U.S. Army Corps of Engineers

New England Division

ADDENDUM TO SHEPLEY'S HILL LANDFILL ANNUAL REPORT - 1996

SHEPLEY'S HILL LANDFILL
DEVENS, MASSACHUSETTS

PREPARED UNDER:

DELIVERY ORDER NO. 0026
CONTRACT NO. DACW33-94-D-0007

APRIL 1997

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGY & SERVICES

ADDENDUM TO
SHEPLEY'S HILL LANDFILL
ANNUAL REPORT-1996

for

SHEPLEY'S HILL LANDFILL
DEVENS, MASSACHUSETTS

January 1997

Prepared by: Joseph P. Coyne
Joseph Coyne, Site Engineer

Date April 24, 1997

Approved by: Pamela Foti
Pamela Foti, Project Manager

Date April 24, 1997

Approved by: Richard Skryness
Richard Skryness, Project Manager

Date April 24, 1997

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGY & SERVICES

Shepley's Hill Landfill Annual Report
TABLE OF CONTENTS

EXECUTIVE SUMMARY

This annual report has been prepared to document the monitoring and maintenance activities conducted at the Shepley's Hill Landfill in Devens, Massachusetts as required by the Record of Decision (ROD) for areas of contamination 4, 5, and 18 (ABB-ES, Oct 1995). This report was developed for the U.S. Army Corps of Engineers (USCOE), New England Division (NED), by Stone & Webster Environmental Technology and Services (SWEC).

This report documents the results of the first round of the Long Term Monitoring and Maintenance Plan conducted in accordance with the approved LTMMP (SWEC May 1996) by SWEC in November 1996. This report is an addendum to the Annual Report previously issued on January 31, 1997. Activities conducted as part of the LTMMP include a yearly inspection of the landfill cover as well as semi-annual groundwater sampling. Post closure monitoring is required for a period of 30 years.

An annual Landfill inspection was conducted and observations were made regarding vegetative cover, unwanted vegetation, erosion, settlement, and the condition of previously repaired areas. The drainage swale leading to Plow Shop Pond is filled with sand outwash and runoff water is cutting into an adjacent hillside causing more sediments to be deposited into Plow Shop Pond. Combustible gas readings were collected from 18 gas vents on the landfill. Five of the vents indicated positive readings for methane, carbon dioxide, Percent Lower Explosive Limit (LEL), and oxygen. The highest readings for methane (0.4%), carbon dioxide (0.6%) and LEL (11%) and the lowest oxygen reading (20.1%) were registered at Vent # 15. Four other vents had slightly elevated methane and carbon dioxide readings. These gas measurements are within the parameters of a mature landfill. Measurements of LEL of above the 10% require restriction such as no sparking tools or open flames.

The first round of long term groundwater sampling was performed on 14 wells along the northern portion of the landfill. Samples were collected in accordance with the *Draft EPA's Low Flow Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. (July 1996) Samples were analyzed for Volatile Organic Compounds, Semi-Volatile Organic Compounds, Inorganics, and general water quality parameters. Analytical results from the most recent groundwater sampling have indicated the presence of arsenic above cleanup levels in monitoring wells SHL-20, SHL-11 and SHL-19. This is consistent with previous sampling results from these wells. Arsenic concentrations found in the other monitoring wells samples demonstrate a decreasing trend. All wells previously sampled were designated as Group 2 wells. Group 2 wells are wells where cleanup levels have not been attained historically. The evaluation criteria for Group 2 wells is a 50 percent reduction in risk in the Group 2 wells by 1998, with an additional 25 percent reduction by 2003 and attainment of cleanup goals by 2008.

The new wells (SHM-96-5B, SHM-96-5C, and SHM-96-22B) also had arsenic readings above the cleanup levels. These elevated arsenic concentrations may be biased high due to the presence of suspended solids in the groundwater. Analytical data collected from these new wells will be

used to calculate baseline concentrations. Risk reduction will be evaluated during the second five year review in 2003.

Corrective actions to address the problems associated with the landfill cap include: the reseeding of depressed areas and an access road; and the installation of a new rip-rap curb to minimize erosion along the drainage ditch which leads to Plow Shop Pond. Corrective actions for landfill cap maintenance will be conducted within the next year. Corrective actions for future groundwater sampling include redevelopment of the newly installed wells to minimize potential suspended solids and analysis of both filtered and non-filtered groundwater samples for inorganic parameters. The wells were redeveloped in January, and the next round of groundwater sampling will be conducted in May 1997.

1.0 INTRODUCTION

This annual report has been prepared to document the monitoring and maintenance procedures conducted at the Shepley's Hill Landfill in Devens, Massachusetts (ABB-ES Oct 1995) based on the Record of Decision (ROD) for Shepley's Hill Landfill Areas of Contamination 4, 5, and 18. This report was developed for the U.S. Army Corps of Engineers (USCOE), New England Division (NED), by Stone & Webster Environmental Technology and Services (Stone & Webster).

The Long Term Monitoring and Maintenance Plan (LTMMP) for Shepley's Hill Landfill outlines the landfill closure monitoring and maintenance procedures. These procedures include a semi-annual groundwater sampling program to monitor contaminants, and an annual visual inspection and gas emission monitoring of the landfill cap. This report documents the first round of the LTMMP conducted by Stone & Webster in November 1996. Post closure monitoring is required for a period of 30 years.

2.0 LANDFILL CAP MAINTENANCE ACTIVITIES

The ROD for the Shepley's Hill Landfill required monitoring and maintenance of the landfill cap. A Landfill Close-Out report was prepared which provided recommendations for Landfill Cap Improvements to properly maintain the cap and general long term monitoring and maintenance activities. The cap improvement recommendations include correcting a depression within the landfill, regrading drainage structures, and ensuring proper cap tie-down. Landfill Cap improvements were conducted during the summer of 1996, by the USACOE contractor IEM Seeland. Specific improvements were made as described below and as detailed in Figure 2-1.

- Repair of eroded areas of the Landfill Cap.
- Revegetation of selected areas of the cap to enhance vegetative growth.
- Removal of overgrown vegetation and accumulated debris and sand in drainage swales.
- regrading of areas around existing catch basins to promote proper drainage.
- Correcting a ponded area at the northern end of the landfill by installing a new drainage swale through the area.

