MALCOLM PIRNIE

REMEDIAL ACTION REPORT

CITY OF JOHNSTOWN LANDFILL CLOSURE CONSTRUCTION CERTIFICATION REPORT

Town of Johnstown
Fulton County, New York

Prepared by:

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CITY OF JOHNSTOWN
LANDFILL CLOSURE CONSTRUCTION
CERTIFICATION REPORT

REMEDIAL ACTION REPORT

CITY OF JOHNSTOWN
JOHNSTOWN, NEW YORK
PROJECT NO: 2384-00-1

JULY 1997

Robert R. Martens, P.E.
Vice President

MALCOLM PIRNIE, INC.

15 Cornell Road
Latham, New York 12110

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1.0 INTRODUCTION

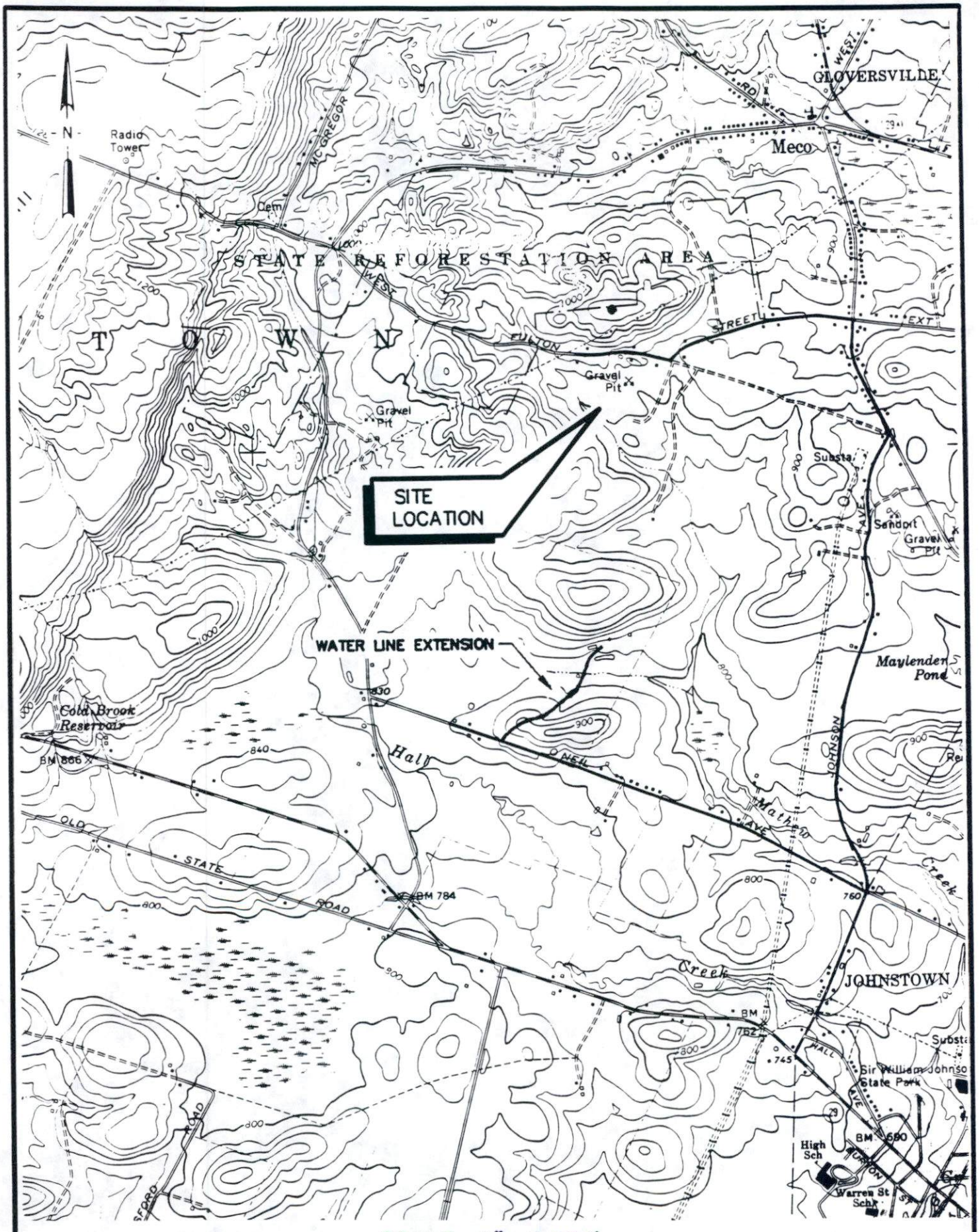
1.1 BACKGROUND

The City of Johnstown Landfill is located in the Town of Johnstown, Fulton County, New York. The site is generally bordered by low density residential areas along West Fulton Street Extension to the north, and mixed wooded and agricultural lands to the east, south and west of the site. The landfill is located in a former borrow pit. The location of the landfill is indicated on Figure 1-1.

The City used approximately 37 acres of the 68 acre landfill site as a sanitary landfill from 1947 until 1989. Wastes from local tanneries and textile mills were accepted at the site until 1977. Wastewater treatment plant sludge was also disposed at the landfill from 1973 until 1979. The tannery wastes contained elevated levels of chromium and the wastewater sludge contained elevated levels of chromium, iron and lead.

The Johnstown Landfill was placed on the National Priorities List of Superfund sites by the United States Environmental Protection Agency (USEPA) (I.D. No. NYD980506927) and the New York State List of Inactive Hazardous Waste Sites by the New York State Department of Environmental Conservation (NYSDEC) (I.D. No. 518002). As a result of a 1992 Remedial Investigation/Feasibility Study (RI/FS), the USEPA issued a Record Of Decision (ROD) selecting a remedy which included relocation of sediments from a gravel pit adjacent to the landfill, construction of a landfill cap in accordance with 6 NYCRR Part 360 regulations, extension of the municipal water supply system, installation of a chain-link fence around the landfill and placement of warning signs, as appropriate. The City of Johnstown retained Malcolm Pirnie Inc. (Malcolm Pirnie) to conduct the remedial design, obtain bids, provide construction administration and resident engineering, and prepare the Construction Certification Report (Remedial Action Report) for the closure of the landfill and extension of the municipal water supply system.

The contract for the closure of the City of Johnstown Landfill was competitively bid and awarded to Delaney Construction Corporation (Delaney Construction) of Mayfield, New



SCALE: 1"=2,000'

MALCOLM PIRNIE

CITY OF JOHNSTOWN
FULTON COUNTY, NEW YORK

SITE LOCATION MAP

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FIGURE 1-1

York. The closure construction began in December 1995, and was generally completed by December 1996.

During December 1995 and January 1996 Delaney Construction set up support facilities, installed perimeter site access controls, determined the limits of waste, completed the majority of the waste relocation and placed intermediate cover material where required. Delaney Construction suspended construction in the middle of January 1996 due to inclement weather conditions.

When the project resumed in May 1996, the remaining portion of the waste relocation activities were completed. Once the waste relocation activities were complete the separation fabric, gas vent material, 60 mil linear low density polyethylene (LLDPE) geomembrane, barrier protection material and topsoil were placed and the site was seeded. A site inspection was conducted on December 3, 1996. Based on the results of that inspection, a list of the work to be completed was prepared by Malcolm Pirnie and transmitted to Delaney Construction in a letter dated December 11, 1996. A copy of that correspondence is included as Appendix A.

During May 1997, Delaney Construction remobilized to the site to repair erosion damage and complete the work which had been identified as remaining to be completed. This work was completed by May 23, 1997. On June 11, 1997, the Final Inspection of the Landfill Closure Construction was conducted by representatives of Malcolm Pirnie, the NYSDEC and the USEPA.

1.2 PURPOSE AND SCOPE

The purpose of this report is to summarize the observations made and data collected during the construction of the landfill cap. Specifically, this report will include:

- Summary tables of the laboratory testing results for the soil and synthetic components of the cap.
- The "as built" construction survey.
- The "as constructed" 60 mil LLDPE panel layout.

A separate Remedial Action Report will be prepared for the municipal water system extension.

