key Aspects of the Operation and Maintenance Plan

The Operation and Maintenance (O&M) Manual will be provided under separate cover. It was prepared as required by the ROD and meets the requirements of 6NYCRR Part 360. The manual provides a comprehensive discussion of the necessary monitoring, routine maintenance, emergency contingencies, personnel, record keeping, and reporting associated with the 30-year post-closure period. This section of the CMR summarizes key aspects of the O&M Manual.

Inspections and Routine Maintenance:

Site maintenance covers the routine inspection and upkeep of all of the major site components and their respective functions over the 30-year post closure care period. The minimum initial frequency of inspections will be four times per year, then less frequent pending the condition of site features, unless otherwise indicated or approved by the NYSDEC. All records on frequency of inspection and general maintenance will be submitted to the NYSDEC as discussed in Section 5.4.

The following scheduled maintenance activities should be adequate to maintain the remedial system in proper operating condition.

The Town of North East or a contracted landscaping firm will perform the required routine maintenance which will include the following:

- Cutting of the vegetation on the final cover and grass-lined ditches and swales three times a year (late spring, mid-summer, and late autumn). The seed mix specified for the final cover is designed for the infrequent mowings which are necessary to prevent the invasion of weeds and brush.

- Fertilization, liming, and other vegetation-maintenance chores will be conducted annually in the spring. The level of fertilization and liming will be selected for the grass species, soil type, and setting. The seeding requirements will be provided in the O&M Manual.

- Cleaning the swales, downchutes, and perimeter channels of accumulated leaves, twigs, and other debris concurrently with mowing of the vegetation. Failure to remove debris from the drainage features could result in scour or breaching of the channel.

Quarterly inspections of the remedial components will be performed after scheduled maintenance tasks by a qualified civil or environmental engineer experienced in the construction and

function of a multi-layered cover system. In addition, an inspection will be performed after all significant rain event. The purpose of these inspections will be to identify any potential problems with the remedial system that are not being addressed adequately by routine maintenance, and to document the current condition of the system. The engineer will complete the site inspection checklist after each inspection and submit it to the NYSDEC as soon after the inspection as possible. The engineer will prepare an annual report for submission to the NYSDEC which will document the current condition of the system.

For each inspection will the engineer evaluate the following items and will estimate the nature and extent of corrective action required.

- Surface Water Control Features - Channel cross-sections must be inspected to ensure that sideslopes are stable. Checks will be made for scour, sediment deposition, breaches, rodent holes, and other damage. The stone-lined channels also will be checked for undermining and damage to geotextile.

- Leachate Seeps - Any areas of leachate seeps will be noted and monitored. The need for adding remedial controls in any such areas will be assessed.

- Landscaping - The vigor and density of the vegetative cover on the cap, channels, and swales will be assessed. The location and extent of bare, sparse, and undernourished areas will be noted. Areas of significant weeds, woody brush, or deep-rooted vegetation will be noted.

- Vermin Control - The cap will be inspected for damage due to vectors and/or burrowing animals. Any damaged areas will be flagged and noted.

- Erosion - The presence and extent of any rills or other signs of erosion of the final cover, ditches, swales, or downchutes will be noted.

- Gas Vents - The condition of gas vents will be inspected and noted. Checks will be made for clogging of the vent opening by birds or insects.

- Settlements - Visual evidence of differential settlement of the final cover will be noted and its impact on the integrity of the final cover, swales, or required drainage patterns will be assessed.

- Fence - The fence will be inspected for signs of vandalism and other damage. No scheduled maintenance is required.

- Access Roads -Vehicular traffic across the landfill cap will be limited to the engineered access roads. These vehicles will be necessary to inspect and maintain the site, and to perform necessary services. Rutting, cracking, or other damage to the across roads across the landfill will be noted.

Significant Concerns

Significant problems other than those previously discussed, require an event-specific solution. A qualified civil/environmental engineer must perform the following:

Emergency Contingencies

- Determine the nature and extent of the problem
- Identify the cause of the problem and the steps required to prevent it from recurring
- Determine how to repair the failed area to original operating condition

This process should begin immediately upon discovery of the problem. The NYSDEC will be notified of the nature and extent of the problem within 30 days of its discovery.

Remedial Materials

Materials removed from remediation areas may be reused in the remedy provided they are uncontaminated or not altered from their required originally-constructed state. Products such as stone and drainage net contaminated by sediments may be taken offsite and washed free of sediments. Geotextile material used in landfill cap construction must be new since degradation and clogging may not be visible to the human eye. Geotextile is typically bonded to drainage net so it appears likely that geonet will be replaced along with any replaced geotextile. Geomembrane can be re-used provided it appears in new condition and excessive strain (maximum 10 percent) has not occurred.

Earthen materials may be re-used in the remediation provided they are not commingled with adjacent materials. All materials to be disposed will be taken off of the landfill site and disposed at the Town's own expense. Materials contaminated with leachate will be disposed of at a facility permitted to landfill such waste.

Water Sampling

Groundwater and surface water samples will be collected on a regular basis, three times during 1998, for site-related parameters from nearby residential wells and from selected existing monitoring wells. If increases are noted through this monitoring program at or immediately upgradient of the residences, the State and USEPA will make a determination of the need for appropriate action (e.g., extension of a public water line) to remedy the situation.

2.0 GENERAL CONSTRUCTION REQUIREMENTS

Features discussed in this section include those activities which are common to all major aspects of the project. They are provided here to avoid repeating a discussion of these features under each report section.

2.1 Record Conditions

2.1.1 Record Drawings

As noted in this report, the landfill closure was completed in substantial conformance with the Construction Drawings. Any minor changes are noted in the text or on the Supplemental Record Drawings.

2.1.2 Supplemental Record Drawings

Supplemental Record Drawings were prepared to document the Record information of the grading fill (subgrade), geomembrane liner, barrier protection layer, and final grades (top of topsoil). The following Supplemental Record Drawings were prepared by the parties shown and are presented in the CMR attachments.

- Grading Fill (Subgrade) Record Drawings – Joanne Crum Land Surveyor
- LLDPE Geomembrane Panel Record Drawings - Chenango
- Top of the Barrier Protection Layer - Joanne Crum Land Surveyor
- Final Grades - Joanne Crum Land Surveyor

2.2 Onsite Inspection

Daily inspection of construction activities was provided by URSG throughout the contract. URSG prepared daily inspection reports to document the work performed by the Contractor, the equipment and labor used, and verification that the requirements of the contract documents were satisfied.