3.0 LANDFILL CAP MONITORING ACTIVITIES

Shepley's Hill Landfill cap was inspected on November 15, 1996. The following observations were made regarding vegetative cover, unwanted vegetation, erosion, settlement, and the condition of previously repaired areas. Areas are described in a counter-clockwise direction, beginning at the northern extent of the landfill. Appendix A contains the Landfill Maintenance Checklist which summarizes the observations presented below. All observations are also presented on Figure 3-1.

The drainage swale just beyond the northern extent of the cap is severely scoured, in some places 2 feet deep. This was an area that was previously repaired.

The area around the newly installed drainage swale (which drains the depressed area) was hydroseeded following construction. The seed has not germinated satisfactorily. Wetland species (purple loosestrife and woolgrass) are present around the perimeter of the depressed area.

Soil is beginning to erode from a previously repaired area of the hillside, northwest side of landfill, between Vents #1 and #3 and depositing in the drainage swale.

Erosion has reappeared and requires additional repair in the previously repaired area (landfill side of swale) just north of Vent #3.

Wetland species (purple loosestrife and soft rush) are present in the area around Vent #3.

There are four small depressions noted in the vicinity of Vent #6 and between Vents #4 and #7. They range is size from 6 ft x 20 ft to 25 ft x 35 ft. Pooling water was present in all the areas, wetland vegetation was present in the two areas around Vent #6.

The drainage swale northwest of Vent #6, which was mowed to remove overgrown vegetation, has wetland species (purple loosestrife and soft rush) present on the northern edge of the mowed area.

In the drainage swale starting west of Vent #9 and flowing north, wetland species are present all the way up to the southern limit of overgrown vegetation removed from this swale. Species include purple loosestrife, woolgrass, and soft rush. A small area of the swale, approximately 150 ft from Vent #9, is eroded.

The catch basins in the southwest portion of the landfill, which were reset and regraded, look good, grass has grown in.

Standing water and wetland vegetation is present in the drainage swale along the southern boundary of the landfill. It extends from the culvert up to the riprap area north of Vent #13. The vegetation was recently mowed, but there is evidence of the presence of cattails, Phragmites, soft rush, and beggarticks. Some woody species, including birch, pine, and locust, are present on the southeast corner of the cap.

The formerly repaired area east of Vent #11 has eroded again, approximately 6 inches deep. A new area of erosion was noted just south of this area, approximately 12 to 18 inches deep.

The riprap in the drainage swale leading to Plow Shop Pond has been filled by sand outwash again. During high volume runoff, water jumps the rip rap drainage swale at the first bend, cuts into an adjacent hillside and mobilizes more sediment which eventually deposits in Plow Shop Pond. The erosion at the bend of the drainage swale is very severe, extending approximately 15 to 20 feet beyond the edge of the riprap into the sand bank. Sand has been deposited all the way along the swale, and out into Plow Shop Pond. Two guard pipes around Piezometer N-4 have been undermined.

The southeast corner of the repair area east of Vent #8 is eroding back again.

The repair area on the hillside between Vents #2 and #5 has not revegetated successfully and will need to be watched.

A summary of Corrective Action measures for the Landfill Cap are included in Section 9.0

4.0 LANDFILL GAS MONITORING RESULTS

The purpose of the landfill gas monitoring program is to establish long-term trends with regard to gas production and venting. A combustible gas survey was performed to determine whether methane, hydrogen sulfide, or volatile organic compounds have accumulated in the subsurface of the landfill site.

The first annual landfill gas sampling was conducted on November 15, 1996. The weather at the time of sampling was sunny, with temperatures in the low 30's (F). Barometric pressure as measured by the Landtec GA-90 landfill gas monitor was 1,033 mb. Gas samples were field analyzed for the following parameters using the listed equipment:

Parameter	Equipment
Total Volatile Organic Compounds (VOC)	HNu Photoionization Detector (PID)
Percent Oxygen	Landtec GA-90 landfill gas monitor
Hydrogen Sulfide (ppm)	Combustible Gas Indicator (CGI)
Percent Lower Explosive Limit (LEL)	CGI
Carbon Monoxide (ppm)	CGI
Percent Carbon Dioxide	Landtec GA-90 landfill gas monitor
Percent Methane	Landtec GA-90 landfill gas monitor

The CGI and the Landtec GA-90 were both calibrated in the shop by Heinrich Environmental. The PID was calibrated in the field to 100 ppm isobutylene.

The 18 gas vents were identified using Drawing 833-90-01 Sheets 1-5 of the Landfill Cap Design. No evidence of venting landfill gas was observed.

Therefore, prior to gas sampling, two vent volumes were purged from the soil gas vent using an exhaust fan arrangement. Samples were collected by holding the monitoring equipment in the exhaust produced by the fan. Results were recorded on the Landfill Gas Monitoring form (Appendix B). After sampling, all vents were marked on two sides with their appropriate number using a black marker. The locations of the gas vents are depicted in Figure 3-1.

Results are summarized as follows: No VOCs were found at any of the vents; likewise hydrogen sulfide and carbon monoxide levels were all zero. Methane readings registered at five wells.

- Vent #8 registered methane at 0.1%, with carbon dioxide at 0.1%, an LEL of 2%, and an oxygen level of 21.2%.
- Vent #9 showed methane at 0.1%, an LEL of 1%, and an oxygen level of 21.2%.
- Vent #15 registered the highest readings, with methane at 0.4%, carbon dioxide at 0.6%, an LEL of 11%, and the lowest oxygen level at 20.1%.
- Vent #17 registered methane at 0.1%, carbon dioxide at 0.2%, an LEL of 2%, and an oxygen level of 21.0%.

- Vent #18 showed methane at 0.2%, carbon dioxide at 0.1%, an LEL of 2%, and an oxygen level of 21.2%.

Two other vents, #4 and #16, had LELs of 2% and 1%, respectively. Oxygen levels at the vents which did not register any of the other measured parameters ranged from 21.2% to 21.5%.

No odors were noticed at any of the vent locations.

These gas measurements are within the parameters of a mature landfill. Measurements of LEL above the 10% require restriction such as no sparking tools or open flames. Vent 15 is the only location to exceed the LEL criteria of 10%.