2.0 CHRONOLOGY OF EVENTS

The following represent the major events associated with the landfill closure project:

1992	Remedial Investigation/Feasibility Study Completed
1993	Record of Decision Issued
04/95	Design Report Completed
08/95	Design Documents Completed
08/08/95	Project Advertised for Bid
09/07/95	Bids Received and Opened
10/17/95	Notice to Proceed Issued to Delaney Construction
12/14/95	Initiated Waste Relocation and Regrading
01/10/96	Initiated Excavation of LaGrange Pit
01/15/96	Completed Excavation of LaGrange Pit
01/17/96	Initiated Backfilling of LaGrange Pit
01/19/96	Completed Backfilling of LaGrange Pit
01/19/96	Contractor Demobilized from Site for Winter Shutdown
05/08/96	Contractor Remobilized to Site and Continued Regrading Waste
05/15/96	Initiated Monitoring Well Decommissioning
05/22/96	Completed Monitoring Well Decommissioning
06/12/96	Initiated Geotextile Installation
06/14/96	Initiated Gas Collection Material Placement
06/27/96	Generally Completed Waste Relocation and Regrading
07/08/96	Initiated Gas Migration Prevention Trench Construction
07/09/96	Completed Excavation of Gas Migration Prevention Trench
07/09/96	Initiated Geomembrane Installation
07/16/96	Initiated Barrier Protection Material Placement
07/31/96	Initiated Topsoil Placement
09/03/96	Completed Geotextile Installation
09/07/96	Generally Completed Gas Collection Material Placement
09/11/96	Initiated Gas Monitoring Well Installation
09/13/96	Completed Gas Monitoring Well Installation
10/02/96	Initiated Seeding of Landfill Cover
10/09/96	Completed Liner Installation
10/11/96	Initiated Construction of On-Cap Access Road
10/23/96	Initiated Fence Installation
10/26/96	Completed Placement and Grading of Barrier Protection Material
10/31/96	Completed On-Cap Access Road
11/05/96	Completed Topsoil Placement on Cap
11/22/96	Completed Seeding
12/03/96	Conducted Site Inspection
12/96	Completed Fence Installation
12/96	Contractor Demobilized From Site
5/97	Contractor Remobilized to Repair Erosion/Reseed Disturbed Areas
06/11/97	Final Inspection

3.0 LANDFILL CLOSURE DESIGN AND MATERIALS

3.1 GENERAL

This section briefly describes the components and the materials used for the construction of the landfill cap. The quality assurance and quality control testing that was performed on the materials used in construction is also described. The cap system consists of the following layers:

- Geotextile
- Gas Collection
- Geomembrane
- Barrier Protection
- Topsoil

3.2 GEOTEXTILE LAYER

The geotextile layer consists of separation fabric placed directly on the intermediate cover and below the gas vent layer. The purpose of this geotextile layer is to prevent the migration of soil particles from the intermediate cover into the gas vent layer. The geotextile layer consists of a needle-punched, non-woven polypropylene fabric manufactured by Amoco, Style No. 4506. The acceptance criteria for the geotextile separation fabric follow:

Property	Test Method	Specified Minimum Value	Actual Minimum Value
Grab Tensile Strength	ASTM D4632	145 lbs	150 lbs
Grab Tensile Elongation	ASTM D4632	50%	50%
Burst Strength	ASTM D3786	220 lbs	350 lbs
Puncture Strength	ASTM D4833	60 lbs	90 lbs
Weight	ASTM D3776	6.0 oz/sy	6.0 oz/sy
Trapezoid Tear Strength	ASTM D4533	60 lbs	65 lbs

Property	Test Method	Specified Minimum Value	Actual Minimum Value
Permittivity	ASTM D4491	1.7 sec-1	1.7 sec-1
Water Flow Rate	ASTM D4491	130 gal/min/sf	90 gal/min/sf
Equivalent Opening Size	ASTM D4751	70-140 sieve	70 sieve

3.3 GAS COLLECTION LAYER

The gas collection layer consists of 12-inches of sand placed above the geotextile and below the geomembrane. This layer collects gases that may emanate from the waste. Gas collected in this layer will be vented to the atmosphere through PVC gas vents. The PVC gas vents with two, twenty foot laterals each, were installed at a minimum frequency of one per acre of capped landfill. A total of 37 gas vents were installed.

The gas collection layer consists of clean, well-graded sand, free from organic matter, roots, debris, vegetation, wood, sod, frozen soil lumps, and other deleterious materials. In accordance with the contract specifications, a particle size analysis (ASTM D422) was performed for each 1,000 cubic yards of in-place material. In addition, lab permeability (ASTM D2434) and maximum/minimum index density (ASTM D4254/D4253) tests were performed for each 5,000 cubic yards of in-place material. Internal friction angle (ASTM D3080) tests were also performed for each 10,000 cubic yards of in-place material. The gas collection layer was required to have a minimum permeability of 1×10^{-3} cm/sec when compacted to 90 percent of the maximum index density and to have an internal friction angle in excess of 30 degrees. The acceptance criteria for the gradation of the gas collection sand follow:

Sieve Size	Percent Passing by Weight
1/2 inch	100
No. 200	0 to 10

Approximately 58,000 cubic yards of gas collection material were placed during the construction of the 12-inch layer. Fifty-eight sieve analyses, and 12 lab permeability, 12 maximum/minimum index density and six internal friction angle tests were performed on the material. The collection of samples and the laboratory analyses were completed by Malcolm Pirnie. Summaries of the results of the particle size, maximum and minimum index density, internal friction, and laboratory permeability tests may be found in Tables 3-1, 3-2, 3-3 and 3-4, respectively.

The gas collection material was obtained from two sources. The first 12,000 cubic yards of material were obtained by screening run-of-bank material from Delaney Construction's Meco Pit, located in the Town of Johnstown. The balance of the material was run-of-bank sand obtained from the Simek Sand Pit, located on Maple Avenue Extension in the Town of Johnstown.

3.4 GEOMEMBRANE LAYER

The geomembrane layer consists of one sheet of linear low density polyethylene having a nominal thickness of 60 mil. The geomembrane was placed above the gas collection layer and below the barrier protection layer. The geomembrane was manufactured by Poly-Flex, Inc. (Poly-Flex). The resin supplier for the 60 mil LLDPE geomembrane was Phillips Chemical Company, Inc. (Phillips).

The LLDPE geomembrane was manufactured from virgin polyethylene resins. The resins supplied to Poly-Flex were tested by Phillips and were required to meet the following minimum properties:

Property	Test Method	Value	Units
Specific Gravity	ASTM D1505	0.92	g/cm-3
Melt Flow Rate	ASTM D1238E	1.3(max)	g/10 Min
Percent Carbon Black	ASTM D1603	2.0 to 3.0	%
Carbon Dispersion	ASTM D3015	A1, A2 or B1	Rating

TABLE 3-1

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing By Weight	
	1/2-inch	No. 200
GV-01	100	8.3
GV-02	99.1	6.8
GV-03	100	7.2
GV-04	99.3	6.8
GV-05	100	8.6
GV-06	98.4	6.5
GV-07	96.3	8.9
GV-08	100	9.9
GV-09	97.4	9.2
GV-10	100	9.6
GV-11	100	10.0
GV-12	100	9.9
GV-13	99.6	10.6
GV-14	98.9	9.7
GV-15	100	5.1
GV-16	100	5.4
GV-17	100	6.3
GV-18	100	4.9
GV-21	100	9.1
GV-22	100	7.4

TABLE 3-1 (Continued)

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing By Weight	
	1/2-inch	No. 200
GV-23	100	2.4
GV-24	100	5.6
GV-25	100	7.4
GV-26	100	3.7
GV-27	100	2.6
GV-28	100	4.0
GV-29	100	7.7
GV-30	100	3.2
GV-31	100	2.7
GV-32	100	2.4
GV-33	100	2.7
GV-34	100	3.0
GV-35	100	2.8
GV-36	100	2.2
GV-37	100	1.8
GV-38	100	1.8
GV-39	99.4	2.6
GV-40	99.5	2.5
GV-41	99.5	3.4
GV-42	99.3	2.0
GV-43	100	2.4

TABLE 3-1 (Continued)

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing By Weight	
	1/2-inch	No. 200
GV-44	100	2.7
GV-45	100	1.3
GV-46	100	5.2
GV-47	100	3.0
GV-48	100	3.5
GV-49	100	4.4
GV-50	100	3.2
GV-51	100	2.3
GV-52	100	2.2
GV-53	100	3.6
GV-54	100	4.3
GV-55	100	3.5
GV-56	100	5.5
GV-57	100	4.2
GV-58	100	3.3
GV-59	100	3.4
GV-60	100	3.4

TABLE 3-2

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

MAXIMUM/MINIMUM INDEX DENSITY

MPI Sample No.	Minimum Index Density (PCF)	Maximum Index Density (PCF)
GV/01-05	102.1	128.5
GV/06-10	101.0	129.0
GV/11-15	102.4	131.5
GV/16-18	102.1	125.0
GV/21-25	95.0	113.5
GV/26-30	92.5	112.8
GV/31-35	90.5	109.7
GV/36-40	92.9	110.5
GV/41-45	92.4	109.6
GV/46-50	91.4	111.3
GV51-55	91.5	111.2
GV/56-60	90.8	113.5

TABLE 3-3

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

INTERNAL FRICTION ANGLE TEST RESULTS

Sample No.	Direct Shear (degrees)
GV/01-10	36.2
GV/11-20	42.9
GV/21-25	42.2
GV/26-35	35.5
GV/36-45	41.3
GV/46-55	38.6

TABLE 3-4

QUALITY ASSURANCE TEST RESULTS
GAS VENTING MATERIAL

PERMEABILITY TEST RESULTS

Sample No.	Coefficient of Permeability (cm/sec)
GV/01-05	5.9 E-3
GV/06-10	3.5 E-3
GV/11-15	2.7 E-3
GV/16-18	8.5 E-3
GV/21-25	1.0 E-2
GV/26-30	1.2 E-2
GV/31-35	1.7 E-2
GV/36-40	2.1 E-2
GV/41-45	1.5 E-2
GV/46-50	2.1 E-2
GV/51-55	1.8 E-2
GV/56-60	1.2E-2

The LLDPE liner material was evaluated for compliance, and certifications of material quality were received prior to the delivery of the material. Production quality control was conducted by Poly-Flex. The acceptance criteria for the completed sheet was based on the following absolute minimum properties:

Property	Test Method	Value	Units
Thickness (Nominal 60 mil)	ASTM D751	0.054	Inches
Density	ASTM D1505	0.92	g/cm-3
Melt Flow Rate	ASTM D1238 Condition E	1.0(max)	g/10 Min
Carbon Black Content	ASTM D1603	2 to 3	%
Coefficient of Linear Thermal Expansion	ASTM D696	2.0(max)	C^{-1}
Tear Resistance	ASTM D1004	35	lb (min)
Dimensional Stability	ASTM D1204 212F 1 hour	3	%
Percentage Elongation at Break	ASTM D638*	300	%
Tensile Stress at Break	ASTM D638*	110	(lbs/sq.in.)
Puncture Resistance	FTMS 101B Method 2065	78	lbs

* Speed 20 ipm, Test Specimen, Type IV

3.5 BARRIER PROTECTION LAYER

The barrier protection layer consists of a 12-inch layer of sandy soil placed above the geomembrane and below the topsoil. The primary function of the barrier protection layer is to prevent damage to the underlying geomembrane.