2.3 Construction Photographs

Color photographs and slides were taken throughout the duration of the construction. Regular photographic documentation of construction progress was provided by both the Contractor, as required by the contract documents, and by URSG. Color photographs of major project aspects are included in Appendix B.

2.4 Survey

The Contractor obtained the services of Joanne Crum Land Surveyor, to perform all survey work required during the construction. All work was referenced to the existing horizontal and vertical control utilized during previous phases of the project established at the site. Horizontal control was referenced to a site-specific Northing and Easting system. Vertical control was based upon National Geodetic Vertical Datum 1929 (sea level).

2.5 Grade Control

For all survey work, Grace Industries obtained the services of Joanne Darcy Crum, a minority survey firm licenses to perform work in New York State. The Crum firm was responsible for all survey control and limited record information as directed by Grace.

Pre-construction Survey: Prior to the onset of any construction on the landfill, the Crum firm performed a complete topographic survey of the site. The survey was performed using a total

computer survey equipment using random survey shots over the landfill with emphasis on special features and items such as monitoring wells.

The record information was transferred to a CADD file and used to produce a CADD drawing of the landfill showing all features and contour lines. An electronic copy of the drawing has been forwarded to our office for our files.

Crum also surveyed and established the Limits of Waste and the Limits of Liner from the design coordinates obtained from URSG. The lines were established and staked in the field.

Subgrade Grade Control: Crum installed grade stakes across the entire landfill. Each stake was marked with the final grade as determined from the URS design drawings. Grace and his subcontractor's grades the original landfill cap and placed grading fill (Alternate Grading Fill) to the elevations and grades as marked by grade stakes established by Crum.

Upon the completion of the placement of the AGM, Crum again performed a complete topographic survey of the entire landfill. Since Crum did not establish a grid for control of the survey, again the record survey was performed using random survey shots over the landfill with emphasis on special features and grade control.

The record information was transferred to a CADD file and used to produce a CADD drawing of the landfill showing all features and contour lines. An electronic copy of the drawing has been forwarded to our office for our files.

During the review of the record drawing, it was discovered that Grace had several small areas wherein the survey indicated the slopes were less that the 2% requirement. The discovery was made upon receiving the Crum record information, which was after Grace has started to deploy the geosynthic liner systems on the areas effected.

Review by URSG, the Town of North East, Grace and the NYSDEC finally came to the resolution slope corrections could be made in placement of the Barrier Protection layer.

Geosynthic Liner System: The first survey effort was to establish the new transition line, the limit wherein the slope changes from a 2% slope to a 10% slope. Crum obtained from their topographic records of the subgrade this new limit or line based upon calculations.

Contrary to the requirements of the design documents, Grace and his subcontractors failed to any survey regarding the placement of the liner. Therefor some of the basic information such as coordinate locations of all destructs, repairs, panel corners, etc. were never obtained.

No other survey control was provided during the placement of the geosynthic liner system.

Barrier Protection Layer: The thickness installation of the Barrier Protection Layer (BPL) was by using grade stakes cut/fill marks. To prevent damage to the liner, all stakes were installed upside down points up, as to not damage the liner system. Removal of all stakes included each hole was inspected to insure no damage to the liner system.

As the BPL was placed and spread on the liners system, survey was performed and stakes were installed. Thickness verification was both by checking grade stakes and by the URSG resident engineers and contractor's superintendent performing numerous hand excavation to insure the minimum amount of BPL was installed. As areas of the BPL was completed to grade, Crum preformed another topographic survey to establish the record survey information required by the contract.

Topsoil: The thickness of the topsoil was controlled similar to the method used to control BPL. Survey stakes were used and hand excavation checks by the project Resident Engineer and contractors superintendent were used.

As areas of the topsoil was completed to grade and before seeding were performed, Crum performed another topographic survey to establish the record survey information required by the contract.

2.6 Sedimentation and Erosion Control

The Contractor was required to take all necessary measures to minimize the migration of sediments off site and establish run-on/ run-off control. These measures included:

- Installation and maintenance of a perimeter silt fence
- Construction of temporary ditches to divert overland flows
- Placing hay bales and check dams in drainage ditches

In addition, the Contractor was required to minimize the build-up of debris on Regan Road during construction. The road were machine-swept and washed down using a water truck as needed.

2.7 Construction Equipment

Construction methods and equipment used are discussed in sections, where they are specifically applicable. A summary of the equipment used is presented in Table 2.1.

2.8 Nuclear Densitometer Calibration

Nuclear Densitometer Troxler units was used to measure the in-place moisture and density of the compacted soil lifts for the final cover construction. The densitometer was also used to measure the in-place moisture and density of compacted aggregate materials. Testing was performed in accordance with manufacturers recommendations, ASTM D-2922, and ASTM D-3017.

2.9 Subcontractors

Grace utilized the following subcontractors on the North East Landfill Remediation project:

John Robinson – 90% of All Work

Joanne Crum Land Surveyors – Surveying, aerial photography

Spectra – AGM Laboratory testing

Chenango – Geosynthetic Installation

TABLE 2.1

LIST OF CONSTRUCTION EQUIPMENT

EXCAVATORS

CAT 215B Backhoe
219LC Backhoe

LOADERS

CAT 936 Loader
CAT 938F Loader
416B Loader/Backhoe
505-19 Loader

COMPACTION EQUIPMENT

CAT CS 563 Smooth Drum Roller
CASE 620 Smooth Drum Vibratory Roller
INTENUS CU 25D Smooth Drum Vibratory Roller
Sheepsfoot Roller (tow behind)
CASE 602 Smooth Drum Roller (tow behind)

BULLDOZERS

CAT D4H Dozer
CAT D5 Dozer
CAT D5HLPG Dozer
CAT D6H Dozer
Dresser TD-9H Dozer

TRUCKS

Water Truck

MISCELLANEOUS EQUIPMENT

Post Hole Digger
18-inch Disc Harrow (tow behind)
Power Screens
12-inch Wood Chipper
Timberjack 450A Grappler Skid
23-inch MABART Tree Destroyer
MABART Tree Feller/Buncher
Tractor with York Rake
Tractor with Seeder

Rancourt – Site Clearing

Advance Testing Company – Soil Testing

2.10 Bog Turtle Study

One of the excavation items of work was to excavate an area north of the landfill in the adjacent wetlands. Excavation was required to remove contaminated sediments.