5.0 GROUNDWATER ELEVATIONS

Groundwater elevations were collected from each well during groundwater sampling activities. Table 5-1 lists the water level elevations for each well. Locations of monitoring wells are shown in Figure 3-1.

In addition to these semi-annual groundwater measurements, quarterly groundwater measurements of these wells are conducted by ABB-ES. During the 5-year review, groundwater elevations will be re-evaluated to identify hydraulic gradients and to confirm changes due to the construction of the landfill cap.

TABLE 5-1
Monitoring Wells and Elevations

Well Identification	Groundwater Elevation (ft)
SHL-3	218.29
SHL-4	217.77
SHL-5	215.09
SHL-9	215.41
SHL-10	217.59
SHM-93-10C	218.72
SHL-11	217.22
SHL-19	218.17
SHL-20	217.77
SHL-22	213.73
SHM-93-22C	212.39
SHM-96-22B	*
SHM-96-5B	*
SHM-96-5C	*

ft- feet
TOC - Top of Casing
TOPVC - Top of PVC
* Indicates these wells will be surveyed before the next scheduled sampling event.

6.0 GROUNDWATER SAMPLING

Groundwater sampling activities at the landfill are scheduled to be collected semi-annually, once in the spring (April/May) and once in the fall (October/November). The first round of groundwater sampling was conducted in November 1996. Wells are designated as wither Group 1 or group 2 wells. Wells which have historically attained cleanup goals are given a Group 1 designation. Wells which have not historically attained cleanup goals are designated as Group 2 wells. All wells which were previously sampled have been given a Group 2 designation. The three newly installed wells were also given a Group 2 designation based on the sampling results discussed in Section 7.0.

6.1 Preparation for Sampling

Wells sampled as part of the long term monitoring program included SHL-3, SHL-4, SHL-5, SHL-9, SHL-10, SHL-11, SHL-19, SHL-20, SHL-22, SHM-93-10C, SHM-93-22C, SHM-96-22B, SHM-96-5B, and SHM-96-5C. The contract laboratory was contacted 2 weeks prior to sampling and the necessary coolers and bottles were shipped to Stone and Webster shortly before the sampling date. All sampling equipment (including the Grunfos Rediflow II pump and teflon lined tubing as well as a power converter and generator) was shipped to Stone & Webster the day preceding the sampling event. All equipment was inventoried and tested to ensure it was accounted for and functioning. The well logs of each of the wells to be sampled was reviewed by the field team and brought to the landfill during the sampling event to confirm the screen depths. Ron Difilippo of the BRAC Environmental Office at Devens was contacted for arrangements to obtain access to the landfill and well keys.

6.2 Sampling

The first phase of sampling was conducted by Stone & Webster on November 13-20, 1996. Monitoring wells were purged and sampled in accordance with the *Draft EPA's Low Flow Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (July 1996) using an adjustable rate, low flow submersible pump. Well dedicated teflon lined tubing was used for sample collection and was decontaminated after each well was sampled. The teflon-lined tubing will be stored indoors between sampling rounds, in place of storing it in the well itself, which can cause iron buildup on the tubing.

During sampling, the generator used to power the pump was located at an upwind area at least 30 feet away from the well being sampled, to minimize potential contamination from the exhaust. Upon initial opening of each well, headspace readings and initial water levels measurements were collected. This information was recorded on the groundwater field analysis forms found in Appendix C. The pump intake was lowered to the middle of the screen of each well to be sampled when possible. When the water level was below the top of the screen, the pump was positioned to a depth between the top of the water level and the bottom of the screen.

Once the pumping was initiated, at least one volume greater than the stabilized drawdown volume plus the extraction tubing volume was purged. Water quality parameters, including temperature (temp), specific conductance, pH, oxidation reduction potential (ORP), turbidity, and dissolved oxygen (DO) were collected every 3 to 5 minutes to ensure proper purging of the wells before each well was sampled. The results are listed on Groundwater Field Analysis Forms located in Appendix

C. All water quality parameters, except turbidity, were monitored using a flow-thru cell and a Sonde-YSI water meter. Turbidity samples were not collected from the flow through cell due to the silt buildup which commonly occurs in the cell. The tubing was disconnected from the cell for turbidity readings. Sampling was conducted when parameters became stabilized for three consecutive reading. Samples were collected directly from the tubing connected to the pump. Observations made during the sampling activities include:

- Due to the low ambient field temperatures, the Sonde-YSI water meter was erratic in reading pH and turbidity levels.

- There were no headspace concentrations above background recorded from any of the sampled monitoring wells.

- Due to the water level being deeper than the top of the screen, the pump at well SHL-4 was set at 13 feet bgs instead of 10 feet bgs.

- Monitoring well SHL-3 was almost dry (depth to water was 30.17 ft and depth of the well is 34 feet). The volume of water in the well was less than the volume of the teflon-lined tubing used and the recharge was very slow. The pump was unable to draw sufficient water from the well and no sample could be collected.

7.0 LABORATORY TESTING

All samples were analyzed by NET Laboratories of Bedford, Massachusetts. Samples were hand delivered to laboratory within 24 hours of collection. Chains of Custody (COCs) were used to identify and document the samples being shipped and were included in the shipment.

7.1 Analyses

Table 6-1 indicates the analysis and procedures used for groundwater samples collected at Shepley's Hill Landfill.

7.2 Results

The evaluation of contaminants at the Shepley's Hill Landfill is based on the reduction of carcinogenic risk rather than reduction of contamination as a measure of progress toward attainment of cleanup. This approach prevents a situation in which failure to attain a concentration reduction goal for a minor contributor to risk (i.e. 1,2-dichloroethane) overshadows the achievement of a 50 percent reduction of concentration of a higher carcinogenic risk (arsenic). Risk reduction will be evaluated during the first five year review in January 1998. However, for the annual reports the contaminant concentrations will be referenced against the cleanup goals and MCLs as a benchmark. It should be noted that the majority of the risk present at Shepley's Hill landfill is due to elevated arsenic concentrations in the groundwater. Therefore this discussion will focus on this contaminant.

Analytical results for groundwater analysis are presented in the form of a hits only table for chemical contaminants. (Table 7-2). This table presents only detectable concentrations of chemical contaminants, compared against the applicable cleanup goal or MCL if there is no established cleanup goal. Results of all wet chemistry analyses are included in the table. The results of sampling are summarized below.