The barrier protection material was clean material, free from wood, sod, organic matter, roots, debris, vegetation and other deleterious materials. In accordance with the contract specifications, a particle size analysis (ASTM D422) was performed for each 1,000 cubic yards of in-place material. Maximum/minimum index density (ASTM D4254/ D4253)

tests were to be performed for each 5,000 cubic yards of in-place material. Internal friction angle (ASTM D3080) tests were performed for each 10,000 cubic yards of in-place material. The barrier protection layer was required to have an internal friction angle in excess of 30 degrees. The acceptance criterion for the gradation of the barrier protection layer follows:

Sieve Size	Percent Passing by Weight
1/2 inch	100

Approximately 58,000 cubic yards of barrier protection material were placed during the construction. Sixty sieve analyses, four standard Proctor tests, 8 maximum/minimum index density tests and six internal friction angle tests were performed on the material. The collection of samples and the laboratory analyses were completed by Malcolm Pirnie. A summary of the results of the particle size, standard Proctor, maximum and minimum index density and internal friction angle tests can be found in Tables 3-5, 3-6, 3-7 and 3-8, respectively.

The barrier protection layer material consists of screened run-of-bank material obtained entirely from the Simek Sand Pit, located on Maple Avenue Extension in the Town of Johnstown.

3.6 TOPSOIL LAYER

The topsoil layer consists of six inches of fertile, loamy soil suitable for establishing and maintaining vegetation on the cap. The primary function of the topsoil layer is to stabilize the surface of the cap and prevent erosion of the cap materials.

The topsoil layer consists of fertile, friable, surface soil that has the ability to support vegetation. In accordance with the contract specifications a sieve analysis (ASTM D422), organic content test (ASTM D5368) and pH analysis (ASTM D4972) were performed for each 5,000 cubic yards of in-place material. The topsoil was required to have an organic

TABLE 3-5

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing by Weight 1/2-Inch Sieve
BP-01	100
BP-02	100
BP-03	100
BP-04	100
BP-05	100
BP-06	100
BP-07	100
BP-08	100
BP-09	100
BP-10	100
BP-11	100
BP-12	100
BP-13	100
BP-14	100
BP-15	100
BP-16	100
BP-17	100
BP-18	100
BP-19	100
BP-20	100

TABLE 3-5 (Continued)

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing by Weight 1/2-Inch Sieve
BP-21	100
BP-22	100
BP-23	100
BP-24	100
BP-25	100
BP-26	100
BP-27	100
BP-28	100
BP-29	100
BP-30	100
BP-31	100
BP-32	100
BP-33	100
BP-34	100
BP-35	100
BP-36	100
BP-37	100
BP-38	100
BP-39	100
BP-40	100

TABLE 3-5 (Continued)

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

SIEVE ANALYSIS TEST RESULTS

MPI Sample No.	Percent Passing by Weight 1/2-Inch Sieve
BP-41	100
BP-42	100
BP-43	100
BP-44	100
BP-45	100
BP-46	100
BP-47	100
BP-48	100
BP-49	100
BP-50	100
BP-51	100
BP-52	100
BP-53	100
BP-54	100
BP-55	100
BP-56	100
BP-57	100
BP-58	100
BP-59	100
BP-60	100

TABLE 3-6

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

STANDARD PROCTOR TEST RESULTS

Sample No.	Optimum Moisture Content (% M)	Maximum Dry Density (PCF)
BP/1-5	11.5	110.5
BP/6-10	10.9	110.2
BP/11-15	11.8	110.3
BP/16-20	12.0	111.4

TABLE 3-7

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

MAXIMUM/MINIMUM INDEX DENSITY

MPI Sample No.	Minimum Index Density (PCF)	Maximum Index Density (PCF)
BP/21-25	91.8	109.8
BP/26-30	91.4	110.3
BP/31-35	93.1	114.9
BP/36-40	93.5	115.9
BP/41-45	93.2	115.4
BP/46-50	96.8	113.9
BP/51-55	95.4	113.9
BP/56-60	96.4	115.6

TABLE 3-8

QUALITY ASSURANCE TEST RESULTS
BARRIER PROTECTION MATERIAL

INTERNAL FRICTION ANGLE TEST RESULTS

MPI Sample No.	Direct shear (degrees)
BP/01-10	36.8
BP/11-20	42.9
BP/21-30	39.0
BP/31-40	40.7
BP/41-50	46.2
BP/51-60	40.9

content between two and 20 percent, and a pH between 5.5 and 7.6. The acceptance criteria for the gradation of the topsoil follow:

Sieve Size	Percent Passing by Weight
2	100
3/4	90-100
No. 200*	10-80

*The clay content of the material passing the No. 200 sieve shall not be greater than 60 percent.

Approximately 30,000 cubic yards of topsoil were placed during the construction of the topsoil layer. Eight sieve analyses, organic content tests, and pH analyses were performed on the material. The collection of samples was completed by Delaney Construction and observed by Malcolm Pirnie. The laboratory analyses were completed by Construction Technologies, Inc. Summaries of the results of the sieve analyses, organic content tests and pH analyses may be found in Tables 3-9 and 3-10.

The topsoil was obtained from two off-site sources. The first 20,000 cubic yards of topsoil consisted of a screened silty clay obtained from Delaney Construction's Meco Pit, located in the Town of Johnstown. The remaining 10,000 cubic yards of material consisted of a screened silty sand obtained from the Simek Sand Pit, located on Maple Avenue Extension in the Town of Johnstown.

The topsoil was seeded with the specified seed mix following placement.

3.7 BACKFILL FOR THE LAGRANGE PIT

The backfill used to replace the excavated sediments of the LaGrange Pit was a sandy material which was clean, free from wood, organic matter, roots, debris, vegetation, sod and other deterious materials. In accordance with the contract specifications, a particle size analysis (ASTM D422) was performed for each 5,000 cubic yards of in-place material. The backfill material was specified to have a maximum of 10 percent of its particles by weight passing the No. 200 sieve. Approximately 8,000 cubic yards of material were placed in the

TABLE 3-9

QUALITY ASSURANCE TEST RESULTS
TOPSOIL

SIEVE ANALYSIS TEST RESULTS

Sample No.	Percent Passing by Weight			
	2-inch	3/4-inch	No.200	No. 200 (Clay)
96-5607	100	93.6	28.5	48
96-5727	100	95.5	50.2	36
96-5728	100	97.8	53.0	45
96-5822	100	99.8	38.3	30
96-5823	100	100	51.3	45
96-5839	100	98.9	42.3	40
96-5917	100	100	18.2	50
96-5918	100	100	21.1	50

TABLE 3-10

QUALITY ASSURANCE TEST RESULTS
TOPSOIL

pH/ORGANIC CONTENT TEST RESULTS

Sample No.	Organic Content (%)	pH
96-5607	2.7	6.9
96-5727	2.6	7.4
96-5728	2.7	7.6
96-5822	2.3	7.2
96-5823	2.9	7.5
96-5839	2.4	7.2
96-5917	2.2	7.1
96-5917	2.2	7.1

LaGrange Pit as backfill. Two sieve analyses were completed and the analytical results follow:

La Grange Sample 1	3.4 % Passing the No. 200 Sieve
La Grange Sample 2	6.9 % Passing the No.200 Sieve

The collection of the samples was completed by Malcolm Pirnie. The samples were analyzed by Construction Technology, Inc. The backfill for the LaGrange Pit was obtained from on-site locations to the south of the LaGrange Pit and to the east of the landfill.

4.0 LANDFILL CLOSURE CONSTRUCTION AND DOCUMENTATION

4.1 GENERAL

This section describes the construction of the landfill cap from the installation of the separation fabric through the placement of topsoil. A description of the individual daily activities were summarized in the Inspector's Daily Reports which are maintained in Malcolm Pirnie's project files. In addition, other related construction which occurred on-site during the construction of the landfill cap has also been documented in these reports.