An application to work in a known wetland area was filed with the U. S. Army Corps of Engineers. One of several comments and requirements as part of the approval of the wetlands permit was that a Bog Turtle study would be performed in the area of work.

Bog Turtles are an endangered species, which only occupy very small areas of select wetlands. The COE intent was to insure that no endangered species would be effected by the excavation work. URS Greiner sub-contracted the work to Ms. E. Ann Poole. There were no bog turtles found at the site.

The Bog Turtle Study Report is presented in Appendix D.

3.0 SITE GRADING AND LANDFILL SUBGRADE PREPARATION

3.1 Construction Requirements

In order to prepare the subgrade for the final cover system, the Contractor was required to clear the area, place acceptable fill material, and provide a suitable condition for over-lying cover materials.

Clearing and grubbing of the landfill and adjacent surfaces was required to remove all vegetation and debris. Topsoil stripped from the work areas was stockpiled in designated areas on site. Throughout the duration of the contract, the Contractor was required to construct and maintain temporary erosion and sedimentation controls around the topsoil stockpiles. Surficial debris (tires) was removed and disposed of at an offsite facility.

The required subgrade for most of the landfill final cover system was attained by placing acceptable offsite material and material obtained from onsite and offsite activities such as excavations. Onsite material used as fill included material from clearing operations, trench-excavated soil, and existing landfill waste excavated for landfill regrading. Onsite material used as fill included material from a contaminated sediment area excavation located northeast of the landfill.

After required final cover subgrade elevations were achieved, the Contractor was required to prepare the subgrade suitable for the overlying final cover. Subgrade preparation was required on all existing in-place materials and on imported grading fill prior to placing overlying layers of the landfill final cover system. Requirements included a subgrade surface free of stones greater than 1-inch, organic matter, irregularities, protrusions, loose soil, any debris which could be detrimental to the integrity of the final cover system, and cause any abrupt changes in grade. The subgrade was damp to dry, structurally sound, and compacted or mechanically tamped to ensure a smooth and stable surface.

Grading operations occurring outside the limits of the final cover system were performed in accordance with the requirements of the Contract drawings. As necessary, these areas were graded

to ensure proper stormwater drainage (run-off) by blending the new contours into the existing contours.

3.2 Contaminated Soil Excavation

Excavation was required for contaminated sediment area located northeast of the landfill.

3.3 Surficial Debris and Solid Waste Excavation

Excavation into waste was required for construction within of the landfill for subgrade preparation and for the gas vent installation. All excavated material was hauled, placed, and compacted in 12-inch loose lifts on site.

3.4 Offsite Grading Fill and Alternate Grading Materials

The alternate grading material (AGM) was provided several suppliers including: by A.J. Recycling, Inc., and Barlow Properties, Inc. Grading fill material was placed in 12-inch loose lifts by a bulldozer and compacted with two to four passes of a vibratory smooth drum roller.

3.5 Construction QA/QC Monitoring

3.5.1 QA/QC Requirements

The QA/QC monitoring requirements for site grading and subgrade preparation included visual observation, laboratory testing, and survey results. URSG visually verified that rocks 6 inches or greater or other deleterious materials had been removed prior to compaction. Unsuitably wet soil materials were aerated, regraded, and rerolled. Unacceptable soil materials were removed and properly disposed of off site. There was no Contract requirement for in-place density testing of the subgrade, however compaction was verified by visual observation.

After the subgrade was prepared as required and approved by URSG based on visual observation, the Contractor submitted Record Drawings showing the landfill grades including final

subgrade contours for URSG's review. The landfill grades were checked by URSG using survey record drawings. Where corrective grading was required, the affected area was regraded, recompacted, resurveyed, and Record Information was submitted to URSG for review. Final subgrade contours are presented on attached Supplemental Record Drawing.

The quantity of QA/QC tests performed is contained in the SPECTRA report, Appendix "E".

4.0 PERMANENT SURFACE WATER MANAGEMENT

Contract Drawing Nos. 10, 11, and 16 provide the locations of the permanent surface water management structures which include:

1. Swales and downchutes on the landfill surface.
2. Stone-lined channels around the perimeter of the landfill.
3. Stilling Basins and Culverts

Test results for the various construction materials are presented in Appendix E and summarized on Tables 4.1 and 4.2.

4.1 Drainage Swales, Downchutes, and Stone-Lined Channels

Eight drainage swales were constructed on top of the final cover system to control surface run-off. Barrier protection layer material was utilized to construct the swales directly on top of the barrier protection layer of the final cover system. The barrier protection layer material was placed and compacted in maximum 12-inch lifts to a total berm height which varied depending on the slope of the landfill. The barrier protection layer material was compacted to a minimum of 95 percent of the standard proctor maximum dry density. There was no numerical moisture content requirement.

Four of the swales discharge into two downchutes. The remaining swale discharges into a rip stone-lined channel The side berms of the downchutes were constructed of barrier protection layer material and subjected to QA/QC testing in the same manner as the swales. The test results are presented in Appendix E. The downchute surface lining consists of 12 inches of 6-inch stone underlain by, from top downward, 6 inches of washed bedding stone, and geotextile filter fabric along the entire length. The downchutes carry stormwater flow from the swales to stone-lined stilling basins which discharge to an eighteen-inch diameter corrugated pipe culvert, which discharges to the stone-lined perimeter channels around the landfill, with eventual discharge to a tributary of Webatuck Creek, located north of the landfill.

4.2 Culverts and Stilling Basins

Twelve-inch diameter corrugated pipe culverts were installed at fifty foot intervals under the perimeter access road along the east and north sides of the landfill.

Eighteen-inch diameter corrugated pipe culverts and stilling basins were installed at two locations as shown on Contract Drawing No. 16.

4.3 Stone Lined Perimeter Drainage Channels

Stone-lined perimeter drainage channels were also constructed to collect and control both surface water run-on and run-off. Channel lining consisted of stone. Perimeter channels, in general, are underlain by geosynthetics and No. 2 stone.