Volatile organics were detected at low concentrations. The only trigger compound detected above its clean up goal was dichlorobenzene (total) (6 J μg/L) in monitoring well SHL-20. Dichlorobenzene (total) was also detected in monitoring wells SHL-4 (at 1 J μg/L), SHL-4 (Dup) (at 1 J μg/L), SHM-96-5B (at 2 J μg/L) and SHM-96-22B (at 2 J μg/L). The trigger compound 1,2-dichloroethane was detected at a maximum concentration of 5 J μg/L in monitoring well SHM-96-22B. 1,2-Dichloroethane was also detected in monitoring wells SHM-96-5B (at 3 J μg/L) and SHM-96-5C (at 2 J μg/L). Other volatile organic compounds detected in groundwater samples include 1,1-dichloroethane (at 2 J μg/L), benzene (at 3 J μg/L), chlorobenzene (at 2 J μg/L), and m and p-xylene (at 28 μg/L).

Semi-volatile organic analysis was conducted only for the presence of dichlorobenzenes, which were detected in wells SHL-22 (1 J μg/L), SHL-20 (5 J μg/L), SHL-11 (2 J μg/L), SHM-96-5B (1 J μg/L). These concentrations do not exceed the cleanup goal for dichlorobenzene of 5 μg/L.

TABLE 7-1
Groundwater Sample Analysis and Procedures

PARAMETERS	METHOD
Volatile Organic Compounds xylenes Acetone 2-butanone 2-methyl pentanone	USEPA 8260 USEPA 8260
Semi-Volatiles 1,2,-dichlorobenzene 1,3,-dichlorobenzene 1,4,-dichlorobenzene	EPA-SW 8270
Inorganics Arsenic Barium Cadmium Chromium Cyanide (wet chemistry) Iron Lead Manganese Mercury Selenium Silver Copper Zinc	EPA-SW 6010
General Parameters (measured in Laboratory) Total Dissolved Solids Total Suspended Solids Chloride Hardness Nitrite-Nitrate as N Sulfate Alkalinity Biochemical Oxygen Demand Chemical Oxygen	 NED METHODS USEPA 160.2 USEPA 300 USEPA 354.1 SW9056 USEPA 310.1
General Parameters (measured in the field) pH Temperature Specific Conductance Dissolved Oxygen Oxygen Reduction Potential VOCs (Headspace)	

USEPA - U.S. Environmental Protection Agency
VOCs - Volatile Organic Compounds

TABLE 6-2
LONG TERM GROWNDWATER MONITORING

SHEPLEY'S HILL LANDFILL
DEVENS, MA
NOVEMBER 14-20, 1996

ANALYTE	SHL-9/GW	SHM-93-22/GW	SHL-22/GW	SHL-5/GW	SHL-20/GW	SHL-11/GW	SHL-19/GW	SHL-4	Cleanup Levels (µg/L)
VOCs (µg/L)									
1,1-Dichloroethane									NL
1,2-Dichloroethene (total)									5
Benzene									5*
Chlorobenzene									100*
m and p-Xylene									10,000*(1)
Dichlorobenzenes (total)					6 J			1 J	5
TICs (total)	54 NJ		7 NJ	6 J	20 NJ	8 NJ		14	NA
Semi-VOCs (µg/L)									
Dichlorobenzenes (total)			1 J		5 J	2 J			5
TICs (total)		29	67	2 J	97	83	5 J	40	NA
Inorganics (µg/L)									
Arsenic	46.9	44.6	24.8	12.0	244	332	138	48.8	50
Barium	13.8 B	72.0 B	20.7 B		93.8 B	132 B		45.0 B	2,000*
Chromium		5.2 B							100
Copper	9.3 B			10.1 B					1,300*(1)
Iron	8180	639	2900	3730	16300	91200	14000	6510	NL
Lead									15
Manganese	538	602	1790	618	8730	3490	2040	946	NL
Zinc	9.6 B	23.4	49.1	15.5 B	5.3 B	8.5 B	3.3 B	2.9 B	NL
Cyanide (total)	ND	ND	ND	ND	ND	ND	ND	ND	200
Wet Chemistry (mg/L)									
Alkalinity***	72	290	480	49	480	350	34	85	NA
BOD- 5 Day	16	ND	9.6	ND	ND	22	ND	ND	NA
Chemical Oxygen Demand	33	ND	23	33	54	60	ND	ND	NA
Chloride- IC	1.5	36	67	1.9	68	67	1.7	7.6	NA
Nitrate/Nitrite		ND	ND	ND	ND	ND	2.0	0.67	NA
Solids, dissolved (TDS)	190	440	650	140	720	540	120	120	NA
Solids, suspended (TSS)		11	12	ND	9.0	20	12	ND	NA
Sulfate, IC		7.1	ND	ND	0.38	ND	ND	5.4	NA

Notes:

ND = not detected

NL = Not Listed

NA = Not Available

* = No cleanup values wee listed so the Maximum Contamination Level (MCLs) were used

** There were a total of 3 Trip Blanks analyzed, one of which had detectable hits as shown in the Table

*** The detection units for the Alkalinity test were ppmCaCO3

(1) for contaminants which had no project specific Cleanup Levels, the MMCL's were used.