The original landfill design consisted of constructing a synthetic and soil cap system over approximately 37.7 acres of landfill surface. However, during construction additional waste was discovered outside of the landfill's limits in several locations. Based on test pit information obtained during the waste relocation activities, the city decided to extend the landfill cap system to include some of the areas of extraneous waste. In other areas, the waste was relocated to under the landfill cap. Generally, if the waste outside of the defined limits was excessively deep, then the cap was extended. Otherwise, the waste was relocated to low areas within the area to be capped. The cap extensions at the site totaled approximately 0.3 acres. The approximate amount of waste relocated from outside the original limits of the cap into the landfill was 6,350 cubic yards.

Several areas identified during the remedial investigation as containing waste were determined to be free of waste. In the areas free of waste, the landfill cap system was not constructed, resulting in a reduction in the landfill footprint of approximately 0.9 acres. This resulted in an overall net areal reduction of 0.6 acres of landfill cap from that which was contained in the original design. A survey of the completed landfill has been included in Appendix B.

4.2 GEOTEXTILE LAYER

The geotextile separation fabric was placed directly above the intermediate cover and below the gas vent material. Placement of the separation fabric occurred between June and September 1996. To avoid extended exposure of the fabric to the elements, the separation fabric was placed ahead of, but no longer than fifteen days prior to the gas collection layer. The geotextiles were deployed in the direction of the slope, overlapped four inches and sewn with a double lock stitch in accordance with the contract specifications.

Malcolm Pirnie observed the deployment and sewing of the geotextile. In some locations the sewing machine malfunctioned. These areas were identified and repaired in accordance with the contract specifications. No specific quality assurance testing was required during the installation of the geotextile layer.

4.3 GAS COLLECTION LAYER

4.3.1 Construction

The gas collection layer was placed directly on top of the geotextile and below the geomembrane. Placement of the gas collection layer occurred between June and September 1996.

The gas collection material was hauled to the site from an off-site source and stockpiled at the edge of the landfill. The gas collection material was then loaded into off-highway trucks and hauled to the required location on the landfill. The gas collection material was placed in one 12-inch lift with a wide- tracked, low ground pressure (LGP) bulldozer. After the gas collection material was graded, it was lightly rolled with a smooth drum vibratory roller to stabilize it.

4.3.2 Construction Documentation

Representatives of Malcolm Pirnie were present during the placement of the gas collection material. The lift thickness was monitored by using plastic concrete cylinder containers with grade stakes placed in them. The grade stakes were marked with the required

thickness. In addition, the lift thickness was verified by Malcolm Pirnie through test pits. As required, the contractor surveyed the gas collection layer on a 50 foot by 50 foot grid to verify the thickness of the layer.

4.4 GEOMEMBRANE LAYER

4.4.1 Construction

Delaney Construction contracted with Chenango Construction, Inc. (Chenango) of Binghamton, New York to install the 60 mil LLDPE geomembrane. Chenango is a certified installer for Poly-Flex, the manufacturer of the geomembrane. Both smooth and textured 60 mil LLDPE geomembrane were installed as part of the landfill cap construction. Textured LLDPE geomembrane was required for any areas of the landfill where the slope exceeded 15 percent. However, some areas with slopes less than 15 percent received textured LLDPE geomembrane to expedite the construction schedule, even though it was not required.

Chenango installed the LLDPE geomembrane between July and October 1996. The LLDPE geomembrane was delivered to the site on flatbed tractor trailers. Upon arrival at the site, the quality assurance representatives from Malcolm Pirnie and Chenango visually inspected the rolls for transport damage. In accordance with the contract documents, a large specimen was cut from each roll as it arrived on-site and has been archived by the city. The rolls were staged in an area away from construction traffic.

The 60 mil LLDPE geomembrane was placed directly on top of the gas collection material. The surface of the gas collection layer was inspected for stones or material which could damage the liner, and was approved and accepted in writing by the Poly-Flex certified quality control representative prior to unrolling the geomembrane. A representative of Malcolm Pirnie was present to witness the inspection of the gas collection layer by the Poly-Flex certified representative. The LLDPE geomembrane was deployed in accordance with the contract specifications with the sheets oriented along the slope. An "as-built" panel layout prepared by Chenango has been included in Appendix C.

The LLDPE rolls were transported around the site using an all-terrain fork-lift with a spreader bar. The fork-lift positioned the rolls and the installation crew unrolled the liner. Hand clamps were used to unroll and provide the proper overlap of the liner. The LLDPE panels were held in place using sand bags until field seaming could be completed. Panels were not placed during precipitation, in the presence of excessive moisture or during periods of high winds. Each panel was inspected for damage during installation and damaged areas were marked for repair. Repairs were completed in accordance with the contract documents.

The LLDPE geomembrane seams were welded. Field seams were made by overlapping adjacent panels a minimum of three inches. Hand-held extrusion welders were used for repairs and in locations where the self-propelled fusion welders could not be operated. Destructive samples were taken at a minimum of every 500-feet, or more often if seam quality was suspect. In the event that a seam failed the destructive test, the extent of the problem was defined by cutting out additional samples on both sides of the failure to isolate the suspect section of weld. A failed destructive test was required to be bounded on both sides with a passing destructive test. The resulting area was then repaired and retested to determine compliance. In addition to destructive test sampling, all fusion and extrusion seams were non-destructively tested.

Non-destructive testing of field seams was conducted in accordance with the contract documents. The preferred testing procedure for double-fusion welds was to pressure test the air channel formed by the welding process for five minutes at 30 psi. The maximum allowable pressure drop over the five minute test period was 3 psi. However, when a double fusion weld was unable to be air pressure tested due to blockages in the air channel, those seams were non-destructively tested using a vacuum box. The majority of the extrusion welds were non-destructively tested using a vacuum box with the exception of the gas vent boot sleeves, which were spark tested.

4.4.2 Construction Documentation

The LLDPE geomembrane installation was monitored in several ways. Placement and seaming of the material was visually inspected by quality assurance representatives from Chenango and Malcolm Pirnie. The calibration and operating condition of the seaming

apparatus was monitored by Chenango's quality assurance representative and observed by Malcolm Pirnie.

The rolls of LLDPE were observed during deployment and seaming and inspected to examine the upper surface for evidence of defect or damage. Deficiencies found were marked and subsequently repaired. Upon completion of an area of the geomembrane and prior to covering it with subsequent layers of material, the geomembrane was inspected by Malcolm Pirnie to identify damage from the installation procedures. Defects and damaged areas were repaired, retested and reinspected prior to acceptance.

Prior to seaming of the geomembrane, each seamer for each specific seaming apparatus to be used was required to conduct test seams on a sample of the geomembrane to be welded. Specimens were then cut from the test seams and tested on a portable tensiometer. Test seams were made prior to commencing seaming and at least once every four hours during seaming. Samples of all test seams were archived by the city.

Chenango collected destructive seam samples at locations identified by Malcolm Pirnie. Each destructive sample was cut into two pieces, one retained by the city and the other sent to Malcolm Pirnie's geosynthetic and soils laboratory for analysis. The destructive test results are summarized and presented in Table 4-1. Indicated in the table are several destructive samples that were not sent to the laboratory because they failed in the field. Those seams containing the samples were repaired and re-tested in accordance with the contract documents. The locations of all destructive test results are shown on the "as-built" provided by Chenango and included in Appendix C.

Chenango performed all non-destructive testing. As previously described, the double-fusion welds and extrusion welds were non-destructively tested. Areas that failed the pressure test or vacuum test were repaired and retested. Malcolm Pirnie was present during the non-destructive testing.