TABLE 4.1.1

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

NO. 4 STORE – SUBBASE COURSE

Source: J. DeArdino's

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4	Min. 1/sourcer	1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	0

TABLE 4.1.2

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

UNDERDRAIN FILTER STONE TYPE 1

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4	500 cy Min. 1/sourcer	1	1
Permeability	1/source	1	1
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	0

TABLE 4.1.3

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

BEDDING STONE

Source: Route 82 Sand and Gravel

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Section 620-2.05 1990	500 cy's Min. 1/sourcer	1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	None

TABLE 4.1.4

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

3-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4		1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	None	None	None

TABLE 4.1.5

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

6-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4		1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/Source	None	None

TABLE 4.2.1

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

NO. 4 STONE SUBBASE COURSE

Source: J. DeArdino's

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 2 inches	100	100
% finer than ¼ inch	51.1	30 – 65
% finer than # 40 sieve	10.5	5 – 40
% finer than #200 sieve	4.9	0 – 10

TABLE 4.2.2

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

UNDERDRAIN FILTER STONE TYPE 1

Source: Dutchess Quarry

Test Description	Range of Test Results and Lab Test	Requirement
Grain Size		
% finer than 1 inch	100	100%
% finer than ½ inch	100	30 – 100%
% finer than ¼ inch	16.1	0 – 30%
% finer than # 10 sieve	1.9	0 – 10%
% finer than #20 sieve	1.3	0 – 5%
Maximum Index Density	111.5 – Max. 110.0	None
Permeability	8.64 x 10 cm/sec at 110.8 (pcf)	1.0 x 10E-3 cm/sec @ 100% of Max. Index Density.

TABLE 4.2.3

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

BEDDING STONE

Source: Route 82 Sand and Gravel

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 4-inch	100%	100
% finer than 1 inch	17%	15-60
% finer than ¼ inch	2.1	0-25
% finer than # 40 sieve	1.5	0-10

TABLE 4.2.4

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

3-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 4.5 inches	100	100
% finer than 3 inches	29.3	0 – 50
% finer than 1 inch	0	0– 1

TABLE 4.2.4

AGGREGATE MATERIAL – RANGE OF TEST RESULTS

6" RIP RAP

Source: Dutchess Quarry

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 9 inches	100	100
% finer than 6 inches	42.8	0 – 50
% finer than 3 inches	0	0 – 10
% finer than #200 sieve		

5.0 BARRIER PROTECTION LAYER

5.1 Construction and Material Requirements

The barrier protection layer is directly beneath the topsoil of the final cover system and on top of the Geosynthetic Drainage System (GDS). The barrier protection layer was placed in a single 12-inch thick layer. The maximum particle size in this material is 3 inches measured in its greatest dimension. Each lift was required to be compacted to a minimum of 95 percent of the Standard Proctor maximum dry density. There was not any specific numerical moisture requirement for the barrier protection layer.

5.2 Construction Methods and Equipment

As mentioned in Section 5, a test pad procedure was also required for the barrier protection layer. The general methods and procedures employed in the successful completion of the test pad were implemented for the placement of the barrier protection layer as part of the final cover system. The test pad was constructed on top of the GDS layer of the in-place final cover.

The borrow material was generally hauled directly from the stockpiles to the area of placement using offsite trucks from both the Owner-furnished sources and the offsite Contractor-furnished sources. The soil was spread over the GDS using a low ground pressure dozer. Care was taken to prevent damage to the underlying GDS during the placement operation. Each lift was compacted with a minimum of two to four passes with a vibratory smoothdrum roller.

If a lift failed in-place moisture-density testing, the affected area would receive either additional compaction or be completely reworked depending on the cause of failure. The Contractor made additional passes with the vibratory smoothdrum roller if the lift required additional compaction. This procedure was repeated until the area met the moisture-density requirements.

5.3 Construction QA/QC Monitoring Requirements, and Results

5.3.1 QA/QC Requirements

Construction QA/QC monitoring of the placement of the barrier protection layer soil included visual inspection of placement procedures, as well as moisture-density tests performed on the compacted fill using a nuclear densitometer. Nuclear densitometer tests were conducted in accordance with ASTM D3017 and D2922. These tests determined the in-place moisture content and dry density, respectively. The minimum frequency of tests was nine test per acre-lift. The acceptance criterion for moisture-density tests was in-place dry density greater than 90 percent of the Standard Proctor maximum dry density.

The barrier protection layer was placed in a 12-to 24-inch thickness to avoid damaging the underlying geosynthetics. In-place moisture-density tests taken on these layers generally were performed at a 10-inch depth to assure that the underlying geosynthetics were not punctured during testing. All holes left by the nuclear densitometer were filled with soil of the same type as the fill layer itself and compacted prior to placement of the topsoil layer.

The quantity of QA/QC tests performed versus the number required is presented in Tables 5.1 and 5.2. The range of QA test results is presented in Table 5.3.

5.3.2 QA/QC Test Results

In-place moisture-density tests were performed on each lift of the barrier protection layer at or exceeding the minimum frequency of 9 per acre per lift. The total number of tests required versus the total number of in-place moisture-density tests performed for QA/QC testing is presented in Table 5.1.

TABLE 4.1

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

NO. 4 STONE – SUBBASE COURSE

Source: J. DeArdino's

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4	Min. 1/sourcer	1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	1

TABLE 4.1 (Con't)

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

UNDERDRAIN FILTER STONE TYPE 1

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4	500 cy Min. 1/sourcer	1	1
Permeability	1/source	1	1
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	1

TABLE 4.1 (Con't)

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

BEDDING STONE

Source: Route 82 Sand and Gravel

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Section 620-2.05 1990	500 cy's Min. 1/sourcer	1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/2500 cy's Min. 1/Source	1	None

TABLE 4.1 (Con't)

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

3-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4		1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	None	None	None

TABLE 4.1 (Con't)

AGGREGATE MATERIAL – TEST FREQUENCY SUMMARY

6-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed
Grain Size NYSDOTTSS Table 703-4		1	1
Permeability	None	None	None
MAX. Index Density ASTM D 4253	1/Source	None	None

TABLE 4.2

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

NO. 4 STONE SUBBASE COURSE

Source: J. DeArdino's

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 2 inches	100	100
% finer than ¼ inch	51.1	30 – 65
% finer than # 40 sieve	10.5	5 – 40
% finer than #200 sieve	4.9	0 – 10

TABLE 4.2 (Con't)

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

UNDERDRAIN FILTER STONE TYPE 1

Source: Dutchess Quarry

Test Description	Range of Test Results and Lab Test	Requirement
Grain Size		
% finer than 1 inch	100	100%
% finer than ½ inch	100	30 – 100%
% finer than ¼ inch	16.1	0 – 30%
% finer than # 10 sieve	1.9	0 – 10%
% finer than #20 sieve	1.3	0 – 5%
Maximum Index Density	111.5 – Max. 110.0	None
Permeability	8.64 x 10 cm/sec at 110.8 (pcf)	1.0 x 10E-3 cm/sec @ 100% of Max. Index Density.