TABLE 6-2 (Continued)
LONG TERM GROWNDWATER MONITORING

SHEPLEY'S HILL LANDFILL
DEVENS, MA
NOVEMBER 14-20, 1996

ANALYTE	SHL-4/(DUP)	SHL-93-10C	SHL-10	SHM-5B	SHM-5C	SHM-96-22B	Trip Blank	Equipment Blank	Cleanup Levels (µg/L)
VOCs (µg/L)									
1,1-Dichloroethane				2 J					NL
1,2-Dichloroethene (total)				3 J	2 J	5 J			5
Benzene				2 J	1 J	3 J			5*
Chlorobenzene					2 J				100*
m and p-Xylene					28				10,000*(1)
Dichlorobenzenes (total)	1 J			2 J	1 J	2 J			5
TICs (total)	9 NJ			10 NJ		16 NJ	32 NJ	10	NA
Semi-VOCs (µg/L)									
Dichlorobenzenes (total)				1 J		2 J			5
TICs (total)	30	48	14 J	51	44	198		17	NA
Inorganics (µg/L)									
Arsenic	43.3	12.4	3.4 B	1440	71.0	324			50
Barium	47.2 B			39.0 B	84.4 B	61.9 B			2,000
Chromium									100
Copper	6.9 B	9.5 B	5.9 B						1,300*(1)
Iron	6690	415		11900	61900	51900			NL
Lead				2.6 B	2.7 B				15
Manganese	965	77.6	3.9 B		4830	7510		1.8 B	NL
Zinc	9.7 B	22.4	4.5 B					2.9 B	NL
Cyanide (total)	ND	ND	ND	ND	ND	ND	ND	ND	200
Wet Chemistry (mg/L)									
Alkalinity***	78	190	13	380	330	380		ND	NA
BOD- 5 Day	ND	ND	ND	ND	ND	6.0		ND	NA
Chemical Oxygen Demand	19	35	16	53	64	47		ND	NA
Chloride- IC	7.7	29	0.94	68	33	70		0.24	NA
Nitrate/Nitrite	0.65	0.15	0.94	ND	ND	ND		ND	NA
Solids, dissolved (TDS)	120	290	36	520	410	500		ND	NA
Solids, suspended (TSS)	ND	ND	ND	17	24	73		9.0	NA
Sulfate, IC	5.4	23	4.4	1.4	9.6	0.91		0.82	NA

Notes:
ND = not detected
NL = Not Listed
NA = Not Available
* = No cleanup values wee listed so the Maximum Contamination Level (MCLs) were used
** There were a total of 3 Trip Blanks analyzed, one of which had detectable hits as shown in the Table
*** The detection units for the Alkalinity test were ppmCaCO3
(1) for contaminants which had no project specific Cleanup Levels, the MMCL's were used.

Arsenic was detected at concentrations greater than the cleanup goal of 50 μg/L in the following monitoring wells: SHL-20 (244 μg/L), SHL-11 (332 μg/L), SHL-19 (138 μg/L), SHM-96-5B (1,440 μg/L), SHM-96-5C (71.0 μg/L), and (SHM-96-22B) 324 μg/L.

Recently installed monitoring wells SHM-96-5B, SHM-96-5C, and SHM-96-22B were sampled for the first time as part of this sampling effort. These new wells, which show exceedences of cleanup levels, will be classified as Group I wells. Reduction of risk will not be evaluated during the first five-year site review following installation. Analytical data collected during the November 1996 sampling will be used to calculate baseline concentrations, and risk reduction will be evaluated in the next five years. The evaluation criteria for these wells will be a 50 percent reduction in the incremental risk between cleanup levels and baseline concentrations for chemicals of concern in each subsequent five-year review, and attainment of cleanup levels by January 2008.

These three newly installed wells (SHM-96-5B, SHM-96-5C, and SHM-96-22B) were not developed as aggressively as the previously installed wells and may have resulted in increased suspended solids in the samples. Therefore the analytical results from the newly installed wells may be biased high. It is unlikely that arsenic would be present at 1440 ug/L in the dissolved phase. These wells will be redeveloped prior to the next sampling round to reduce potential suspended solids. Both filtered and unfiltered samples well be analyzed for arsenic during the next sampling round to confirm this. Samples to be collected for metals analysis will also be both filtered and unfiltered during the next sampling round.

High concentrations of arsenic are also observed at the location of monitoring well SHL-11 and SHL-20. Historically, groundwater analytical results from SHL-11 have always showed arsenic concentrations > 300 μg/L. Historical groundwater analytical results from SHL-20 showed a recent increase in the concentration of arsenic. In 1991, groundwater samples from SHL-20 were less than 100 μg/L (98 μg/L in August of 1991 and 89 μg/L in December of 1991). More recent sampling which took place in March of 1993 showed an arsenic concentration of 330 μg/L, nearly three times greater than the previous sampling results. The latest round of groundwater sampling by Stone & Webster show SHL-20 having an arsenic concentration of 244 μg/L. These results show a consistent presence of arsenic at SHL-11 and SHL-20. Refer to Appendix D for a graphical comparison of arsenic concentrations in monitoring wells for the previous and current sampling periods.

8.0 QUALITY CONTROL

7.1 Field Quality Control

A Photoionization Detector (Hnu) and an explosive meter (LEL meter) were used to monitor ambient air conditions during the groundwater sampling. Both instruments were calibrated prior to sampling on a daily basis. If any instrument calibration drift was evident at any time during sampling, the equipment was recalibrated. During rainy weather, the Hnu and LEL were stored in dry vehicles when not being used to minimize humidity effects on the instruments.

One equipment blank was collected from the pump and tubing after decontamination had been conducted. No contaminants were detected in the Equipment Blanks. One field duplicate was collected from monitoring well SHL-4. Duplicate precision was acceptable within 0.0 to 8.0%. Three trip blanks were sent to the lab with samples. No contaminants were detected the trip blanks. All QC data is included in Table 7-1.

7.2 Laboratory Quality Control/Data Validation

Seven laboratory blanks were analyzed as part of the Shepley's Hill Landfill groundwater field event. No contaminants were detected in any of the laboratory blanks.

The data validation for the organics and general chemistry found all data to be acceptable. However, data correction was required for inorganic analysis during data validation. These corrections included qualifying non-detects (U) due to action level calculations and qualifying estimated data due to high recoveries for chloride during spiking.

Organics

No MS/MSDs were analyzed as per the direction of Stone & Webster

Section Four - Semivolatile Organic Compounds: FD Cases 2089 and 2091

Data Completeness:
The TIC page for SBLK1120J was missing. There were no laboratory control sample (LCS) results. The laboratory was contacted and they sent us the TIC page for SBLK1120J and the LCS results.

Holding Times:
All holding times were met for organics analyses for both Cases.

Surrogate Recoveries:
The surrogate recovery for nitrobenzene-d_5 was 22% in sample SHL11GW, below control limits of 35-114%. No qualifications were necessary since all sample results in Case 2089

were either non-detect (ND) or below the reporting limit. All other surrogate recoveries were within QC limits.

GC/MS Tuning:
All GC/MS tunes had relative mass-to-charge percentages within acceptable ranges.

Calibrations:
The %RSDs and RFs in the initial calibrations were within QC limits. Incorrect mean RRFs were used for comparison to the RRFs in the continuing calibrations run on 11/21 and 11/22 in both Cases. However, the %Ds between the mean RRFs in the initial calibration and the RRFs in the continuing calibrations were acceptable.