TABLE 4-1

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-01	104.0	113.3	122.0	Y	FTB
DS-02	112.9	114.8	129.3	Y	FTB
DS-03	111.3	111.3	123.7	Y	FTB
DS-04	113.1	113.8	125.4	Y	FTB
DS-05	105.3	111.2	123.9	Y	FTB
DS-06	108.1	106.2	123.7	Y	FTB
DS-07	110.5	110.0	128.9	Y	FTB
DS-08	113.5	112.9	129.2	Y	FTB
DS-09	114.4	116.4	129.6	Y	FTB
DS-10	118.7	120.8	135.9	Y	FTB
DS-11	115.2	118.8	136.1	Y	FTB
DS-12	120.7	117.0	135.6	Y	FTB
DS-13	124.9	121.4	141.7	Y	FTB
DS-14	112.8	114.0	131.0	Y	FTB
DS-15	101.3	105.3	125.8	Y	FTB
DS-16	109.9	107.8	133.6	Y	FTB
DS-17	105.6	104.8	124.1	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-18	109.4	114.0	131.0	Y	FTB
DS-19	111.8	109.6	114.7	Y	FTB
DS-20	108.8	117.1	139.3	Y	FTB
DS-21	112.4	115.8	141.5	Y	FTB
DS-22	121.8	116.5	153.0	Y	FTB
DS-23	107.0	109.3	134.8	Y	FTB
DS-24	115.4	113.6	157.7	Y	FTB
DS-25	114.6	124.8	159.1	Y	FTB
DS-26	113.1	113.5	152.9	Y	FTB
DS-27	123.5	117.7	149.5	Y	FTB
DS-28	120.7	127.7	155.0	Y	FTB
DS-29	111.3	108.0	131.6	Y	FTB
DS-30	106.0	109.5	145.1	Y	FTB
DS-31	113.4	113.6	144.2	Y	FTB
DS-32	113.8	120.0	143.3	Y	FTB
DS-33	115.7	116.8	104.7	Y	FTB
DS-34	111.7	119.7	144.4	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-35	122.1	119.2	150.4	Y	FTB
DS-36	110.1	120.1	147.6	Y	FTB
DS-37	111.1	108.0	123.2	Y	FTB
DS-38	112.5	109.7	130.9	Y	FTB
DS-39	112.3	122.7	140.3	Y	FTB
DS-40	107.6	106.0	134.7	Y	FTB
DS-41	113.5	121.6	130.74	Y	FTB
DS-42	107.4	109.1	138.7	Y	FTB
DS-43	106.5	109.5	137.7	Y	FTB
DS-44	108.6	104.3	136.5	Y	FTB
DS-45	111.9	104.3	144.8	Y	FTB
DS-46	107.8	100.7	142.2	Y	FTB
DS-47	101.0	105.2	138.4	Y	FTB
DS-48	109.7	106.2	143.8	Y	FTB
DS-49	107.0	112.4	144.5	Y	FTB
DS-50	109.0	100.8	146.8	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-51	101.6	101.3	130.8	Y	FTB
DS-52	106.2	113.0	142.1	Y	FTB
DS-53	107.9	110.8	131.9	Y	FTB
DS-54	108.2	45.4	123.9	Y	FTB
DS-55	113.9	117.6	131.6	Y	FTB
DS-56	110.8	102.8	115.9	Y	FTB
DS-57	106.0	111.8	139.8	Y	FTB
DS-58	106.8	102.4	143.5	Y	FTB
DS-59	114.6	115.0	137.9	Y	FTB
DS-60	106.4	109.9	120.8	Y	FTB
DS-61	111.2	109.8	132.5	Y	FTB
DS-62	104.9	103.0	134.6	Y	FTB
DS-63	99.5	100.9	127.7	Y	FTB
DS-64	111.1	105.6	139.6	Y	FTB
DS-65	106.4	107.4	136.5	Y	FTB
DS-66	105.5	102.8	135.5	Y	FTB
DS-67	104.6	102.7	145.3	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-68	111.4	107.2	140.1	Y	FTB
DS-69	105.3	102.7	140.3	Y	FTB
DS-70	106.0	105.5	129.5	Y	FTB
DS-71	103.8	112.7	139.9	Y	FTB
DS-72	105.3	106.1	139.0	Y	FTB
DS-73	99.8	110.9	141.2	Y	FTB
DS-74	104.1	114.2	126.6	Y	FTB
DS-75	105.8	109.7	135.3	Y	FTB
DS-76	107.5	108.4	139.7	Y	FTB
DS-77	109.2	109.9	140.9	Y	FTB
DS-78	100.3	102.6	144.2	Y	FTB
DS-79	99.4	106.3	134.8	Y	FTB
DS-80	105.0	96.0	125.2	Y	FTB
DS-81	114.0	109.1	148.3	Y	FTB
DS-82	106.4	92.3	134.5	Y	FTB
DS-83	105.2	103.8	126.8	Y	FTB
DS-84	102.6	105.0	124.9	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-85	114.8	115.6	135.3	Y	FTB
DS-86	102.1	99.4	141.7	Y	FTB
DS-87	114.3	109.5	147.0	Y	FTB
DS-88	103.1	101.3	134.1	Y	FTB
DS-89	115.5	113.3	134.7	Y	FTB
DS-90	104.0	103.7	135.0	Y	FTB
DS-91	117.1	112.6	125.6	Y	FTB
DS-92	118.7	114.0	129.3	Y	FTB
DS-93	116.2	92.8	136.8	Y	FTB
DS-94	121.3	120.0	146.9	Y	FTB
DS-95	107.0	105.0	147.8	Y	FTB
DS-96	111.7	109.8	146.9	Y	FTB
DS-97	109.2	104.1	143.2	Y	FTB
DS-98	110.4	116.2	143.9	Y	FTB
DS-99	109.9	114.6	151.1	Y	FTB
DS-100	110.1	108.3	137.5	Y	FTB
DS-101	114.5	105.4	138.3	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-102	112.0	107.8	134.9	Y	FTB
DS-103	112.3	111.1	136.1	Y	FTB
DS-104	110.3	115.9	142.6	Y	FTB
DS-105	113.1	118.4	141.7	Y	FTB
DS-106	111.5	118.9	140.4	Y	FTB
DS-107	116.2	110.9	146.4	Y	FTB
DS-108	117.9	113.1	128.6	Y	FTB
DS-109	113.2	118.3	129.0	Y	FTB
DS-110	116.6	109.5	139.3	Y	FTB
DS-111	111.7	101.1	137.7	Y	FTB
DS-112	101.8	109.9	134.6	Y	FTB
DS-113	115.2	114.6	132.1	Y	FTB
DS-114	109.2	113.2	124.0	Y	FTB
DS-115	110.5	118.7	132.4	Y	FTB
DS-116	104.6	114.2	129.3	Y	FTB
DS-117	123.9	115.7	135.8	Y	FTB
DS-118	120.9	121.0	143.3	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-119	112.3	109.0	127.9	Y	FTB
DS-120	112.5	113.7	127.4	Y	FTB
DS-121	106.6	113.2	140.3	Y	FTB
DS-122	119.0	118.0	139.9	Y	FTB
DS-123	116.7	112.1	127.6	Y	FTB
DS-124	NOT	SENT	TO	LAB	
DS-125	115.2	120.5	138.5	Y	FTB
DS-126	113.1	113.5	135.3	Y	FTB
DS-127	113.2	115.9	132.9	Y	FTB
DS-128	119.7	117.7	130.6	Y	FTB
DS-129	106.3	108.9	127.5	Y	FTB
DS-130	104.6	111.6	137.4	Y	FTB
DS-131	112.2	114.7	128.1	Y	FTB
DS-132	113.4	111.1	132.8	Y	FTB
DS-133	118.2	114.2	137.5	Y	FTB
DS-134	120.3	113.3	138.0	Y	FTB
DS-135	120.1	123.8	139.9	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-136	130.5	130.8	137.4	Y	FTB
DS-137	120.5	120.8	137.3	Y	FTB
DS-138	122.5	123.6	140.8	Y	FTB
DS-139	110.2	110.6	133.9	Y	FTB
DS-140	117.6	111.3	135.9	Y	FTB
DS-141	120.3	106.9	138.4	Y	FTB
DS-142	111.3	121.4	140.5	Y	FTB
DS-143	120.7	121.8	136.7	Y	FTB
DS-144	114.8	118.8	134.4	Y	FTB
DS-145	114.9	117.3	137.5	Y	FTB
DS-146	115.6	112.7	132.6	Y	FTB
DS-147	111.8	108.4	142.4	Y	FTB
DS-148	120.9	119.5	128.2	Y	FTB
DS-149	124.5	75.0	133.1	N	NFTB
DS-149A	107.2	98.5	114.5	Y	FTB
DS-149B	99.9	102.7	122.4	Y	FTB
DS-150	121.6	125.9	138.1	Y	FTB
DS-151	111.3	122.0	128.0	Y	FTB
DS-152	116.1	110.4	129.0	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-153	107.6	106.7	123.9	Y	FTB
DS-154	73.6	107.3	130.4	N	FTB
DS-154A	105.5	89.6	106.8	Y	NFTB
DS-154B	99.6	96.8	107.2	Y	FTB
DS-155	111.6	115.0	126.9	Y	FTB
DS-156	117.9	120.6	128.0	Y	FTB
DS-157	96.6	106.8	123.7	Y	FTB
DS-158	NOT	SENT	TO	LAB	
DS-159	112.7	109.8	129.5	Y	FTB
DS-160	110.8	112.2	136.7	Y	FTB
DS-161	108.0	118.2	107.5	Y	FTB
DS-162	NOT	SENT	TO	LAB	
DS-163	107.0	110.5	135.3	Y	FTB
DS-164	115.9	109.2	130.8	Y	FTB
DS-165	114.0	110.9	135.7	Y	FTB
DS-166	115.0	110.4	132.3	Y	FTB
DS-167	NOT	SENT	TO	LAB	