TABLE 4.2 (Con't)

AGGREGARE MATERIAL – RANGE OF TEST RESULTS

BEDDING STONE

Source: Route 82 Sand and Gravel

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 4-inch	100%	100
% finer than 1 inch	17%	15-60
% finer than ¼ inch	2.1	0-25
% finer than # 40 sieve	1.5	0-10

TABLE 4.2 (Con't)

AGGREGATE MATERIAL – RANGE OF TEST RESULTS

3-INCH RIP RAP

Source: Dutchess Quarry

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 4.5 inches	100	100
% finer than 3 inches	29.3	0 – 50
% finer than 1 inch	0	0– 1

TABLE 4.2 (Con't)

AGGREGATE MATERIAL – RANGE OF TEST RESULTS

6" RIP RAP

Source: Dutchess Quarry

Test Description	Range of Test Results	Requirement
Grain Size		
% finer than 9 inches	100	100
% finer than 6 inches	42.8	0 – 50
% finer than 3 inches	0	0 – 10
% finer than #200 sieve		

TABLE 5.1

IPD SUMMARY

Test Description	Min. Frequency Required	Total Tests Required	Total Test Performed	Actual Frequency
Barrier protection layer material	9/acre /lift	81	86	9.56/acre/lift
Roadway Subbase Aggregate	1/100 LF/Lift	25	15	One/167/lift
Swales and Downchutes	1/100 LF/Lift	25	14	One/178 LF/Lift

NOTES:

1) Total number of tests required is based on 2,500 ± 8.2 acre (of 40 ml liner) 9 acres of barrier protection layer material.

2) Total number of tests required is based on 2,500 lineal feet of earth in place.

3) Total number of tests required is based on 2,500/lineal feet of swales and downchutes in place.

TABLE 5.2

BARRIER PROTECTION LAYER MATERIAL – TEST FREQUENCY SUMMARY

Source: Allen Sand and Gravel

Test Description	Min. Frequency Required	Total Tests Required (1)	Total Test Performed
Grain Size with/hydrometer ASTM D-422	1/2500 cy	12	12
Standard Proctor ASTM D-698	1/5,000 cy and when a change in material occurs.	6	6
As Received Moisture Content ASTM D-2216	1/500 cy	56	57
Atterberg Limits ASTM D-4318	1/500 cy	56	57
Interface Friction ASTM D-5321	1/5 acres	3	3

NOTES:

1) Total number of tests required is based on 28,100 cubic yards of earth fill in place.

TABLE 5.3

BARRIER PROTECTION LAYER MATERIAL – RANGE OF TEST RESULTS

Source: Allen Sand and Gravel

Test Description	Range of Test Results	Requirement
Grain Size w/hydrometer ASTM D-422		
% finer than 3/8 inch	100	100
% finer than #200 sieve	61.4 – 76.2	30 – 70
% finer than 0.002 mm	1.8 – 3.9	$\leq$ 20
Standard Proctor		
Maximum Dry Density	108.6	None
Optimum Moisture Content	15.6	None
As received moisture content	9.0 – 15.9	None
Atterberg Limits	NP	NP
Interface Friction	Test No. 1 26.7	$\geq$26°
Organic content	0.0 – 0.5%	$\leq$5%

NOTES:

1) NP = Non-plastic

TABLE 5.3

BARRIER PROTECTION LAYER MATERIAL – RANGE OF TEST RESULTS

Source: Allen Sand and Gravel

Test Description	Range of Test Results	Requirement
Grain Size w/hydrometer ASTM D-422		
% finer than 3/8 inch	100	100
% finer than #200 sieve	61.4 – 76.2	30 – 70
% finer than 0.002 mm	1.8 – 3.9	$\subseteq$ 20
Standard Proctor		
Maximum Dry Density	108.6	None
Optimum Moisture Content	15.6	None
As received moisture content	9.0 – 15.9	None
Atterberg Limits	NP	NP
Interface Friction	Test No. 1 26.7	$\supseteq$26°
Organic content	0.0 – 0.5%	$\subseteq$5%

NOTES:

1) NP = Non-plastic
2) Tests results for the range of 25,000 cy to 28,100 cy are not available.

6.0 GEOTEXTILES, GEOCOMPOSITES, AND EROSION CONTROL PRODUCTS

6.1 Construction and Material Requirements

A geosynthetic drainage system (GDS) was constructed directly on top of the 40 mil LLDPE geomembrane to collect infiltration to the final cover and transmit it to landfill swales and perimeter channels. The GDS was required primarily on slopes greater than 10 percent. The GDS was constructed of a single layer of geonet with geotextile bonded to it on both sides. The top geotextile functioned as a filter geotextile and the bottom geotextile functioned as a friction geotextile for necessary interface friction purposes. This material was required to provide a transmissivity of at least 9.7 x 10-5 square meters per second (m^2/sec). This material was also required to provide a minimum interface friction angle with the adjoining layers of 26 degrees. These requirements were to provide seepage stability.

6.2 Material Quality Testing

Laboratory testing of the GDS was required by the Contract Documents. This system was tested for transmissivity with the actual materials used in construction to simulate field conditions. The geocomposite provided a transmissivity rate of greater than 9.7×10^{-5} m^2/sec. Friction angle testing resulted in a friction angle exceeding the minimum required. All material quality testing results exceeded requirements.

6.3 Construction Methods and Equipment

Prior to installing the GDS, all the QA/QC requirements were successfully met for the 40 mil LLDPE geomembrane. Also, the Contractor swept or washed the geomembrane to remove accumulated dust, dirt, and debris prior to placement of the GDS.