Blanks:
No target compounds were detectable in lab blanks SBLK01119J, SBLK1120J, SBLK1121J, and SBLK1122F. The following tentatively identified compounds (TICs) were detected:
SBLK1119J - TIC Isopropyl alcohol at an estimated concentration of 2J ug/L
SBLK1120J -
SBLK1121J - TIC N,N-Dimethylformamide (est. concentration of 6 NJ ug/L) plus 4 unknowns at estimated concentrations between 2J and 5J ug/L.
SBLK1122F - TIC N,N-Dimethylformamide (est. concentration of 6NJ ug/L) plus 2 UNKNOWNS at estimated concentrations of 2J and 4J ug/L.

No target compounds were detectable in the EQUIPMENT BLANK. Four unknown compounds plus a butylated hydroxytoluene were detected as TICs at estimated concentrations below the reporting limit in the EQUIPMENT BLANK. No qualifications were made based upon these findings.

Duplicates:
In samples SHL4 and SHL4DUP, the dichlorobenzenes were ND. TICs results were also similar with several unknowns eluting between 3 and 11 minutes. SHL4 had an unknown peak present at a very low concentration that was not present in the duplicate. Also SHL4 detected diethylphthalate (13.13 minutes) and 2(3H)-benzothiazolone (13.82 minutes) each at 2 NJ ug/L, but neither were detected in the duplicate. No actions were required.

Internal Standards:
Internal standard areas and retention times were within QC limits.

Section Three - Volatile Organic Compounds - FD Cases 2089 and 2091

Data Completeness:
There were no LCS results. The laboratory sent us the LCS results.

Holding Times:
All analyses were performed within holding times.

Surrogate Recoveries:
All surrogate recoveries were within QC limits.

GC/MS Tuning:
Tunes run on 10/30, 11/11, 11/20, 11/21, 11/22(2), 11/25, 11/26, 11/27, and 12/2 had relative mass-to-charge percentages within acceptable ranges.

Calibrations:
The %RSDs and RFs for the initial calibrations run on 10/30, 11/11, 11/20, 11/22, and 12/2 were within QC limits for the dichlorobenzenes. The %Ds between the mean RRFs in the initial calibrations and the RRFs in the continuing calibrations run on 11/21, 11/22(2), 11/26, and 11/27 were all acceptable. For the continuing calibration run on 11/25, 1,2-dichlorobenzene had a %D of 20.4%, slightly above the SW-846 QC limit for continuing calibration RRFs. Since the results in the only sample affected (SHL5GW) were ND, no action was taken.

Blanks:
No target or TIC compounds were detectable in lab blanks VBLK1121L, VBLK1122L, VBLK1122K, VBLK1125H, VBLK1126L, VBLK1127L, and VBLK1202H and in two of the three Trip Blanks. In the third Trip Blank, associated with samples collected on 11/19, no target compounds were detected, but one TIC, trimethyl silanol, was detected at an estimated concentration of 32 NJ ug/L. In the Equipment Blank, no target compounds were detected, but one TIC, trimethyl silanol, was detected at an estimated concentration of 10 NJ ug/L. No qualifying actions were required.

Duplicates:
In samples SHL4 and SHL4DUP, the dichlorobenzenes were ND except for 1,4-dichlorobenzene, which was detected at the low concentration of 1J ug/L in both samples. TICs results were also similar with two unknowns in SHL4 at estimated concentrations of 8 and 6J ug/L (the latter is probably trimethyl silanol based upon the retention time and TIC identifications in other samples. SHL4DUP detected the TIC trimethyl silanol at an estimated concentration of 9NJ ug/L. No actions were required based upon these results.

Internal Standards:
Internal standard areas and retention times were within QC limits.

Inorganics

Section Two - Metals Analysis and Hardness Calculation - FD Cases 2089 and 2091

Data Completeness:
See ICP Serial Dilutions Section

Holding Times:
All analyses were performed within holding times.

Calibrations:
All Initial Calibration and Continuing Calibration Verification %Rs were within QC limits for both Cases.

Interference Check Sample (ICS):
All ICS %Rs were within required limits of 80 to 120%.

Blanks:
SDG 2089 - The Initial Calibration Blank (ICB) and Preparation Blank (PB) had negative values for barium at two to three times the reporting limit. The ICB and Continuing Calibration Blanks (CCB) had negative values for iron at 10 to 20 times the reporting limit and the PB for iron had a low level 4.83 ug/L. Lead was present in the PB at 2.4 ug/L, and selenium was present in the ICB at 1.0 ug/L.
SDG 2091 - Four of the CCBs for barium had blank levels of between 1.0 and 6.0 ug/L. Manganese had low levels of blank contamination in two of the CCBs and the PB. Zinc also had low levels of blank contamination in two of the CCBs and the PB. The ICB, CCB, and PB had negative values for iron (plus one positive value in one of the CCBs) at 1 to 20 times the reporting limit.

Action levels were calculated by multiplying the highest blank level for a given analyte by five. All positive results less than the action level are qualified U. No qualification is required if the test result is greater than the action level.

	Analyte	Action Levels
SDG 2089	Ba	12
	Fe	152
	Pb	12
	Se	5
SDG 2091	Ba	30
	Fe	132
	Mn	9.5
	Zn	23

Actions taken based upon these action levels were to qualify lead U in samples SHL9GW, SHM9322, SHL22GW, SHL5GW, and SHL10; qualify barium U in samples SHL19GW, SHL9310C, SHL5GW, and SHL10; and qualify iron U in sample SHL10 in SDG 2089. In SDG 2091, qualify zinc U in samples SHM9622B, EQPTBLK, SHM5C, and SHM5B; qualify iron and manganese U in sample EQPTBLK.

Spike Sample Recovery/Post Digest Spike Recovery
Spiked sample recoveries were within the required range of 75 to 125% for all analytes. Therefore, no post-digest spike recovery was required.

Replicate and Duplicate Sample Results
Replicate analyses were performed for SDG 2089 on sample SHL10 for all analytes except mercury, and on sample SHL4DUP for mercury; for SDG 2091, analyses were performed on sample SHM5B for all analytes. All results met QC requirements.