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-168	103.0	108.2	107.4	Y	FTB
DS-169	109.9	112.2	125.6	Y	FTB
DS-170	NOT	SENT	TO	LAB	
DS-171	NOT	SENT	TO	LAB	
DS-172	NOT	SENT	TO	LAB	
DS-173	NOT	SENT	TO	LAB	
DS-174	NOT	SENT	TO	LAB	
DS-175	NOT	SENT	TO	LAB	
DS-176	NOT	SENT	TO	LAB	
DS-177	NOT	SENT	TO	LAB	
DS-178	NOT	SENT	TO	LAB	
DS-179	NOT	SENT	TO	LAB	
DS-180	107.1	102.6	127.4	Y	FTB
DS-181	110.9	113.9	143.3	Y	FTB
DS-182	102.3	103.9	107.6	Y	FTB
DS-183	112.3	113.2	138.9	Y	FTB
DS-184	116.6	114.9	145.4	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-185	113.2	110.4	146.7	Y	FTB
DS-186	109.5	107.7	138.4	Y	FTB
DS-187	110.0	102.9	107.5	Y	FTB
DS-188	104.0	105.3	127.8	Y	FTB
DS-189	105.1	108.3	135.8	Y	FTB
DS-190	111.5	108.3	127.8	Y	FTB
DS-191	112.8	109.8	129.8	Y	FTB
DS-192	105.8	106.9	107.2	Y	FTB
DS-193	109.6	109.0	128.7	Y	FTB
DS-194	99.1	99.9	115.6	Y	FTB
DS-195	111.1	106.3	131.2	Y	FTB
DS-196	106.5	104.4	133.4	Y	FTB
DS-197	107.9	110.9	107.4	Y	FTB
DS-198	118.3	115.0	129.9	Y	FTB
DS-199	111.9	117.0	136.2	Y	FTB
DS-200	111.5	111.2	126.4	Y	FTB
DS-201	108.1	118.4	132.1	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-202	110.1	112.5	107.2	Y	FTB
DS-203	112.1	118.3	139.1	Y	FTB
DS-204	111.6	115.0	136.0	Y	FTB
DS-205	109.7	109.3	140.9	Y	FTB
DS-206	109.0	113.5	134.4	Y	FTB
DS-207	110.5	112.4	107.7	Y	FTB
DS-208	107.9	106.0	144.2	Y	FTB
DS-209	109.6	108.9	138.1	Y	FTB
DS-210	101.1	99.4	118.4	Y	FTB
DS-211	121.5	118.8	137.8	Y	FTB
DS-212	111.3	107.7	138.0	Y	FTB
DS-213	115.3	106.6	138.0	Y	FTB
DS-214	104.8	110.9	107.5	Y	FTB
DS-215	113.6	110.0	141.2	Y	FTB
DS-216	110.1	104.2	124.0	Y	FTB
DS-217	113.0	117.8	130.8	Y	FTB
DS-218	111.8	105.2	132.9	Y	FTB

TABLE 4-1 (Continued)

QUALITY CONTROL TEST RESULTS
60 MIL LLDPE LINER

DESTRUCTIVE TEST RESULTS

Sample Number	PEEL: Maximum Avg. Tension (ppi)		SHEAR Maximum Avg. Tension (ppi)	Passing (Y or N)	Mode of Failure
	Side A	Side B			
DS-219	112.6	107.2	106.7	Y	FTB
DS-220	111.0	106.2	125.6	Y	FTB
DS-221	116.3	115.2	131.4	Y	FTB
DS-222	102.1	104.0	124.4	Y	FTB
DS-223	103.3	103.0	120.9	Y	FTB
DS-224	106.6	103.9	107.5	Y	FTB
HW-1	107.3	N/A	133.5	Y	FTB
HW-2	97.8	N/A	125.0	Y	FTB
HW-3	92.6	N/A	121.4	Y	FTB

4.5 BARRIER PROTECTION LAYER

4.5.1 Construction

The barrier protection layer was placed directly on top of the geomembrane and below the topsoil. Placement of the barrier protection layer occurred between July and October 1996.

The barrier protection material was hauled from the off-site borrow pit and stockpiled on-site. The barrier protection material was then loaded into off-highway trucks and hauled to the edge of the fill area for placement. The material was placed in one 12-inch lift using a low ground pressure bulldozer. Compaction was achieved using a smooth drum vibratory roller. The lift was compacted to provide a stable base for operating equipment and placement of the topsoil.

4.5.2 Construction Documentation

Representatives of Malcolm Pirnie observed the placement of the barrier protection material. Since the barrier protection material was a coarse grained, gap graded cohesionless soil, in-place density tests were not conducted. The lift thickness was monitored by placing plastic concrete cylinder containers on the geomembrane. Grade stakes were marked with the required lift thickness and placed in the concrete cylinders to protect the underlying geomembrane from the grade stakes. The final layer thickness was verified by Malcolm Pirnie with random test pits. In addition, the contractor surveyed the top of the barrier protection layer on a 50 foot by 50 foot grid to document the barrier protection layer thickness. The test pits were completed to expedite the process and allow construction to proceed without waiting for the survey notes to be reduced and compiled.

4.6 TOPSOIL LAYER

A six-inch thick topsoil layer was placed directly on the barrier protection layer. Placement of the topsoil on the cap occurred between July and November 1996. Field quality control was not required on the topsoil, with the exception of verifying the thickness of the

completed layer. Malcolm Pirnie representatives observed the placement of the topsoil and verified its depth with random test pits. As required, the contractor surveyed the topsoil layer on a 50 foot by 50 foot grid to document the thickness of the layer. Malcolm Pirnie observed the seeding and mulching of the topsoil layer.

4.7 OTHER CONSTRUCTION

In addition to the landfill cap construction, some related construction was performed under the terms of the contract. This work included the construction of an access road, perimeter fencing, site drainage controls, and the excavation of sediments from the LaGrange Pit.

4.7.1 Access Road

A 20-foot wide 700-foot long access road was constructed over the landfill cap to connect the city's on-site borrow pit to the lands owned by Fulton County which are located to the south of the landfill. The access road consisted of a geotextile stabilization fabric, one foot of general fill and one foot of surface gravel.

The geotextile stabilization fabric was placed directly on the barrier protection layer. The stabilization fabric was placed just ahead of the general fill layer to prevent displacement from wind and prolonged exposure to the elements. The one foot layer of general fill was placed and compacted prior to placing the gravel surface course. The one foot thick layer of gravel was placed and compacted on top of the general fill layer. Both the general fill layer and the gravel layer were compacted using a smooth drum vibratory roller. Malcolm Pirnie observed the construction of the access road.

4.7.2 Perimeter Site Fencing

The perimeter of the landfill has been fenced. Delaney Construction subcontracted the installation of the fence to Butler Fence, Inc. from Syracuse, New York. Installation of the fence occurred during November and December 1996, after the majority of site grading was completed. The perimeter fence consists of approximately 6,000 linear feet of six-foot high chain-link fence. Three double-swing gates were installed to provided access to the site,

the on-site garage and the adjacent Fulton County parcel. The perimeter fence was installed to restrict access to the site and prevent unauthorized trespass on the landfill.

4.7.3 Site Drainage Controls

Two large drainage swales were constructed, one in the northeastern corner and the other in the southwestern corner of the landfill to convey runoff from the cap and surrounding areas to two storm water detention basins.

The swale in the northeastern corner of the landfill receives runoff from a large contributing area along West Fulton Street Extension, as well as a portion of the cap. The northeastern swale ultimately discharges to the former LaGrange Pit. The majority of the northeastern swale was constructed over the cap system. In order to protect the underlying cap components from erosion, synthetic and concrete channel liners were used in the bottom of the swale. Approximately 150 linear feet of North American Green, C350, synthetic channel liner were installed immediately upstream of the concrete channel liner. Tri-Lock articulated concrete channel was installed in the final 200 linear feet of the swale. The Tri-Lock channel liner discharges into a rip rap-lined, flared apron to dissipate energy in the storm water prior to its ultimate discharge to the former LaGrange Pit.

The swale in the southwestern corner of the landfill receives runoff from a large portion of the landfill cap, as well as a large portion of the private property that borders the landfill to north. As with the northeastern swale, the southwestern swale was constructed using both the synthetic and concrete channel liners. Approximately 250 linear feet of North American Green, C350 synthetic channel liner were installed upstream of the Tri-Lock articulated concrete channel liner. Tri-Lock articulated concrete channel was installed in the final 250 linear feet of the swale. The Tri-Lock channel liner discharges into a rip rap-lined, flared apron to dissipate energy in the storm water prior to its ultimate discharge to the borrow pit storm water detention basin.

The remainder of the capped landfill drains by sheet flow to the south and east sides of the landfill. On the south, approximately half of the run-off flows to the storm water detention basin in the borrow pit and the other half flows toward the southeast. On the east, the majority of the run-off flows to the former LaGrange Pit.

4.7.4 LaGrange Sediment Excavations

The sediments located in the LaGrange Pit, which were identified during the Remedial Investigation as being potentially contaminated, were excavated to the lines and grades shown on the contract documents. The LaGrange Pit sediments were excavated to elevation 856 and were placed within the landfill prior to capping. The resulting excavation was backfilled with granular fill to an elevation of 862. The area now serves as a storm water detention basin for the northeastern swale and the entire eastern portion of the landfill.

5.0 DEVIATIONS

5.1 GENERAL

Several deviations from the contract documents and the NYSDEC-approved remedial design occurred during the construction of the City of Johnstown's Landfill Closure Project. The following is a brief summary of the significant deviations.

5.2 DELETION OF PORTIONS OF THE "RAIN-FLAP"

The approved remedial design required the construction of a "rain-flap" around the perimeter of the landfill and at the areas of transition between textured and smooth geomembrane. The "rain-flap" consisted of welding an 11-foot wide roll of geomembrane to the containment geomembrane and subsequently placing a double-sided geocomposite drainage material over the geomembrane flap. The last two feet of the flap was exposed and covered with drainage stone. The purpose of the "rain-flap" is to minimize the amount of hydraulic pressure on the containment liner and increase the stability of the barrier protection layer.

During construction of the cap system, Malcolm Pirnie determined that the "rain-flap" along West Fulton Street Extension was not required and presented both construction and maintenance problems. Malcolm Pirnie made this determination due to the lack of drainage contributing to the capped areas along West Fulton Street Extension.