After the proposed GDS installation area was cleaned, the geocomposite was rolled down the slope perpendicular to grading contour lines in such a manner as to continually keep the sheet in tension under its own weight. If necessary, the geocomposite was stretched by hand after unrolling

to minimize wrinkles. A minimum seam overlap of 4 inches was maintained. The geonet-to-geonet laps were tied using plastic fasteners at 5-foot intervals along the roll lengths and at 6-inch intervals at butt seams. Butt seam overlaps measured foot minimum. All seams of geotextile filter for adjacent panels were continuously machine sewn together. In instances where a sewing machine could not be used, geotextile was thermal bonded using a lyster.

6.4 Construction QA/QC Monitoring Requirements

6.4.1 QA/QC Requirements

The construction QA/QC monitoring requirements for the placement of the GDS included the following:

- Visual observation of materials for damage or irregularities
- Inspection of GDS panel installation and seaming to verify that tying, sewing, and thermal bonding operations met requirements

6.4.2 QA/QC Results

The GDS layer installation was conducted in accordance with QA/QC requirements. QA/QC monitors observed material placement. All work was monitored continuously to ensure that overlap and seaming standards were met with no siltation occurring. The QA/QC monitors determined acceptability of the in-place product by observing the work and by QA/QC test results.

7.0 PASSIVE GAS VENTING SYSTEM

7.1 Construction and Material Requirements

A passive gas venting system was constructed on top of the prepared landfill subgrade to vent any gases which may accumulate underneath the final cover. The system consisted of a continuous GDS type of gas collection layer plus gas vent riser pipes. A total of 12 gas vents were installed. As required, gas vent riser pipes were constructed as shown on the Contract Drawings. All gas vents were constructed a minimum of 3 feet into the waste and extended a minimum of 3 feet above the top of the final cover. The sub-liner perforated section of the vent pipe was surrounded by NYSDOTSS No.1 stone. Slot size was 0.125 inch and the pipe had an opening area of 45 square inches per foot. The vent and U-shape outlet of the top is constructed of Schedule 40 PVC pipe. The ends of the outlets were equipped with screen to keep birds out.

On some slopes greater than or less than 10 percent, a gas collection layer consisting of a GDS-type geocomposite (geonet which functions as the gas venting layer, sandwiched between two geotextiles) was constructed as required to extend radially outward at least 2 feet beyond the limit of waste. Upper geotextile for this application functions as a friction geotextile and lower geotextile functions as a filter geotextile.

Within major landfill plateau areas with less than 10 percent slopes, geocomposite was a two-layer system made of geonet and geotextile filter. The geocomposite met the requirement of producing a minimum gas phase transmissivity of 9.7×10^{-5} m^2/sec. The geocomposite was tested for the transmissivity by the Contractor's independent testing laboratory resulting in conformance to the Contract Documents. This material was also required to provide a minimum interface friction angle with adjoining layers of 9 degrees on less than 10 percent.

7.2 Construction Methods and Equipment

Gas vents were installed using an excavator to penetrate the final cover subgrade to depth of 3 feet. The excavations were backfilled with the riser pipe and stone. The riser pipe was extended

above the subgrade and protected for subsequent final cover construction. Upon completion of the final cover system, a Furnco (flexible) coupling, blast gate and U-shape bend with bird screen covering the outlet was installed at each gas vent.

After completion of subgrade, URSG field personnel checked the corresponding area for any deleterious materials and conditions such as sharp objects, tires, leachate seeps and compaction for final approval. Geocomposite was rolled down the slope perpendicular to the grading contours in such a manner as to continually keep the sheet in tension under self weight. If necessary, the geocomposite was stretched by hand after unrolling to minimize wrinkles. A minimum seam overlap of 4 inches was maintained. The geonet-to-geonet laps were tied using white plastic fasteners at 5-foot intervals along the roll lengths and at 6-inch intervals at butt seams. Butt seam overlaps measured 1 foot minimum. Outside of major landfill plateau areas having slopes less than 10 percent, friction geotextile between adjacent panels was sewn together. Geotextile filter was sewn in the less than 10 percent slope area. In instances where the sewing could not be performed, geotextile was fused with a lyster.

Gas vent geocomposite was placed radially outward at least 2 feet beyond the limit of waste. Beyond that, geotextile cushion was placed, overlapping with geocomposite by 1 foot. Friction geotextile and geotextile cushion were heat bonded together with a lyster.

During the subsequent installation of the geomembrane overlying the gas vent composite, there were instances when the gas vent layer required repair due to rain events. During rain events, the geocomposite portion of the gas vent system occasionally would become clogged with silt. The entire portion of clogged geocomposite was removed, and a new section of geocomposite installed by tying and continuously seaming the geotextile.

7.3 Construction QA/QC Monitoring and Requirements

The construction QA/QC monitoring requirements for the placement of the gas venting system included the following:

- Visual observation of materials for damage or irregularities

- Inspection of geocomposite panel installation and seaming to verify that tying, sewing and heat fusion operations met the requirement

- Observation of gas vent pipe installation

7.4 QA/QC Results

The geocomposite gas vent layer installation was conducted in accordance with QA/QC requirements. Acceptability of the in-place product was determined by observing the work and by QA/QC test results. URSG field personnel observed material placement. All work was monitored continuously to ensure that overlap and seaming standards were met with no siltation occurring.

8.0 LLDPE GEOMEMBRANE SYSTEM

8.1 Geomembrane System

8.1.1 Construction and Material Requirements

The LLDPE geomembrane layer for the final cover system was required to be textured and have a minimum thickness of 40 mils. The LLDPE geomembrane was required to be manufactured from an approved resin having a minimum (blended) density of 0.915 gram per cubic centimeter and a maximum melt flow index of 1.3 grams per 10 minutes. Physical and environmental standards specified for the final geomembrane product were provided in the Contract Documents. Interface friction requirements were established for all materials in contact with the geomembrane as detailed in the previous sections.

1. Geocomposite Drainage System - 26 Degrees at 1V:3H slopes

2. Gas Vent Layer - 26 Degrees at 1V:3H slopes
   Gas Vent Layer - 9 degrees at less than 10 percent slopes

3. Minimum required seam strengths were as follows:

Material	Peel Adhesion	Shear
Textured 40 mil	20 lb/in	30 lb/in

All welds were required to exhibit a film-tear-bond (FTB) during destructive seam testing, meaning the geomembrane sheet itself must tear before the weld failed.