Results of field duplicate analysis also had satisfactory %D values.

Laboratory Control Sample (LCS):
All LCS recoveries in both SDGs were within QC limits of 80 to 120%.

Standard Addition Results:
Standard addition results were satisfactory, with correlation coefficients of 0.9999 and 1.0000 for both SDGs.

ICP Serial Dilutions:
For SDG 2089, the sample selected by the laboratory for serial dilution was inappropriate, in that only one analyte met the CLP criterion of "minimally a factor of 50 above the IDL". Several other samples would have been better candidates. Therefore, the results of the serial dilution for this SDG should not be used. For SDG 2091, the serial dilution results were within the 15% QC limit for all analytes except zinc. However, the initial sample result for zinc was only about 7 times the IDL, thus not satisfying the CLP criterion. No actions were taken based upon these results.

Section Twelve - General Chemistry Analysis - SDGs 2089 and 2091

Data Completeness:
For TDS, Method Blank result should be 7.0, not < 11.0. Narratives failed to note that the LCS BOD result was high in both SDGs, and the cyanide and chloride spike recoveries were outside QC limits in SDG 2091. The system generated response factors for IC calibration were missing. Results were corrected and sent to us.

Holding Times:
All analyses were performed within holding times.

Calibrations:
All Initial Calibration and Continuing Calibration Verification %Rs were within QC limits for cyanide for both Cases. All correlation coefficients for calibration of chloride, nitrate/nitrite, and sulfate by ion chromatography and for calibration of COD were ^{3} 0.998.

Blanks:

Blank results for all wet chemical analyses were below reporting limits except for TDS, which had a value of 7 mg/L in both batches. No sample result was affected since each was greater than 5 times the blank value.

Matrix Spike Recovery:
Spike recovery for cyanide was 70% in both Cases. No actions were taken since all cyanide results were ND. Chloride had high %R of 140% in Case 2091. Actions taken were to qualify chloride estimated J in all field samples in Case 2091: SHM-96-22B, Equip. Blank, SHM-5B, and SHM-5C.

Laboratory Control Samples:
All %Rs fell within the range of 80 to 120% except for BOD, which had 122% R in both Cases. The few positive BOD results in samples SHL-9/GW, SHL-22/GW, SHL-11/GW in Case 2089, and sample SHM-96-22B in Case 2091, were qualified estimated J.

Duplicates:
Duplicate precision was excellent for these analyses, falling within the range of 0.0 to 8.0%.

9.0 CORRECTIVE ACTION

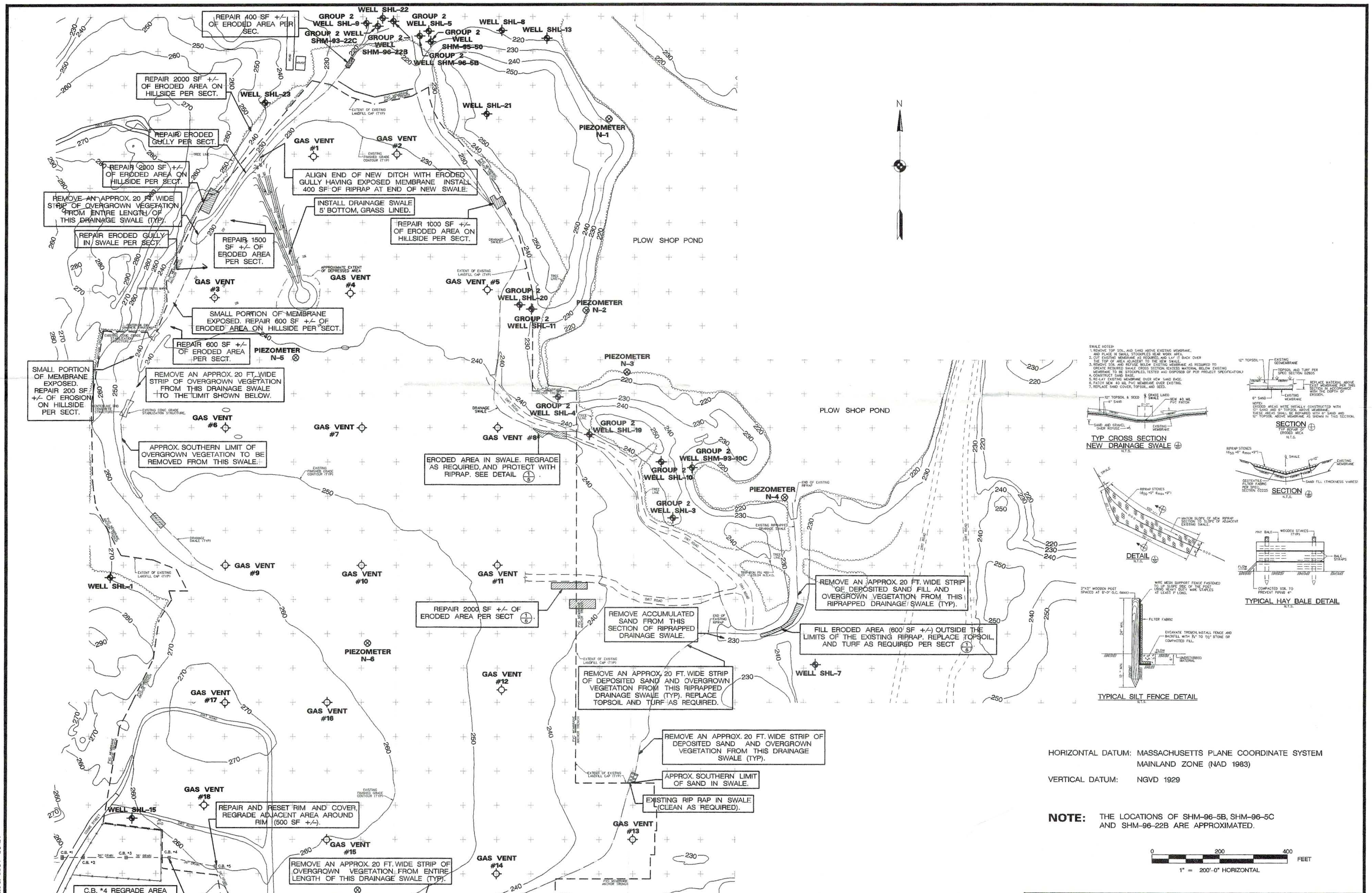
Corrective action required for the landfill cover is focused primarily on regrading and reseeding eroded areas. More specifically, it is recommended that the newly installed drainage swale, which drains the depression area, be reseeded in the spring. The access road adjacent to the western drainage swale requires regrading and reseeding as well. Depressed areas should be surveyed to establish current conditions. These areas can then be monitored to determine if depressions are increasing in depth or area. A new rip-rap curb is required in the drainage ditch which leads to Plow Shop Pond. The new rip-rap will serve to keep water in the drainage swale and minimize erosion which has been caused by the overflow of the swale. The final recommendation is to install rip rap adjacent to the repair area east of Vent No. 8. All landfill maintenance activities are scheduled to be completed within the year, prior to the next landfill inspection in November 1998.