Portions of the "rain-flap" that were designed to be installed along the transition line from textured to smooth geomembrane were not installed for two reasons. In areas of minimal slope, the construction of the "rain-flap" presented difficulty in maintaining the required 18 inches of material over the geomembrane while maintaining drainage off the cap. Secondly, along the southern side of the landfill the relatively short slopes presented difficulty in placing the subsequent layers of soil material and would have resulted in a maintenance problem.

Prior to deleting any portions of the "rain-flap", Malcolm Pirnie verified that the deletion of the "rain-flap" would not affect the stability of the cap system. Along portions of the eastern, southern and western slopes, additional rows of geocomposite were installed, since the material could not be returned to inventory. The additional rows of geocomposite provided an increase in the slope stability and the constructability of the cap system.

5.3 REDUCTION IN LANDFILL FOOTPRINT

During the construction of the landfill cap system, Delaney Construction dug a number of test pits at the proposed limits of the landfill. During these activities, waste was identified outside the proposed limits in several areas. However, in other areas, waste was not present where expected.

In areas where waste was identified outside of the original landfill footprint, the waste was relocated to low areas within the area to be capped. However, in an area directly behind the property owner located on the west side of the landfill (Bradt property), it was determined that the waste was excessively deep, and the most cost-effective solution was to extend the cap system to include this area. The total amount of surface area that the cap system was extended was approximately 0.3 acres.

In addition, Malcolm Pirnie determined that waste was not present beyond the original property line on the east side of the landfill. Malcolm Pirnie instructed Delaney Construction not to install the landfill cap in areas where waste was not present. The resulting reduction in the landfill footprint was approximately 0.9 acres, as shown on the as-constructed drawings included in Appendix B.

5.4 OVERSIZE PARTICLES IN THE GAS VENT MATERIAL

During construction of the landfill cap system, Delaney Construction used its Meco Pit as the source of material for the initial 20,000 cubic yards of gas vent material. During the processing of the material, a small percentage of material was shown to be retained on the 1/2-inch sieve. The contract documents required that all gas vent material pass the 1/2-inch

sieve. Upon investigation, Malcolm Pirnie determined that oblong particles were passing through the 1/2-inch equivalent metric sized "harp" screen in the field, but were being retained on the sieves in the laboratory. Therefore, Malcolm Pirnie accepted the stockpile of processed material. Malcolm Pirnie instructed Delaney Construction to modify the screening process to eliminate the reoccurrence of this problem. Delaney Construction replaced the metric "harp" screen with a smaller sized opening of a "modified-harp" screen. This change in screen type was successful in removing the oversized particles in the remaining gas vent material processed at the Meco Pit. Malcolm Pirnie determined that these oblong particles did not present any increased potential for damage to the geomembrane, nor would they compromise the effectiveness of the gas vent material.

5.5 CONTRACT TIME EXTENSION

The original date for substantial completion for the Landfill Closure Construction Project was September 1, 1996. Delaney Construction requested a 60-day time extension due to abnormal weather conditions during the fall of 1995 and the spring of 1996. The extension of the contract time was approved.

6.0 DECLARATION

6.1 GENERAL

Malcolm Pirnie personnel have inspected the City of Johnstown Landfill Closure Construction from the preparation of the subgrade through and including the placement of the topsoil layer. Based on field inspections made by Malcolm Pirnie and the field and laboratory test data collected by Malcolm Pirnie or the contractor and subcontractors, the construction inspected at the site was completed in substantial accordance with the construction contract documents approved by the EPA and NYSDEC, excluding the deviations discussed in this document. It should be noted that the inspections and monitoring identified in this report were made under the identified conditions. Conclusions made in this report were based on these inspections and data obtained from field and laboratory tests. Topographic survey measurements were made by Delaney Construction and its sub-contractors. The geosynthetic production quality control testing was completed by Poly-Flex or other companies acting on their behalf. Malcolm Pirnie reviewed the results of this testing. The as-built drawings for the LLDPE liner were prepared by Chenango.

7.0 POST-CLOSURE OPERATION AND MAINTENANCE PLAN AND ENVIRONMENTAL MONITORING PLAN

7.1 POST-CLOSURE OPERATION AND MAINTENANCE PLAN

The approved Post-Closure Operation and Maintenance Plan is included as Section 2.4.1 of the Final Design Report for the Landfill Closure Project, dated August 1995.

7.2 ENVIRONMENTAL MONITORING PLAN

The approved Environmental Monitoring Plan is included as Section 2.4.2 of the Final Design Report for the Landfill Closure Project, dated August 1995.

8.0 SUMMARY OF PROJECT COSTS

8.1 GENERAL

A summary of the landfill closure project costs from the remedial design phase through completion of construction activities is included in Table 8-1, below. As described in the previous sections, the overall foot print of the landfill decreased during the construction of the landfill cap system. In addition, field conditions resulted in some minor revisions to the location and quantity of "rain-flap" required on the project. These changes in the size of the landfill footprint and the "rain-flap" resulted in approximately a $41,000 net credit to the City of Johnstown. The credit resulted in a total construction cost of $2,958,747 for the landfill cap system.

TABLE 8-1

SUMMARY OF PROJECT COSTS

LANDFILL CLOSURE CONSTRUCTION:	
Feasibility Study Estimate (Total direct costs, excluding contingency, engineering and legal costs)	$8,434,520.00
Lump Sum Bid Amount	$3,000,000.00
Final Cost	$2,958,747.00
ENGINEERING (Includes design, construction inspection, and contract administration)	$502,397.00
TOTAL	$3,461,144.00

APPENDIX A

List of Work to be Completed -
End of 1996

file

MALCOLM PIRNIE

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

December 11, 1996

Mr. Timothy Delaney
President
Delaney Construction Corporation
28 North School Street
PO Box J
Mayfield, NY 12117

Re: Johnstown Landfill Closure Project, Required 1997 Spring Work

Dear Mr. Delaney:

Based on my site walk-over before the December 3, 1996 progress meeting and my conversations with Mike Delaney, the following is a list of the work to be completed in the Spring of 1997.

- Repair the barrier protection and topsoil layers in the areas that have been damaged from the fall rains and the areas damaged by the spring melts.
- Repair the topsoil layer in the areas that have been damaged by your topsoil subcontractor.
- Seed and Mulch the areas outside of the perimeter fencing, including but not limited to, the area behind the Bradt Property, along the toe of the LaGrange slope and along the toe of the South slope.
- Clean the areas in which the stone on the rain flap has been covered with eroded soil.
- Clean and flush the culvert installed on West Fulton Street Extension.
- Seed and Mulch the on-site borrow pit.
- Clean up miscellaneous debris inside and outside the perimeter of the landfill, such as, scrap pallets, pipe from the fencing contractor, grade stakes and traffic cones.
- Clean and regrade the area along the bend in West Fulton street Extension, near the one car garage.

FOUR CORPORATE PLAZA WASHINGTON AVENUE EXTENSION ALBANY, NY 12203-5496 518-869-7257 FAX 518-869-4411

MALCOLM PIRNIE

- Install the missing section fence on the LaGrange slope (THIS FALL/WINTER).
- Furnish and install the 12 foot gate across the LaGrange road.
- Provide five (5) keyed alike keys for the gates.
- Adjust all gates for proper alignment and operation.

Should you have any questions or comments on this list of required work, please feel free to contact me.

Very truly yours,

MALCOLM PIRNIE, INC.

Matthew J Spartic, P.E.
Project Engineer

cc: Charles Ackerbauer, P.E., L.S. - City of Johnstown

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RECYCLED PAPER

APPENDIX B

As-Built Construction Survey

N

DELANEY C.C. Plan North

Legend :

- Anchor Trench
- Project Fence
- Fence Gate
- 6" PVC Gas Vent — GV#0X
- Monitoring Station Well — MW #0X
- Survey Monument — Mon # X
- Property Monument
- Utility Pole — PP #X
- RipRap (Medium)
- RipRap (Fine)
- RipRap (Tri-Lock)
- Property Fence or Line (appox.)

N 17250 E 13900

N 17250 E 14750

N 15750 E 13000

N 15750 E 14750

LANDS N/F OF WINTERMUTE

LANDS N/F OF QUINN

LANDS N/F OF CITY OF JOHNSTOWN

LANDS N/F OF BRAST

West Fulton St. Ext.

Low Point 877.3

Low Point 869.9

NOTES:

1) ALL COORDINATES SHOWN HAVE BEEN BASED UPON THE 1994 GROUND CONTROL SURVEY COMPLETED BY A.A. MAJOR SURVEYORS, INC. THESE COORDINATE VALUES ARE REPUTEDLY ON THE NEW YORK PLANE COORDINATE SYSTEM.

2) VERTICAL DATUM IS BASED UPON THE 1994 GROUND CONTROL SURVEY COMPLETED BY A.A. MAJOR SURVEYORS, INC.

3) MR. MAJOR CONFIRMED IN THE FIELD HORIZONTAL POINTS # 110, 111, & 112 AS WELL AS THE GUARD POST BENCH MARK ON 07 NOV. 1995.

4) THE ANCHOR TRENCH WAS OBSERVED TO THE ANGLE POINTS IN THE CENTER OF THE DUG TRENCH.

5) SURVEY AND MAP IS LIMITED TO AREA IMPROVED BY CONSTRUCTION ACTIVITIES.