8.1.2 Material Quality Testing

Material QA/QC testing included that performed by the manufacturer's. This testing was conducted on both LLDPE resin and finished geomembrane product. Resin testing was performed

to determine melt flow index and density. Geomembrane rolls were tested for sheet thickness, melt flow index, tensile properties, tear strength, puncture resistance, carbon black content, and carbon black dispersion. Manufacturers' test results are provided in the LLDPE Installation Report (Appendix H).

Interface friction testing of the LLDPE was performed by an independent laboratory under contract to the Contractor. All tested friction angle values exceeded the minimum required project specifications. Tests reports are provided in Appendix G.

Because of the excellent durability of LLDPE geomembrane, the Contract Documents did not specify that the geomembrane should be covered within a certain period of time after deployment.

8.1.3 Gas Vent Layer Acceptance

Prior to the placement of any geomembrane, the URSG field personnel and the Contractor's QA/QC officer inspected the gas vent layer and geotextile cushion, as applicable, for any damage or conditions which may affect the integrity of the subsequently placed geomembrane. The gas vent composite was deployed a minimum 2 feet beyond the limit of waste.

8.2 Construction Methods and Equipment

Geomembrane panels were placed perpendicular to the grading contours. Geomembrane rolls were transported and installed using a rubber-tired fork lift with a telescopic boom. Panels were carefully set in place and unrolled by hand.

The seams were welded together by a fusion or an extrusion welding process. The fusion welding process employed a double hot-wedge welder which fused the two panels together into a double seam with an air channel in the between. The extrusion welding process utilized an extrusion welder to place a bead of LLDPE weld between two panels. In the fusion process, the panels were prepared by being cleaned immediately prior to welding. The extrusion welding process was used

for most patches and in areas where the fusion welder could not be utilized due to access constraints. Panels welded together by an extrusion weld were first tack-welded with a lyster, then abraded in the seam area with a grinding wheel prior to application of the extrusion weld.

All penetrations, such as gas vent pipes were constructed using pipe boots to maintain the integrity of the geomembrane system during such fine work. Pipe boots consist of a section of LLDPE geomembrane with a protruding pipe-like section. The boots were welded to the surrounding geomembrane and welded or clamped to the pipe. The Contractor constructed all the boots in the field as per the Contract Documents.

8.3 Construction QA/QC Testing

8.3.1 QA/QC Requirements

Construction QA/QC monitoring requirements and reporting for the placement of the LLDPE geomembrane included the following:

- Start-up testing
- Destructive seam testing
- Nondestructive seam testing
- Panel placement report
- Welding report
- Installation report

8.3.1.1 Start-up Testing

At the start of each work day and after each break that resulted in an equipment shutdown, a start-up field test of the seaming equipment was performed on a test strip at or near the work location under the same conditions that existed for the geomembrane welding. The test weld, which was required to be a minimum of 3 feet in length, was run for each welding machine used. During winter when the temperature dropped below 41 degrees Fahrenheit (F), the minimum test lengths

were extended to 5 feet for extrusion welds and 24 feet for fusion welds. No welding was allowed below 20 degrees F. One-inch wide cutouts of the test strips were subjected to tensile testing (bonded seam strength) and peel adhesion testing at the site.

A seam test was considered a failure if:

- In the one-dimensional linear tension test (bonded seam strength), the bonded portion of the seam tore before the adjacent sheet material.

- In the peel adhesion test, the two sheets comprising the seam separated at the bond interface before tearing an individual sheet.

- In addition to the above criteria, the bonded seam strength testing and peel adhesion testing was required to meet specified minimum strengths.

A log was maintained by the Contractor and URSG for the purpose of recording all test results.

8.3.1.2 Destructive Seam Testing

At a minimum frequency of one test per 500 lineal feet of weld, a short section of the fabricated seam was cut from the installed geomembrane and tested on site for linear tension and peel adhesion. A duplicate sample concurrently was sent to the Contractor's laboratory for the peel and shear tensile testing. The cutout sections were wide enough to perform the required field tests, as well as to obtain a minimum of ten 1-inch wide specimens for laboratory tensile testing (i.e. five 1-inch specimens for laboratory peel, and five 1-inch specimens for laboratory shear testing). The size of cutout section for the laboratory testing was a minimum of 24 inches wide by 15 inches long with the longer dimension parallel to the seam. The sample for the laboratory testing was cut into two parts for distribution as follows:

- One sample for laboratory testing by an independent testing laboratory.

- One sample for Town of North East archive storage.

8.3.1.3 Nondestructive Seam Testing

URSG field personnel and the Contractor's QA/QC officer visually inspected all seams together. In addition, the Contractor was required to test all seams (in the presence of the URSG field personnel monitor) utilizing a vacuum box or air pressure testing as nondestructive testing. The URSG field personnel monitor observed all nondestructive seam testing and documented all results.

8.3.1.4 Panel Placement Report

Prior to panel placement, URSG field personnel inspected the gas vent layer and geotextile cushion, as applicable, for any damage or conditions which would interfere with the integrity of the geomembrane. After the geomembrane was deployed, URSG field personnel walked with the Contractor's QA/QC officer to jointly look for any damage in the geomembrane which required repair. The Contractor's Panel Placement Report is included in Appendix H.

8.3.1.5 Welding Report

Double hot-wedge fusion welders were used to weld the panels as they were deployed. When it was not feasible to use double hot-wedge fusion welders due to repairs, gas vent, and manhole penetrations, etc., an extrusion welder was used. The Contractor's welding report is included in Appendix H.

8.3.2 QA/QC Test Results

Installation of the LLDPE geomembrane layer for the final cover system was carried out in accordance with the Contract documents. The results of the QA/QC testing are discussed below.

8.3.2.1 Start-up (Trial) Testing

Start-up (trial) samples were tested in the field on a Columbine International Tensile and Peel Test Machine (Tensiometer). The tensiometer was then calibrated. If the welding machines failed their start-up calibration tests, then one or more parameters (e.g., preheat or extruded temperature, machine speed) were varied until passing results were obtained. A copy of the start-up test results from the Contractor and URSG are included in Appendix H.

8.3.2.2 Destructive Seam Test Results

Destructive seam testing was carried out in accordance with QA/QC requirements. Field tests were conducted on a portion of the samples on the same tensile and peel machine described. If the field tests satisfied the Contract requirements, then the samples were sent to the independent laboratory for laboratory peel and shear testing. The locations of all destructive seam samples are shown on the attached supplemental record drawings. The LLDPE geomembrane destructive seam test reports from the Contractor and URSG are included in Appendix H.