Landfill gas measurements are well within the parameters for a mature landfill. Measurements of LEL above the 10% require restriction such as no sparking tools or open flames. Vent 15 is the only location to exceed the LEL criteria of 10%. However, the provisions for non-sparking tools and no open flames is standards for landfill maintenance.

Corrective action for future groundwater sampling at the Shepley's Hill Landfill includes redeveloping monitoring wells SHL-96-5B, SHL-96-5C, and SHL-96-22B to reduce the TSS concentration in future sampling rounds. It is likely that the high Arsenic (1440 μg/L) is attributable to high TSS and is not representative of dissolved arsenic in the groundwater. The monitoring wells were redeveloped in January 1997.

It is also recommended that both filtered and unfiltered samples will be analyzed for arsenic during the May 1997 sampling round to confirm this.

Monitoring well SHL-3, was not sampled during this round due to a very low water table elevation, and slow recharge. For the next round of sampling, a smaller diameter tubing will be utilized. If this is unsuccessful, the well will be purged dry. Once the well recharges a sample will be collected with a bailer and water quality parameters will be recorded.



ARMY CORPS OF ENGINEERS

FIGURE 2-1
FORT DEVENS
SHEPLEY'S HILL LANDFILL REPAIRS

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGY & SERVICES
BOSTON, MASSACHUSETTS

P:\esk\c02\0.dgn 24-APR-1997 09:27

MONITOR ERODED AREA RIP RAP IF SCOURING CONTINUES.

GROUP 2 WELL SHL-9

WELL SHL-22

GROUP 2 WELL SHL-5

GROUP 2 WELL SHM-93-22C

GROUP 2 WELL SHM-96-22B

WELL SHL-8

WELL SHL-13

GROUP 2 WELL SHM-95-5C

GROUP 2 WELL SHM-96-5B

WELL SHL-23

WELL SHL-21

PIEZOMETER N-1

GAS VENT #1

GAS VENT #2

BACKFILL ANIMAL BURROW / USE ROPEL REPELLENT

MONITOR REVEGETATION OF HILLSIDE

MONITOR EROSION OF PREVIOUSLY REPAIRED HILLSIDE

UNSATISFACTORY GERMINATION OF HYDROSEEDED AREA AROUND SWALE. RESEED IN SPRING 1997.

PLOW SHOP POND

REPAIR ERODED GULLY IN SWALE

MONITOR WETLAND VEGETATION AROUND PERIMETER OF DEPRESSION.

GAS VENT #3

GAS VENT #4

GAS VENT #5

BACKFILL ANIMAL BURROW / USE ROPEL REPELLENT

GROUP 2 WELL SHL-20

PIEZOMETER N-2

GROUP 2 WELL SHL-11

MONITOR WETLAND VEGETATION

PERIODICALLY MOW AND CLEAN VEGETATION FROM THIS DRAINAGE SWALE TO THE LIMIT SHOWN BELOW. MONITOR WETLAND VEGETATION.

PIEZOMETER N-5

SURVEY AND MONITOR SMALL DEPRESSIONS.

PIEZOMETER N-3

GROUP 2 WELL SHL-4

SURVEY AND MONITOR SMALL DEPRESSIONS. MONITOR WETLAND VEGETATION.

GAS VENT #6

GAS VENT #7

BACKFILL ANIMAL BURROW / USE ROPEL REPELLENT

GAS VENT #8

EXTEND RIP RAP INTO ERODED AREA.

GROUP 2 WELL SHL-19

GROUP 2 WELL SHM-93-10C

GROUP 2 WELL SHL-10

PIEZOMETER N-4

GROUP 2 WELL SHL-3

PLOW SHOP POND

MONITOR EROSION IN SWALE.

APPROX. SOUTHERN LIMIT OF VEGETATION TO BE MOWED IN THIS SWALE.

GAS VENT #9

GAS VENT #10

GAS VENT #11

WELL SHL-1

SAND DEPOSITED ALONG LENGTH OF SWALE.

REPAIR ERODED AREAS. REGRADE ACCESS ROAD TO DIVERT RUNOFF.

INSTALL RIP RAP CURB TO PREVENT RUNOFF FROM SPILLING OUT OF RIP RAP CHANNEL.

WELL SHL-7

PIEZOMETER N-6

GAS VENT #12

GAS VENT #17

GAS VENT #16

GAS VENT #18

WELL SHL-15

BACKFILL ANIMAL BURROW / USE ROPEL REPELLENT

GAS VENT #15

GAS VENT #13

GAS VENT #14

MONITOR ENTIRE LENGTH OF THIS DRAINAGE SWALE (TYP) FOR WETLAND VEGETATION. PERIODICALLY MOW.

PIEZOMETER N-7

WELL SHL-17

WELL SHL-12

WELL SHL-25

WELL SHL-6

N

HORIZONTAL DATUM: MASSACHUSETTS PLANE COORDINATE SYSTEM MAINLAND ZONE (NAD 1983)

VERTICAL DATUM: NGVD 1929

NOTE: THE LOCATIONS OF SHM-96-5B, SHM-96-5C AND SHM-96-22B ARE APPROXIMATED.

0 200 400 FEET

1" = 200'-0" HORIZONTAL

ARMY CORPS OF ENGINEERS

FIGURE 3-1
FORT DEVENS
SHEPLEY'S HILL LANDFILL MONITORING

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGY & SERVICES
BOSTON, MASSACHUSETTS

24-APR-1997 09:29

P:\esk\s01\0.dgn