6) PROPERTY LIMITS SHOWN WERE TAKEN FROM THE CONSTRUCTION PLANS AND THE TWO CONCRETE MONUMENTS WERE REPLACED IN THE SAME HORIZONTAL LOCATION AS FOUND PRIOR TO CONSTRUCTION ACTIVITY !

CERTIFICATION:

I HEREBY CERTIFY THAT THIS MAP WAS PREPARED BY ME 15 DEC. 1996

BASED UPON FIELD SURVEYS COMPLETED 3 DEC 1996, PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION.

THE SURVEY DATA WAS COLLECTED AS THE WORK WAS IN PROGRESS FOR EACH LIFT.

WILLIAM E. BRANNON, LS

NYS Registration # 490683

LICENSED LAND SURVEYOR — WILLIAM E. BRANNON — 49083 — STATE OF NEW YORK

DELANEY CONSTRUCTION CORPORATION

28 North School Street
P.O. Box J
Mayfield, New York
12117-0199

Ph: (518) 661-5304 FAX: (518) 661-5818

REVISIONS			
NO.	BY	DATE	REMARKS

CITY OF JOHNSTOWN
Landfill Closure Project

SITE PLAN
IMPROVED AREA
Scale: 1 inch = 100 Feet

Delaney Const. Corp.
Date: Dec. 1996
Sheet 1 of 3
Dwg. # M90FG100

WARNING -- IT IS A VIOLATION OF NEW YORK EDUCATION LAW SECTION 7209.2 FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED THE ALTERING PERSON SHALL COMPLY WITH THE REQUIRMENTS OF NEW YORK EDUCATION LAW, SECTION 7209.2

N
C. C. Plan North

LANDS OF VANDENBURGH

LANDS OF VAN DUSEN

LANDS OF GAY OF JOHNSTOWN

LANDS OF BRADY

Mon # 1
N 1777032
E 1397537
ELEV 937.99

PROPOSED MW 9401

GVM01 GVM02 GVM03 GVM04 GVM05 GVM06 GVM07 GVM08 GVM09 GVM10 GVM11 GVM12 GVM13 GVM14 GVM15 GVM16 GVM17 GVM18 GVM19 GVM20 GVM21 GVM22 GVM23 GVM24 GVM25 GVM26 GVM27 GVM28 GVM29 GVM30 GVM31 GVM32 GVM33 GVM34 GVM35 GVM36 GVM37

Existing Fence

INV. ELE. 889.31

INV. ELE. 888.11

INV. ELE. 917.6

West Fulton St. Ext.

MATCHLINE (SHEET 3)

NOTE
SEE SHEET #1 FOR LEGEND AND OVERVIEW OF SITE

LICENSED LAND SURVEYOR
WILLIAM J. SHERMAN
49083
STATE OF NEW YORK

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DELANEY CONSTRUCTION CORP.
28 North [illegible] Street
P.O. Box [illegible]
Mayfield [illegible] York
12117-0158
[illegible] 18

NO	BY	DATE	REMARKS

REVISIONS

CITY OF JOHNSTOWN
Landfill Closure Project

SITE PLAN
CAPPED AREA (NORTH)
Scale: 1 inch = 60 Feet

Delaney Const. Corp
Date: Dec. 1996
Sheet 2 of 3
Dwg. # M00FG00N

Mon # 1
N 17170.32
E 13915.37
ELEV 937.59

GRAPHIC SCALE
1" = 60'

C. C. Plan North

(SHEET 2)
MATCHLINE

West Fulton St. Ext.

GV#01 GV#02 GV#03 GV#04 GV#05 GV#06 GV#07 GV#08 GV#09 GV#10 GV#11 GV#12 GV#13 GV#14 GV#15 GV#16 GV#17 GV#18 GV#19 GV#20 GV#21 GV#22 GV#23 GV#24 GV#25 GV#26 GV#27 GV#28 GV#29 GV#30 GV#31 GV#32 GV#33 GV#34 GV#35 GV#36 GV#37

MW #01
MW #02
MW #03
MW #04
MW #05
MW #06
MW #07
MW #08
MW #09
MW #10
MW #11
MW #12
MW #13
MW #14
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MW #16
MW #17
MW #18
MW #19
MW #20
MW #21
MW #22
MW #23
MW #24
MW #25
MW #26
MW #27
MW #28
MW #29
MW #30

LANDS NOW OR FORMERLY OF BRADT

BM ELEV. 939.19
PP #3
Top of Plastic Cap

Mon # 2
N 16644.07
E 14863.76
Elev. 926.85

LICENSED LAND SURVEYOR
WILLIAM E. BRANNON
40083
STATE OF NEW YORK

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TITLE
SEE SHEET #1 FOR LEGEND AND OVERVIEW OF SITE

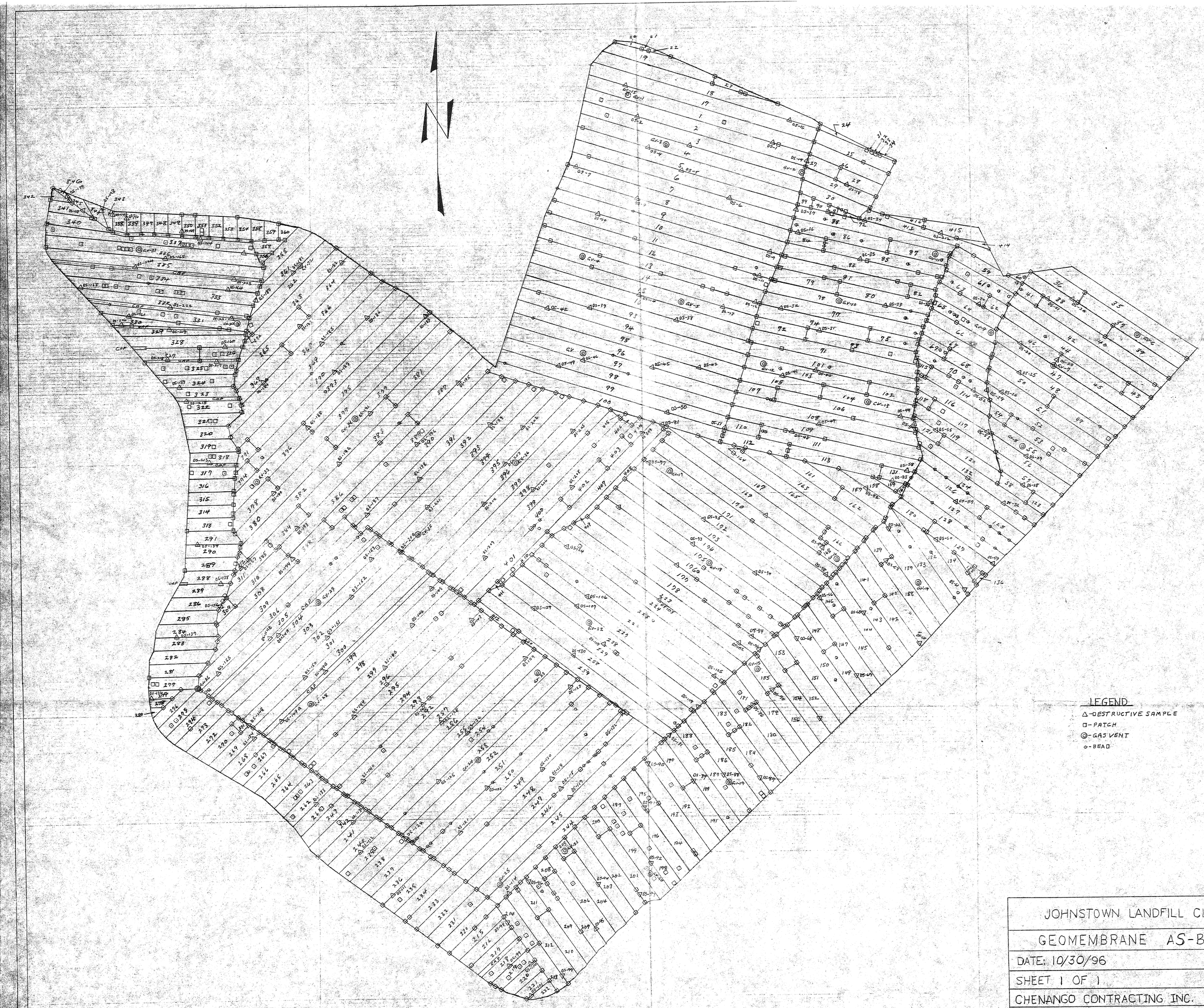
DELANEY CONSTRUCTION CORPORATION
28 North School Street
P.O. Box J
Mayfield, New York
12117-0199
Ph (518) 661-5304
FAX (518) 661-5818

REVISIONS			
NO.	BY	DATE	REMARKS

CITY OF JOHNSTOWN
Landfill Closure Project

SITE PLAN
CAPPED AREA (SOUTH)
Scale: 1 inch = 60 Feet

Delaney Const. Corp.
Date: Dec. 1996
Sheet 3 of 3
Dwg. # M90FG60S



JOHNSTOWN LANDFILL CLOSURE

GEOMEMBRANE AS-BUILT

DATE: 10/30/96 PROJECT: 951

SHEET 1 OF 1 SCALE: 1"=60'

CHENANGO CONTRACTING INC.

18 THOMAS STREET
BINGHAMTON NY 13901
(607) 648-8500