When a sample failed either its field or laboratory testing, additional destructive seam samples were collected and tested to bracket the failed seam area. These samples were noted as "B" (before) and "A" (after) to indicate their locations in relation to the failed sample and the direction of travel of the welding machine. "A" or "B" samples were always taken from seams made by the same machine on the same day as the failed sample. These additional (bracket) samples were 10 feet apart from the failed sample. When both "A" and "B" samples passed laboratory testing, the seam between them would be covered with a strip, or cap, of geomembrane and then welded. On occasion, an "A" or "B" sample would not required to be collected if the failed seam location was within 10 feet of the beginning or end of the weld constructed that day.

8.3.2.3 Non-Destructive Seam Test Results

The entire length of all seams for LLDPE geomembrane was nondestructively tested by Contractor and observed by the Contractor's QA/QC monitor and URSG field personnel. The results of all testing were recorded by the monitor and documented by Grace.

Double fusion welded seams created by the hot double-wedge welder were air pressure tested. In this method, both ends of the seam were sealed off and a test needle connected to a pressure gauge was inserted in one end of the seam. The air in the channel was pressurized to between 25 and 32 pounds per square inch (psi). If the pressure was maintained with less than a 4 pounds per square inch (psi) drop over 5 minutes, the seam was deemed acceptable. The seam was then opened at the far end from the pressure gauge and the drop in pressure observed by the URSG field personnel as verification that the entire length of seam had been opened and tested. Seams which failed air-pressure testing were rewelded and then vacuum-box tested.

Where possible, all the extrusion welds were vacuum tested. A soap and water solution was applied to the seam area. A minimum of 5 psi suction was maintained for 15 seconds or until a leak was observed in the seam. In the few instances where a vacuum box could not be applied to a portion of a seam due to gas vent and manhole penetrations, etc., such welds were carefully scrutinized by visual inspection. Such inspections were always carried out by a qualified inspector.

All the boots for gas vents, conduits, manholes, poles and supporting cables were field fabricated. All the boots were vacuum tested and visually inspected.

Any holes or leaks detected by the nondestructive seam tests were repaired, and the resultant patch tested. Only when all portions of a seam had been successfully tested would the Contractor and URSG concur that the entire seam, including patches, had passed the nondestructive seam test. Copies of all nondestructive seam test reports from the Contractor and URSG are included in Appendix H.

8.3.2.4 Panel Placement

Each roll of geomembrane was assigned a panel number or numbers. A panel is define as the unit area of continuous in-place geomembrane sheet which is to be seamed. One roll may constitute one panel if the roll was uncut or the roll could be cut into several panels. All panels were welded with 3-inch overlap on the same day that they were deployed. Even though the cover system is considered veneer-stable with no interface friction concerns, all the cross-seams (seams parallel to grading contours) on slopes greater than 10 percent were welded at about 45 degree angles to the contour so that primary stresses were not oriented perpendicular to the seam. These cross-seams were at least 45 degree angles apart on the adjacent panels. At the end of each working day, panels were properly secured with sand bags. The length of every panel was measured along the center of the panel. The typical width of each panel was 23 feet. Most of the "pie-type", pieces such as at corners, were triangular in shape. Surface areas for all the pie-pieces were calculated in the Contractor's Panel Placement Report. The Panel Placement Report includes panel number, roll number.

8.3.2.5 Welding Report

The machines which were start-up tested were used to weld the panels together after their deployment. The parameters monitored, like preheat temperature and speed, were the same as those in the start-up tests. All seams are identified in the Contractor's Welding Report, a copy of which is included in Appendix H.

8.3.2.6 Installation Report

The Contractor prepared and submitted an Installation Report which included all the field quality control forms and test results completed by the Contractor during the installation of LLDPE geomembrane. Specifically, the Installation Report includes the following:

- Certification letter
- Geomembrane roll numbers and certifications

- Panel roll numbers and placement date
- Geomembrane seaming records
- Geomembrane seam test records
- Geomembrane trial seam records
- Geomembrane seam destructive log
- Repair log
- Subgrade acceptance
- Installer warranty
- Record drawing coordinates

A copy of the Installation Report is included in Appendix H.

9.0 TOPSOIL AND TURF

9.1 Construction and Material Requirements

A 6-inch topsoil layer was placed above the barrier protection layer to complete the final cover system. The landfill surface was covered with Contractor supplied topsoil from off-site sources. Offsite topsoil generally exceeded the contract requirements. Final acceptance was based on an acceptable stand of turf. The entire landfill site subsequently was mulched, fertilized, and seeded to establish vegetative growth in accordance with the Contract Specifications.

9.2 Construction Methods and Equipment

The Contractor-furnished topsoil material was hauled directly to the area of placement using dump trucks. The topsoil was spread in a minimum 6-inch layer using bulldozers. Required thicknesses for the topsoil were verified using grade stakes and hard excavation test.

9.3 Construction QA/QC Monitoring Requirements

To demonstrate a minimum of 6 inches of topsoil was placed, the Contractor hand dug test holes on a grid no greater than 40 feet x 40 feet. A URSG representative was present to verify the results. In area where less than 6 inches of topsoil was observed, additional topsoil was placed and graded, with subsequent depth verification.

TABLE 2.1

LIST OF CONSTRUCTION EQUIPMENT

EXCAVATORS CAT 215B Backhoe 219LC Backhoe **LOADERS** CAT 936 Loader CAT 938F Loader 416B Loader/Backhoe 505-19 Loader **COMPACTION EQUIPMENT** CAT CS 563 Smooth Drum Roller CASE 620 Smooth Drum Vibratory Roller INTENUS CU 25D Smooth Drum Vibratory Roller Sheepsfoot Roller (tow behind) CASE 602 Smooth Drum Roller (tow behind) **BULLDOZERS** CAT D4H Dozer CAT D5 Dozer CAT D5HLPG Dozer CAT D6H Dozer Dresser TD-9H Dozer	**TRUCKS** Water Truck **MISCELLANEOUS EQUIPMENT** Post Hole Digger 18-inch Disc Harrow (tow behind) Power Screens 12-inch Wood Chipper Timberjack 450A Grappler Skid 23-inch MABART Tree Destroyer MABART Tree Feller/Buncher Tractor with York Rake Tractor with Seeder